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A new research project at DTU

Harilaos N. Psaraftis
Professor

Background on impact: many studies/papers

- Kalli et al (2009)
- Ljungström et al (2009)
- Stavrakakis et al (2009)
- Hader at al (2010)
- ECSA: Notteboom et al (2010)
- EC: Bosch et al (2009), Kehoe et al (2010), Delhaye et al (2010)
- ECSA & ICS: Grebot et al (2010)
- EMSA (2010)
- etc

- Special issue of Tr. Res. Part D on ECAs (2014)

Special issue

Transportation Research Part D xxx (2014) xxx–xxx

Contents lists available at ScienceDirect

Transportation Research Part D

journal homepage: www.elsevier.com/locate/trd

ELSEVIER

Editorial

Emission control areas and their impact on maritime transport

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Transportation Research Part D 28 (2014) 74–90

Contents lists available at ScienceDirect

Transportation Research Part D

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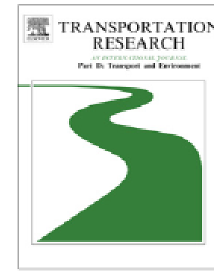

The possible designation of the Mediterranean Sea as a SECA: A case study

George P. Panagakos [a,1], Eirini V. Stamatopoulou [a,2], Harilaos N. Psaraftis [b,*]

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Results

- Shift to road >5%
- Less SOx
- Less CO_2 !

1

2

- RoPax going 23 knots
- Low load factor

Ne

Transportation Research Part C 52 (2015) 57–73

Contents lists available at ScienceDirect

Transportation Research Part C

journal homepage: www.elsevier.com/locate/trc

Maritime routing and speed optimization with emission control areas

Kjetil Fagerholt [a,*], Nora T. Gausel [a], Jørgen G. Rakke [b], Harilaos N. Psaraftis [c]

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[c] Department of Transport, Technical University of Denmark, Lyngby, Denmark

- Speed optimization, ship routing and ECAs

Transportation Research Part D 39 (2015) 56–64

Contents lists available at ScienceDirect

Transportation Research Part D

journal homepage: www.elsevier.com/locate/trd

On two speed optimization problems for ships that sail in and out of emission control areas

Kjetil Fagerholt [a,b], Harilaos N. Psaraftis [c,*]

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[b] Norwegian Marine Technology Research Institute (MARINTEK), Trondheim, Norway
[c] Department of Transport, Technical University of Denmark, Lyngby, Denmark

- Where to cross the ECA and what the speeds should be outside and inside the ECA

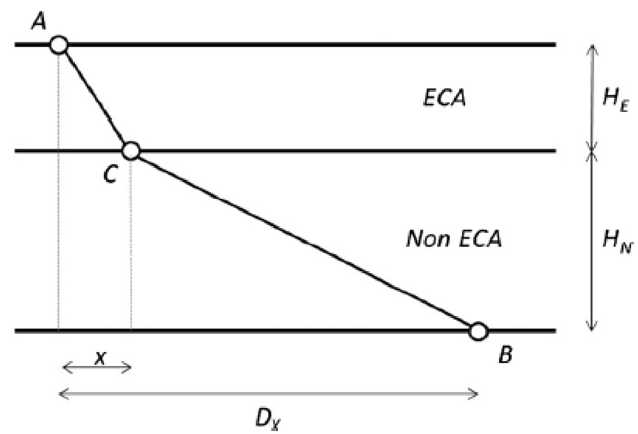


Fig. 5. Illustration of the ECA refraction problem.

The new DTU project:

- **Mitigating and reversing the side-effects of environmental legislation on Ro-Ro shipping in Northern Europe**

- Main objective: identify and assess possible technical, operational, regulatory and financial measures for the mitigation and reversal of the negative repercussions of environmental legislation to the market shares of Ro-Ro shipping in Northern Europe.

- Sponsor: Danish Maritime Fund

- Duration: 2 years (15/6/2015-14/6/2017)

Remarks

- The fact that fuel prices have dropped precipitously since the summer of 2014 has alleviated the repercussions of the new regulations.
- However, this was also the case for the road mode and the risk of route closure still exists, particularly if fuel prices rise again in the future.
- Some operators have already shut down some of their routes.

- → Need to be on the alert.

