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OPPORTUNITIES AND POTENTIAL OF TRANSPORTATION ON THE DANUBE

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ABSTRACT

The fundamental trends of transportation of goods are negative concerning the two important mass transport technologies, the rail and inland navigation in the EU. This phenomenon is problematic even from the view of competitiveness and ecology if we just consider the facts that these modes of transport are cheaper than road transport and cause less pollution or other negative externalities. For the improvement of this unfavorable position, these two technologies need a drastic change in the level of service and business models, particularly in the used infrastructure. One of the most fundamental issues within transportation is the question of navigation on the Danube, where Hungary is also a stakeholder. In this paper I try to find the most important factors of this issue and try to identify the fundamental principles of a new Danube shipping strategy in Central-Europe. This analysis is first of all based on the statistical data on transportation networks.
Keywords: transport, rail, inland waterways, Danube, inland navigation

INTRODUCTION

Basic trends of goods transport in the EU

Because of the huge growth in consumption and the process of globalization, the role of global transportation systems becomes more and more important all over the world and also in Europe. The transportation sector is one of the most important parts of the global economic system. Due to the improvements in logistics and the related IT services, there is a well-organized global economic network today. This global transport system is precise, fast, calculable and stable. Meanwhile there has been other significant change in the role of different transportation technologies. The most stable and reliable technology is air transportation with the most expensive prices and lowest share from the overall transportation. Due to the well-developed road network and the termination of inside EU border system, the best deal on the transportation market today is road transport. This technology is fast, predictable, and also very flexible with better prices compared to air transport. Within the European Union the short sea shipping has also an important role. From the 50s and also in the last 20 years, there is a negative trend and a smaller share in the use of rail transport and inland waterways (as we can see in the *Table 1*).

Table 1

Modal split in the EU, goods transport (1995-2007, %)

Year	Road	Rail	Inland waterways	Pipelines	Sea	Air
1995	42.1	12.6	4.0	3.8	37.5	0.1
2000	43.0	11.4	3.8	3.6	38.1	0.1
2001	43.1	10.7	3.7	3.7	38.8	0.1
2002	43.8	10.5	3.6	3.5	38.6	0.1
2003	43.7	10.5	3.3	3.5	38.8	0.1
2004	44.	10.6	3.5	3.4	37.9	0.1
2005	44.9	10.3	3.5	3.4	37.9	0.1
2006	45.0	10.7	3.4	3.3	37.6	0.1
2007	45.6	10.7	3.3	3.0	37.3	0.1

Source: *European Union*, 2009

As we can see, in the EU the share of the two most important mass transportation types are low with the rail sector having 10.7% and the inland waterways having only 3.3% in the total goods transport. The share of these two transport modes shows a descending trend between 1995 and 2007. Meanwhile the road transport sector has a nearly 50% share of the total transportation industry in the EU. It is considered to be a typical and natural trend characteristic to developed western countries. But if we consider the data from the USA, which is the nearest comparison for the EU, we can find a very different situation (*Table 2*).

Table 2

Modal split in the USA, goods transport, 1995-2006, %

Year	Road	Rail	Inland waterways	Pipelines
1995	31.2%	39.7%	11.0%	20.5%
2000	32.4%	42.1%	9.8%	15.7%
2001	32.5%	42.8%	9.3%	15.4%
2002	32.9%	42.4%	9.2%	15.5%
2003	33.4%	42.4%	8.6%	15.6%
2004	32.8%	43.1%	8.7%	15.4%
2005	32.6%	43.8%	8.2%	15.3%
2006	31.8%	45.6%	8.2%	14.4%

Source: *European Union*, 2009

The modal split in the USA is very different compared to the European one. Although in the USA there is no see shipping and air traffic data in this statistic, but the relation between the output of road, rail and the inland waterways is very differentiated compared to the EU data. Other important findings is the rising trend of the rail sector share in the analyzed period, and the absolute levels of road

and rail transportation shares, where rail technology has a leading role. So we can see, that the situation in the EU is not a typical situation compared to other well-developed countries or regions.

