

COSTS ANALYSIS IN MULTIMODAL TRANSPORT

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ABSTRACT

It is well known that multimodal transport refers to the transportation of goods by using more than one mode of transport. The purpose of this paper is to determine the best transport solution in terms of transport costs, taking into account the combinations of transport modes that can be used to transport the freight, the transport distances for each segment and also the handling and transport costs involved on each segment.

Keywords: Multimodal transport, cost, ITU, TIET.

1. INTRODUCTION

Taking into consideration the complexity and importance of transport as an essential component of the global economy, we can say that the debate on aspects of this broad field can be always considered current.

International transport generally involves the use of variable transport ways, each connection corresponding to a transfer, storage or a transport operation that takes place either in the country of origin, a transit country or the country of final destination. The development of 'door to door' transport imposed also the development of multimodal transport because this allows combining in the most advantageous way all the benefits of each mode of transport.

For realizing this study we assume that we will transport 3,000 tons of fertilizer from expedition point Targu Mures, Romania to destination point Rotterdam, Netherlands.



Figure 1 The localization of the expedition and destination point of the cargo

Source: www.maps.google.ro

2. ANALYSIS OF POSSIBLE TRANSPORT ROUTES

2.1. Rail transport

The first transport route that can be used to transport the 3,000 tons of fertilizers may consist in a direct route, using the rail transport. The route on which the freight will be transported will cross four countries: Germany, Austria, Hungary and Romania, from Targu Mures to Rotterdam (Targu Mure - Simeria- Arad- Curtici- Szolnok- Budapest- Gyor- Sopron- Viena- Linz- Salzburg-Munchen- Stuttgart- Koln- Venlo- Dordrecht- Rotterdam).

The shortest rail distance between Targu Mures and Rotterdam is about 2,000 km. Fertilizers in bags belong to general palletized cargo category, with high volume that requires protection against atmospheric agents. In order to transport this type of cargo by rail we will use Gas wagons. Given the transport capacity of a train we will have:

- 3000 tons: 50 tons/wagon = 60 wagons
- A complete train has 30 wagons, so we will need two complete trains to transport goods.

In order to determine the transport costs we will need: freight name, transport distance, dispatch weight and other requirements provided by this type of transport and its costs.

For the rail transport of this freight, we will need to use the Tariffs of import, export and transit of CFR Marfa that takes into consideration whether the expeditions are made of complete wagons or of Intermodal Transport Units (ITU).

If the transport distance exceeds 1,200 km, the transport cost is determined as follows:

- a) It is established the distance that exceeds 1,200 km;
- b) From the distance of 1,200 km we subtract the distance resulting from point a);
- c) We determine the transport costs for the distance resulting from point b);
- d) We determine the difference between the transport cost obtained for the distance of 1,200 km and the one obtained at point c);
- e) The transport cost is obtained by adding the transport cost for the distance of 1,200 km and the one that resulted at point d).

Costs determination

According to the table on fares for wagons expeditions from TIET (Tariff of import, export and transit of CFR Marfa), for a distance between 1,151-1,200 km, the price is 209.76 lei/ton.

➤ Loading operations cost:
Approximately 2.00 Euro/ton => Loading cost= 3,000 tons × 2.00 Euro/ton = 6,000 Euro

➤ Rail transport cost:
Due to the fact that the transport distance exceeds 1,200 km, the transport price is determined as follows:

- a) 2,000km - 1200km= 800 km

- b) $1,200\text{ km} - 800\text{ km} = 400\text{ km}$
- c) According to TIET for a distance of 381- 400 km the price is 85.50 lei/ton.
- d) Price difference = $209.76\text{ lei/ton} - 85.50\text{ lei/ton} = 124.24\text{ lei/ton}$
- e) Transport cost = $209.76\text{ lei/ton} + 124.24\text{ lei/ton} = 334\text{ lei/ton}$

Transport cost = $75.90\text{ Euro} \cong 76\text{ Euro}$ (1 Euro = 4.4 lei)

