Transport and its Role in the Society

I. Dostál* & V. Adamec
Transport Research Centre, Brno, Czech Republic
** Corresponding author: ivo.dostal@cdv.cz*

DOI: 10.2478/v10158-011-0006-8

ABSTRACT: Non-motorised transport, pedestrian, and bicycle transport are most often considered to be the most environmentally friendly types of personal transport; the railway is considered as environmentally friendly as well. Air transport seems to be a problem and the worst impact on the environment is represented by road transport, mainly individual. Rail transport is considered to be the most environmentally friendly regarding the transportation of goods, on the other hand the most unfavourable is road transport. The evaluation of water transport is ambiguous, because it represents a significant risk in case of accidents and the building of the infrastructure represents a significant interference with the countryside and river ecosystems.

KEY WORDS: Transport, society, means of transport, history.

1 INTRODUCTION

Every country of the world has a different potential and therefore people do not find everything they need for life in their nearest environments. They are forced to transport their goods (raw materials, information) and themselves as well. The globalization of the economic system and growing specialization of individual regions increase this need. Therefore, transport is one of the fundamental pillars of current economics. However, it is among economic restrictive factors as well, since the quality of transport systems limits a number of economic processes. Although the trend of increasing economic demands on transport systems already started in the era of industrialization, it has accelerated since the second half of the 20th century in connection with the gradual transition to the free market and global economics. A lot of economic processes, ranging from commuting to work, through supplying raw materials and energies, up to the distribution of goods to consumers are directly connected with transportation. Transport plays an irreplaceable role in the social sphere as well. It enables people to communicate, meet each other and exchange ideas. Since the time immemorial, transport and habits in using transport, have represented a certain status in the social hierarchy. In modern society, which tries to overcome the social barriers, an equal access to transport is one of the main principles. However, a lot of groups of inhabitants, such as disabled people, elderly people, or low-income inhabitants are access handicapped, which highlights their status on the edge of society. It is necessary to adopt the transport system to their needs so that they can be more integrated in society.

The counterpoint of positive effects of transport is its negative impact on health and the environment. The land use and operation of the transportation network affects landscape, flora and fauna in the environment of transport infrastructure and contributes to the deterioration of the living conditions in cities, where the majority of people are exposed to pollutants with a negative impact on their health. Therefore, transport is currently facing an uneasy task - to find a balance between the inevitable development, economic and social benefits on the one hand, and the protection of health and the environment on the other hand.

2 MODES OF TRANSPORT

Transport occurs in a lot of forms which can be characterized according to various attributes and needs in terms of infrastructure, means of transport, or service transport infrastructure. We could define nodes which provide transport services and which create the transportation network through connection with the infrastructure. Movement of the means of transport in the transportation network is assured technically and organizationally by the transportation infrastructure. Each transport relationship is defined by its origin, i.e. its origin and its destination (Rodrigue et al., 2009; Brinke, 1999).

There are many ways to classify transport. The most common way is to consider the environment (see Figure 1), but there are more parameters which could be considered such as the object of transportation (passenger transport – freight transport), number of people transported (individual – mass), frequency (irregular – regular), access of public (private – public), transport distance (local – regional – long-distance), location of the trip origin and trip destination in relation to geographical units (interurban – interstate – intercontinental), and spatial relation of the origin and destination of the analyzed area (inner – outer – transit). Transportation of the information which is provided by telecommunication services is usually not included in the classification.

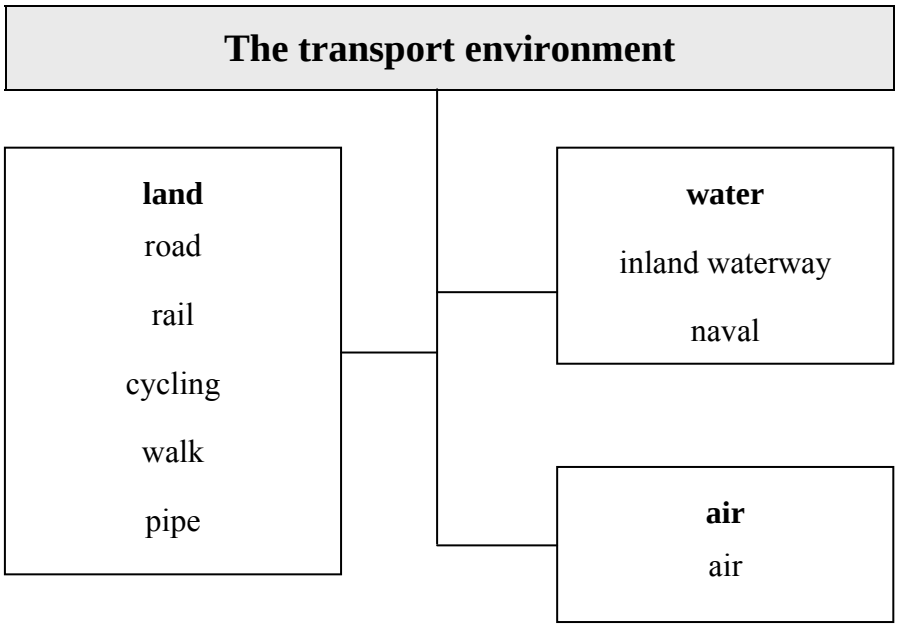

Figure 1: Basic classification of transport.