DISCLAIMER

- **No results yet! (being at month 7)**
- **BUT: I will try to explain what we are doing**

Structure of the project

- 4 Work Packages

- WP1 Project management

- WP2 Enhanced modal split and emissions models (Year 1)
  - Task 2.1 Scenario definition and data collection
  - Task 2.2 Modal split model development and calibration
  - Task 2.3 Emissions and external cost calculator

- WP3 Measures to mitigate or reverse modal shifts (Year 2)
  - Task 3.1 Measures from the Ro-Ro operator
  - Task 3.2 Measures from policy makers

- WP4 Dissemination

Case studies based on

DFDS

Current DFDS network

- 18 Routes (22 links)
- 38 vessels
- Up to 535 departures/week, 13 countries, 30 ports
- 4 main areas
  - North Sea (9 Routes, 20 vessels)
  - Baltic Sea (5 Routes, 7 vessels)
  - Cross-Channel (3 Routes, 6-7 vessels)
  - Mediterranean (1 Route, 1-2 vessels)

Main route selection criteria

- 6-8 Routes
- Geographical Balance
- Distance (good spread between short and long routes)
- Volume & frequency of service
- Vessels (various types & abatement technologies)

Other Criteria

- Diverse mix of countries (9 in proposed)
- Include important hubs (Immingham, Gothenburg, Klaipeda)
- Terminals at large container ports (Felixstowe, Rotterdam)
- Select the cross channel route with most competition (Dover Calais)

Active routes to study (7)

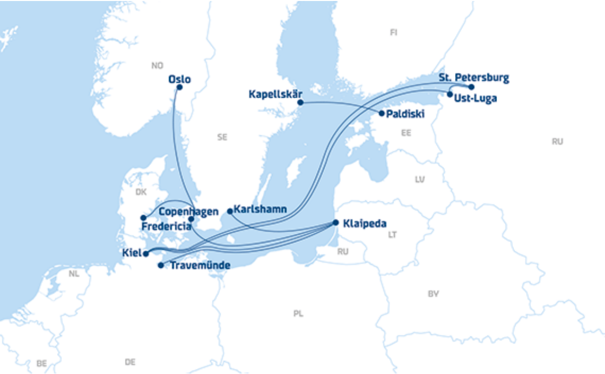
Route	Vessel		Vessel Capacity	
	Type	Tech	Lane meters	Passengers
NORTH SEA				
Gothenburg – Ghent – Brevik	RoRo	Scrubber	3831	12
	RoRo	Scrubber	3831	12
	RoRo	Scrubber	3831	12
Copenhagen – Oslo	Cruise	Scrubber	(450 cars)	1790
	Cruise	MGO	(320 cars)	1989
Esbjerg – Immingham	RoRo	Scrubber	3000	12
	RoRo	MGO	3000	12
Rotterdam – Felixstowe	RoRo	Scrubber	2772	12
	RoRo	Scrubber	2772	12
	RoRo	MGO	1680	12
BALTIC SEA				
Klaipeda – Kiel	RoPax	Scrubber	2115	328
	RoPax	Scrubber	2240	328
Klaipeda – Karlshamn	RoPax	MGO	2490	600
	RoPax	MGO	2496	600
CROSS CHANNEL				
Dover – Calais	RoPax	MGO	1784	1100
	RoPax	MGO	1949	405

Also!

- Esbjerg- Harwich (recently shut down)
- Marseille-Tunis (outside SECA)