So, the rail transport cost for 3,000 tons will be:

$3,000\text{ tons} \times 76\text{ Euro/ton} = 228,000\text{ Euro}$

➤ Unloading operations cost:

Approximately 2.25 Euro/ton: Unloading cost = $2.25\text{ Euro/ton} \times 3000\text{ tons} = 6750\text{ Euro}$

Total costs for rail transport on the route Targu Mures- Rotterdam: $6,000\text{ Euro} + 228,000\text{ Euro} + 6,750\text{ Euro} = 240,750\text{ Euro}$

2. 2. Rail transport followed by river transport

A second route taken into consideration for transporting the 3000 tons of cargo can be a combined route, rail transport from Targu Mures to the river port Drobeta Turnu Severin, where the cargo will be transhipped onto a river ship for transiting the river section up to the port of Rotterdam.

- a) The distance Targu Mures- Drobeta Turnu Severin will be realised by rail transport. The cargo will be transported same as in the first scenario, during two complete train expeditions of 30 wagons each, on 4 axles type Gas covered wagons.
- b) The ship used for river transport can be a cargo type ship with a loading capacity allowing the transport of 3000 tons and a maximum draft enabling the river transport without restrictions.

Costs determination

In this case the distances are divided as follows:

- The rail distance from Targu Mures to Drobeta Turnu Severin is of 453 km.
- The river distance between Drobeta Turnu Severin and Rotterdam is of 2,678 km.

➤ Wagons loading operations cost:

Approximately 2.00 Euro/ton => Loading cost = $3,000\text{ tons} \times 2.00\text{ Euro/ton} = 6,000\text{ Euro}$

➤ Rail transport cost:

The amount of freight = 3,000 tons of fertilizer

Rail distance = 453 km

According to TIET for a distance between 431- 460 km the price is of 94.43 lei/ton.

Rail transport cost = $94.43\text{ lei/ton} \times 3,000\text{ tons} = 283,290$

lei $\cong 64,384\text{ Euro}$

➤ Transhipment costs:

The transhipment costs charged by CFR for this type of freight (fertilizers in bags), is of 4.11 Euro/ton.

Transhipment costs = $4.11\text{ Euro/ton} \times 3,000\text{ tons} = 12,330\text{ Euro}$

➤ River transport cost:

The amount of freight = 3,000 tons of fertilizer

Approximately 20 Euro/ton => River transport costs = $20\text{ Euro/ton} \times 3,000\text{ tons} = 60,000\text{ Euro}$

➤ Unloading operations cost:

Approximately 2.25 Euro/ton: Unloading cost = $3000\text{ tons} \times 2.25\text{ Euro/ton} = 6,750\text{ Euro}$

Total costs for rail- river transport route, Targu Mures- Rotterdam: $6,000\text{ Euro} + 64,384\text{ Euro} + 12,330\text{ Euro} + 60,000\text{ Euro} + 6,750\text{ Euro} = 149,464\text{ Euro}$

2.3. Road transport followed by river transport

A third transport route considered for transporting the 3,000 tons of fertilizer can be a combined route, road transport from Targu Mures to the river port Drobeta Turnu Severin, where the cargo will be transhipped onto a river ship for transiting the river section up to the port of Rotterdam.

The distance between Targu Mure and the river port Drobeta Turnu Severin is of 453 km. The suitable mean of transport is the covered truck, which has a maximum speed of 90 km/h. The maximum load capacity of a truck is 24 tons, which means that in order to transport the 3,000 tons of fertilizer packed in bags of 40 kg, we will need 125 trucks ($125\text{ trucks} \times 24\text{ tons} = 3,000\text{ tons}$).

Costs determination

➤ Trucks loading operations cost:

Approximately 2.00 Euro/ton => Loading cost = $3,000\text{ tons} \times 2.00\text{ Euro/ton} = 6,000\text{ Euro}$

➤ Road transport cost:

The amount of freight = 3,000 tons of fertilizer

Road distance = 453 km

Transport cost: approximately 3 lei/km for a truck of 24 tons.

