Alba Martínez López

From: Ana Casaca <ana-argonaut@sapo.pt>
Sent: viernes, 02 de diciembre de 2011 0:57
To: amartinezl@udc.es
Cc: 'Susana Rebocho'
Subject: -SPAM-2012 SSS Research Conference Full Paper Notification
Attachments: 2012 SSS Full Paper Template.doc; 2012 SSS Call for Papers.pdf

Importance: High

2012 International Research Conference on Short Sea Shipping Full Paper Notification

Dear Alba Martínez-López

It is with great pleasure that the 2012 SSS Local Organizing Committee informs that your paper

"SEA MOTORWAYS VS. ROADS: AN ANALYSIS OF THEIR RELEVANCE ON THE SPANISH-FRENCH ATLANTIC COASTLINE "

has been accepted for the ***2012 International Research Conference on Short Sea Shipping***, 2-3 April, Lisbon, Portugal.

But, it is the opinion of the reviewers that you consider the issue(s) mentioned below in order to increase the quality of your paper:

Reviewer 1
Introductory Comment
The topic is interesting and "reminds" original work done for the SSS94 and SSS96 Conferences, where problems of modal split related to SSS routes were thoroughly discussed (e.g. Psaraftis 1994 and Schinas 1996 on the Greek Costal Shipping System and on the Adriatic Corridor). Apparently many researchers have contributed since in this field and many methodological issues have been addressed even since.
General Comments
The paper can be improved and get a higher 'average grade' if only the following points can be explained better or clearly stated in the text:

1. Methodological Approach: the authors should include a paragraph discussing the methodological challenges. While most researchers perform calculations on the basis of generalized cost, authors seem to work separately with time and cost elements. This implies that no other element, such as bias and non-explained ones, are taken or can be taken into account. Moreover, the calibration is based on population; this point is debatable (although I am not familiar with the regional economic condition), consumption, imports and exports could be critical parameters (among others) for the trade between the

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The Key dates / Milestones

June 30, 2011 Deadline for submission of extended abstracts (closed).
July 15, 2011 Notification of abstracts Acceptance (closed)
September 15, 2011 Submission of full papers deadline (closed)
November 30, 2011 Refereed papers returned to authors for revision and notification of acceptance
January 31, 2012 Submission of final papers
February 14, 2012 Authors presenting the papers registration deadline
March 22, 2012 Submission of Powerpoint presentations deadline
March 31, 2012 Delegates attending the

original O-D points.

2. The simulation procedure: this paragraph needs explanation and clarification. Moreover the simulation with distributions of two crests and "fat tails" should be thoroughly discussed.

Finally, the authors could include an annex with the key data (distances, etc.) and some hints for the reproduction of their analysis and of their results, as this will assist other research teams to work with their data and on the basis of their methodology.

Reviewer 2

The literature on SSS is a bit light and greater depth here would provide better justification for the factors and issues raised in the conclusion. Also more explanation is needed on the rationale for the routes chosen in Table 2.

Please use the SSS 2012 Word Template for submitting you full paper. Instructions for formatting references can be found in the pdf document attached.

IMPORTANT:

If your paper has been accepted, and if you need a VISA, please get in touch with Susana Rebocho (susana.rebocho@cargoedicoes.pt) **reading in copy for her to issue you a declaration for you to get the VISA. Please let us also know which consulate you are going for us to control the VISA process.**

Greetings from Lisbon

Ana Casaca

****

Ana Cristina F. C. Paixão Casaca,
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Conference registration deadline

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Short Sea Shipping 2012

April 2-3, 2012 | Lisbon - Portugal

Message from the Chairman
Message from the Director of Cargo Edições
About the Conference Organiser
About the Conference Chairman

Message from the Chairman

On behalf of Cargo Edições Lda, I am honoured to invite the International Research Community, the Industry, International Organizations and Governments to the International Research Conference on Short Sea Shipping to be held in April 2012, in Portugal. The focus on short sea shipping (formerly known as international cabotage, international coastal trade or international coastal shipping), and often defined as the movement of freight by sea without crossing an ocean, i.e. within the same continent, rests upon its importance and attention given at a policy level for the last twenty years.

After the European Commission released its Communication on the Common Transport Policy in December 1992, the subject under consideration has promoted much debate, to the extent that other regions of the world such as the United States/Canada, Australia, Asia, New Zealand are considering it at a policy level as well. In 2008, at an European level, short sea shipping accounted for 36,6% of all intra-European freight and according to the 1992 Commission Communication there is a potential market share of 14% that short sea shipping can grasp from long distance road transport.

As a result, numerous research projects have been funded at regional and national levels to find out solutions that promote this 'mode of transport' as a viable alternative to road transport and that contribute to its integration within multimodal/intermodal transport chains. Within this context, numerous meetings, workshops and conferences of a regional character have been organised to discuss and disseminate information and research work.

Against this geographical scope, the present Conference aims at covering the whole world so as to become an international forum / research platform for the exchange of research information and knowledge among those interested in this 'mode of transport' / research area and related issues. This provides a unique opportunity to see how our neighbouring countries and regions are approaching this 'mode of transport' and what lessons can be learnt. Moreover, an international Conference as it is proposed is a valuable event for young researchers, students and newcomers to the industry since it provides the opportunity to interact with more senior and experienced researchers and practitioners.

As such, the international character of the Conference has fostered its theme to be "**Five continents – different perspectives – one objective: to move cargo by sea**". While filling the existing gap from a geographical perspective, it builds upon the body of knowledge and research carried out so far and presented in the regional meetings, at encouraging ongoing international information exchange, at strengthening the regional network, at building knowledge upon difference of opinion and experience, and fostering exchange of expertise and learning through active participation of community representatives, academia, governments, private research agencies and national research centres. Numerous topics have been identified to meet this objective and any gap left is more than welcomed to be addressed and the outcome of this work will be published in the Conference Proceedings.

The Conference scientific program will follow the traditional layout of other research related conferences and details about the Conference deadlines can be seen here. Apart from the working sessions, there will always be opportunity for people to get together, to exploit networking opportunities, and eventually, to relax before a new working period starts again. We believe that the Conference comes up as a unique opportunity and we welcome the International Research Community, the Industry, International Organizations and Governments to discuss and suggest solutions that contribute to a better performing competitiveness environmentally friendly sector vis-à-vis road transport.

Bem-vindo a Lisboa, Portugal.
Welcome to Lisbon, Portugal

Ana Cristina Paixão Casaca
Conference Chair
Operational Director of ESPRIM

Email: **ana.cristina@sss2012.org**

back

Message from the Director of Cargo Edições

It is with great pleasure that Cargo Edições organizes the 2012 International Research Conference on Short Sea Shipping, in Lisbon, Portugal, and in this regard I take this opportunity to thank the numerous people working with us to organize such an important event.

In the name of the organization of this shipping and port international conference to be held in Portugal, let me say that we are proud that our humble contribution will foster the development of the shipping and port sectors at a local, regional and international levels.

We welcome all delegates belonging to International Research Community, the Industry, International Organizations and Governments to the 2012 International Research Conference on Short Sea Shipping, and we are at your disposal to assist you with any information that you may need for you to come to this conference and during your stay in Portugal.

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Your feedback will also be very important so that we can improve our performance, today or, if possible, in a future conference. We wish that your stay is so good that you will always feel the need to come back to this country, which in previous times gave an enormous contribute to the development of the world.

We are sure that the programme to be offered will meet your expectations and the continuous success of previous conferences. The conference provides an excellent opportunity for experts from the International Research Community, the Industry, International Organizations and Governments to meet and exchange ideas and promises to be exciting and stimulating due to the wide range of topics of direct interest and relevance to the industry as presented in the Call for Papers Invitation.

The Local Organisation Commiteee has been working hard in order to gather in Lisbon high standard Speakers and we trust your visit to this Conference proves worthwhile and rewarding; its success clearly indicates that we work in an exciting, useful, and extremely active area.

We wish you all a pleasant and memorable conference experience.

Bem-vindo a Lisboa, Portugal
Welcome to Lisbon, Portugal

Luís Filipe Duarte
Managing Director
Cargo Edições
Email: **fduarte@cargoedicoes.pt**

back

About the Conference Organiser

Cargo Edições, has been established in the market for 20 years, and is a specialised publisher in transport and logistics publications; it publishes the magazines '*Cargo, Transportes e Logística*', '*Frota*', and the Newsletters on-line *Cargo News online* and *Frota.News*, as well as the *Anuário dos Portos de Portugal* (Annual Ports Directory). The *Cargo, Transportes & Logística* magazine focuses on all subjects related to the movement of cargo and modes of transport, addressing issues concerning operators, carriers, shipping agents, stevedoring companies, rail and air companies, freight forwarders and other players that somehow have a link to the activity. It is the leading magazine of the transport sector in Portugal, namely of the shipping one. It is published monthly, and is supplemented by the Newsletter *Cargo News online* that delivers freshly news to its readers; the latter is distributed three times per week. The *Frota* magazine, is publishedbimonthly together with *Cargo, Transportes & Logística*, to supplement information related to the transport of goods by road. *Frota* magazine is also supplemented by a weekly Newsletter online sent by email, the *Frota.news*. Cargo Edições has also been involved in publishing some books related to the transport and logistics sector, which can be seen on their Internet Web site (http://www.cargoedicoes.pt) and in organizing national and international workshops and conferences related to the sector such as the 18th International Port Training Conference and the Annual Conference of the International Association of Maritime Economists, in 2005 and 2010, respectively.