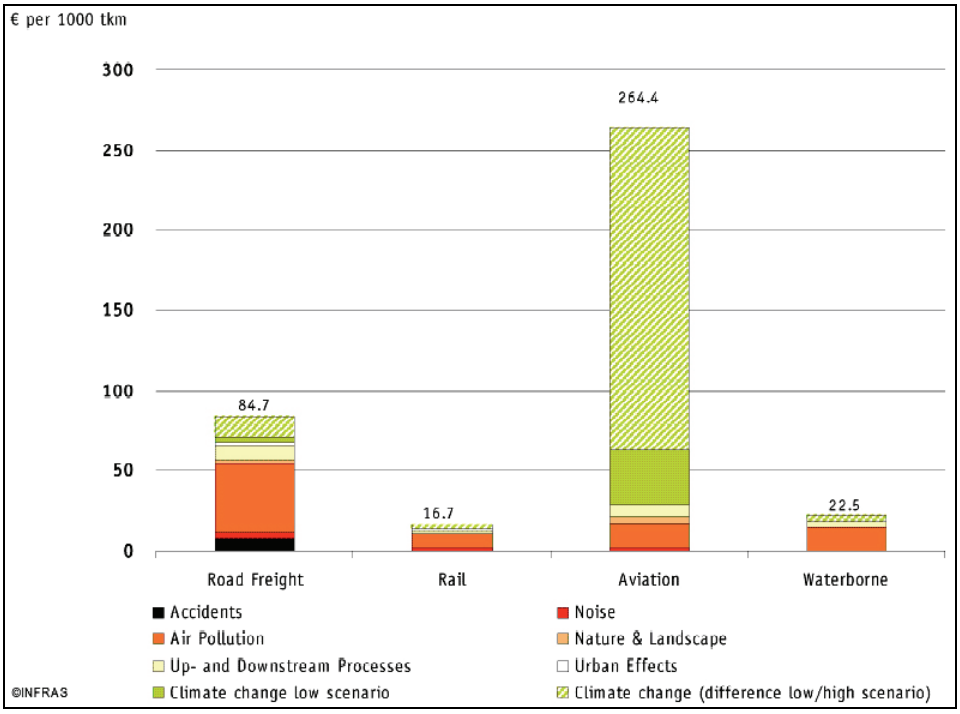
The importance of modal split

The importance of the above mentioned trends is not necessarily obvious at first sight. The changes in the roles of each technology are a natural process considering the development of economic systems. However there are some dimensions – primarily the use of ecological resources – according to which it is a very important question which transportation technology has the biggest role. Research findings from the last decades show significant difference on the environmental impact of different transportation modes. There are also differences in the consideration of the extent and features of land use and the cost and characteristics of infrastructure needed. The use of ecological resources appears in the direct costs, since the level of energy needed for transportation is related to the extent of pollution and costs.

Choosing between the inland modes of goods transportation it is important to consider the external impacts of the decision made because the level of the environmental impact of each technology is significantly different (*Figure 1*).

Figure 1

Differences of transport technologies in external costs



Source: *IWW*, 2009

One of the characteristics of this issue is that besides data points there are excessively complicated model calculations. Due to this the scattering between results is high. In this study we do not intend to deal with the details of this problem. The data above are from a current study made by an institute (*IWW*, 2009) engaged in this issue long since.

The data show that external costs per TKM significantly differ according to transportation technologies. The external costs of shipping are one and a half times, while costs of road transportation are fifth times bigger compared to railway data as base. According to the model the most extreme external costs are caused by air transport, which are ten times bigger than the values of railway transport.

Environmental policy is considered to be a significant topic on the EU level, and also on the level of member states. According to this view, in transportation policy it represents consistently the conception of railway development. At present this conception does not seem to be successful, since in most member states the share of railway in goods transport stagnates or decreases.

DRIVERS OF CHOICE

In this analysis it is important to emphasize the similarities between railway and shipping technology. Basic characteristics and the most relevant problems are similar in the cases if the two transportation modes, so the reasons of weak competitive position of road transport can be characterized. The most important aspects of decisions made by those who buy transportation services can be identified along a few factors. According to these aspects differences are significant between individual and mass transport. In the last few decades in the transportation of goods it is of big importance that goods and products arrive at the right place precisely in the right time. The decrease in transportation periods and the increase of the flexibility of time management is a general tendency. In Europe in all of the above mentioned aspects road transportation is much stronger than railway except prices, which are almost the only strength of mass transport. It is also worth considering the question of commodity groups since in the case of certain goods road transport is not effective (goods with high density and big volumes of mass products, for example coal). In this case switching road transportation modes is not possible. Differences in Europe can be seen from *Table 3*.