The transportation networks for individual types of transport are described and classified on the base of various parameters, the most common being the network length, density, shape and configuration of infrastructure, number of the main nodes, route deviation, coherence of the network, and the load of traffic volumes.

3 HISTORICAL DEVELOPMENT OF TRANSPORT

Historical development of society and the history of transport have always been closely related to each other. The quality of transport in various periods reflected the level of society development, but on the other hand, it was transport which gave a boost to society's growth in many time periods. The technical advancement in the production of vehicles allows to follow the technological development of production industries in different time periods.

There had been no forms of motorized transport until the end of the 18th century and the main driving gear of land transport was the traction power of animals, while wind power was used on water. Transport speed was very low, as well as the number of the total quantity of transported goods. Owing to the fact that water transport was more effective, as there was no quality road network, the vast majority of cities grew up near waterways, either on the seacoast or close to big rivers. Obviously, there were some exceptions, such as ancient Rome. Apart from agriculture bound to the fertile lowlands of big rivers like the Nile, the Euphrates or the Indus, the basis for all ancient civilizations was trade. The majority of transport relations occurred only on a local scale, the international trade was marginal and was mainly restricted to luxury goods, such as spices or jewellery.

The Middle Ages were characterized by the growing importance of trade and the progress in the field of sea navigation. The voyages of the Arab and Viking ships were followed by the development of trade in the North and the Baltic Sea, controlled by Hansa, and in the Mediterranean Sea, which was dominated by Italian city states. Their naval traditions were then followed by the Spanish and Portuguese, who gained the upper hand in the world seas at the turn of the 15th and 16th century thanks to the great geographical discoveries. The colonial trade flourished, which brought new kinds of commodities and raw materials to Europe; mainly precious metals and spices became the main import articles. The slave trade flourished as well and a huge amount of European goods found their markets in colonies. In the 17th century the leading role in the naval trade is passed into the hands of the English, Dutch and French. The colonial trade stimulated the further economic development of manufacturing in Europe.

The biggest revolution in transport since the invention of wheel was brought about by the invention of the steam engine in the mid-18th century. During the 19th century it became well established in all kinds of industry and transport. While the steamships started to rule on the world's rivers and oceans, transport overland was quickly mastered by railway. The railway held back all other forms of sea transport, shortened travel times and changed the perception of distance between big towns to figures unimaginable. Steam was later replaced by the combustion engine which allowed the automobile transport advancement and a short time later the birth of air transport as well. After World War I, road and air transport became significant competitors to railway transport, first in the USA, and in Europe a few years after. Thanks to transport, the individual regional economic markets gradually started to become interconnected, creating a world-wide one.

A big development in air transport came after World War II., mainly after the introduction of the jet airplanes, which made regular intercontinental passenger flights possible. This allowed to reach various parts of the world within a few hours. It allowed regional development of regions which had been on the peripheries until then;

namely the industrial countries of East Asia, led by Japan and Korea, and new tourist destinations in the Caribbean Sea, the Pacific, and the Indian Ocean.

Since the 1960s the world's powerful countries have started exploring the space. In spite of the fact that the first "space tourists" have already embarked on an orbit around the Earth, the regular usage of space transport is conditioned by further technological progress. It's goal needs to reach the cost reduction of space devices in such a way that their price would be reduced to a price of similar terrestrial devices. It would also allow the change in the composition of the cargos transported to space because, in comparison with present conditions. We cannot expect a growth in the quantity of transported scientific, communication, or army satellites, therefore only the volume of commercial transportation is to be increased. Another trend which can be expected in the future is further increase in the total volumes of transportation and density of transport networks, unification of transport routes and their concentration in transport corridors. More and more demands are being placed on accelerating and improving transport services.

Approximately 30 years ago the world community asked about the responsibility for the exploitation of non-renewable resources and the condition of the environment. Transport plays a significant role in the consumption of some of the non-renewable resources, mainly oil, and also in increasing air pollution, therefore transport is one of the crucial aspects in the conception of sustainable development. Searching for environmentally friendly forms of transportation has become a necessity which will require gradual renaissance of rail transport and the development of new drives for road transport.

4 INDIVIDUAL MODES OF TRANSPORT

The individual modes of transport are characterized by certain advantages and disadvantages which influence their use on the transport market. The categorization of the individual transport modes in the following text corresponds with the basic categorization of transport mentioned in Figure 1. To see how individual transport modes are used in the transport market, we need to compare the transport performances on various levels, e.g. a national level, local level, transport of certain goods, etc. The individual transport modes usually compete with each other. The competition depends on the aspects of price, speed, availability, frequency, safety, comfort, etc. Multi-modal transport covers only a small part of the market so far.