back

About the Conference Chairman

Ana Cristina Paixão Casaca obtained her elementary nautical studies degree at Escola Náutica Infante D. Henrique (ENIDH) in Paço D'Arcos, Portugal. She was a deck officer in Portuguese shipping companies and lectured at the Instituto de Tecnologias Náuticas. After getting her Bachelor degree in 1995, she got her M.Sc. Degree in International Logistics at the Institute of Marine Studies belonging to the University of Plymouth in 1997. Her will to carry out research work led her to proceed with her Ph.D. in International Transport/Logistics at the University of Wales-Cardiff, which successfully finalized in 2003. Since 1998, she has been publishing articles in professional magazines, namely *Cargo, Transportes e Logística* and research papers in well known international Academic Journals (*Maritime Policy and Management*, *Maritime Economics and Logistics*, *Marine Policy*, *International Journal of Logistics Research and Applications*, *Journal of International Logistics and Trade*, *International Journal of Physical Distribution and Logistics Management*, *and the International Journal of Transport Management*). She is a member of the Institute of Chartered Shipbrokers (ICS) and of the International Maritime Economists Association (IAME). Presently, she is the Operational Director of ESPRIM - Centro de Acostagens, Amarrações e Serviços Marítimos, Lda. Additionally, she is involved in other activities where she uses her expertise. Since 2003, she has been invited by the European Commission to review transport related projects and to evaluate transport related proposals. She is a Guest Lecturer of the Netherlands Maritime University, and Coacher of the Copenhagen Business School Blue MBA in Shipping and Logistics. She was the Chairman and Co-Organiser of the 2010 IAME Annual Conference that was held in Lisbon, Portugal, a work which she drew on the expertise gained from her shipping and academic backgrounds and whose passion for research is now drawing her into this new venture as Chairman and Co-Organiser of the International Research Conference on Short Sea Shipping.

back

Short Sea Shipping 2012

April 2-3, 2012 | Lisbon - Portugal

International Steering Committee
Paper Review Committee
About the Paper Review Committee Chairman
Local Organizing Committee

International Steering Committee

The 2012 International Research Conference on Short Sea Shipping International Steering Committee (ISC) is made up of well-known representatives (hereinafter Members) drawn from nearly all Universities, International Organizations and the Industry that have developed a high reputation in shipping, ports and logistics matters, and which are internationally recognized by the industry they serve. The present ISC embraces a balanced selection of about 18 Members chosen according to their area of research and work performed and who are the cornerstone of the shipping and ports research network. Members were individually invited 'ad personam' by the Conference Chairman. The ISC function is to provide guidance and assistance to the Local Organizing Committee, and contribute to the publicity and promotion of the 2012 International Research Conference on Short Sea Shipping Conference. Maintaining the quality of submitted research papers, and an appropriate balance between the interests of researchers and practitioners, are also particularly important goals. The following Members are part of the International Steering Committee:

Name	Institution / Organisation	Country
Professor A. Güldem Cerit	Dokuz Eylül University	Turkey
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Professor Chin-Shan Lu	National Cheng Kung University	Taiwan
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Professor Theo Notteboom	University of Antwerp	Belgium
Professor Wayne Talley	Old Dominion University	United States
Dr Y. H. Venus Lun	Hong Kong Polytechnic University	Hong Kong

back

Paper Review Committee

The 2012 International Research Conference on Short Sea Shipping Paper Review Committee (PRC) will be made up of reviewers who have been involved before and are familiar with the process, even though new blood is always encouraged and always welcomed. Each reviewer will be asked to rank a number of papers in order to obtain a robust procedure. The Local Organising Committee will then take the reviewers comments and send them to the Authors in order to improve the quality of the work being presented. The Chairman of the 2012 International Research Conference on Short Sea Shipping PRC is Irene Rosberg, Programme Director, Copenhagen Business School. Abstracts will be reviewed based on the following criteria: The relevance of the argument to the conference theme The importance of the research The originality of the topic The quality of the abstract Papers will be reviewed on the following criteria: Appropriateness of title Clarity and organization of the paper Contribution to discipline Evidence/Source usage Importance of the topic to the field Originality/innovativeness Paper length Problem formulation Quality of writing Relevance, quality and strength of the argument For conceptual papers only: Use of evidence to support position Logical development of concept/theory For empirical papers only: Ability of variables/concepts to be measured or expressed quantitatively or qualitatively Research design Statistical analysis Authors are expected to comply with the changes proposed.

The following Members are part of the International Paper Review Committee:

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back

About the Paper Review Committee Chairman

Irene Rosberg holds the important position of the Director of Executive MBA in Shipping and Logistics (The Blue MBA) at Copenhagen Business School (CBS), one of Europe's leading institutions of its kind. She is responsible for the design, development and co-ordination of The Blue MBA. She has a fundamental role in building global relationships and networks within the maritime industry on behalf of CBS. She also promotes research identifying challenges and future issues for the maritime industry as a whole. She is a member of many international boards and committees. Based on her extensive international network and experience, she has been entrusted with major roles in varied maritime-related activities, and speaks at leading maritime events. In 2009 a survey showed that she was amongst the top 20 most influential women in the shipping industry in Denmark. She is also involved in various maritime related research and served as the chairman of the Scientific Papers Review Committee for the International Association of Maritime Economists (IAME 2010), a post in which she drew on expertise from her wide maritime connections, both in terms of academic and industry input. In 2010 she was appointed a judge for the Lloyds List Global Awards As a member of judging panel Irene will be called in to give her opinion and comments on all the award submissions which Lloyds List receives for their Annual Global Awards.

back

Local Organizing Committee

TThe 2012 International Research Conference on Short Sea Shipping LOC is responsible for handling all administrative, organisational and financial tasks related with the preparation, execution and closure of the conference. The IAME 2010 LOC is made up of: Ana Cristina Casaca (Operational Director of ESPRIM) Irene Rosberg (Programme Director, Copenhagen Business School) Luís Filipe Duarte (Director of Cargo Edições)

Manuel do Nascimento Casaca (Port Consultant) Mário Oliveira (Cargo Edições Consultant) Sónia Carvalho (Cargo Edições) Susana Rebocho (Marketing, Cargo Edições)

back

Proceedings of the 2012 International Research Conference on Short Sea Shipping

April 2-3, 2012 | Estoril - Portugal

DAY 1 2 April **DAY 2** 3 April

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SEA MOTORWAYS VS. ROADS: AN ANALYSIS OF THEIR RELEVANCE ON THE SPANISH-FRENCH ATLANTIC COASTLINE

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ABSTRACT

The development of multimodal routes via Sea Motorways in Western Europe is especially interesting for Spain and France due to the relevance of the flow of trade between the two countries and the congestion of their principal connections through the Pyrenees. The main aim of this paper is to identify the most suitable maritime route taking into account the competitiveness of multimodal routes versus the alternative road transportation routes. The analysis will be carried out in terms of time and cost through a mathematical model that considers the point of view of load owner that has been operating between these countries since 2006. To do so, indexes of time and cost will be defined and evaluated for every available route in the model in accordance with a multi-criteria decision matrix.

The results obtained will allow decision-making in absolute terms. A sensitivity analysis will be subsequently carried out through a Monte Carlo simulation in order to evaluate the influence on the results of the forecast assumed to construct the matrix. In addition, this simulation will make it possible to identify the most important inputs influencing the competitiveness of multimodal transport via a Sea Motorway. The results obtained are thus not only quantitative, but also qualitative and could also be very useful for shippers and port authorities, allow them to modify some of these inputs.

Keywords: Sea Motorways, Selection of Maritime Routes, Monte Carlo Simulation, Sensitivity Analysis

1 Author for correspondence and presenting the paper

SEA MOTORWAYS VS. ROADS: AN ANALYSIS OF THEIR RELEVANCE ONTHE SPANISH-FRENCH ATLANTIC COASTLINE

1. INTRODUCTION

The level of congestion reached by some of the main land transport corridors within the EU suggests the need to divert traffic from roads to alternative modes of transport with the aim of reducing the costs derived from the high traffic concentration borne by the former. This reduction would affect both social costs (related mainly to accident levels and environmental degradation) and private costs (longer travelling time).

To achieve this goal, the development of Short Sea Shipping (SSS) has been contemplated in European Transport Policy. Although the definitions given for SSS are numerous, according to the European Commission the term refers to "the movement of cargo and passengers by sea between ports situated in geographical Europe or between those ports situated in non-European countries having a coastline on the enclosed seas bordering Europe".

The main advantages associated with SSS compared to road transport are: its lower number of accidents, its low infrastructure costs, its capacity to reach ultra-peripheral regions and its lower impact on the environment (authors such as Vanherle et al. (2010) have made important clarifications regarding this subject). In spite of all these advantages, however, road transport continues to be predominant for channelling the flow of intra-communitarian freight. The main reasons why transport decision-makers are reluctant to adopt intermodal transport are related to the perception of SSS as an out-dated, slower, rigid and complex alternative from an administrative point of view, in addition to being less reliable. Potential users thus tend to consider SSS to bea less satisfactory option than road transport when offering a door-to-door service (see Medda et al. 2010 and Triunfante Martins et al. 2010).