It can be seen that railway transport and inland shipping are not competitive in Europe. The problems are complex: some of them are basic, technology driven others are due to bad management. The price of mass transport is usually better than at other transport modes, but there is a lack of active, innovative, competitive attitude. Due to this there is no proper level of high quality service in this field. Though there are partial break out points, but we have to face with dealing with relevant problems even on the short run. There would be a great need of serious innovative progress and the overcoming of the present technical barriers.

Table 3

Comparison of individual and mass transport, from consumer view

	Road and Air	Rail and Inland navigation
Speed	Fastest modes of transport	Badly organized transport – with significant competing time advantages
Costs	High price levels; good price value rate of services	Low expenses, low price value rate
Type of goods	Any type of goods with a few exceptions	Effective mode in the case of a few goods
Size of package	Any type of goods except a few with extreme sizes	It can handle just a few technology (e.g. container)
Safety	High level	Badly managed risks
Timelines	Reliable, well-planned	Influenced by many external factors
Additional services	Widely available, innovative technologies	Just a few services
Flexibility	Flexible in time and space	Not flexible in time and space

Relevant transport technologies in Hungary

The geographic location of Hungary has relevant consequences considering European transportation trends from the Hungarian point of view:

1. The country does not have an exit to the sea, thus sea transport and sea shipping is not a direct mode of transport.
2. Due to the country's central position and Helsinki corridors, there is a great potential of transport and transit traffic.
3. The country is located along the borders of two regions (East and West), which have different transportation potentials, thus handling transit goods can have economic potential above average.

The field is divided in two cases of transport technologies. Air and road transport play a proportionate role to economic and technical development In the last 20 years the main part of necessary motorway network has been completed, thus road traffic infrastructure is equal or similar to the important transport directions compared to the developed European countries. The share of air transport is lower in the total market, but also in this mode it fits with the expected potential.

Railway transport and inland shipping are lagging behind. In the case of railway, network infrastructure for freight transport is well established since it is no big difference if the maximum permitted speed of the lines is 100 km/hour or 160 km/hrs. There are network elements, directions, where the capacity is scarce, but even more problem that there are deficiencies in the technical condition of the railway network. This discredits not only the competitiveness of certain routes, but causes general problems related to reliability. In the case of using railway lines in bad condition, malfunctions happen more often, so the risk that an ordinary

transport does not arrive in time, is relatively high. Besides the conditions of the network, there are other factors in this field. There are many deficiencies in the field of complementary infrastructure, as well.

In the case of shipping the situation is worse considering infrastructure. There are problems with the shipping routes, transport infrastructure and services. Infrastructure in ports is not completed, there are a small number of ports, and the levels of their services are low. The importance of shipping in the Hungarian economic system is insignificant; the performance of shipping does not meet with the given possibilities.

So rail and inland water transport is lagging behind technologies providing unique services. The level of services does not meet with the criteria of demand, infrastructure is not completely build, operating service providers are not capable of offer services to customers with goods which can not be transported on the road because of the attributes of the goods (*Fleischer*, 2011).

VISIONS OF TRANSPORT NETWORKS AND THE ROLE OF THE DANUBE

According to the above mentioned, the vision of an ideal logistic network in Europe is where in the main corridors there is a modern transportation system integrating railway and inland shipping solutions. At the starting and endpoints (with a 100-150 km radius) road transport would be prevalent. Air transport would be applied only in the cases of urgent, unique, high quality required and classic postal services. In this case the share of transport technologies with lower environmental load could be increased but at the same time it would not negatively affect the European competitiveness and standard of living. In fact, through indirect impacts there would be a positive effect in the case of both factors. According to this vision, the main European corridors would have bigger and more important role than they have now. The Danube is one of the most important transit waterways in Europe. At the moment the Danube is an isolated element in the transport system, the share of intermodal transport is very low within shipping (*Table 4*).