Road transport cost/truck = $3\text{ lei/km} \times 435\text{ km} \times 1.24\text{ (VAT)} = 1,618.2\text{ lei/truck}$

Road transport cost = $125\text{ trucks} \times 1,618.2\text{ lei/truck} =$

$202,275\text{ lei} \cong 45,971.6\text{ Euro}$

➤ Transhipment costs:

Approximately 2.75 Euro/ton => Transhipment cost = $2.75\text{ Euro/ton} \times 3,000\text{ tons} = 8,250\text{ Euro}$

➤ River transport cost:

The amount of freight = 3,000 tons of fertilizer

Approximately 20 Euro/ton => River transport costs = $20\text{ Euro/ton} \times 3,000\text{ tons} = 60,000\text{ Euro}$

➤ Unloading operations cost:

Approximately 2.25 Euro/ton: Unloading cost = $3000\text{ tons} \times 2.25\text{ Euro/ton} = 6,750\text{ Euro}$

Total costs for road- river transport route, Targu Mures- Rotterdam: $6,000\text{ Euro} + 45,971.6\text{ Euro} + 8,250\text{ Euro} + 60,000\text{ Euro} + 6,750\text{ Euro} = 126,971.6\text{ Euro}$

2.4. Rail transport followed by maritime transport

The fourth transport route considered for transporting the 3,000 tons can be a combined route, rail transport from Targu Mures to the maritime port of Constanta, where the cargo will be transhipped onto a ship for maritime transport to the port of Rotterdam.

- a) The distance Targu Mures- Drobeta Turnu Severin will be realised by rail transport. The cargo will be transported same as in the first scenario, during two complete train expeditions of 30 wagons each, on 4 axes type Gas covered wagons.
- b) The distance between port of Constanta and port of Rotterdam is of 3,340 nautical miles, approximately 1,804 km. The ship used for maritime transport can be a cargo type ship with a loading capacity allowing the transport of 3000 tons.

Costs determination

- Loading operations cost:

Approximately 2.00 Euro/ton => Loading cost= 3,000 tons × 2.00 Euro/ton = 6,000 Euro

- Rail transport cost:

The amount of freight =3,000 tons of fertilizer
 Rail distance= 642 km
 According to TIET for a distance of 642 km the price is of 127.20 lei/ton.
 Rail transport cost= 127.20 lei/ton × 3,000 tons =

381,600 lei ≅ 86,727.3 Euro

- Transhipment costs:

The transhipment costs charged by CFR for this type of freight (fertilizers in bags), is of 4.11 Euro/ton.
 Transhipment costs= 4.11 Euro/ton × 3,000 tons =12,330 Euro

- Maritime transport cost:

The amount of freight =3,000 tons of fertilizer
 Maritime distance= 3,340 nautical miles= 1,804 km
 Approximately 30 Euro/ton => Maritime transport costs= 30 Euro/ton × 3,000 tons= 90,000 Euro

- Unloading operations cost:

Approximately 2.25 Euro/ton; Unloading cost= 3000 tone × 2.25 Euro/ton= 6,750 Euro

Total costs for rail- maritime transport route, Targu Mures-Rotterdam: 6,000 Euro + 86,727.3 Euro + 12,330 Euro + 90,000 Euro + 6,750 Euro = 201,807.3 Euro

2.5. Road transport followed by maritime transport

The fifth transport route considered for transporting the 3,000 tons of fertilizer can be a combined route, road transport from Targu Mures to the maritime port of Constanta, where the cargo will be transhipped onto a ship for maritime transport to the port of Rotterdam.

