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Source / Izvornik: **Pomorstvo : scientific journal of maritime research, 2014, 28, 17 - 21**

Journal article, Published version

Rad u časopisu, Objavljena verzija rada (izdavačev PDF)

Permanent link / Trajna poveznica: <https://um.nsk.hr/um:nbn:hr:187:246480>

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Download date / Datum preuzimanja: **2024-07-10**



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Multidisciplinary
SCIENTIFIC JOURNAL OF
MARITIME RESEARCH



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Multidisciplinarni
znanstveni časopis
POMORSTVO

Impact of external costs on the implementation of Motorways of the Sea system

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ABSTRACT

Motorways of the Sea is a name for a concept that aims introduction of new intermodal maritime logistics chains which should lead to structural changes in the organization of transport in the next few years. These chains should be sustainable and commercially more efficient and improve access to the same markets across Europe and relieve Europe's maritime system. In order to develop this concept in its entirety, as a prerequisite it is necessary to conduct a detailed cost-benefit analysis and analysis of the impact of maritime highways on the environment. One of the most important and indispensable parts of the analysis are external costs. External costs are part of the external effects affecting the decline in total output, and they consist of predominantly maintenance of the natural environment. External costs of transport reflect the cost of those expenses which occur as a result of the exploitation of the transport system. These are therefore the costs of traffic accidents, noise, climate changes, air pollution, traffic congestion, environmental degradation, additional costs in urban areas (separation of certain types of traffic and lack/scarcity of space). In this scientific paper external costs and their potential impact on project implementation of maritime highways is analysed. Considering the fact that the paper will not conduct testing on specific maritime routes, given analysis of external costs will be performed only on a theoretical level, i.e. the external costs will be defined as well as their role in road investments.

ARTICLE INFO

Review article
Received 9 March 2014
Accepted 9 April 2014

Key words:

Costs
External costs
Motorways of the Sea
CBA
Environmental analysis

1. Introduction

It is well known that traffic plays a very important role in global economy and in the development of individual countries. Traffic is also an important factor to increase specialization and social division of labor and has a strong effect on the socio-political aspects of development by the impact on strengthening the unity and cohesion of the market, establishment and strengthening the integrity of the state by establishing and developing links with other countries. The transport sector in the EU accounts for about 10% of GDP and employs about 10 million people. In the world trade, the maritime transport plays a very important role. More than two-thirds of the total international trade in goods is carried out by sea and the intensity, direction, structure and dynamics of marine flows are relevant indicators of global concentration, pointing to the importance of the positioning of the world's centers of production and consumption. Leading role in the global maritime transport are shippers from EU countries, who now control about 40% of the world fleet.

The development of motorways of the sea involves the creation of new intermodal maritime logistics chains in Europe, which aim to improve access to markets across Europe. Traffic is also the creator of negative effects. Firstly those are: air pollution (high emissions of harmful gases of transport means), noise (vibration), extraordinary events (traffic accident) and traffic congestion. Above mentioned negative effects are so-called categories of *external cost*. It is estimated that the external costs of transport in Europe are 8% of GDP. The subject of scientific research in this paper are the features and the role of external costs in road investments, their internalization in maritime transport as leading transport branch in global trade with special emphasis on the importance of developing motorways of the sea. Quality system development of maritime logistics chains involves combining maritime, road and rail traffic as well as inland waterways in order to increase the efficiency of transportation. This includes a reduction in transport costs, shorter travel time of goods to the final destination and reduction of environmental pollution.

This paper is the result of one year research work on the MoS project (Motorways of the Sea).

2. Preliminary elements relevant for the implementation of the Motorways of the Sea system

Implementation of the motorways of the sea system understands creation of common development strategy of all the countries in the area of transport and including transport systems of the east coast in European development programs. [6] The planning and implementation of motorways of the sea system is an extremely complex project, which requires the implementation of a detailed analysis of the project. Since the project includes investment in public infrastructure and facilities, it is very important to make impact evaluation of its implementation on future development of each country and thus Croatia in order to justify the necessary investment, and to determine costs objectively. Such a system before implementations entails certain analytical methods to evaluate the benefits of the project, such as cost-benefit analysis that is focused on the social evaluation.

The procedure of cost benefit analyses consists of: [7]

- defining the project, determining the expected costs and benefits and their measurements

- choice of discount rate, discounting costs and benefits, and
- comparison of the present value of costs and benefits for a decision on acceptance or rejection of a particular project.