In an attempt to invert this perception, the White Paper on Transport (2001) introduced the concept of the Sea Motorway as a tool to develop SSS. Sea Motorways are maritime corridors; i.e. a network of ports and intermodal services that offer a SSS transport in a particular zone of the EU. In 2003, the European Commission revised the Trans-European Network of Transport (TEN-T) including as an objective for 2020 the implementation of Sea Motorways in 4 corridors (TEN-T Project 21): i) the Baltic Sea Motorway; ii) the Western Europe Sea Motorway ; iii) the South-East Europe Sea Motorway; and iv) the South-West Europe Sea Motorway, connecting Spain, Portugal, France, Italy and Malta, and linking up with the South-East Europe Sea Motorway, including links to the Black Sea.

Aside from the choice of ports of call, the setting-up of Sea Motorways requires the establishment of frequency of service for the connections between these. This will make it possible to offer a door-to-door service in similar conditions of cost and quality to those offered by road transport (González Laxe et al. 2007). In other words, the success of the Sea Motorways depends on their capacity to integrate their services in an intermodal chain of transport without additional costs due to bureaucracy or an inefficient port service (Paixão Casaca et al. 2010). All this makes the selection of the port critical for the success of the Sea Motorway. However, the papers devoted to port selection within the SSS framework are very scarce and tend to be limited to the shipping companies perspective. Here we propose to adopt the perspective of the transport service as a whole.

The aim of this paper is to develop a tool able to identify the ports that form the best maritime route to support an intermodal chain that is competitive with respect to road transport. In order to do so, we propose as a case study the implementation of a Sea Motorway that connects the Atlantic Coastline of Spain and France. The structure of the paper is as follows. We define the framework in Section 2:i.e. the port alternatives taken into consideration to establish an intermodal alternative to road transport. In Section 3, we analyse each of these alternatives, comparing their potential competitiveness in terms of cost and time. In Section 4, we assess the results obtained in terms of the risk assumed with respect to the

hypothesis carried out to analyse the competitiveness of the different proposed alternatives. Finally, Section 5 presents the main conclusions of the paper.

2. THE FRAMEWORK

The amendment of the TEN-T led to the signing of a bilateral agreement between Spain and France in 2006 to promote the development of Sea Motorways to link up their respective Atlantic coastlines. As a result, an intergovernmental commission was created with the aim of drawing up a proposal for the selection of Sea Motorway projects. The requirements are: i) a service frequency of at least 4 departures per week each way during the first two years of operating; ii) a frequency of at least 7 departures per week each way once these 2 years have elapsed; iii) annual traffic of at least 350,000 semi-trailers should have been reached at the end of 5 years; and iv) rising to 850,000 after 10 years. The selected projects would receive additional resources to those stipulated in the Marco Polo II Programme. The main parameters to assess such projects are: the volume of traffic attracted (and diverted from the road), the quality of the project (according to the number of ports linked up, service frequency and quality of the infrastructure) as well as the expected economic and financial results (see Baird and Aperte 2010).

The purpose of this paper is not to identify which ports better fulfil these requirements, but to determine which ones are better disposed to develop an attractive intermodal chain versus the road alternative. The analysed ports were chosen firstly for their location, their relevance within their port system, and their potential to establish a Sea Motorway. All of them have an important hinterland; they are considered Category A ports (they have international relevance and an annual volume of traffic of over 1.5 million tons of freight or 200,000 passengers). They also fulfil the dock draft and surface requirements needed for the demands of the service for Ro-Ro (see Henesey and Mbiydzenyuy 2010).

Table1: Distance of alternative routes (km)

Spanish port	French port	Maritime distance	French endpoint	Land distance
Vigo	Calais	1390	Rennes	1453
	St. Nazaire	915	Paris	1577
	Le Havre	1232	Lille	1793
Ferrol	Calais	1206	Rennes	1412
	St. Nazaire	717	Paris	1553
	Le Havre	1049	Lille	1751
A Coruña	Calais	1225	Rennes	1392
	St. Nazaire	717	Paris	1514
	Le Havre	1217	Lille	1731
Gijón	Calais	1156	Rennes	1061
	St. Nazaire	563	Paris	1184
	Le Havre	1152	Lille	1400
Santander	Calais	1164	Rennes	892
	St. Nazaire	508	Paris	1015
	Le Havre	1006	Lille	1231
Bilbao	Calais	1206	Rennes	795
	St. Nazaire	522	Paris	917
	Le Havre	1049	Lille	1134

Source: Spanish Merchant Navy Association.

Taking all these aspects into account, the Spanish ports of Vigo, Ferrol, A Coruña, and Gijón along with the French ports of Saint Nazaire, Le Havre and Calais were considered in this paper as possible endpoints of the Sea Motorway (see Table1). The last three ports are the best located to connect with Rennes, Paris

and Lille; the three most important cities in the country accessible from the Atlantic coastline, and consequently, the 3 French endpoints of the respective intermodal chain.

In the Spanish case, the port itself was considered as the endpoint of the route for two reasons. Firstly, these ports are located in the same provinces as the most important population/activity centres of their hinterland (see García-Alonso and Sánchez-Soriano 2007). Secondly, these centres are the main generators of traffic on the Spanish northern coastline. It should be noted that the inland provinces of Madrid and Zaragoza also channel an important volume of traffic through the Northern coastline, but they were ruled out as possible route endpoints for the intermodal chain. This is because both use the port of Bilbao to channel the bulk of their traffic to the North (see García-Alonso and Sánchez-Soriano 2010), and we have not included this port in the present study.

The port of Bilbao and Santander were ruled out as a possible maritime route endpoint because the Sea Motorways through Atlantic ports prove to be interesting for maritime inter-port distances ranging between 834 and 1400 km, in accordance with the conclusions of previous researches (see the Emma project, from the IV Framework programme of the European Commission, or the INECEU project, funded by the Spanish Ministry of Development). Likewise, the EU (COM-1999) also recommended respecting the minimum threshold of 1385 km of land distance to establish an intermodal chain of transport (these references were established for the European case. For other contexts, see for example Brooks and Trifts 2008).

Considering the previously mentioned thresholds, the combinations of Ferrol, A Coruña and Gijón with Saint Nazaire were ruled out too due to their maritime proximity. However, the alternatives of Gijón-Calais and Gijón-Le Havre were considered, as the maritime distance between them is adequate and both options respect the land distance threshold for one of the chain endpoints (Lille).Table 2 thus shows the port combinations finally analysed in this paper to create a Sea Motorway.

Table2: Possible maritime routes for the implementation of a Sea Motorway.

Spanish port (l)	French port (k)
Vigo	Calais
	St. Nazaire
	Le Havre
Ferrol	Calais
	Le Havre
A Coruña	Calais
	Le Havre
Gijón	Calais
	Le Havre

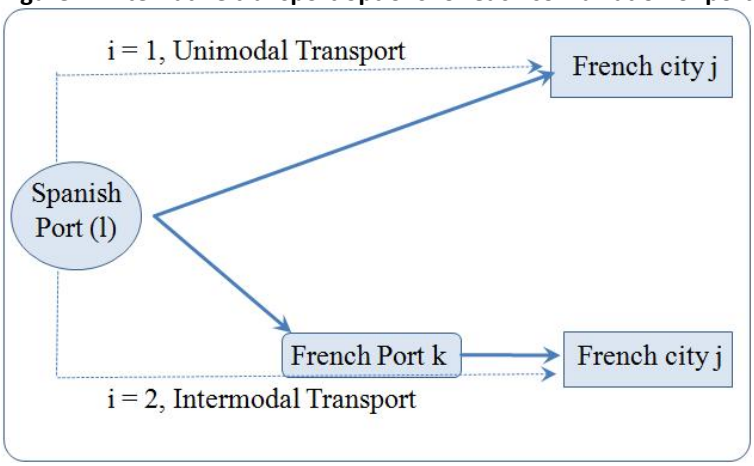
3. THE MULTI-CRITERIA DECISION MATRIX

A multi-criteria decision method was used to analyse the possibilities of success of the resulting intermodal chain. This type of analysis allows us to evaluate which of the alternatives considered better accomplishes a series of objectives taking into account pre-established criteria. The identification of the best option is made by aggregating the assessment of the achievement of each criterion, normalized for each alternative. The two fold aspect of the multi-criteria analysis accomplished in this paper leads to a complex decision matrix. In this particular case, the ultimate goal is to identify which of the Sea Motorways forms the intermodal chain with the best chances of success versus road transport to connect the Spanish endpoints to the three French endpoints (Rennes, Paris and Lille).

In order to choose among the alternative Sea Motorways, the different modes of transport were also compared previously considering the established criteria (see Figure 1). First, for each of the three possible French route endpoints, both transport alternatives are evaluated observing the criteria. This is done for all possible intermodal chains derived from the alternative Sea Motorways (port combinations shown in Table 2). Having done so, and after having added the assessment of the criteria for each alternative mode of

transport, the Sea Motorway offering the resulting intermodal chain the best chances of success can be identified.

Figure 1: Alternative transport options for each combination of ports



The goal is thus not to analyse either the intermodal competition between the two options, or which ports can develop an optimal maritime route from the point of view of the shipping companies (vehicle route problems) or even the design of a port network (commodity problems), but rather to identify which one favours the offer of a competitive door-to-door service with respect to the unimodal service.

As we know that volume of trade and the evolution of transport costs are inversely related, the flows of freight could benefit from a reduction of the latter. Such a reduction could be in monetary terms or in terms of time (see Limao and Venables, 2001). Likewise, the time and cost variables are decisive factors in the selection of the transport mode for freight (see Garcia-Menendez et al., 2004). Accordingly, generalized cost components of transport were assessed according to the time and the costs expended on each route (Martinez-Lopez and Garcia-Alonso, 2011).

