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SELECTION OF SHORT SEA SHIPPING TRANSPORT CHAINS IN WESTERN EUROPE, BASED ON EXTERNAL COSTS

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Abstract

According to the mid term review of the EU White Paper on Transport, Short Sea Shipping is expected to grow at a rate of 59% in metric tonnes, from 2000 to 2020. If we consider that the overall expected growth in freight exchanges is of 50% (also in volume), sea transport is one of the most feasible way to reduce traffic congestion on European roads. Marine transport is a possible way to compete with road transport in certain traffics, mainly when assuming external costs. This paper is going to analyse five multimodal routes, considering three different levels of powered ships, which one is going to be the most efficient in terms of external costs.

Keywords: Short sea shipping, western Europe, external costs.

INTRODUCTION

The European transport policy looks to be a sustainable activity that will boost the economic activities in the whole Union. The pollutant emissions reduction and a best equilibrium among different transport modes, releasing the roads from traffic congestion are the basic pillars of the mentioned policy. These factors are encouraging the public and private stakeholders to use in a more extensive way the freight rail mode and of course the maritime alternative, in a constant find for the best solution.

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Most of the developed countries use a national net of roads to move freight, despite it being the most expensive, pollutant transport mode, maintaining the highest rate of fuel consumption per cargo unit (REALISE, 2009).

The maritime sector is one of the less pollutant ways in addition to the additional capacity to contribute to reduce the road congestion in Europe. Particularly the short sea shipping is thought to be the quickest way to reach the sustainability goal. But this opportunity could pose some other inconvenient such as a superior traffic growth and a subsequent increase of the pollutant emissions in the port areas.

On the other hand, the massive use of every day fastest ships affording a competence in time to the truck, could remove the ecological ticket from the marine sector to other means, due to the superior needs in terms of power and then consumption (and emissions). This last question is going to be further analysed.

This paper has been divided in four sections. Firstly, some previous research in this field of our research group is described. Secondly, the definition of the environment regulations applied to transport policies and the different external impacts. Thirdly, the quantification and valuation of external costs on previous selected short sea shipping routes in SW Europe and finally, the conclusions and further research of this study.

PREVIOUS RESEARCH

The previous research carried out by the TRANSMAR research group integrated in the Technical University of Catalonia was the INECEU project, proposing after an exhaustive study some alternative multimodal lines against road transport in SW Europe. Keeping in mind the figures of road traffic passing the Pyrenean borders, the group analysed most of the volumes moved between Spain and France. Among all the Spanish regions we should note the activity of Catalonia, the Basque country, Valencian and Andalusia. The French counterpart is contested by the Pyrenean regions of Aquitaine, Languedoc-Roussillon and Midy-Pyrenees together with Ile-de-France, Rhône-Alps and Provence-Alps-Côte d'Azur.

The French territory is also crossed by important traffic fluxes southbound coming from Westafalia, Baden-Würtemberg and Bayern in Germany and the northern part of Italy. From Spain it is possible to identify the main traffic towards Westfalia and Baden-Würtemberg in Germany, Lombardia in Italy and destinations more spread out up in Great Britain, Holland and Belgium. Regarding the nature of the cargo, we should note that the South and South-East part of the Iberian Peninsula, together with the Valencia coast, are big producers of fruits and vegetables, with the group of manufactured or canned food and alcoholic drinks. This is one of the larger cargo groups that is exported from Spain. There is important traffic involving solid bulk such as building materials or scrap iron, together with oil and chemical products from ports with refineries nearby that are firmly committed to removing trucks carrying dangerous or toxic substances from the road to ships that have specifically designed containers, or Ro/Ros, that will benefit society as a whole.

The study concluded that:

1. The industry in the Mediterranean basin accepts the concept of Short Sea Shipping due to the superior road distance to between Spain and Italy compared to sea link;
2. The Atlantic bulk traffics should take advantage of the SSS funding and official policies using multi purpose ships accepting different kinds of traffic;
3. Fast ships could be justified when serving trips less than 12 hours away and when cost is not so important provided a minor time of delivery can be guaranteed;
4. The conditions shown in the first phases of the study can be submitted to change, always benefiting the ship position when considering factors such as road congestion, accidentability, noise or pollutant emissions.