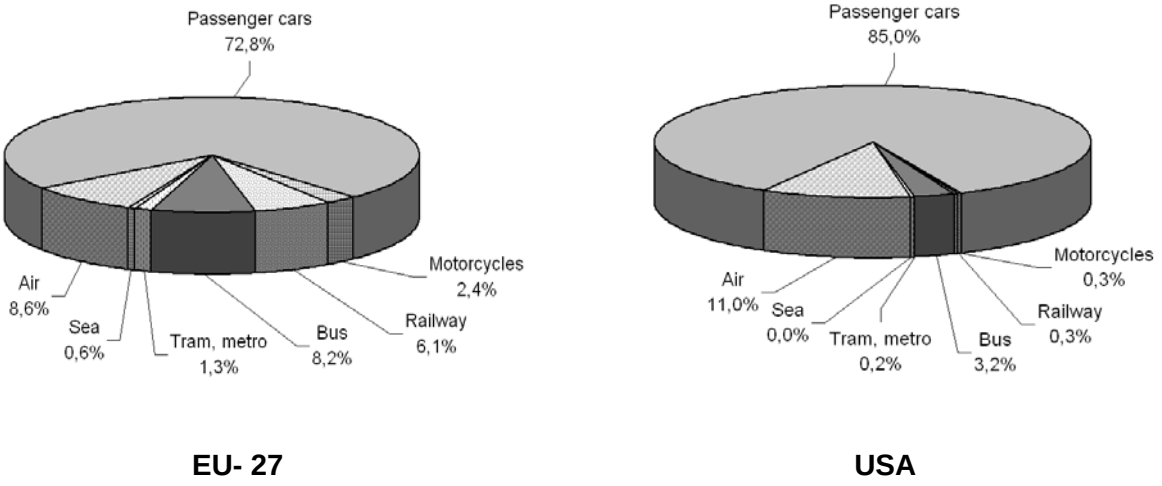

Figure 2: Modal split in passenger transport in 2006 in EU-27 and USA.

A large share of individual automobile transport compared to other modes of transport is characteristic for developed countries regarding the field of passenger transport. In Europe public transport has a proportion of 25 %, compared to 75 % of individual transport, but the difference is even higher in the USA, because individual motoring reaches a proportion of 85 % (see Figure 2). What is typical for the transport system in the USA, compared to Europe, is its minimum use of railways and city transport and a greater use of air transport.

Up until the 1960s railway had dominated in the field of freight transport. Its market proportion has started to decrease significantly in favour of truck transport since that time. The current proportion of rail transport regarding the total overland transport reaches only 16 % (Figure 3). In the countries of Eastern Europe this trend became more obvious after 1990. Railways were unable adapt to the quick social and economic changes in a sufficiently short time, and therefore, over several years, the modal split changed completely in favour of more adaptive and operative truck transport.

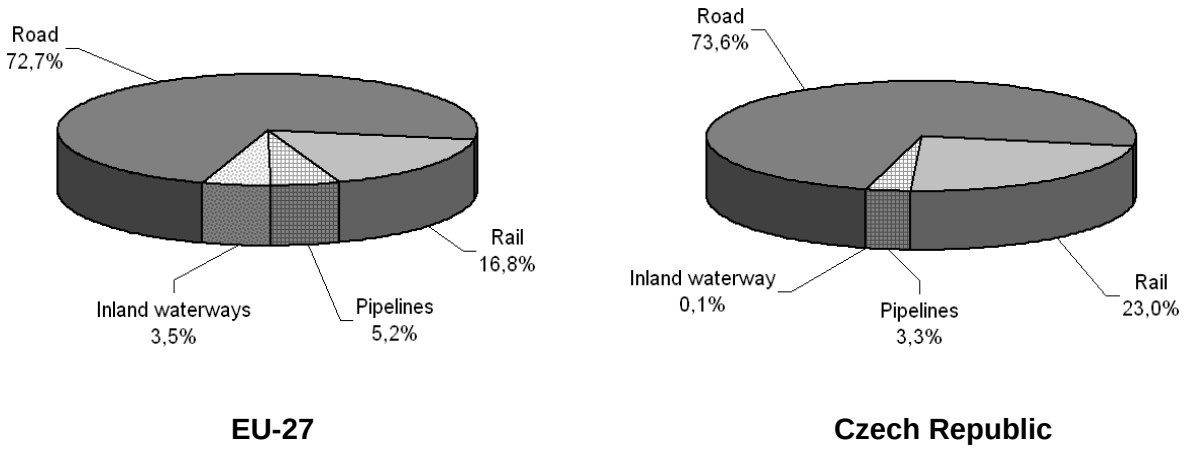

Figure 3: Modal split of freight overland transport in the countries of EU-27 and the Czech Republic in 2006.

4.1 Road transport

Road transport plays a main role in passenger and freight transport nowadays, especially for short and medium distances. Compared to the railways, it has an advantage of higher operability and availability; a disadvantage is a lower degree of organization in its operation, a higher negative influence on the environment, and, above all, low traffic safety.