We propose an index to assess each of these criteria, as in (1) and (2).

$$I^{T}_{ijkl} = 1 - \frac{Time_{ijkl}}{\sum_{i=1}^{2} Time_{ijkl}} \quad (1)$$

$$I^{C}_{ijkln} = 1 - \frac{Cost_{ijkln}}{\sum_{i=1}^{2} Cost_{ijkln}} \quad (2)$$

where (1) is the time index, and (2) the cost index. The sub-indexes represent:
-transport alternatives (i: road or SSS);
-the route endpoint in France (j: Rennes, Paris or Lille);
-the considered French port (k: Saint Nazaire, Le Havre or Calais); and
-the port and route endpoint in Spain (l: Vigo, Ferrol, A Coruña and Gijón).
The year in which the trip takes place is also considered for the calculation of the cost index (n: 2006, 2007, 2008 or 2009).

Both indexes are normalized according to the two transport alternatives taken into consideration (i) to reach a route endpoint (j) leaving from the other (l). So they respectively fulfil (3) and (4). Hence, the closer the index value is to 1, the less time/cost will be needed with respect to its alternative.

$$\sum_{i=1}^{2} I^{T}_{ijkl} = 1 \quad (3)$$

$$\sum_{i=1}^{2} I^{C}_{ijkln} = 1 \quad (4)$$

As seen previously, Rennes, Paris and Lille are the reference cities considered to calculate the corresponding indexes for each mode of transport. Once the indexes have been calculated, the assessment for each Sea Motorway alternative is aggregated. This aggregation is done using Relevance Indexes, defined according to (5) and (6). In this case, they are interpreted as the probability (the relevance) of the decision-maker choosing a particular transport option (mode and route) taking into account the access conditions (in terms of time and cost) to the three cities (which are the French endpoints of the route).

$$RI^{T}_{ikl} = \sum_{j=1}^{3}\left(I^{T}_{ijkl} \times \alpha_j\right) \quad (5)$$

$$RI^{C}_{ikln} = \sum_{j=1}^{3}\left(I^{C}_{ijkln} \times \alpha_j\right) \quad (6)$$

Where IT_{ijkl} and IC_{ijkln} are respectively the indexes in terms of time and cost of each modal alternative (i) associated with the French port (k). This port will be the hub for the French endpoints (j) and the Spanish end point (l). Finally, αj is the weighting factor. In this particular case, we use as weighting factor the population of the endpoints, according to (7). Nevertheless, it could be used their GDP, foreign trade, consumption or any other.

$$\alpha_j = \frac{Population_j}{\sum_{j=1}^{3} Population_j} \quad (7)$$

In order to calculate the duration of the maritime voyage, we considered a speed of 35 Kn and a loading/unloading speed at the port of 34 units/hour. For road haulage, European legislation (Regulation 561/2006) and an average truck speed of 90 km/h were taken into account. Likewise, to calculate the cost indexes corresponding to the maritime distance, the estimations used in the INECEU Project were replicated. For the road distances, the annual data given by the Observatory of Road Freight Transport Costs (General Department for Road Transport of the Secretariat of State for Transport of the Ministry of Public Works and Infrastructure) were considered. The same port rates were assumed for all facilities.

The results are shown in Tables 3 and 4. Table 3 shows the relevance indexes in terms of time for all the routes analysed in this paper. Table 4 gives the corresponding costs indexes for each endpoint of the Spanish route.

Taking as a criterion the time involved, we can see that the Vigo–St. Nazaire, Ferrol–Le Havre and A Coruña–Le Havre Sea Motorways form the most competitive intermodal chains versus road. In addition, the intermodal chains through the French port of Calais offer the worst results. In this respect, it is worth emphasizing the case of the maritime routes of Vigo–Calais, where the intermodal alternative is equivalent to its unimodal counterpart, and Gijón–Calais, where the unimodal option is the most suitable. With regard to the cost criterion, we can see that all the intermodal chains are preferable to unimodal transport except for the chains that use the Gijón–Calais maritime route. In this case a tie occurs between the two modal alternatives. Besides, the Calais option is also found to be the least advantageous for the rest of the Spanish ports. On the other hand, it is worth noting the advantage that the intermodal alternative offers compared to road transport when it takes the form of the Ferrol–Le Havre Sea Motorway.

Table 3. Relevance Indexes in terms of time

	Vigo		**Ferrol**		**A Coruña**		**Gijón**	
	Truck	SSS	Truck	SSS	Truck	SSS	Truck	SSS
French port	RI^{T}_{1k1}	RI^{T}_{2k1}	RI^{T}_{1k2}	RI^{T}_{2k2}	RI^{T}_{1k3}	RI^{T}_{2k3}	RI^{T}_{1k4}	RI^{T}_{2k4}
Saint Nazaire	0.45	0.55	---	---	---	---	---	---
Le Havre	0.47	0.53	0.45	0.55	0.45	0.55	0.49	0.51
Calais	0.50	0.50	0.48	0.52	0.48	0.52	0.52	0.48

Table4. Relevance Indexes in terms of cost

	2006		2007		2008		2009	
	Truck	SSS	Truck	SSS	Truck	SSS	Truck	SSS
Vigo	RI^{C}_{1k11}	RI^{C}_{2k11}	RI^{C}_{1k12}	RI^{C}_{2k12}	RI^{C}_{1k13}	RI^{C}_{2k13}	RI^{C}_{1k14}	RI^{C}_{2k14}
St. Nazaire	0.43	0.57	0.43	0.57	0.42	0.58	0.43	0.57
Le Havre	0.43	0.57	0.43	0.57	0.42	0.58	0.43	0.57
Calais	0.46	0.54	0.45	0.55	0.45	0.55	0.46	0.54
Ferrol	RI^{C}_{1k21}	RI^{C}_{2k21}	RI^{C}_{1k22}	RI^{C}_{2k22}	RI^{C}_{1k23}	RI^{C}_{2k23}	RI^{C}_{1k24}	RI^{C}_{2k24}
Le Havre	0.42	0.58	0.41	0.59	0.40	0.60	0.41	0.59
Calais	0.45	0.55	0.44	0.56	0.43	0.57	0.44	0.56
A Coruña	RI^{C}_{1k31}	RI^{C}_{2k31}	RI^{C}_{1k32}	RI^{C}_{2k32}	RI^{C}_{1k33}	RI^{C}_{2k33}	RI^{C}_{1k34}	RI^{C}_{2k34}
Le Havre	0.42	0.58	0.42	0.58	0.41	0.59	0.42	0.58
Calais	0.45	0.55	0.45	0.55	0.44	0.56	0.45	0.55
Gijón	RI^{C}_{1k41}	RI^{C}_{2k41}	RI^{C}_{1k42}	RI^{C}_{2k42}	RI^{C}_{1k43}	RI^{C}_{2k43}	RI^{C}_{1k44}	RI^{C}_{2k44}
Le Havre	0.47	0.53	0.46	0.54	0.46	0.54	0.47	0.53
Calais	0.50	0.50	0.50	0.50	0.49	0.51	0.50	0.50

In order to facilitate the comparison between the different Sea Motorways, we define the Differential Indexes of Relevance in terms of time and cost, according to (8) and (9).

$$DIR^{T}_{k} = RI^{T}_{2k} - RI^{T}_{1k} \tag{8}$$

$$DIR^{C}_{kn} = \left(RI^{C}_{2kn} - RI^{C}_{1kn}\right) \times \beta_{n} \tag{9}$$

Where RITk and RICkn are respectively the relevance indexes in terms of time and cost, and βn is the weighting factor with respect to the annual traffic between France and the corresponding Spanish port, according to (10):

$$\beta_{n} = \frac{Traffic_{n}}{\sum_{n=1}^{4} Traffic_{n}}, \qquad \forall\, n = 2006 \text{ a } 2009 \tag{10}$$

The Differential Indexes of Relevance reflect the appeal of each Sea Motorway versus the road alternative for transport users. The higher the value of the index, the higher the appeal of the intermodal option is. The Port Indexes can then be defined from these Differential Indexes. In terms of time, they match the respective Differential Index of Relevance. However, in terms of cost, it is necessary to take into account the year, as shown in (11):