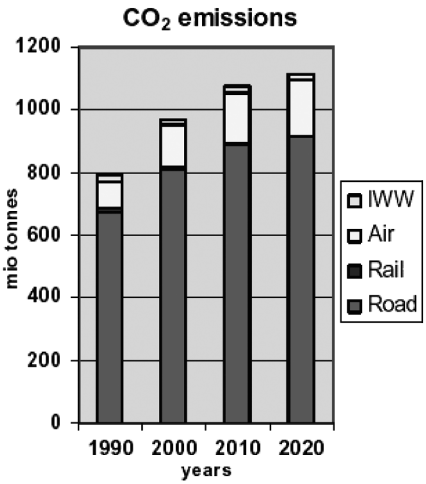
ENVIRONMENTAL BALANCE OF TRANSPORT ACTIVITIES

The European Union through its sustainable development strategy and the White Paper on transport, has repeatedly manifested its interested to reduce the transport generated impacts. In this sense, there exists a common application of measures to solve the environmental threats in the transport sector.

Regarding road transport, the European Parliament has adopted the Euro V and VI regulations, being progressively stricter regulation on vehicle pollutant emissions, specially referred to particles emission and nitrogen oxides (NO_x) limits. The Euro V will be applied from the 1st September of 2009 and establishes a decrease of 80% in the particles emission limits, what means the future fitting of particles filters on board vehicles. The Euro VI regulation, will enter in force in 2014 and will pose stricter limits, with the aim to reduce the nitrogen oxides up to a 68% from the nowadays levels.

The maritime transport emissions are regulated mainly by the MARPOL Convention and some specific European regulations. The new regulations regarding the SO_2 and NO_x maximum emission levels will reduce this kind of pollutant components, the maritime transport weakest point, in the future. Maritime transport is

Figure 1. CO_2 emissions segregated by transport mode in millions of tonnes.

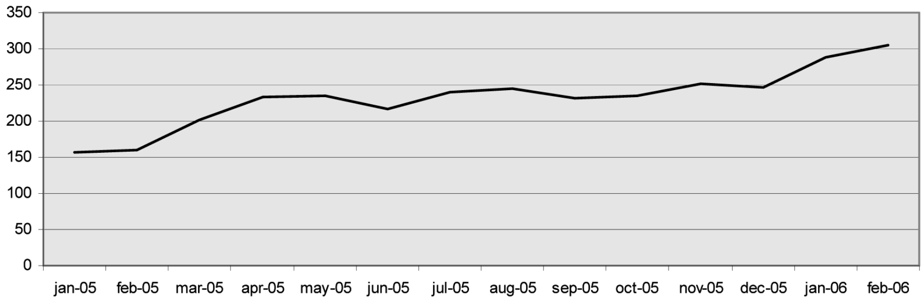


Source: Keep Europe moving. Midterm review of transport white paper. DGTREN, European Commission the responsible of the biggest volume of SO_2 into the atmosphere, only to be compensated by means of reduced sulphur content fuels or cleaning exhaust gases systems. Despite of this scenario, in respect to the CO_2 emissions, road transport is responsible for the 80% of the whole, and this justifies the interest for reducing the share of road transport. Additionally the NO_x emissions split in the European Union, points up to a 51% from road vehicles and a 12% from the other transport modes.

As a whole, the balance of emissions to atmosphere is positive to maritime transport and not at all for the road one. This last justifies supporting actions to multimodal chains with marine sections based on short sea shipping links, as a way to reach a more sustainable mobility within Europe.

However the progressive entrance of High Speed Crafts in the market in the short sea shipping traffics as a way to compete with road speeds means also a superior consumption rate because of the fitted high output engines and the derived emissions. Also the high oil price poses the operating companies in an economic threat.

Figure 2. Bunker prices during the period 03/01/06-14/02/06



Source: Grimaldi Group Napoli.

We must mention other factors affecting the rate of short sea shipping pollutant emissions as the fleet age and the highest number of trips done.