In spite of this fact, road transport dominates in the transport market in the majority of developed countries, mainly in the freight sector. Its position is still being strengthened thanks to the building of high capacity multi-lane motorways, which create new main axes of the road network. The motorway network is then completed hierarchically with roads classified into categories which are based on their significance in terms of function and technical condition. In the developing countries, on the other hand, an insufficient road network frequently consisting of unpaved roads predominates. The construction of motorways, when considering its size and high terrain demands is demanding in terms of horizontal and vertical alignment, which results in higher land use, amount of necessary building work, as well as the total price.

In the area of the current Czech Republic, a rapid development of motorism occurred in the 1970s. Until that time, there had been a relatively low number of automobiles. Their number started to grow and the trend, which is apparent until today, after a temporary decrease in the 1980s, continued with another boom after 1990 as a consequence of rapid social changes (see Figure 4).
At the same time a significant decrease in the total number of vehicles, classified in the category of single-track vehicles, as well as buses, occurred.

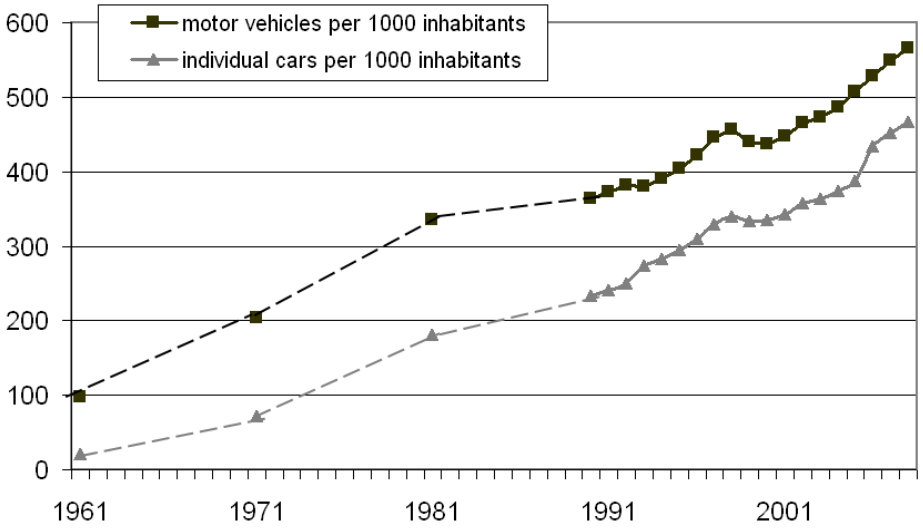

Figure 4: Number of automobiles in the area of the Czech Republic between 1961 and 2008.

The growth of motorization gradually increases the demands on the quality of the road network. The first motorways were first built in the territory of the Czech Republic in 1935, but the construction was later suspended and the finished parts were abandoned (Lídl & Janda, 2006). The construction was restored again at the end of 1960s, and the first motorway section was completed in 1971. On 31 December 2009 the total of 729 km of motorways were in operation in the Czech Republic, which is expected to increase up to 944 km in the future (Brunclík & Vorel, 2009). Attention is currently being paid mainly to the completion of the motorway D8 to Germany towards Dresden, D11 from Prague to Hradec Králové, and a part of D1 from Kroměříž towards Lipník nad Bečvou. With the exception of the cross-border section Bohumín - Polish A1, the motorway D47 is finished and integrated in the transport network as a part of D1. The motorway D3 will connect Praha with České Budějovice and Upper Austria. Its construction is going to be more intensive in the near future.

The construction of new roads and the extension of the existing road capacity is unable to satisfy the current demand, which the current road network is unable to cope with in some sections, which results in congestions. Simple densification of the motorway and road network brings with it the phenomenon of traffic induction, which is an increase in automobile transport as a consequence of the improvement of the qualitative and quantitative parameters of the transport network. This increase occurs, to a certain degree, at the expense of public transport and, partially, as a consequence of generating new traffic which would not otherwise exist at all.

The rapid increase of road transport volumes slowed down with the arrival of the economic crisis, but further growth in road transport on the European as well as national level

is expected with the improvement of the economic situation. To limit the negative consequences affecting health and the environment which will be brought about by this further increase, an application of various measures is necessary.

4.2 Rail transport

Regarding railways we often encounter a broader term rail transport, which besides railway includes tram transport and trolleybus transport. The borderline between rail and tram transport is ambiguous in some cases, as modern transport solutions of operation in large cities prefer the interconnection of individual systems.

Rail transport requires the construction of a transport route based on rails through which the locomotives and railway carriages are moved. In comparison to the road network, the railway network has a higher route deviation, which is given by the lower adhesion of vehicles. Therefore, railway is more affected by geographical conditions of landscape and has a lower ability to overcome the elevation, which brings higher financial costs in the construction of new railways. The greatest advantages of railways are its speed and the high capacity, so it has a valuable role in passenger transport mainly in high-density areas and, concerning freight transport. It is the most effective transport of mass material, like agricultural products, or raw materials, such as wood, coal, iron ore, and building materials.

