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METHOD FOR COMPARATIVE ANALYSIS OF ENVIRONMENTAL PERFORMANCE IN TRANSPORT

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Abstract: *The main objective of this analysis is focused on establishing the models and main trend lines characteristic for the transport chains, by using a critical and comparative approach over the environment performance point of view. The approach is often used in Europe and it is fundamented on life –cycle assessment for several transportation means. Over this point of view, the assessment of the environmental impact used in this study is proposing a set of specific markers (OECD Core Set of Indicators – OECD 1995).*

In this paper we are showing that for the known economic efficient maritime transport chain, there is necessary to be carried a comparative assessment relative to other transportation means and that will be related with the environmental performance. The paper opens new research trends in order to improve the transport chains both from the economic efficiency but also from the environmental efficiency point of view, important criteria promoted by the European Policies in transport industry.
Keywords: *transport chain, naval transport, environmental performance.*

1. FOREWORD

This paper is fundamented on the Life Cycle Assessment methodology, recommended for transport activities environmental impact assessment. The impact categories for the transport industry should be developed by using applicable characteristic, normalizing and assessment factors. This will extend and improve the alternative transport systems environmental activities. The purpose of this study is to establish some models and perspectives is order to be able to make a comparison of various transport chains environmental performance from the life cycle assessment approach.

2. GENERAL CONSIDERATIONS

A transport chain is defined as the sum of all activities supposed by the transport of a product, starting from the market launching moment and until it is delivered toward various destinations. The transport chain is including all the procedures that are related to the management of the transport of various goods between the producer and consumer. We are defining in this paper the transport chain as the combination of various transport elements, which will facilitate the transport between two points. A transport chain can consist on one or several transport systems and nodal points.

Any transport subsystem involved in a transport chain has it's own life cycle. This study will emphasize the operational phases for each subsystem. In order to properly evaluate the transport chains environmental performance, there is necessary to establish system's limits, in such manner that important environment impact will not be excluded from the analysis assessment. For each system of the transport chain should be included the process unit which will contribute to the environmental impact categories.

3. EXPERIMENTAL MODEL

Environmental performance comparative analysis

1st case study: Paper transport on Oslo Bremen route

There are compared two transport chains used for transport of the paper between the producer, located in Oslo and the client, located in Bremen. The A chain is using a vessel which will sail approximately 260 miles from Oslo harbour to Bremen harbour, and a trailer which will travel 30 kilometres, from Bremen harbour to the client.

The B chain is represented by a trailer which will travel 463 km between the producer location, at Oslo and the client's location in Bremen. 19 kilometres of this itinerary are travelled by using a ferry, between Rodby and Puttgarten.

2nd case study: Passenger transport on Lodingen – Sorreise route

In this case there are compared three transport chains:

The A chain is represented by a High vessel which will sail 100 miles, from the centre of the Lodingen to the Sorreisa centre.

The B chain is represented by a plane who will travel 120 km, from the centre of the Lodingen to the airport near Sorreisa and a taxi which will travel 6 km from the airport to the centre of Sorreisa.

The C chain is represented by a road transport mean, which will travel 285 km, from the centre of Lodingen town to the centre of Sorreis town, 55 km from the 285 are travelled by using a ferry.

3rd case study: Frozen fish transport on Molde – Rouen route

In this case there are evaluated two transport chains.

Chain A is represented by a combination between naval transport (67% of the distance in realized with a Ro-Ro vessel) from the Molde harbour to Ijmuiden harbour and road transport (33% of the distance is realized with 22 trailers) from the Ijmuiden harbour to the Rouen harbour. Chain B is a combination between the rod and naval transport systems. The road transport system is represented by a trailer which will travel between Molde and Oslo harbours and then between Kiel and Rouen harbours. The distance between Oslo and Kiel is accomplished by using a ferry.