METHODOLOGY OF STUDY

In this part we are going to compare the environmental impact and the external costs in five multimodal routes considered more efficient than the same link served by a unimodal chain but keeping in mind up to three different speed ships with (conventional, fast conventional and high speed), using the thematic network REALISE (REALISE, 2009) medium costs.

Following will be detailed the considered previous factors to carry out the study.

a) The cost categories are divided in two:
   1. Environmental external costs: local air pollution, global warming and acoustic pollution.
   2. Non environmental costs: accidents and road congestion.

b) In order to estimate the impact of emissions evolution from different transport modes, there will be considered two scenarios:
1. Actual condition: from the regulations in force, that is Euro III standards for road transport and no specific limitation for marine transport.
2. Improved condition: applying future stricter regulations, like in the road sector the Euro IV standard (in force for new trucks from 2006) and for maritime transport considering a decrease of 10% for all the emissions except for S, SO_2 and NO_x.

c) The target routes, are the most efficient ones coming from INECEU project (TRANSMAR, 2005).

Table 1: Routes obtained from the INECEU project.

Route	Origin	Loading port	Discharging port	Destination
Route 1	ZAL Azuq. de Henares	Valencia	Naples	Naples
Route 2	ZAL Barcelona	Barcelona	Civitavecchia	Rome
Route 3	Zal Alicante	Alicante	Genoa	Milan
Route 4	CETABSA Burgos	Tarragona	Genoa	Milan
Route 5	CTB Benavente	Gijón	Hamburg	Berlin

d) In each route will be analysed the multimodal and unimodal possibilities, distinguishing in the marine section, between the conventional, fast conventional and high speed ships, and the road legs will cover from origin to loading port and from discharging port to destination.
The different ships cargo capacities will be also considered, keeping in mind that they are real ships serving short sea shipping traffics:

Table 2: Cargo capacity depending on each type of ship.

Types of ship	Cargo capacity in (FEU)
Conventional ship	103
Fast conventional ship	94
High speed craft	50

The cargo unit is estimated in TEU (or FEU as very close to a trailer longitude) as it is the common unit of freight in sea and road legs, considering the container filled up to a 60% (EIG, 2002).

e) The time used for boarding the cargo from one transport mode to another is split in the following concepts, in 2 hours for port manoeuvring when talking about conventional and fast conventional ships (one hour per move) but only one hour for high speed crafts (half an hour per move). The time spent at port has been obtained for each ship's speed in every different route, then having kept in mind the route distance, speed and a week with only 6 working days, carried out in previous studies (Martínez, 2008).

Table 2: Port times depending the route and ship speed.

Route	Type of Ship	Time at port
Route 1	Conventional ship	8 hours
	Fast conventional ship	4 hours
	High speed craft	6 hours
Route 2	Conventional ship	5 hours
	Fast conventional ship	7 hours
	High speed craft	6 hours
Route 3	Conventional ship	4 hours
	Fast conventional ship	3 hours
	High speed craft	10 hours
Route 4	Conventional ship	8,5 hours
	Fast conventional ship	9 hours
	High speed craft	9 hours
Route 5	Conventional ship	4 hours
	Fast conventional ship	11 hours
	High speed craft	11 hours

Source:Martínez de Osés & Castells. http//:tethys.org, January 2007 and *Heavy weather in European Short Sea Shipping: Its influence on selected routes*. Martínez de Osés & Castells. The Journal of Navigation, Vol. 61. January 2008.

It has been kept in mind the hurly consumption on the base of 200 g/kW x hour, depending on the main engine load. We are going to apply the 80% of engine load when sailing, 40% manoeuvring and 20% for time spent at ports due to operations.

Table 4: Hourly consumption depending on the engine load and power.

Type of ship	Speed	Tm/Hour (80%)	Tm/Hour (40%)	Tm/Hour (20%)
Conventional ship	20	4,1472	2,0736	1,0368
Fast conventional ship	27	5,0688	2,5344	1,2672
High speed craft	40	10,88	5,44	2,72

CONCLUSIONS AND FURTHER RESEARCH.