According to the type of the vehicle drive we differentiate between electric and motor traction. Steam engines, with the exception of some third world countries, are not in regular transport service anymore. Especially the electric traction is considered to be an environmentally friendly type of transport, thanks to its considerably lower energy consumption and lower emissions of pollutants per unit of transported cargo, in comparison to other types of transport. But the indirect consumption of the resources induced by the production of electric energy, with only a small percentage coming from renewable sources, is not negligible.

Nevertheless, the positive effects in terms of health and the environment dominate and, the renaissance of railways is expected. But it has to be adapted to the demands of modern economics and become competitive with road transport, mainly in terms of speed, punctuality, supply patterns of goods, and integration in the multimodal transport systems.

The Czech Republic has a very dense network of railway lines, which is, together with Belgium, the densest in Europe. The first railway arrived in 1839 and by 1870 the whole main network of railway lines was in operation. This network was later complemented with rural side lines. The development of the railway network was finished by World War I., the construction realized after that had to remove the radial arrangement of the main lines towards Vienna and Budapest, inconvenient for the newly formed Czechoslovakia. The most significant railway construction in the area of the Czech Republic realized in the 20th century was the construction of the line Brno - Havlíčkův Brod, opened in 1953. The total operating length of the lines in the Czech Republic reached 9 578 km in 2009; out of which 3 153 km were electrified (MT, 2010). The use of more current systems is a disadvantage which places increasing demands to electric locomotives as the multi-system vehicles have to be used.

The dense railway network of lines gives the Czech Republic great potential for further development of rail transport, but the long-term setback is the high degree of under-investment and the neglected maintenance of some infrastructure. On the other hand, some main lines have been modernized, even up to a speed of 160 km/h, since 1993. These lines are divided into four transit rail corridors (TRC), which cover the crucial transport flows, mainly for international transport. The first two corridors were finished in 2004; the modernization continues on the third and fourth corridor.

The routes of the corridors are mentioned in the following overview:

I.: (Germany -) Děčín – Praha – Č.Třebová – Brno – Břeclav (- Austria)

II.: (Austria -) Břeclav – Přerov – Bohumín (- Poland), connecting line: Přerov – Č. Třebová

III: (Germany -) Cheb – Plzeň – Praha – Č. Třebová – Přerov – Ostrava (– Slovakia)

IV.: (Germany -) Děčín – Praha – Č.Budějovice – Horní Dvořiště (– Austria)

An addition to the above-mentioned corridors, the section from Brno to Přerov, which is included in the priority European projects of the network TEN-T, is planned to be modernized within similar parameters.

The further development of passenger rail transport is expected in urban areas on the main routes from the centres to suburbs. City tramline network may be used by suitable rail vehicles may be used. At medium-range distances, (up to 1000 km), railway will be competitive with air transport on those routes, where high-speed lines, enabling travel speeds over 300 km per hour, will be constructed. In the sector of freight transport, the integration of railway in the combined transport system is its greatest opportunity as it should form the backbone of the overland logistics systems.

4.3 Water transport

Shipping has been used by people since time immemorial, so it is among the oldest modes of transport. It did not need a special infrastructure to be built because water forms natural transport routes, which have become the axes for the transport system in the past. Rivers and lakes were used for this purpose in inland areas and the sea in coastal zones. At the moment, shipping has an irreplaceable role in the freight transport of mass material, like iron ore, coal, or oil. In terms of passenger transport, shipping plays only an additional role nowadays; with the exception of some developing countries, it is mostly used for recreational purposes.

The nodal points of the water transport network are ports. They are large facilities established for ships to be loaded, unloaded, and where ships are taken care of. Ports tend to be connected to the land transport routes through which the goods could be further transported inland. The water infrastructure is formed by rivers, lakes, and man-made constructed canals. A lot of rivers were adjusted for the needs of water transport by canalization, which includes the straightening of the water course, construction of sluice gates, and reinforcement of banks, which bring about dramatic and irreversible changes in river ecosystems.

The Czech Republic is a landlocked country located at the main European water divide between basins of three large European rivers (Labe (the Elbe), Odra (the Oder) and Dunaj (the Danube)) flowing to three different seas (the North, Baltic Sea and Black Sea). That is why it does not have enough of strong water flows, which provide suitable conditions for water transport. The only river which is intensively used for water transport is the Labe, together with the lower flow of the Vltava, with a total length of 303 km. Due to the not very good waterway conditions on the Labe, the regularity of service strongly depends on sufficient water level. The overall length of the navigable waterways, including those only used for recreational purposes, is 664 km.

The overall density of waterways in the Czech Republic is less than 9 km per 1000 km^{-2}., in comparison to 123 km per 1000 km^{-2} in the Netherlands (highest value in Europe) and 51 km per 1000 km^{-2} in Belgium (MT, 2010).

