MULTIMODAL TRANSPORT ANALYSIS BASED ON COMPARATIVE ADVANTAGES OF UNIMODAL MEANS OF TRANSPORTATION

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Abstract: *Transport activity is a complex process of transporting goods or people through two points. A cheap and efficient way of transporting goods is by sea. Transporting goods on inland waterways functionally consist in two elements, the shipping companies and the inland waterways. Some of the advantages of this kind of transport are that is friendly with the environment, it can transport a large quantity of goods, it has a low fuel consumption and has low commercial risks. Inland waterways transport must be studied in comparison with other ways of transporting goods, road and railway. The main comparison points are: transport capacity, transport costs, voyage and the distance. This study will show that inland waterways transport can be used in the future, given up at road transport and making it a best way of transporting goods.*
Key-words: *multimodal transport, naval, freight, means of transportation*

After the maritime transport, inland waterways transport is the cheapest way of transporting goods. The main advantages of this kind of transport are: low rates, low transport costs, low infrastructure costs, the possibility to exploit heavy goods. In terms of shipping rates, inland waterways transport is up to 3 times cheaper than railroad transport and further much cheaper than road and air transports. Other advantages consist in low energy consumption and resources expenditure providing environment protection. Some of the major disadvantages of inland waters are: geographical limitations, low speed of shipping cargo, high trans-shipment costs, and high level of maintenance costs for riverane infrastructure.

The Danube is the major Romanian inland waterway and with the help of the Black-Sea Channel it connects, through the Rhine-Main-Danube to the North side of Europe. The Rhine-Main-Danube connects several European in a transport corridor the next countries: Holland, Germany, Austria, Slovakia, Hungary, Serbia, Romania and Bulgaria. To transport goods on inland waterways the ship owner uses river waybills as carriage documents, where is stated that the shipper of goods protects them all voyage long against any risks. If any damages happen to the goods, the shipper is responsible for them and has to pay a fee to the owner of the goods.

The EU it is interested in the development of inland waterways transport because of its economical and ecological perspective. A program that embraces inland transport is the NAIADES program which includes: creating favorable conditions for development of inland transport services; creating and offering logistic services by building new ships; development of new working places; creating a new imagine of inland waterway transport by promoting it; ensuring a good infrastructure and connecting to other ways of transport.

1. THEORETICAL CONSIDERATIONS

The Danube is the longest and the most important river in Europe. The River flows from South-West Germany to the Black Sea, having a length of 2580 km. The main countries through which the river flows are: Germany, Austria, Hungary, Serbia and Romania. The Danube enters in Romania through Gura Nerei and flows into the Black Sea through Sulina, measuring a length of 1075 km. The Romanian inland waterway network consists also with the Danube-Black Sea Channel and his extension Poarta Alba-Midia Navodari Channel. The maximum draft on the Danube, in Romania, is 7 m in ports like Sulina, Tulcea, Galati and Braila.

The Danube is very important because it brings wealth to the areas where it flows. The Danube sectors are specialized in industry, especially in ore and wood industry and have a major impact in the agriculture. The most industrialized sector of the Danube is the one from Braila to Sulina. The three cities included in this sector, Braila, Tulcea and Galati, are the most industrialized cities on the Danube. This sector is filled with agricultural areas and forests. The European Union is very interested in development of inland waterways transport because it represents an alternative to road and railroad transport. Because of this interest the EU developed the TEN-T infrastructure with the help of BIE, from 2006. The Danube takes part in this infrastructure. Another important European project is PP 18, which connects Rotterdam, through Rhine, to the Black Sea, through the Danube. The Main Channel connects the Rhine River to the Danube, so connecting East Europe to North Europe. This project is one of the most important in the TEN-T program. Even if the project has to bottlenecks along its length, it still remains an alternative to transporting goods.

The Danube in Romania makes stops in 12 ports. Four of these ports are the most industrialized: Giurgiu, Braila, Galati and Tulcea. The port of Giurgiu it is situated at km 943 and has a major port operator, SCAEP GIURGIU PORT SA. Its main services includes: loading and unloading of dry bulk and general goods. Also it has a shipyard for building and ship repair. Braila is a river-maritime port situated on the south bank of the Danube. Its main services includes: handling general goods and dry bulk. The port of Galati offers service such as loading and unloading dry bulk and liquid bulk cargo and also container handling. The port planned the building of a container terminal and a grain terminal. Tulcea is a river port situated on the Danube and it is specialized in ship building and repair. Its future goal is to build a marina, for ships on the Danube.

2. STUDY CASE

The case study exemplifies the use of inland waterway transport in comparison with road and railway transport. This case study will show which mode of transport is faster, cheaper and friendly with the environment. The operator wants to transport coal from Constanta, Romania, to Mainz, Germany, using the Rhine-Main-Danube channel. For this comparison the port operator has chosen three ways of transport: (1) Inland waterway transport from Constanta to Mainz; (2) Road transport Constanta-Mainz and (3) Railway transport Constanta-Mainz.