$$PI^{C}_{k} = \sum_{n=1}^{4} \left(DIR^{C}_{kn}\right) \tag{11}$$

Figure 2: Port Indexes in terms of cost for the Spanish port of Vigo

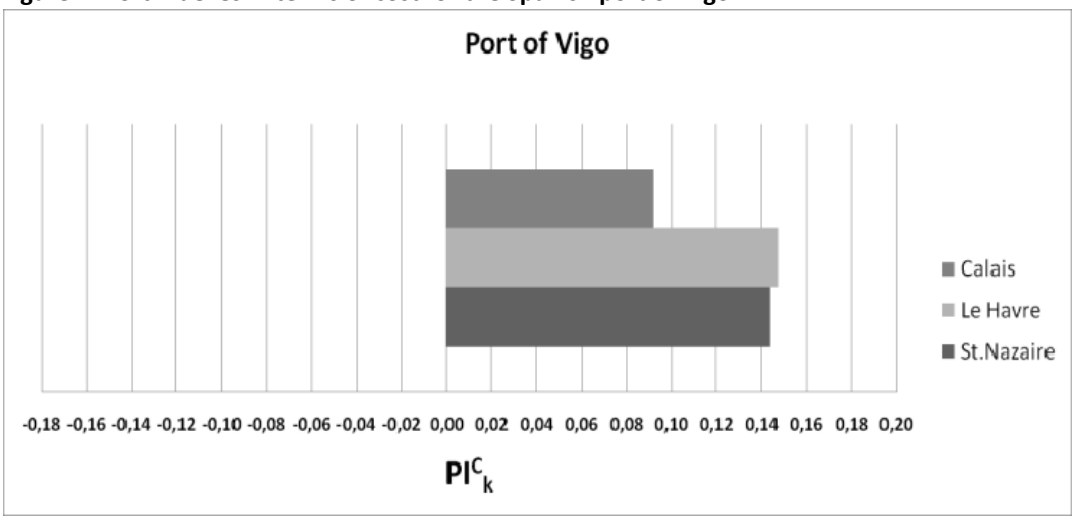


Figure 3: Port Indexes in terms of time for the Spanish port of Vigo

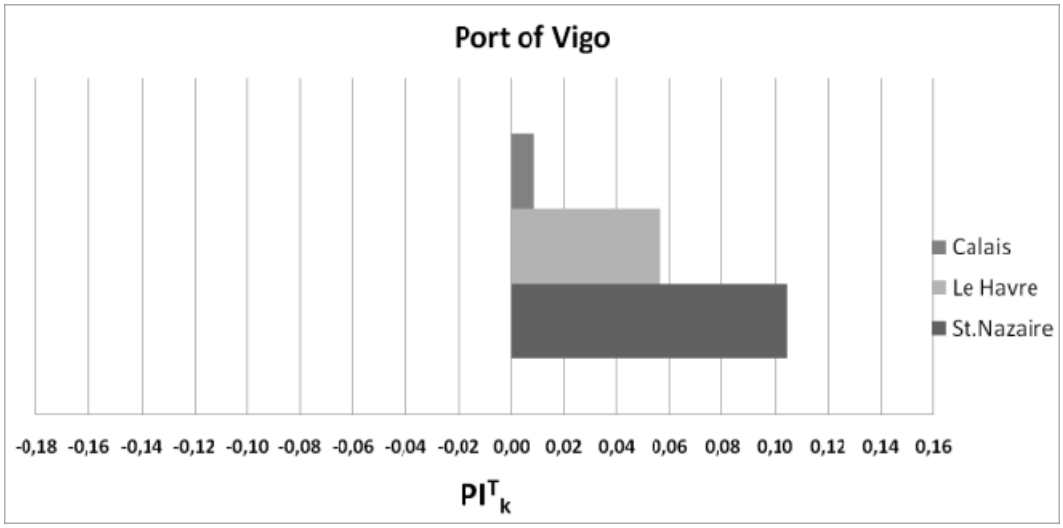


Figure 4: Port Indexes in terms of cost for the Spanish port of Ferrol

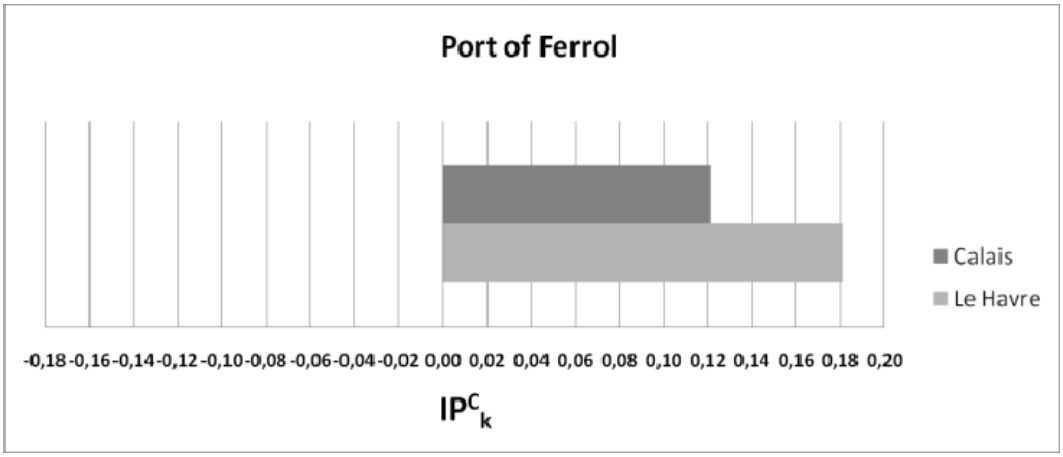


Figure5: Port Indexes in terms of time for the Spanish port of Ferrol

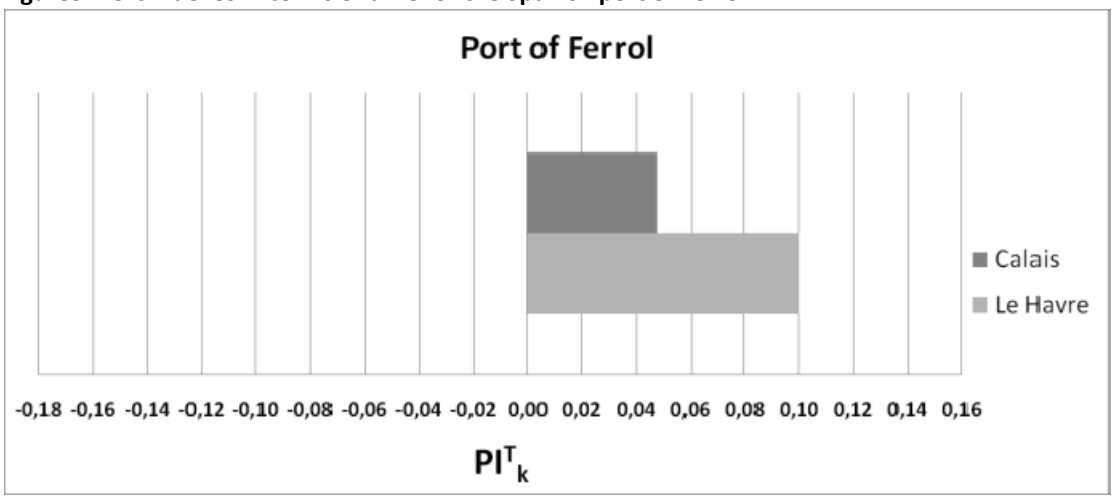


Figure 6: Port Indexes in terms of cost for the Spanish port of A Coruña

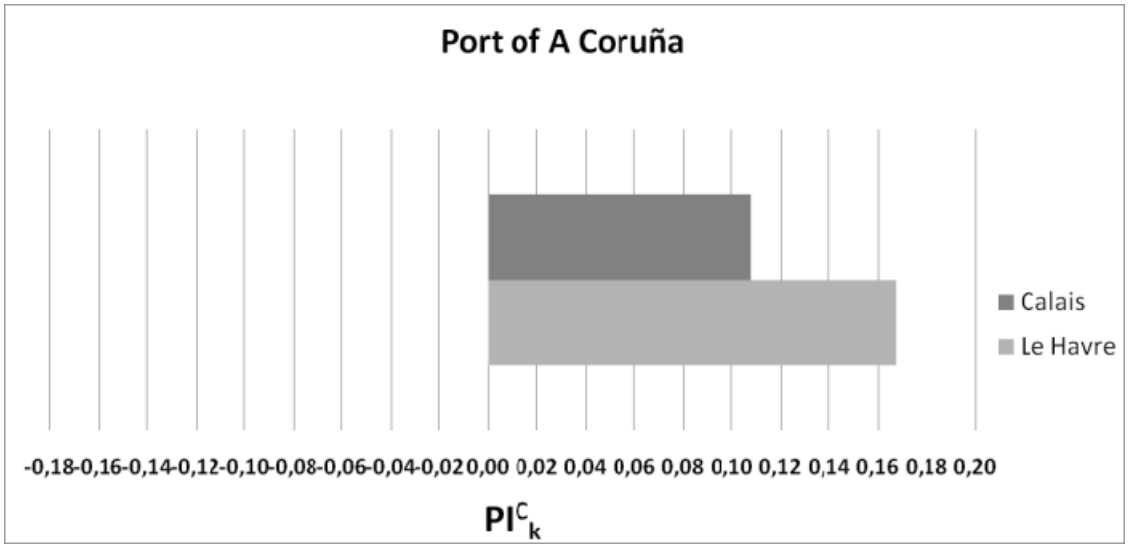


Figure7: Port Indexes in terms of time for the Spanish port of A Coruña

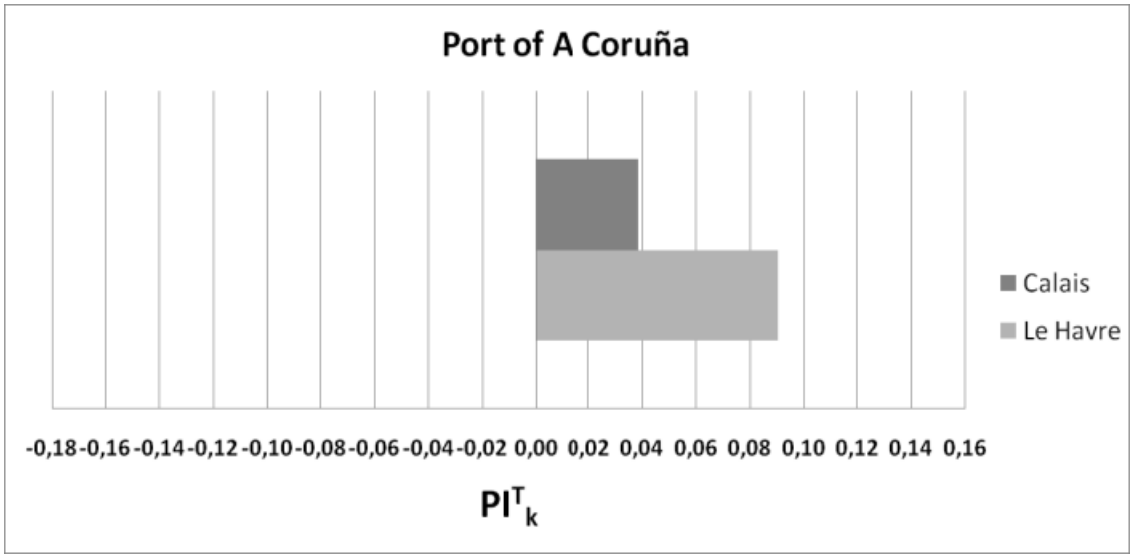


Figure 8: Port Indexes in terms of cost for the Spanish port of Gijón

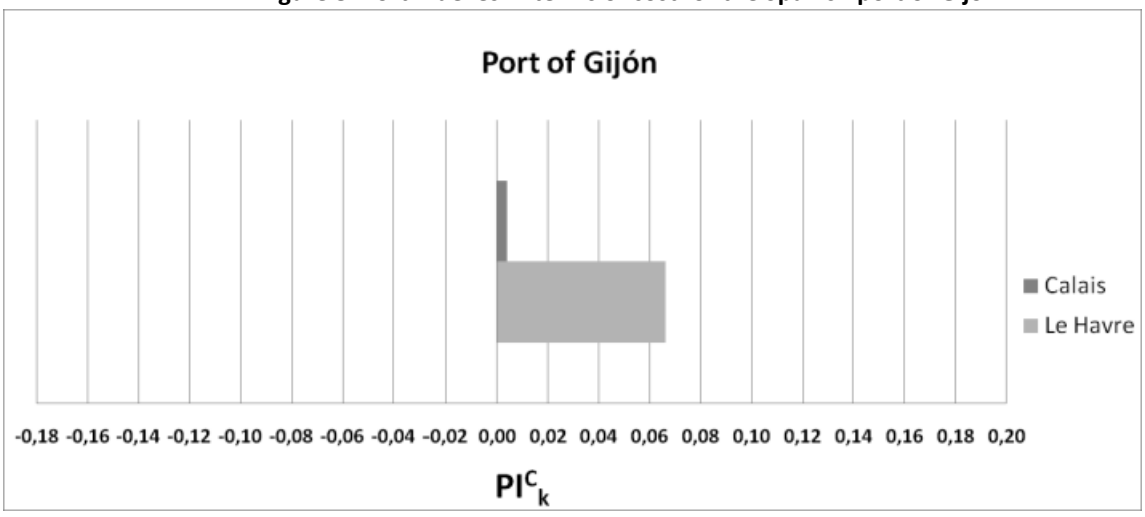
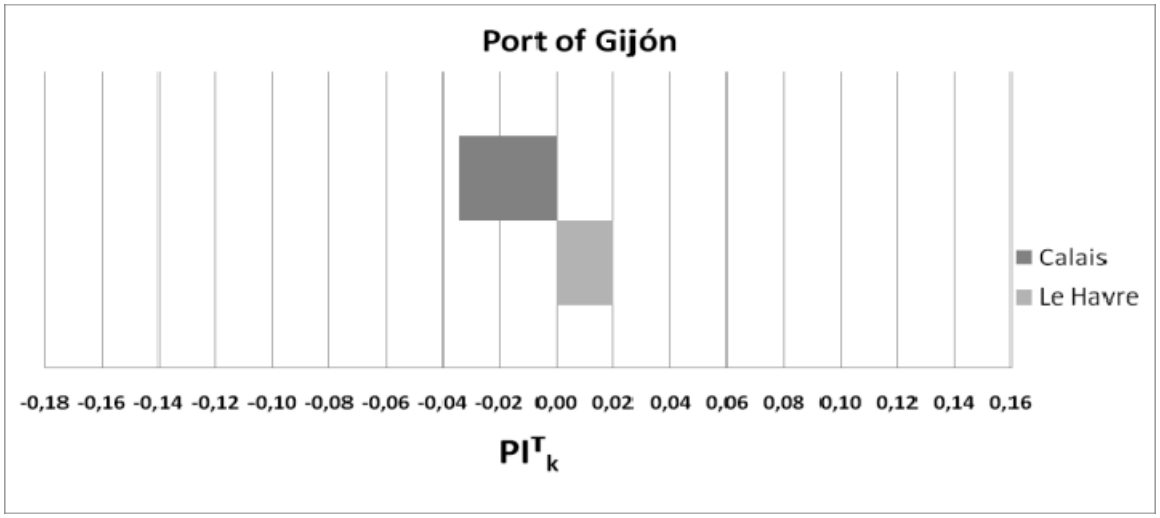


Figure 9: Port Indexes in terms of time for the Spanish port of Gijón



Figures 2 to 5 show the Port Indexes according to both criteria for all the maritime routes analysed. From these data, the most competitive intermodal chains in terms of time are those that use the sea motorways of Vigo-Saint Nazaire and Ferrol-Le Havre, while the maritime routes which include the port of Calais are found to be the worst option for three of the four Spanish ports considered.

In terms of cost, the competitiveness of intermodal transport is even more interesting than when considering the time criterion (higher values). The Ferrol-Le Havre option stands out above the rest as the most competitive versus the road. The A Coruña-Le Havre option is on a similar level, followed by Vigo-Le Havre and Vigo-Saint Nazaire.

3. MONTE CARLO SIMULATIONS

To assess the goodness of the selection of a particular Sea Motorway, a risk analysis of the port index values was carried out taking into account the variation in the variables considered in their calculation using Monte Carlo simulation. This method enables the values of the variables selected to calculate the port indexes to be varied simultaneously.

The probability distributions and the sensitivity analysis for the indexes were thus obtained from these simulations. This allows us; on the one hand, to ascertain whether the port indexes are good estimators for

the corresponding distributions and, consequently, whether the decisions made on the basis of these indexes should be reliable. On the other hand, the sensitivity analysis obtained from the simulation allows us to ascertain the influence of the different forecasts (controllable and non-controllable variables) assumed for the construction of the decision matrixes.

The simulations were carried out on each of the 9 possible routes. As it is a past scenario study case (already known), triangular probability distributions were used with a variation range of 20% between the most and least probable values. The amount of tests carried out in each simulation was 1,600,000, with a 100% certainty for all results obtained.