Table 4

Distribution of inland navigation by origin and target, 2009

Source/Origin	Distribution
Port, landing	55.5%
Road traffic	32.0%
Rail traffic	11.3%
Other ship	1.2%

Source: *Hungarian Port Statistics*, 2010

This means that the importance of shipping on the Danube could increase on the long run. For Hungary it would mean that a larger share of transport, so Hungarian export, import and transit traffic crossing through the country, would be on the Danube.

The Danube can play a decisive role in three trading areas:

- In the Central-European Region the Danube can connect the main regional centers on a low price (at the moment this is a non existent, or too small market).
- It can provide services completing railway transport to the direction of the Rhone and the Black Sea.

The Danube as transport infrastructure

Based on the above mentioned, the Danube can be considered a transport infrastructure with specific and unique natural capabilities. From logistic point of view in the case of routes the problems are the bottlenecks, the changeable physical features and their uncertainty factors. The main feature of the Danube that water level fluctuates, during the year big changes can be observed in the water level. This problem is important in the case of shallow, where the water is not deep so the low level of water makes shipping problematic. Because of this, in the case of low water level, ships can run with less freight, less utilization, which increases unit costs.

According to most of the Hungarian shipping professionals the solution is to terminate drastically the problem which would be achieved by building dams. Thus the water level could be increased and regulated, so problems with shallows would nearly disappear. However dams do not give a proper solution for the problems of shipping industry, because this kind of investments does not improve significantly the situation. The great uncertainty of planning on the river does not improve with investing in a dam. Building dams along the river is such a long period of time, in which case we should rationally think about temporary solutions. (If these solutions were realized this would improve the current situation as well.)

The other way of solving the problem, which is considered to be feasible, is the improvement of the river capacity with building on the water. In this case there are physical intervention in the riverbed, so with dredging the shallows we can reduce the problems. In this case physical interventions are done in the riverbed, and by dredging shallows and dams we can reduce problems. By reducing the occurrence of shallows and dams would naturally improve conditions, but it does not solve the problems by itself. The present solutions tend to mean that the EU expects and requires the reduction of dams and at the same time we could terminate or reduce shallows in the Danube by big water building investments.

However this is problematic from two aspects. On one side it is costly, on the other side it hold significant risks as it reduces the ecological services provided by the Danube. Both factors show that the extent of interventions should be reduced as low as it is possible.

In the last few years professional debates on this issue happened primarily between environmentalists and water and shipping professionals. The first groups is against interventions and try to call attention to the need and of ships which are developed based on Danube needs instead of reshaping the Danube according to

the needs of ships travel on the Rhone. Current model data, made as background research for the Hungarian-Slovak debate, could be used in general with further changes as well. The first attempt was the study of Regional Centre for Energy and Policy Research (*REKK,* 2010) where besides new results model analysis show that big ships can be more effective even in the case of lower saturation and lower water level. Thus this debate is misleading and unnecessary.

The potential flow of wares

The most important potential in Danube navigation is the development of the transport of new types of goods, especially the container-traffic. This option is technically realistic today, but it has a big disadvantage considering competitiveness. If a change in the circumstances happened, the performance of the Danube transport system could achieve a significant growth.

One potential base of this process is the switch from road and rail to navigation in transport. The other main type of opportunities is the formation of new transport directions. Within this potential there are also two options. First there is a potential development in trade inside of Central-Europe. Other possibility is a change in the dominant routes in the Far Eastern traffic: from the ports of North-Europe to the Black Sea.

The typical route today is Rotterdam, or other North-Sea ports via Suez, Gibraltar, and then to Hungary on road. An alternative way is the Black Sea via Bosporus and Konstanza to Hungary, which is significantly shorter, but not so well organized, like the longer way. Because of the bad condition of the road and rail infrastructure of East-Europe, this potential flow of wares is a real opportunity for the inland navigation. But there is also a lack of infrastructure in the host part of the network in Hungary.