Case no. 1 - Inland waterway transport Constanta-Mainz using the Rhine-Main-Danube channel.

Voyage	Constanta-Mainz
Length	2726 km
Duration	310 hours
Way of transport	A convoy consisting of a motor cargo vessel and a push-barge, transporting 4000 t of coal
Fuel costs	75519 €
Other transport costs	98612 €
TOTAL	174131 €

Table no.1: Voyage costs of inland waterways transport

The most important part of case 1 is the calculation of fuel costs. This calculation was made taking into account the total number of days of the voyage, how much fuel does the main engine and generator uses and the general characteristics of those.

Case no 2 - Road transport Constanta-Mainz

Voyage	Constanta-Mainz
Length	2053 km
Duration	31 hours
Way of transport	Lorry of 540 HP, transporting 20 t of coal
Fuel costs	1002 €
Other transport costs	941 €
TOTAL	1943 €

Table no. 2: Voyage costs of road transport

Fuel costs were calculated using considering that the lorry has a specific fuel consumption of 38%. The other transport costs were calculated only for a single driver.

Case no. 3 - Railroad transport Constanta-Mainz

Voyage	Constanta-Mainz
Length	2351 km
Duration	94 hours
Way of transport	A train with 36 cars with a total of 1980 t
TOTAL Transport costs	216900 €

Table no.3: Voyage costs of railroad transport

The transport by railroad has a medium price of 55€ per ton transported. In this cost is included every other cost related with the transport: fuel, taxes, fees, handling, etc.

Another step in this case study is the analysis of the modes of transport by duration, fuel costs and total costs of transport.
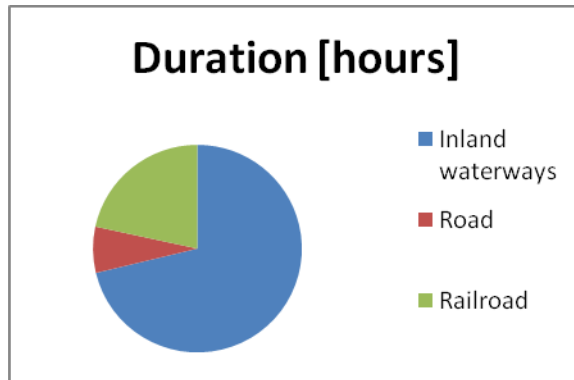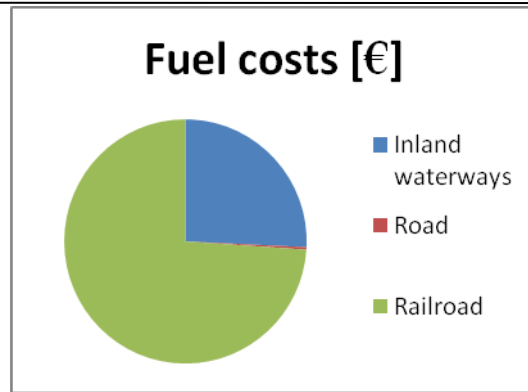

Figure no.1: Duration comparison
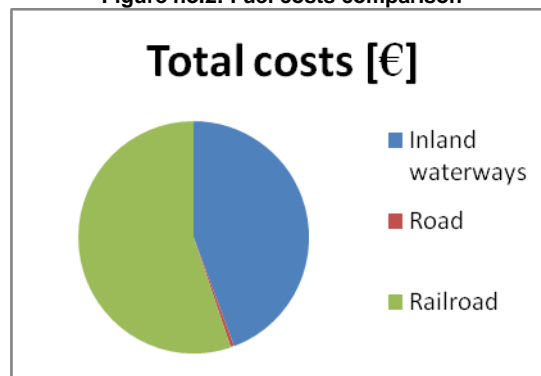
Figure no.2: Fuel costs comparison

Figure no.3: Total costs comparison

The analysis of this charts shows that inland waterways transport is much cheaper, faster than road and railroad transport. Even if the some of the costs are much lower, the inland waterway transport mode can transport a large quantity of goods, 200 times and 2 times larger than other ways of transport.

3. CONCLUSIONS

Inland waterways transport is a mode of transport of the future. It can transport a large amount of goods in a faster, non-expensive and in an ecological way. Inland waterways transport is cheaper than road transport and railroad. In road transport it is very expensive to transfer goods from point A to point B, because of the fuel costs and the road taxes. In railroad transport the costs contains all costs (fuel, handling, taxes, fees, salaries) and they are divided per ton. The speed of inland waterways transport is not that fast as road or railroad, but because of the quantity of goods transported it rivals with the other modes of transport. Road transport is very fast because of the high in Europe, but to transport several tone of goods it is necessary several trips. This is also the case of railroad transport.The most ecological mode of transport is the railroad transport because it's using electricity. The inland waterways transport is also an ecological way of transporting goods, because it doesn't eliminates too much CO_2 into the atmosphere, not like road transport.

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