On the other hand, it is necessary before implementation, to determine who is the actual individual user (manufacturer) of positive effects of some program, or who participates in negative (production) effects of the program, in order to socialize the amount of external diseconomies, or not to appropriate the amount (penalizing or subsidizing). It is one of the basic assumptions of rational allocation of resources.

Near these methods, also important is process of internalization of external costs at the level of individual social entity or program that is achieved by the following measures of the economic system and economic policy [12]:

- adequate regulation of property rights,
- organizing as many activities into separate organizational units,
- selecting of optimal level of decision-making,
- obligatory payment of compensations, taxes and similar fees equivalent to external costs,



Fig. 1 Potential directions of Motorways of the Sea in the Republic of Croatia
 Source: <http://www.mmtpr.hr/UserDocsImages/STRATEGY%20H-cb.pdf>

- making adequate decision coordination between different administrative and political communities.

In addition, it is necessary to mention that with created motorways of the sea system, potential directions of sea motorways would be designed and they would reduce the crowds at a European network of motorways which, in recent years have taken on proportions that threaten the competitiveness of the European economy. Motorways of the sea would create new logistics services and infrastructure, with reduced external costs and with a large flow of goods and passengers.

3. Features and the role of external costs in transport investments

External costs are costs of the environment caused by an activity in the environment and they do not charge its operations. This definition is included in the provisions of the Croatian Regulation on environmental impact assessment which defines benefits and costs that are included in Cost Benefit Analysis [6,533].

External costs are part of the external effects influencing the decline in total output and consist predominantly of maintenance of the natural environment. These costs have not been internalized till now and company or any other source of public sector bore them. Therefore it influenced the decline of total available accumulation intended for economic and social development.

The most important categories of external costs in the transport sector are costs of [7,207]:

- congestion,
- emergencies (accidents),
- air pollution,
- noise,
- impact on climate changes,
- nature and landscape,
- pollution of water and soil,
- protected (specific) areas,
- urban areas,
- impact of traffic capacities on the environment,
- energy dependence.

The costs of congestion are reflected through: an extension of time travel, lack of accurate assessment of traveling time, increased fuel consumption, increased emissions, increased infrastructure spending and means of transport, reducing of service levels, increase of stress and accidents [7]. The external costs caused by air pollution include the impact on human health, impact on structures and materials, loss of crops and damage to forests and the impact on biodiversity and ecosystems. Noise is also one of the negative effects of transport activities. Its level of intensity can be determined based on the degree of disturbance of the population and the physical and psychological effects on health. The costs caused by climate changes are related to: additional

protection of the sea due to rising sea levels (laws and conventions) and global warming. The cause of global warming is creating so called greenhouse effect due to excessive carbon emissions. The cost of transport capacity relate to the environmental impact caused by manufacturing or construction, maintenance and disposition of transport and infrastructure capacities. Costs in urban areas are divided into: effects of separation of certain types of traffic (e.g.: pedestrian and motorized traffic than others), and the problem of the scarcity of available space and fees for insufficient space for non-motorized area (e.g.: bicycle). The costs of energy dependence are the result of unequal share of net imported energy and transportation options.

4. Theoretical application of internalization of external costs on Motorways of the Sea system

State methods of internalization of external costs are regulated through laws, taxes and subsidies. According to the study, "External Cost of Transport" as instruments of internalization in road transport are named [1]:

- mileage tax for heavy vehicles, which includes infrastructure costs, costs of accidents, air pollution, climate changes and noise and it is possible to introduce not only for the roads, but also for other opportunities, based on the differentiation of taxes depending on the use of roads (replacement for the previous vignette system),
- introduction of fees for passenger cars, especially in urban areas, depending on the problem of road capacity, but also on other base (e.g : air pollution),
- scenario of the price of fuel must be in function of ensuring a certain level of tax on fuel based on the impact on the climate (due to the formation of CO₂) and at least 20€ per ton of CO₂ (as a contribution to the objectives of Kyoto agreement) and it is especially important to include international air transport and to try to reduce differences in the amount of taxes within the transport sectors and modes of transportation,
- additional measures in road traffic – to maximize the efficiency of road traffic management, i.e. its control with the help of high technology and intermodal information system, which together with appropriate driving mode (restrictions of speed) contributes to traffic safety,
- application of fee system for railway infrastructure, which system would include external costs based on the application of Directive 2001/14 of the European Community so that the rail transport operator would pay a part of the costs (variable) of the infrastructure,
- application of environmentally accepted solutions of noise and energy use – (UIC implementation of action plans for noise and energy) on the railways,