The high financial costs of the construction of new canals do not provide, in the viewpoint of economic profitability, a lot of opportunities for extending the Czech waterway network. The motorways and railways provide alternative sufficient capacity possibilities for transportation, therefore we may expect the maintenance and eventual improvement of the waterway conditions only on the current routes. However, their adjustments need to be undertaken very carefully since valuable and protected water ecosystems could be greatly at risk by the construction works.

4.4 Air transport

The history of the youngest of the commonly used modes of transport is not longer than a century. In the interwar period the zeppelins were an important mean of transportation, but after World War II, heavier-than-air machines were victories in the battle of the use of airspace. Rapid development in air transport came at the end of the 1950s and the beginning of the 1960s.

Aviation has the main role in the fast transporting of passengers over the long-distance routes. Its role in freight transport is not generally important with the exception of hauling the mail and small parcels. The exception are remote regions of Siberia, equatorial and sub-Saharan Africa, and South America, which have a poor system of surface routes and where air transport is the basis of the transport system.

Air transport uses airspace as its transport route, mainly the stratosphere, so it is independent on the construction of overland transport routes and topographical obstacles in landscape. The only exception is the construction of network nodes - airports - which is very difficult in rough terrain. Airport construction (or expansion) is problematic in densely populated areas as well, due to difficulties to meet the required standards concerning noise.

The total number of passengers transported by air is very low but thanks to the long average trip distance, it occupies approximately 10 % of the share of transportation performance worldwide. In spite of the fact that the media regularly report airplane accidents with a lot of casualties, air transport and rail transport are the safest types of passenger transport for their high degree of operating organization. As mentioned above, the air transport is not used for cargo transportation very much, so it only accounts for approximately 0.25 % of the total volume of freight transport.

As far as the area is concerned, the Czech Republic is among smaller countries, so it does not have very suitable conditions for domestic air transport. However, air transport gradually gains a higher importance in international transport. There are five international airports in regular operation in the Czech Republic: Praha-Ruzyně, Ostrava-Mošnov, Brno-Tuřany, Pardubice, and Karlovy Vary-Dvory. In 2008, air transport was used by more than 7 million travellers in the Czech Republic, which, in comparison to 1993, increased more than five-fold (see Figure 5). 95% of the transported passengers go through Praha-Ruzyně airport where the total number of passengers rises significantly every year.

The demand for air transport will probably continue to rise; nevertheless, a lot of airports are on the limit of their capacity so they are unable to handle new services. Low-cost carriers have been more and more active in recent years as an alternative in the continental Europe. Unlike traditional carriers, they use the rural and regional airports more often. But their offer can only address a certain group of customers. On the main routes, the use of giant aircrafts

is expected; this will allow an increase in the number of seats while keeping the number of flights in current level.

The interconnection of the existing independent national air navigation services is important in terms of flight safety to avoid mistakes in communication with the crews of the individual planes.

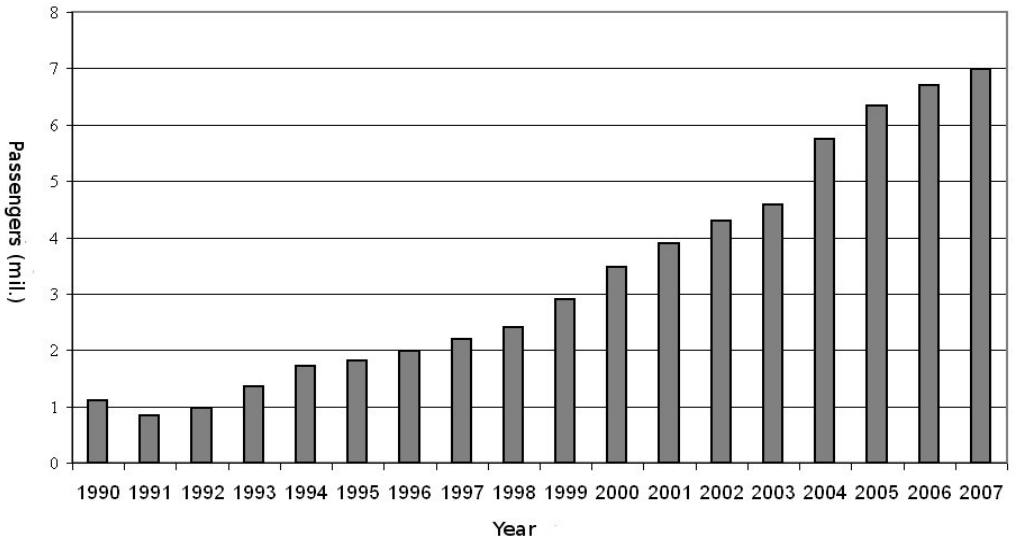

Figure 5: Number of passengers (millions) of air transport with the Czech carriers between 1990 and 2007.