In this last part, we have showed the final results in terms of external costs saving, between a unimodal and a multimodal chain of the 5 different routes, depending on the ship's type and the two mentioned consumption conditions:

Table 3: Multimodal transport savings (in €) per trip in route 1, depending on the ship's type.

Type of ship	Actual condition savings	Improved condition savings
Conventional	130.951,20	76.419,09
Fast conventional	119.528,20	69.761,03
High speed	63.681,50	37.209,71

Table 4: Multimodal transport savings (in €) per trip in route 2, depending on the ship's type.

Type of ship	Actual condition savings	Improved condition savings
Conventional	97.270,11	56.764,04
Fast conventional	88.785,13	51.818,43
High speed	47.302,65	27.639,55

Table 5: Multimodal transport savings (in €) per trip in route 3, depending on the ship's type.

Type of ship	Actual condition savings	Improved condition savings
Conventional	102.210,25	59.646,91
Fast conventional	93.294,35	54.450,13
High speed	49.705,00	29.043,23

Table 6: Multimodal transport savings (in €) per trip in route 4, depending on the ship's type.

Type of ship	Actual condition savings	Improved condition savings
Conventional	58.656,19	34.230,33
Fast conventional	53.539,56	31.247,99
High speed	28.524,55	16.667,37

Table 7: Multimodal transport savings (in €) per trip in route 5, depending on the ship's type.

Type of ship	Actual condition savings	Improved condition savings
Conventional	139.560,46	81.443,11
Fast conventional	127.386,48	74.347,33
High speed	67.868,36	39.656,14

From a general point of view, it is observed that the freight transport represents, in all cases and in both conditions, at least one advantage in respect of external costs compared with unimodal one, however when considering stricter regulations (Euro IV) the savings decrease is important, because of the lower limits posed for road emissions. Also the conventional ships are the most environmental friendly ones, being the difference between the fast conventional and high speed crafts bigger than from conventional to fast conventional ships.

In the analysis we have also obtained the saving per trip per year, and by truck/trip in each route.

Table 8: Yearly (50 weeks) and truck/trip savings for route 1.

Condition	Yearly conventional ship savings	Truck/trip conventional ship savings	Yearly fast conventional ship savings	Truck/trip fast conv. savings	Yearly high speed craft savings	Truck/trip high speed savings
Actual	24.861.866,21	1.271,58	20.428.386,85	1.271,37	9.934.314,04	1.273,63
Improved	14.510.293,59	742,14	11.921.377,98	741,93	5.804.715,14	744,19

Table 9: Yearly (50 weeks) and truck/trip savings for route 2.

Condition	Yearly conventional ship savings	Truck/trip conventional ship savings	Yearly fast conventional ship savings	Truck/trip fast conv. savings	Yearly high speed craft savings	Truck/trip high speed savings
Actual	25.290.227,62	944,37	27.700.961,95	944,52	22.137.639,41	946,05
Improved	14.758.650,39	551,11	16.167.349,44	551,26	12.935.308,08	552,79

Table 10: Yearly (50 weeks) and truck/trip savings for route 3.

Condition	Yearly conventional ship savings	Truck/trip conventional ship savings	Yearly fast conventional ship savings	Truck/trip fast conv. savings	Yearly high speed craft savings	Truck/trip high speed savings
Actual	21.259.731,10	992,33	29.107.837,26	992,49	15.507.958,91	994,10
Improved	12.406.557,38	579,10	16.988.441,83	579,26	9.061.488,32	580,86

Table 11: Yearly (50 weeks) and truck/trip savings for route 4.

Condition	Yearly conventional ship savings	Truck/trip conventional ship savings	Yearly fast conventional ship savings	Truck/trip fast conv. savings	Yearly high speed craft savings	Truck/trip high speed savings
Actual	1.349.092,36	569,48	16.704.342,54	569,57	13.349.491,47	570,49
Improved	787.297,53	332,33	9.749.373,06	332,43	7.800.331,12	333,35

Table 12: Yearly (50 weeks) and truck/trip savings for route 5.