Table 1 Categories of ships and their transport in total fleet of EU and the world in 2010

| Category of ship | Transport and ships' fleet in EU | | | | Transport and ships' fleet in the world | | | |
|---|----------------------------------|---------------|--|--------------------------------|---|---------------|--|-----------------------------|
| | No | Dwt 000 | Mlrd. tkm (cargo) / mlrd. pkm (passengers) | Mlrd. tons/ mil. of passengers | No | Dwt 000 | Mlrd. tkm (cargo) / mlrd. pkm (passengers) | Mlrd. tons/ mil. passengers |
| Tankers (gases, chemicals and, crude oil) | 2067 | 90538 | 5002 | 0.543 | 11917 | 401591 | 22187 | 2.410 |
| Bulk cargo ships | 1279 | 72610 | 3481 | 0.364 | 6551 | 352617 | 16907 | 1.768 |
| General and specialized cargo ships | 2343 | 15016 | 809 | 0.181 | 18053 | 86879 | 4680 | 1.047 |
| Container and frigo ships | 1043 | 36232 | 3524 | 0.377 | 4872 | 122961 | 11958 | 1.278 |
| Ro-Ro and Ro-Pax ships | 1445 | 4729 | 177 | 0.380 | 3603 | 10452 | 391 | 0.840 |
| Total | 8177 | 219125 | 12620 | 1.651 | 44996 | 974500 | 56123 | 7.343 |
| Cruisers and liners | 860 | 406 | 9.5 | 3.319 | 3100 | 1646 | 42.0 | 14.650 |
| Total | 9037 | 219531 | - | - | 48096 | 976146 | - | - |

Source: External cost of maritime transport, Transport and tourism, Brussels, 2011, p. 2.

- use of alternative energy sources (fuels), primarily renewable sources, with their stimulation of substitution of "classic" "fuels,
- parking policy in the city as a higher level and differentiated fees charging depending on the zone of the city [3,786].

Internalization of external costs does not only encourage only the rational use of available resources but also their more equitable distribution in society. The complete internalization of external costs, however, is not possible due to their immeasurability and inability of individualization. In order to quantify external costs in maritime transport it is important previously to define i.e. to classify types of ships on which the calculations relate. It is believed that there are large differences in the intensity and frequency of marine pollution and marine environment with regard to the type of ship. In that sense, is made Table 1, showing six categories of ships over 100 GT. The table shows the fleet for commercial purposes and their turnover for Europe and the world in 2010.

Oil drain is classified in the most important category of maritime accidents. Method of costs estimation resulting by oil outpouring at sea is defined by Nyman (2009). The main categories of costs associated with the oil outpouring are: the cost of removing oil from the surface of the sea, the costs of environmental pollution and socio-economic impact [5,40]. Part of costs of removing and cleaning of oil pollution bears the offender and the other part the citizens of the country where the accident occurred. ITOPF (The International Tanker Owners Pollution Federation Limited) estimated that 83% of the nearly 10 000 tankers during this kind of incident discharged oil amount that was less than 7 tons. The frequency of large spills is relatively low and detailed statistical analysis are rarely possible, therefore, emphasis is placed on the trend identifying [11].

5. Conclusion

External costs of transport are traffic caused social costs, which are not internalized in the transport sector, but compensate from other sources of public sector or community. They reflect the cost of all those expenses incurred as a result of the exploitation of the transport system. The negative impact of maritime transport on people and the environment is expressed through the negative external effects. Despite this, traffic is not the biggest cause of negative impacts on the environment and natural values, yet its effect is important, which is why it is necessary to decrease it systematically.

Initial guidelines in the methodology of internalization of external costs of traffic is to enable individual mobility in a way that will satisfy users' rights of specific transport infrastructure, but also of non-user ones. Internalization reflects the actual evaluation and direct payment by using certain infrastructures. In addition, there are rules created by legal standardization and control system that would be applied to a system of motorways of the sea. The same system would solve many traffic problems and reduce environmental pollution and total external costs. The aim is to relieve European road system by redirecting traffic to rail and inland waterways which is also ecologically more accepted than using road traffic. Furthermore, the Motorways of the Sea system increases traffic safety, because it avoids traffic jams in any sense, and the delay of cargo, etc. The development of motorways of the sea would lead to equalizing traffic flows in Europe and reduce the overall costs of transportation or external costs in traffic by using ports that are close to the final destination. In the paper is given only the theoretical level of external costs and the results could be used for further research and testing during implementation of Motorways of the Sea, in the Republic of Croatia and in the European Union as well.

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