Costs determination

- Loading operations cost:

Approximately 2.00 Euro/ton => Loading cost= 3,000 tons × 2.00 Euro/ton = 6,000 Euro

- Road transport cost:

The amount of freight =3,000 tons of fertilizer
 Road distance= 642 km
 Transport cost: approximately 3 lei/km for a truck of 24 tons.
 Road transport cost/truck= 3 lei/km × 642 km × 1.24 (VAT) = 2,388.24 lei/truck
 Road transport cost= 125 trucks × 2,388.24 lei/truck=

298,530 lei ≅ 67,847.7 Euro

- Transhipment costs:

Approximately 2.75 Euro/ton => Transhipment cost= 2.75 Euro/ton × 3,000 tons = 8,250 Euro

- Maritime transport cost:

The amount of freight =3,000 tons of fertilizer
 Maritime distance= 3,340 nautical miles= 1,804 km
 Approximately 30 Euro/ton => Maritime transport costs= 30 Euro/ton × 3,000 tons= 90,000 Euro

- Unloading operations cost:

Approximately 2.25 Euro/ton; Unloading cost= 3,000 tone × 2.25 Euro/ton= 6,750 Euro

Total costs for road- maritime transport route, Targu Mures-Rotterdam: 6,000 Euro + 67,847.7 Euro + 8,250 Euro + 90,000 Euro + 6,750 Euro = 178,847.7 Euro

2.6. Road transport

The sixth transport route that can be used to transport the 3,000 tons of fertilizers may consist in a direct route, using the road transport, from Targu Mures to the port of Rotterdam. The transport distance in this case will be 1,962 km.

Costs determination

- Loading operations cost:

Approximately 2.00 Euro/ton => Loading cost= 3,000 tons × 2.00 Euro/ton = 6,000 Euro

- Road transport cost:

The amount of freight =3,000 tons of fertilizer
 Road distance= 1,962 km
 Transport cost: approximately 3 lei/km for a truck of 24 tons.
 Road transport cost/truck= 3 lei/km × 1,962 km × 1.24 (VAT) = 7,298.64 lei/truck
 Road transport cost= 125 trucks × 7,298.64 lei/truck=

912,330 lei ≅ 207,347.7 Euro

- Unloading operations cost:

Approximately 2.25 Euro/ton; Unloading cost= 3,000 tone × 2.25 Euro/ton= 6,750 Euro

Total costs for road transport route, Targu Mures-Rotterdam: 6,000 Euro + 207,347.7 Euro + 6,750 Euro = 220,097.7 Euro

3. CONCLUSIONS

In order to choose the most efficient route as per cargo transport and handling costs implied, six scenarios have been analysed taking into consideration all restrictions met on different routes selected.

Total costs for each route considered are shown in the figure below, for a better perception of the cheapest route.

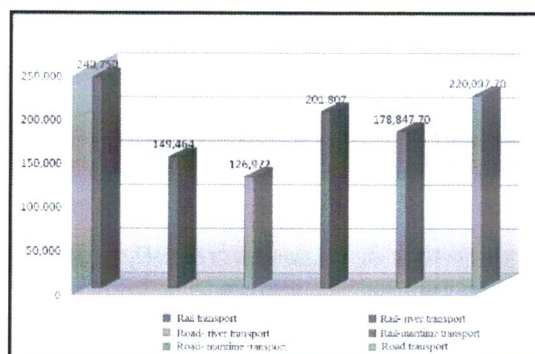


Figure 2 Total costs related to each analysed route

According to the figure above, the most efficient route is the one that use the combined road-river route: Targu Mures- Drobeta Turnu Severin- Rotterdam; but we should consider two important elements: the number of trucks used for the transport of goods and the possibility that the cargo will not arrive at river terminal in time for transshipment.

Although the transport cost is lower using the combined road- river route, the most efficient is the

combined rail- river route, because it requires only two expeditions. By using rail transport the goods will reach the transshipment point all in the same time.

So the best option in terms of costs but also benefits is represented by the combined rail-river route with a transport cost 149,464 Euro.

As stated before and considering our study, we can see that multimodal transport is considered a safe alternative for the future, due to the fact that it meets the demands regarding environmental protection (due to the use of means of transport less polluting), energy conservation and traffic congestions.

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***<http://www.maps.google.ro>

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