There is some alternative data resource in this issue, but there are also problems and conflicts in the comparison of data from different sources (*Table 5*). This data conflicts are problematic, but there is no hard inconsistency inside of one data source. So we use only the Eurostat data in the next part.

Table 5

Differences between the Eurostat and Port data, 2009

Data source:	Rotterdam port	Eurostat	Relative differences
Traffic in Rotterdam, million tons	387.0	346.7	11.6%
Traffic in Amsterdam, million tones	86.7	73.5	18.0%
Traffic in Konstanza, million tons	42.0	29.2	43.9%

Source: *EUROSTAT,* 2011, *Port of Rotterdam*, 2011

Trade between the Danube states

In the trading system formed after 1990, the extent of flow of goods between countries has dropped, meanwhile Eastern-Western relationships have

strengthened. We can assume that trade between countries along the Danube will have more importance on the middle term as organic economic relations will drop (*Table 6*).

Table 6

Road and rail traffic routes with possible Danube affections, 2009

Origin:	**Road**	**Rail**	**Sum**	**Relative scale** (Hungarian inland navigation=100%)
	To the Balkan. Thousand tones			
Belgium	682.0	124.0	806.0	10.4%
Czech Republic	1364.0	1285.0	2649.0	34.2%
Germany	6219.0	1396.0	7615.0	98.3%
Hungary	1881.0	1158.0	3039.0	39.2%
Netherland	994.0	4.0	998.0	12.9%
Austria	3616.0	2073.0	5689.0	73.5%
Sum	14756.0	6040.0	20796.0	268.5%
	To the Central and West-Europe. Thousand tones			
Hungary	8809.0	4835.0	13644.0	8809000
Bulgaria	623.0	101.0	724.0	623000
Romania	3096.0	624.0	3720.0	3096000
Croatia	262.0	749.0	1011.0	262000
Serbia	157.0	420.0	577.0	157000
Sum	12947.0	6729.0	19676.0	12947000

Source: Based on *EUROSTAT*, 2011 statistics

The overall flow of goods between countries on rail and road situated along the Danube surpass the total extent of cargo crossing the Hungarian part of the river. According to this we can assume that the growth of this segment would have a significant positive impact on shipping on the Danube.

Trade with the Far-East

In the case of Europe export-import to the Far East is realized primarily on the sea, this gives the main part of total trade. The route goes to the North Sea with the above-presented detour. The main part of cargo is transported from Western Europe to the other parts of the continent. With proper conditions export and import from the Far East would be much shorter and cost effective to transport on the Black Sea and on the Danube. Based on *Table 7* the biggest part of cargo from the Far East arrives in countries, which are in touch with the Danube-Rhone-Main water route.

Table 7

The share of Far-East-traffic in the European ports, 2009

Origin:	**Traffic** (Million tons)	**Relative scale** (Traffic between far-east and Europe=100%)	**Relative scale** (Traffic of ports in the category=100%)
Danube-Main-Rhine sea ports	100.0	53.0%	11.7%
Adriatic and Mediterranean sea	18.4	9.8%	3.9%
West-Europe ports	59.7	31.6%	3.0%
North-Europe ports	8.0	4.3%	1.8%
Other ports	2.5	1.3%	1.6%
Sum	188.7	100.0%	4.8%

Source: Based on *EUROSTAT*, 2011 statistics

Table 8 shows that cargo arriving in the ports is mainly part of the sea trade in these countries. Road and railway as substitutes of inland shipping are potentials in relevant geographic locations. In the case of most regions sea route is possible, and it dominates the transport performance, in Central-Europe where the lack of sea connection is typical, this level is only 45.2%. Today rail (14.6%) and road (35.7%) give primarily the rest, while inland shipping gives only 0.2%. There can be a shift between these three areas, which can mean an expansion opportunity for Danube shipping.