4. THE ASSESSMENT OF ENVIRONMENTAL IMPACT CATEGORIES

By evaluating the relative contributions of each impact categories of the analysed transport chains for the three case studies, we can conclude the following ideas:

For the 1st case, the results shows that the A chain (naval transport) have the most important contribution to the acidifying process, toxic contamination and eutrophication. On the other hand, chain B has the biggest contribution to climate changes, local air pollution and energy consumption.

For the second case, it is shown that chain B has the best environment performance for all environmental impact categories, excepting climate changes, where chain A is better. Chain C has the worst results, while chain A shows a better environmental performance than chain C.

For the third case, the figure shows that chain A has the best performance for all environmental impact categories, excepting toxic contamination.

5. ASSESSMENT OF THE ENVIRONMENTAL PERFORMANCE

For environmental performance assessment there was used different assessment methods, and their results are shown in the following figures. Figure 1 shows the assessment of the environmental performance for the first case study, using "Eco-indicator 99" method.

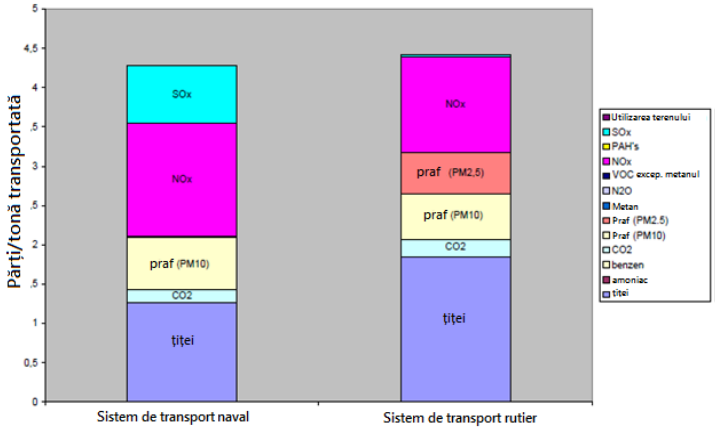

Figure 1: The environmental performance assessed with Econ-indicator 99 method

The most important contributions and the environmental impact are the ecosystem's loss of quality due to the nitrous oxide emissions (NOX) and the consumption of the fossil fuels. In the figure 2 there are shown the results of the environmental performance assessment by using the Environmental priority strategies (EPS).

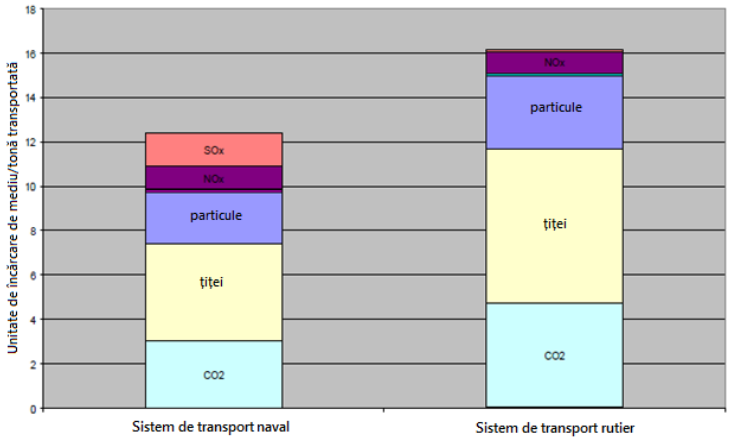

Figure 2: Environmental performance assessed by using EPS

The main contribution to the environmental impact is represented by the CO_2 and dust emissions and also by the fuel consumption.

Figure 3 is representing the environmental performance assessed with the ExternE method. The nitrous oxide (NO_X) and dust emissions have the biggest influence.