4.5 Cycle and pedestrian transport

The cycling is an effective mode of transportation for short distance trips (up to 5 - 8 km) and could be easily combined with other modes of transport, mainly rail transport or urban public transport in the systems called “bike and ride”. In some countries, like China, the Netherlands, or Denmark, bicycle transport has a big share in the modal split within the local transport. Cycle transport is environmentally friendly and has positive effects on health and physical fitness. It is only a little demanding on non-renewable resources; it does not produce air emissions, or even a distinctive noise. The spatial demands are significantly lower when compared to other types of local transportation, excluding walking. The term cycle transport is often restricted only to a free-time recreational activity in the form of cycling tourism, but in the context of transport sustainability, its importance is to be found in everyday use for urban and suburban commuting. The high vulnerability of cyclists in everyday traffic is a big problem and therefore specialized infrastructure, in the form of bicycle paths, is promoted in localities with the high concentration of cyclists. Another problem is a safe storage of bicycles in places of the most common destinations in urban areas, such as workplaces, shops, authorities, particularly in city centres.

Walking is an everyday part of our lives and its quality is one of the criteria which determine the quality of our lives. It is the healthiest and most environmentally friendly of all transport modes, because it has minimal spatial demands and energy consumption, has positive effects on health, and has an important recreational function. In towns it is related mainly to public places, tourist attractions, public vegetation areas as well as publicity transport. Special infrastructure for pedestrians (pedestrian paths and pedestrian zones) is provided at busy places. These zones are common in the centres of large cities where all

other transport modes are excluded, however, exact conditions vary in different cities. Concerning the environment, the permission of access for cyclists to pedestrian zones is positive; and in many towns, pedestrian zones are accessible to trams as well.

4.6 The multi-modal transport

The basic principle of multimodal transportation is the co-operation between individual modes of transport. Therefore, those transport modes which use at least two modes of transport to get from the origin to the destination are considered to be multimodal. It offers a chance to use the most sustainable mode of transport for each part of the trip, so, in terms of health and the environmental impacts, the most environmentally friendly one. For example, the transportation of goods between logistics centres is realised by railway and the local distribution to the destination is provided by road transport. The significant moment to apply this multi-modal approach in freight transport was the introduction of standardized containers which allow easy transhipment of goods between individual transport systems. The multimodality in passenger transport is particularly used in the creation of integrated transport systems. The idea of co-operation between individual transport modes is relatively new, because, for a long time, the transport market had been strictly segmented and economical competition between different transport modes in freight and passenger transport had been fierce. The introduction of state transport monopolies in rail transport, air transport and public road transport was typical for Europe. In connection with the principles of the free market, which are proclaimed by the EU, these monopolies are gradually removed.

A special case of combined transport is the system of the accompanied intermodal transportation, the so-called Ro-La (Rollende-Landstrasse). It provides transport of road trucks on railway on some routes. Two such lines were operated in the Czech Republic: the first one ran from Lovosice to Dresden in Germany, and the other one from České Budějovice to Villach in Austria. However, due to economic reasons (low use, in the first service mainly due to the removal of duty obligation after the accession of the Czech Republic to the EU in 2004) their operation was discontinued; although such systems are still in operation in other countries.

There are 13 terminals for combined transport in operation in the Czech Republic at the moment. These terminals are linked to motorways and railways. Furthermore, four of them allow transhipment to ships of inland waterway transport (MT, 2010). However, virtually all the existing terminals are privately owned. The transport policy for 2005 – 2013 (MT, 2005) brings a task to build a network of public logistics centres in which the pick-up and delivery of shipments in the neighbouring areas will be realized via road transport and the centres will be interconnected by railway.

5 TRANSPORT IN EUROPEAN CONTEXT

The unified European market and the free movement of labour force are among the basic principles of the EU. In the transport sector, there is an effort to adapt transport to the needs of inhabitants. The fundamental strategic document is White paper - "The European transport policy until 2010: Time to decide" (European Commission, 2001) defining over 60 measures which should help in order to meet targets in the Paper. The main targets are: the increase of railway share in modal split and the interconnection of various modes of transport within multimodal logistics chains.

Unfortunately, the transport systems of individual EU countries have developed separately and therefore there is a considerable fragmentation among them,

either from technical or organizational point of view. This trend is apparent mainly in rail transport, whose development, in relation to its favourable environmental characteristics, is one of the European priorities, mainly in the field of international freight transport. For railways, the organization at the national level is typical. The EU has a task to increase the quality of rail transport by improving the technical and managerial level of individual operators and groups of operators or by increasing the competition on routes to achieve a positive effect on customers. The goal should be the opening of the market in the field of freight transport, both at international and national levels; the liberalization of passenger transport is planned in a longer term perspective. The unified market in rail transport requires the unification of the national technical and organization aspects.

In field of road transport, the whole-European coordination and completion of the road network for long-distance transports is necessary. In some regions, particularly in the newly-acceded members, there is an incomplete network of motorways and highways, or, even non-existent. The motorway network is particularly important for passenger transport; long-distance freight transport should be operated with the use of combined transport.