Table 8

The share of Far East traffic in the European ports, 2009

Type	**Central Europe**	**Germany and Poland**	**Baltic countries**	**Mediter-ranean countries**	**North-Europe**	**Other countries**
Sea	45.3	94.9	95.9	97.6	96.2	86.2
Rail	14.6	0.4	0.1	0.3	0.1	0.3
Road	35.7	1.6	2.6	0.7	2.7	3.8
Inland waterway	0.2	0.2	0.0	0.0	0.0	0.8
Other	4.2	2.9	1.4	1.4	1.0	8.9
Sum	100.0	100.0	100.0	100.0	100.0	100.0

Source: Based on *EUROSTAT*, 2011 statistics

There can be identified potential expansion fields, where the Danube could mean a reasonable alternative. Obviously transport on the Danube is already present in some of these cases (mostly in the trade activity of countries situated along the

Danube). So the potential is present also today on the Danube. We should see that there is a great potential in the development of Danube shipping not he middle term. If logistics along the Danube became more competitive, there would be a significant growth in the share of inland shipping.

CONDITIONS OF DEVELOPMENT IN THE DANUBE NAVIGATION

According to current logistic trends it is obvious that the reason for the bad market position of shipping is not the significant increase of unit costs caused by the not proper utilization of ships in those periods where there are shallows on the Danube. The prices of the sector would remain competitive even in those cases (*REKK*, 2010). The problem is that service providers are not capable of providing reliable performance on the Danube. On the one hand it is natural in shipping, at the same time this problem gets bigger without a proper information system and background during long periods and it extremely hinders the use of ships. There is no up to date information and nor forecasts on the presence of shallows. As we do not know the exact size of shallows, we presume them to be bigger and this cause bigger loss than necessary. It could not be planned well (*Gerencsér*, 2009).

It is also a problem that water logistics is a rather isolated issue, since this segment is not integrated in the logistic networks properly. A water trip which end in a logistic center used also by the customer worth much more for the customer than a transfer to a close but isolated port where there are further costs and management requirements for the further transportation of goods.

It could cause significant improvement if there were coordination in transport management concerning rail and water routes since the two technologies are similar in many aspects. They could complete each other if communication and cooperation is regular and well managed between them. However at the moment each segment operates isolated from each other.

Port infrastructure and economic business environment

Infrastructure should serve the good approach and availability of ports and logistic centers. Those port or centers, which cannot be easily reached, will never become intermodal logistic center. Building infrastructure leading to ports is a common task. Hungary is not interested in building new ports, but creating better managed and equipped ports.

Compared to road transport water transport completes that. In an ideal situation water transport on the Danube means transport on long distances, with the use of road transport at the final stations (except those special cases where the source or location of utilization has a direct port connection). Its distance ideally is less than 200 km, but in this case as well transport on the Danube could be relevant in most part of the country.

Economic links of ports

Successful port activity could not be isolated: the intensity of cooperation between logistic centers operating in ports or the economic network of actors present in the

surroundings or within road radius is very determinative for both sides. If these conditions could be realized, port logistic functions are built in port actors' mind, through port services economic performance could grow, and it creates jobs.

Complementing services have particularly great importance considering transit traffic: it is not obvious that shipping transit crossing Hungary cause relevant income in the country because of the size of Hungary and the Hungarian part of the Danube. There is a great need of more ports providing high quality and competitive services and the use of opportunities where high value added services can be provided.

We need to build new nodes in the network harmonized with development of transport systems. In case we need to terminate or relocate those centers, which are not at the right place from this point of view.

CONCLUSIONS: PRINCIPLES OF THE DANUBE TRANSPORT STRATEGY

The most important criteria for the Danube strategy are the completeness: the solutions must be generic for the whole length of the river, and we must improve the conditions of shipping, with only the needed minimal, unavoidable ecological intervention. The five principles of a well-working and competitive river transport system:

- Automatic river-information system on the whole length of the Danube, with water level forecast model system for shipload planning.
- Developing shipping infrastructure with the minimal necessary corrections of the river basin and cost-benefit analysis for the selection of intervention projects.
- Necessary corrections in the legal and economic regulation.
- Developing the terminal logistic system, with network of three-way intermodal logistic centers (rail, road and waterway).
- Developing transport assets, build and rebuild ships, with specific Danube-focus.

With these five principles the transport network on the Danube can provide a more competitive level of service. However it means also lighter building activity on the river basin, with less ecological costs, of course. The cost-benefit analysis gives a chance to find the optimal level of intervention. This instrument is simple and well known, but partly new in the water engineering, especially on the east sector of the Danube.

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