For each simulation, the statistical data related to the real probability distribution (and the theoretical distribution that best fits) and the influences of each variable on the port indexes were obtained. This last point will also allow us to quantify the risk associated with the lack of control over any variables and to explain the results achieved in the risk analysis.

The measurement of the goodness of the port indexes as estimators was carried out considering three features:

-Bias: measured as the difference between the mean and the base case.

-Consistency level: considered as the proximity from the base case to the most probable value in the distribution.

-Efficiency level: the lowest standard deviation means the highest efficiency level for the indexes. This was measured through the Coefficient of Variability.

3.1. Analysis of the port indexes in terms of time

For the calculation of the port indexes in terms of time, the following inputs were assumed as variables: population factors (α_f), the loading/unloading speed in port, the trailer speed and the vessel speed. The values of these variables were taken as forecasts and so could change in other scenarios. This fact implies a risk for the value of the port indexes and, hence, the selected route. Accordingly, these inputs were considered as variables in the simulations for this index.

Table5: Statistical results from the Monte Carlo simulation (in terms of time)

	Vigo			Ferrol		A Coruña		Gijón	
	SN	**LH**	**C**	**LH**	**C**	**LH**	**C**	**LH**	**C**
Port Index (PI^T_k)	0.10	0.06	0.01	0.1	0.05	0.09	0.04	0.02	-0.03
Mean	0.099	0.051	0.003	0.09	0.03	0.07	0.02	0.02	-0.03
Median	0.103	0.055	0.007	0.09	0.04	0.07	0.02	0.02	-0.03
Standard Deviation	0.028	0.03	0.03	0.03	0.03	0.03	0.03	0.02	0.02
Coeff. of Variability	0.28	0.58	9.55	0.34	0.86	0.42	1.5	0.78	-0.44

Where SN is Saint Nazaire; LH, Le Havre; and C, Calais.

Table 5 shows the values obtained from the simulations carried out using the Monte Carlo method. Differences between the index values and the means reflect that the bias taken in the selection of the port is low. However, the level of dispersion of the data is high, with elevated standard deviations. Nonetheless, the preferential order of the considered optimal routes remains the same due to the consistency of the index in all the cases and the distance in absolute values of the indexes among ports.

Table6: Contribution of Inputs to of road variance (%)

	Vigo			Ferrol		A Coruña		Gijón	
	SN	LH	C	LH	C	LH	C	LH	C
Truck speed	-54.40	-55.40	-54.70	-71.40	-71.10	-74.80	-74.50	-20.70	-19.70
Vessel speed	31.00	35.90	37.80	21.10	23.00	19.00	20.50	58.50	63.30
Loading/Unloading speed	12.80	7.90	6.60	6.50	5.30	5.70	4.70	20.70	16.40
Lille	1.00	0.70	0.70	0.50	0.50	0.30	0.30	0.00	0.00
Paris	0.80	0.10	-0.10	0.40	0.00	0.30	0.00	0.10	-0.40
Rennes	0.10	0.00	-0.10	0.00	0.00	0.00	0.00	0.00	-0.20

Where SN is Saint Nazaire; LH, Le Havre; and C, Calais.