The quality transport network is one of the European priorities and, therefore, a concept of Trans-European transport networks (TEN-T) was approved in the 1990s. The concept of networks focused on both road transport and high-speed rail transport, as well as on combined transport and inland waterways. The priority projects, which included the elimination of technological limitations in the transport networks, were defined. An example of such a project is the construction of high-speed railways between Paris, London and Brussels, or the construction of a bridge over the Oresund strait, which separates Denmark and Sweden.

The insufficiently developed transport network in the new member states of the EU is their economic disadvantage compared to the original members. The insufficient condition of transport systems in Eastern Europe was caused by overloading, up to their capacity limits, and neglected maintenance over a long time. The consequence was the reduction in their reliability, longer travel times, and the environmental problems. One of the outcomes of the second Pan-European transport conference, which took place in 1994 in Crete, was the agreed routes of corridors linking the most important centres in Central and Eastern Europe. It meant defining the most important transport routes which were necessary to be funded within the period of up to 15 years. In 1997, at the third conference in Helsinki, certain changes were made so that the corridors would meet the needs of the EU after its enlargement. They are therefore sometimes called the "Helsinki" corridors. The routes of the pan-European corridors are perceived as multi-modal usually involving road and rail components, as well as air or water components in some cases.

Out of the total of 10 pan-European corridors, the fourth pan-European corridor and one of the parts of the sixth pan-European corridor touch the territory of the Czech Republic. The main route of the fourth corridor runs from Berlin/Nuremberg to Prague, Bratislava, Budapest and further splits up to Constanta, Thessaloniki, and Istanbul. Regarding the sixth corridor the main route is from Gdansk through Warsaw and Katowice to Žilina (the connection to the pan-European multi-modal corridor number V, Venice - Ľviv). The arm B concerns the Czech area, which runs through the Moravian ravines and is linked to the pan-European multimodal corridor number V in Bratislava, respectively Vienna.

Regarding the Czech road network, the routes of the current or planned motorways and highways: D5, D8, D1, D2, R48, R55 belong to the pan-European corridors. Concerning the rail network, the pan-European corridors contain main arms of the first and second transit rail corridor and a part of the route of the third and fourth transit corridor. The existing Labe waterway could be classified as a part of the fourth pan-European corridor.

The definition of individual corridors allowed to locate places and routes which require foremost attention when reconstructing and improving the transport infrastructure. The inclusion of a transport project in one of the corridors increases the chance when applying for financial support from the funds of the EU.

Figure 6: Pan-European corridors.

6 SUMMARY

The most environmentally-friendly passenger transport mode is often regarded the non-motorized transport, i.e. walking and cycling. Rail transport is also viewed as environmentally friendly. Air transport seems problematic and road transport has the biggest largest impact on the environment, particularly individual road transport. Regarding freight transport, the most environmentally friendly is considered rail transport, road transport is considered to be the most harmful. The assessment of water transport is ambiguous, since there is a high risk in case of an accident and the infrastructure construction is a dramatic intervention in landscape and river ecosystems.

ACKNOWLEDGEMENTS

The text of this article was produced within the research project of the Ministry of Transport of the Czech Republic No. MD 04499457501 “Sustainable Transport – Chance for the Future”.

REFERENCES

Brinke, J., 1999. *Úvod do geografie dopravy*. Praha: PřF UK, 107 p. ISBN 80-7184-923-5. (in Czech)

Brunclík, A, Vorel, V., 2009. *Páteřní síť dálnic a rychlostních silnic v ČR*. Praha: Agentura Lucie a ŘSD, 81 p. (in Czech)

ČSÚ, 1982. *Sčítání domů a bytů 1980 – Česká socialistická republika*. Praha: ČSÚ, 303 p. (in Czech)

European Commission, 2001. *White paper - "European transport policy for 2010: time to decide“*. Luxembourg: Office for Official Publications of the European Communities, 119 p. ISBN 92-894-0341-1.

FSÚ, 1971. *Předběžné výsledky sčítání lidu, domů a bytů k 1. prosinci 1970 v ČSSR, 1. díl.* Praha: Federální statistický úřad, 214 p. (in Czech)

Jedlička, J., Adamec, V., Jandová, V. et al., 2009. *Studie o vývoji dopravy z hlediska životního prostředí v České republice za rok 2008*. Brno: Centrum dopravního výzkumu, v.v.i., 118 p.

Lídl, V. , Janda, L., 2006. *Stavby, kterým doba nepřála*. Praha: Ředitelství silnic a dálnic, 122 p. (in Czech)

MT, 2005. *Transport policy of the Czech Republic 2005-2013*. Praha (Czech Republic): Ministry of Transport, 61 p.

MT, 2010. *Transport Yearbook Czech Republic 2009*. Praha (Czech Republic): Ministry of Transport, 167 p.

Rodrigue, J-P, Comtois, C., Slack, B., 2009. *The Geography of Transport Systems*, Second Edition. New York: Routledge, 352 p. ISBN 978-0-415-48324-7.

ÚKLKS, 1965. *Sčítání lidu, domů a bytů v Československé socialistické republice k 1. březnu 1961. Díl 3.* Praha: ÚKLKS. (in Czech)