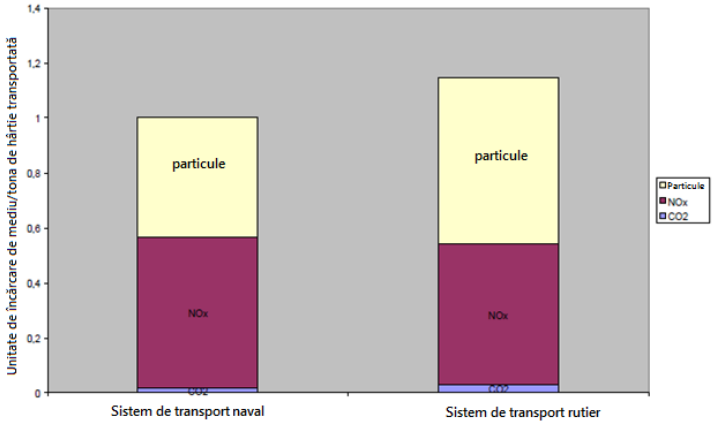

Figure 3: The environment performance assessment using ExternE method

Figure 4 is representing the environmental performance of the two evaluated transport chains, according to the political objectives. Local air pollution and acidification have the biggest contribution on the environmental impact.

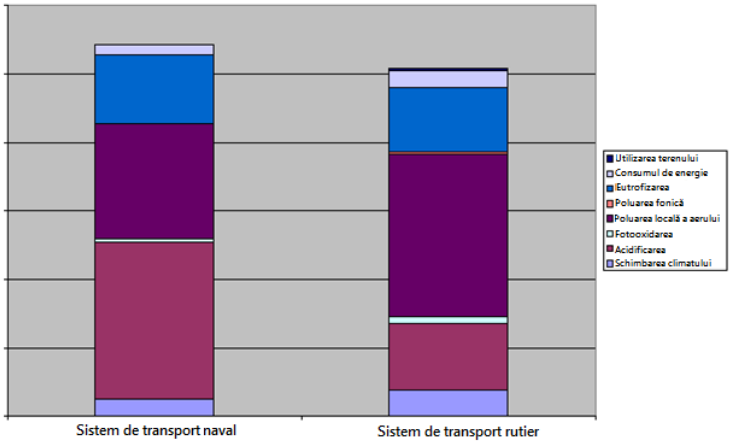

Figure 4: The environmental performance assessment based on the political objectives

6. RESULTS

The main conclusions can be written on the following topics:

It is shown in the paper that for the first case, the A chain have a better environmental performance in opposance to the B chain, both used for the transportation of one ton of goods between Oslo and Bremen. We can see that acidification is the most important environmental impact category that is we don't concern the results of expert groups research results, where the dominant result is represented by the climate changes. By considering that some of the NO_X and SO_X emissions will not affect the land, we can conclude that the maritime transport chain has a better overall environmental performance than the land transport chain.

For the second case it is shown that the results points to the C transport chain (land transport) have the worst results after all assessment standards. The B transport chain (aerial transport) seems to be the best alternative, excepting the EPS assessment, according to which the A transport chain (naval HSLC transport chain) is a better alternative for every transported passenger. In this case we can conclude that aerial transport chain has the best total performance per passenger. When referring to the NO_X emissions, the aerial transport system will be a better alternative. Nevertheless the HSLC alternative has the best environmental performance for several substances (CO_2, CO, NMVOC) while the NO_X shows that naval, land or ferry transport systems have worst performance.

The results for the 3rd case shows that, after making a brief comparison between the A and B transport chains, is shown that the last one have the worst environmental performances for the transported ton on Molde – Rouen route. This is the conclusion for all impact categories and for all assessment methods.

7. CONCLUSIONS

This paper is a premier for transport research in Romania because it is analysing the environmental performance for different transport items by using a wide set of assessment methods. The results are important in order to establish a scientific based relation between the environmental performances for different transport chains. This paper is opening new research paths, focused on developing a new economy – efficiency indicator set for the transport chains, and their systems and subsystems.The authors are considering that the proposed indicators set, but also, the assessment methodology can be further used in other similar studies, in order to establish the environmental impact of a transport route in order to reduce the associated impact.

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