On the other hand, as can be seen in Table 6, the truck speed has a negative influence on the index value for every route regardless of the influence of the road stretch on the multimodal transport. The relative importance of this variable is minimized for the ports of Gijón and Vigo given that the influence of the vessel speed increases in these ports. Thus, the positive and negative contributions balance out for the case of Vigo, while in the case of Gijón the positive contributions are higher than the negative ones (the real distribution is very close to a continuous beta distribution). Finally, as expected, while the relative importance of the vessel speed increases with maritime distance, the relative weight of the speed of loading/unloading is inversely proportional to the maritime route.

Figures 5 and 6show the shapes of the probability distributions obtained from the simulations carried out for each port. Given that the time invested in road transportation is not continuous (Regulation 561/2006), the different shapes of the distributions are mainly due to the different relative weight of the truck speed on the indexes (negative influence). Hence, the time invested in the unimodal route from the extreme ports, (the furthest; Vigo and the nearest; Gijón) is not very sensitive to slight variations in truck speed. The contrary occurs in the case of the intermediate ports (A Coruña and Ferrol), where slight changes in truck speed could mean a difference of one day's travel.

Figure 10: Probability distributions of the simulations for Port Indexes (in terms of time) and the Spanish port of Vigo

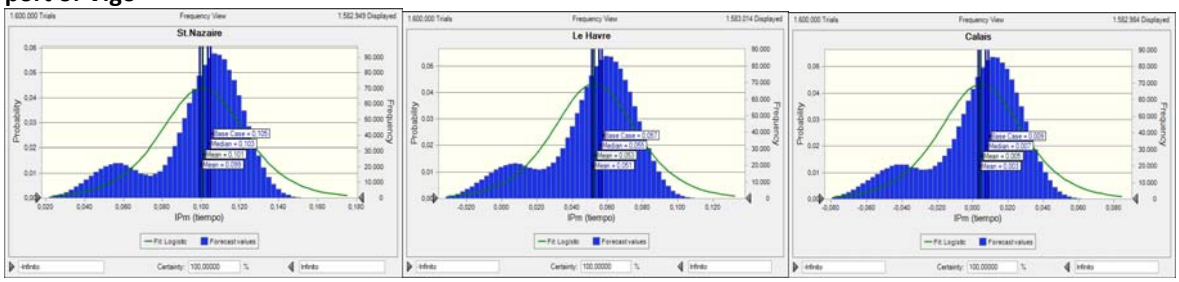


Figure 11: Probability distributions of the simulations for Port Indexes (in terms of time) and the Spanish port of Ferrol

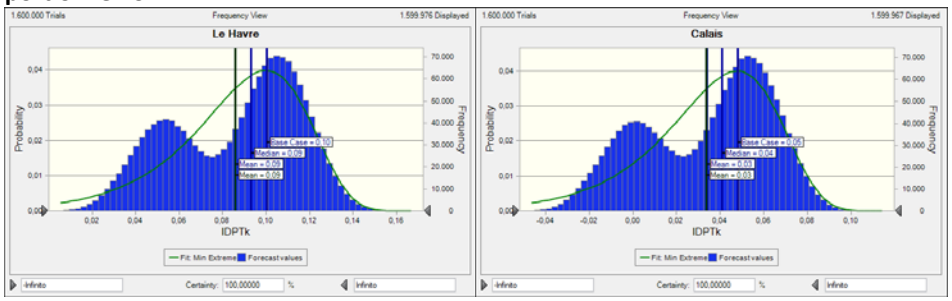


Figure 12: Probability distributions of the simulations for Port Indexes (in terms of time) and the Spanish port of A Coruña

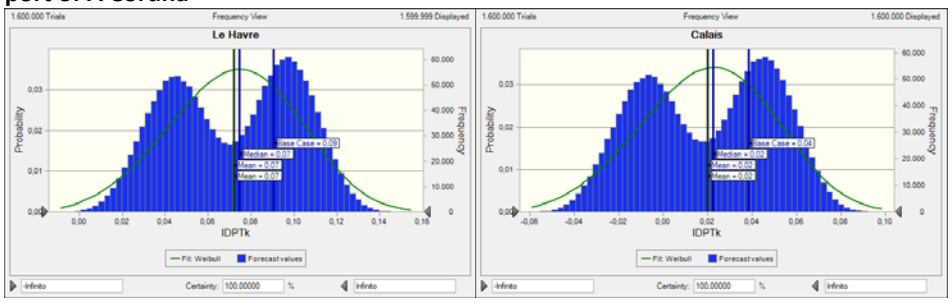
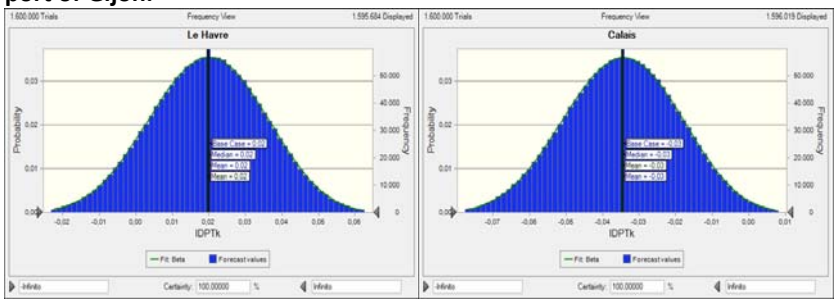


Figure 13: Probability distributions of the simulations for Port Indexes (in terms of time) and the Spanish port of Gijón.



Thus, taking into account the risk analysis, the alternatives of Ferrol-Le Havre and Vigo-St. Nazaire would be the best options as regards the time factor (their port indexes are centred, efficient and consistent). On the other hand, however, the routes chosen taking into consideration the sensitivity analysis would be: Gijón-Calais, Gijón-Le Havre and Vigo-St. Nazaire, as the dependence on non-controllable variables (population factors and the truck speed) is smaller than in the rest of the cases.

Therefore, from the analysis of the port indexes in terms of time, the best route is Vigo-St. Nazaire. Moreover, this route (together with Ferrol-Le Havre) obtained the highest absolute value of the index in the decision matrix.

3.2. Analysis of the port indexes in terms of cost.

For the risk analysis of this index, the assumptions taken into account were: population size at the French route endpoints (, the weighting factor regarding the recorded annual volume of traffic between France and Spain), the land transport cost per km and the freight per transport unit (considering the fuel cost and the capital cost for the shipping company independently). Table 7 shows the statistical data of the probability distributions obtained from the simulations carried out.

Table7: Statistical results from the Monte Carlo simulation (in terms of cost)

	Vigo			Ferrol		A Coruña		Gijón	
	SN	**LH**	**C**	**LH**	**C**	**LH**	**C**	**LH**	**C**
Port Index (PI^C_k)	0.14	0.15	0.09	0.18	0.12	0.17	0.11	0.07	0.00
Mean	0.14	0.15	0.09	0.18	0.12	0.17	0.11	0.07	0.00
Median	0.14	0.15	0.09	0.18	0.12	0.17	0.11	0.07	0.00
Standard Deviation	0.008	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Coeff. of Variability	0.06	0.07	0.1	0.06	0.08	0.06	0.08	0.17	2.97

Where SN is Saint Nazaire; LH, Le Havre; and C, Calais.

The results obtained for all the routes show a high coincidence between the respective value of the port indexes in terms of cost and the means of their simulated distributions. Furthermore, the indexes are efficient and consistent. These indexes are hence good estimators of the probability distributions obtained and the risk associated with the selection of the routes considering the absolute value of this index (see point 2) is therefore low.

Table 8 shows the results from the sensitivity analysis. Once again, the most influential variable on the index value is related to the truck: the cost per km. For each Spanish port, the influence of the road cost increases when the influence of this variable in the multimodal transport decreases (Vigo-St.Nazaire versus Vigo-Calais, for instance). However, this is not found between the routes through different Spanish ports (Vigo-Le Havre versus Gijón-Le Havre, for instance). As expected, the influence of the loading/unloading costs increases with decreasing maritime distance, but total freight costs exert little influence on the index value for all the routes.

Table8: Contribution of Inputs to variance (%)

	Vigo			Ferrol		A Coruña		Gijón	
	SN	**LH**	**C**	**LH**	**C**	**LH**	**C**	**LH**	**C**
€/km (truck)	62.30	67.20	79.68	57.27	71.95	60.64	75.16	87.79	90.85
París	15.60	15.90	5.45	22.36	9.94	20.21	7.86	2.88	-0.02
Rennes	3.50	0.30	-0.09	0.52	-0.02	0.46	-0.06	-0.01	-0.92
Lille	1.40	2.20	4.32	2.71	5.42	2.63	5.27	0.62	1.55
βn	12.60	9.40	4.43	12.81	7.21	11.45	5.98	2.34	0.02
Freight costs due to fuel (€)	-0.40	-0.30	-0.53	-0.30	-0.38	-0.39	-0.46	-0.38	-0.38
Freight costs due loading/unloading costs(€)	-3.80	-3.90	-4.70	-3.44	-4.31	-3.60	-4.46	-5.11	-5.33
Freight costs due to crew costs (€)	-0.60	-0.80	-0.79	-0.59	-0.76	-0.63	-0.75	-0.87	-0.93

Where SN is Saint Nazaire; LH, Le Havre; and C, Calais.