Condition	Yearly conventional ship savings	Truck/trip conventional ship savings	Yearly fast conventional ship savings	Truck/trip fast conv. savings	Yearly high speed craft savings	Truck/trip high speed savings
Actual	14.514.287,95	1.354,96	19.872.291,53	1.355,18	14.116.619,35	1.357,37
Improved	8.470.082,93	790,71	11.598.183,69	790,93	8.248.476,67	793,12

From the previous tables data, it is possible to see that apart from the traffic congestion, accidentability and noise generation, the road transport poses higher external costs than the maritime transport to society, being these costs the positive contribution of sea transport. These environmental benefits could justify some public grants at least in a previous step as an economic incentive to convince the user to utilise the maritime transport. One possible application is the ecological bonus offered by the Italian government in several routes to endorse the trailers and trucks on board a ship instead of doing the route in an only road mode. This measure would withdraw a large number of trucks from Italian, French and Spanish coastal roads, removing pollutant emissions from the air and also retiring trucks from touristical and high populated areas.

The results derived from this paper, could justify an ecological grant should be applied in the analysed routes by the Spanish central government, to national carriers.

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SELECCIÓN DE LAS CADENAS DE TRANSPORTE DEL SSS EN EL OESTE EUROPEO BASADO EN COSTES EXTERNOS

Este artículo presenta una comparativa entre los costes externos generados por los buques de transbordo rodado, frente al transporte en camión. Partiendo del hecho que el transporte marítimo consume menos energía por distancia y unidad transportada, se simulan los consumos de tres tipos de buques en función de su velocidad y su capacidad de carga; y se realiza una comparación de los costes externos generados por cada buque y unidad de carga que puede transportar.

Además se han evaluado las siguientes categorías de costes:

— Costes externos medioambientales: contaminación al aire local, calentamiento global y contaminación acústica.

— Costes externos no medioambientales: accidentes y congestión

Para poder prever la evolución del impacto de las emisiones de los diferentes modos de transporte se han tenido en cuenta dos condiciones:

— Condición actual: a partir de los estándares y normativa que se aplica en la actualidad. En el caso del transporte terrestre se ha aplicado el estándar Euro III.

— Condición mejorada: aplicando una normativa futura que se prevé mucho más restrictiva. En el caso del transporte terrestre se ha aplicado el estándar Euro IV y en el caso del marítimo se ha considerado un 10 por 100 menos de emisiones en todos los agentes excepto para el S, el SO_2 y el NO_x.

En general, se observa que el transporte de mercancías multimodal representa, en todos los casos y en ambas condiciones, una ventaja respecto al unimodal con relación a los costes externos, aunque cuando se aplican las normativas más estrictas se aprecia una disminución acuciante del ahorro en costes externos, ya que la normativa aplicada al transporte terrestre es mucho más severa que la aplicada al transporte marítimo.

A partir de las tablas presentadas en el artículo, se puede observar que aparte del problema de congestión del tráfico que representa el transporte terrestre, el modo marítimo también tiene un beneficio económico asociado al menor impacto medioambiental que se puede traducir en ahorros externos.

Estos beneficios medioambientales podrían justificar unas subvenciones gubernamentales, al menos inicialmente, como una iniciativa de política pública para que los usuarios del transporte unimodal obtuvieran un incentivo económico para utilizar el transporte marítimo de corta distancia. Un ejemplo de este tipo de tasa medioambiental es el denominado *ecobono italiano*, que establece incentivos económicos para los transportistas que embarquen sus camiones o semirremolques en barcos que cubran trayectos alternativos a la carretera.

El principal objetivo es el desarrollo de cadenas logísticas, la potenciación de la intermodalidad, el desarrollo del cabotaje marítimo, la reestructuración del sector de transporte por carretera, la innovación tecnológica y la mejora del medio ambiente. Los resultados del presente proyecto permiten sentar las bases para calcular una tasa medioambiental que podría ser aplicada en las rutas estudiadas como ecobono español.

Asímismo también se aprecia que el transporte marítimo convencional es el que representa un mayor ahorro de los tres modos de transporte marítimo por viaje. Aunque existe diferencia entre el buque convencional y el convencional rápido, se nota una diferencia más relevante entre el convencional rápido y el de alta velocidad.