On the other hand, it is worth noting that the influence of the population factor on the port index is not only dependent on the average distance from the city to the port, or on the absolute value of the population factor for one city versus the others, but rather on a combination of all these factors.

The shape of the probability distributions is shown in the following figures. According to these figures, we can conclude that in all cases the theoretical probability distribution (beta) fits the real distribution. In this case, all the distributions are continuous (there are no important steps).This is mainly due to the fact that the total influence of all the variables for all the routes is positive (see Table 8).

Figure 14: Probability distributions of the simulations for Port Indexes (in terms of cost) and the Spanish port of Vigo.

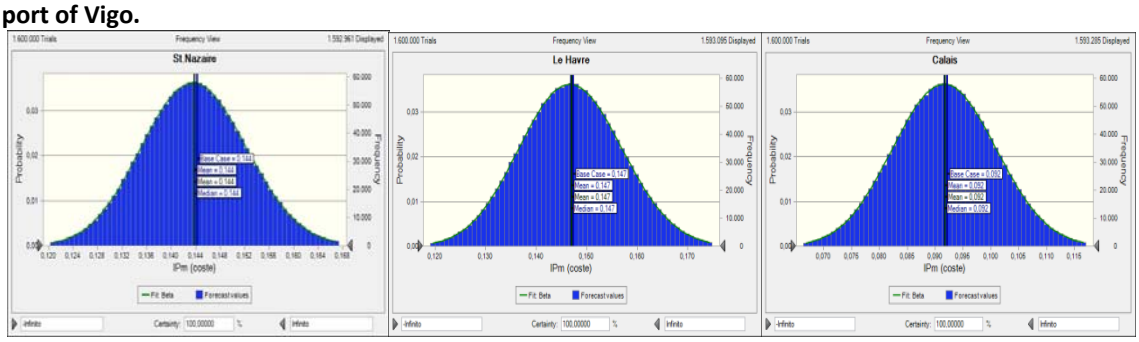


Figure 15: Probability distributions of the simulations for Port Indexes (in terms of cost) and the Spanish port of Ferrol.

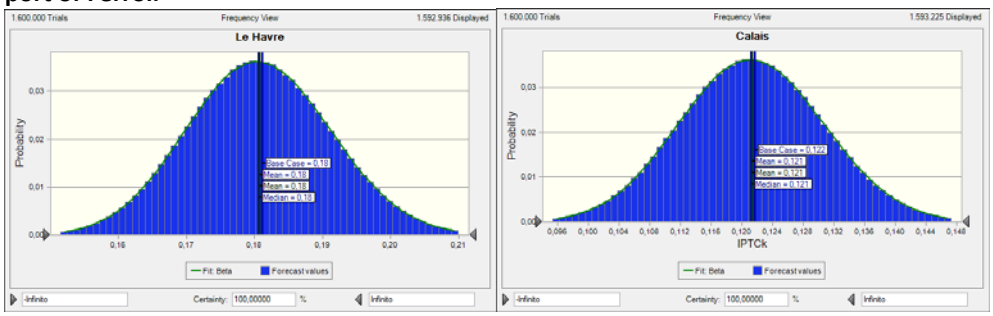


Figure16: Probability distributions of the simulations for Port Indexes (in terms of cost) and the Spanish port of A Coruña.

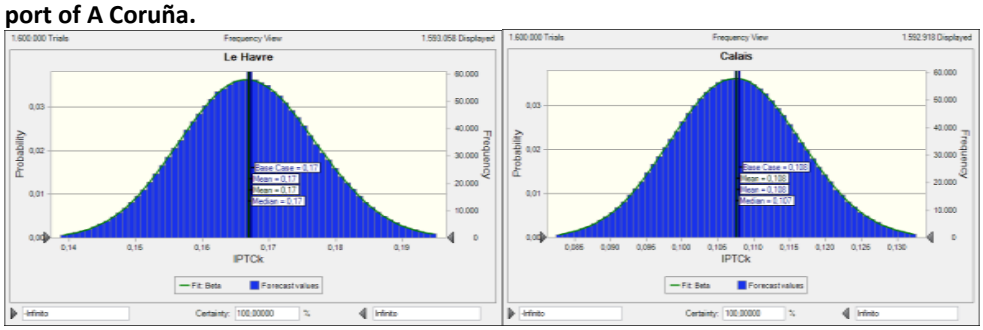
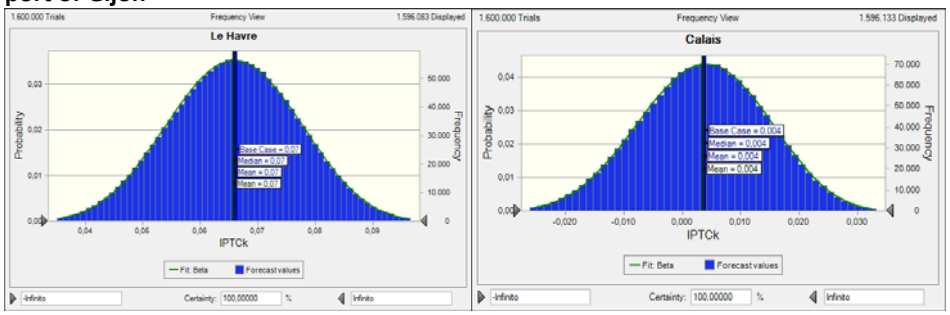


Figure 17 Probability distributions of the simulations for Port Indexes (in terms of cost) and the Spanish port of Gijón



Thus, in terms of the risk analysis, the selection should be carried out in accordance with the absolute values of the index: Ferrol-Le Havre, A Coruña-Le Havre, followed by Vigo-Le Havre and Vigo-St. Nazaire. However, it is worth noting that despite the index value for Vigo-Le Havre being higher than that for Vigo-St. Nazaire, the index is more efficient for the latter route (smaller coefficient of variability). On the other hand, the least dependent routes on the non-controllable variable of road coast are: Ferrol-Le Havre, A Coruña-Le Havre and Vigo-St. Nazaire.

Therefore, taking into account the analysis of the port index in terms of the cost, Ferrol-Le Havre would be the most suitable route.

4. CONCLUSIONS

The results obtained support the usefulness of the indexes presented. They may be used to make an initial assessment of the potential of alternative routes to develop a Sea Motorway that is competitive versus unimodal transport. Applied to the study case presented in the paper, it can be concluded that the intermodal alternative is preferable to its unimodal counterpart for practically all the cases analysed (see Figures 2 to 5). The advantage of the intermodal services versus unimodal transport is especially noticeable when considering the cost of the service. Thus, as expected, the time criterion is the most restrictive point of the competitive advantage of multimodal transport. Taking both perspectives in conjunction, the routes with the highest potential for success are A Coruña-Le Havre, Ferrol-Le Havre and Vigo-Saint Nazaire.

As the value of the indexes depends on the assumptions considered to calculate them, it is convenient to analyse the risk assumed when selecting or rejecting a particular alternative. Monte Carlo simulation was the tool chosen for this purpose. The results obtained from the simulations allow us to state that time and cost indexes are good estimators for two of the pre-selected routes: Vigo-Saint Nazaire and Ferrol-Le Havre. According to this method, the risk assumed by accepting the advantage of intermodal versus unimodal transport on these routes is low. However, the A Coruña-Le Havre option is rejected due to the risk associated to its port index in terms of time.

The Monte Carlo simulation also led to the drawing of conclusions from the sensitivity analysis. For both indexes, the most influential variable is a non-controllable variable: the speed of the truck (limited by regulations) and the road cost (limited by the cost gasoil in the trade), respectively. Thus, the routes with the least sensitive indexes to these variables will assume a smaller risk. The influence of the speed of the truck (negative) on the indexes in terms of time is less for Vigo-St. Nazaire than for A Coruña-Le Havre (54.40% versus 71.40%). The opposite occurs, however, as regards the influence of the road cost on the indexes in terms of cost (62.30% versus 57.27%).

Considering the time advantage as being preferential and the independence of the route with respect to the non-controllable variables, the selected route should be Vigo-St. Nazaire. However, the multimodal routes through the port of Gijón are the most independent ones with respect to the controllable variables. Thus, the expected improving range of competitiveness of these routes through actions taken on their variables is the highest one.

Finally, it should be noted that the influence of the speed of the truck on the competitiveness of the multimodal transport is not continuous but rather occurs in steps. Thus for many routes, slight modifications in truck speed lead to high differences in the competitiveness of multimodal transport. This point is highly dependent on the geographic location of the routes.

On the other hand, the loading/unloading speed is highly relevant in all the multimodal routes through the ports of St. Nazaire and Le Havre, as these are the shortest maritime routes.

Finally, the total freight costs are not so relevant as regards competitiveness in terms of cost as expected. This paper has accordingly also tried to order and quantify the main factors that determine the competitiveness of intermodal versus unimodal transport.

In further studies, the analysis should be broadened to cover the multimodal routes initially rejected (see point 2). This might possibly explain why the Gijón-Saint Nazaire alternative has recently entered into operation with success, but was rejected in this paper because the distance that separates their ports falls outside the range considered desirable.

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