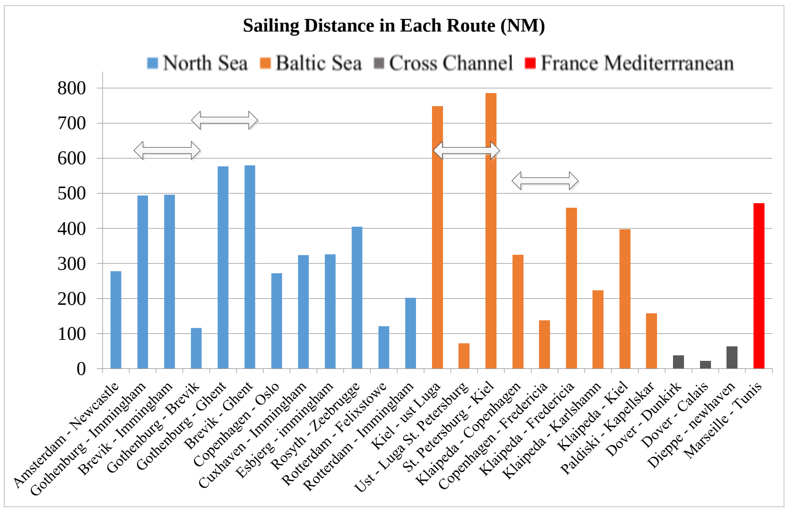
Geographical Balance

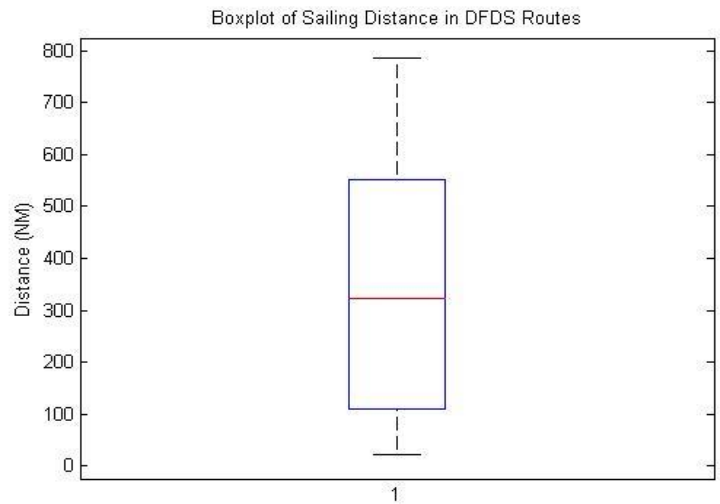
- Roster:
  - 4 Routes in North Sea
  - 2 in Baltic Sea
  - 1 Cross-Channel
  - 1 recently shut down



Short vs long routes

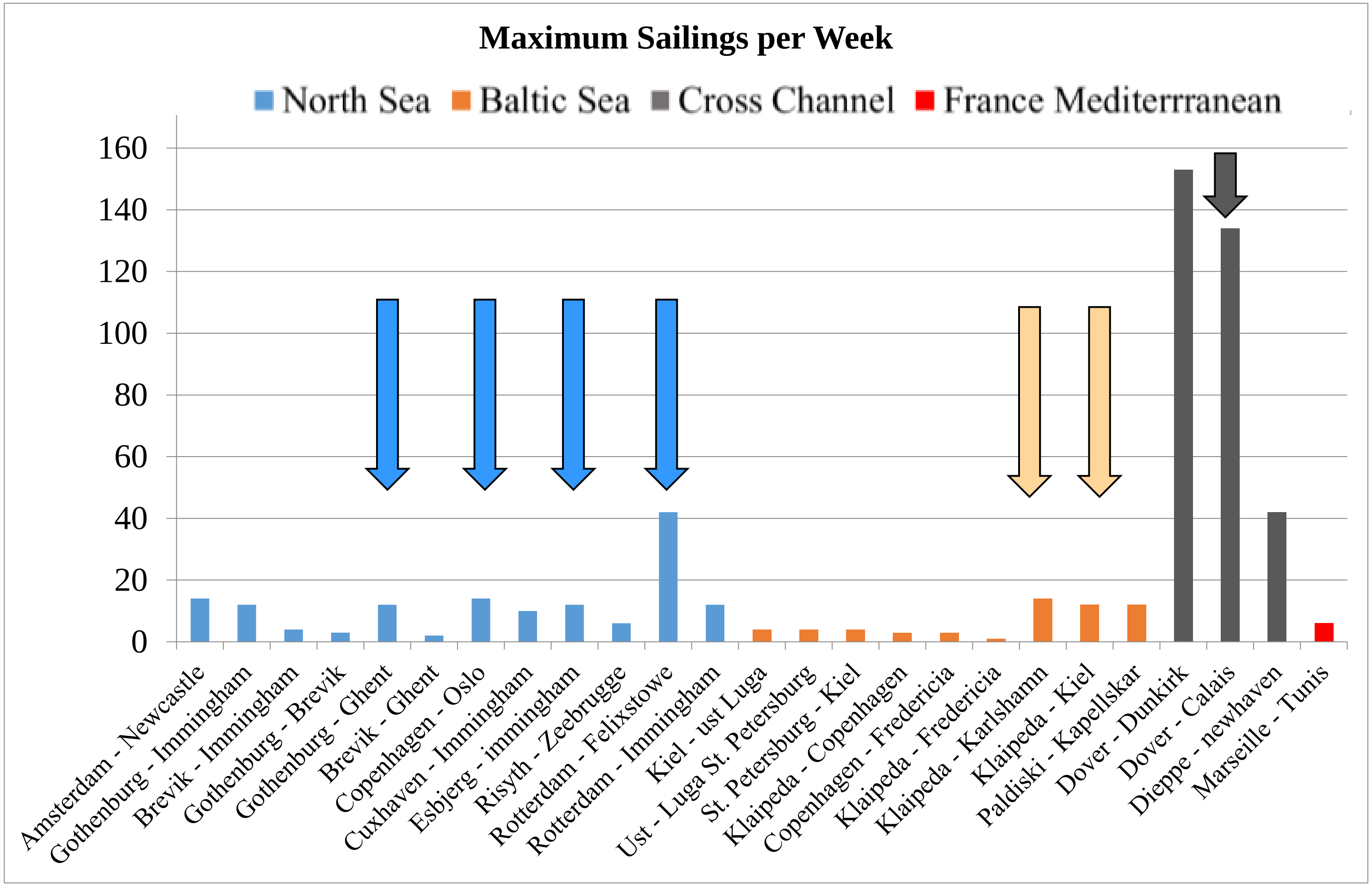
- Distance





Distance of Proposed Routes
577*
326
272
121
397
223
22

Frequency of Service



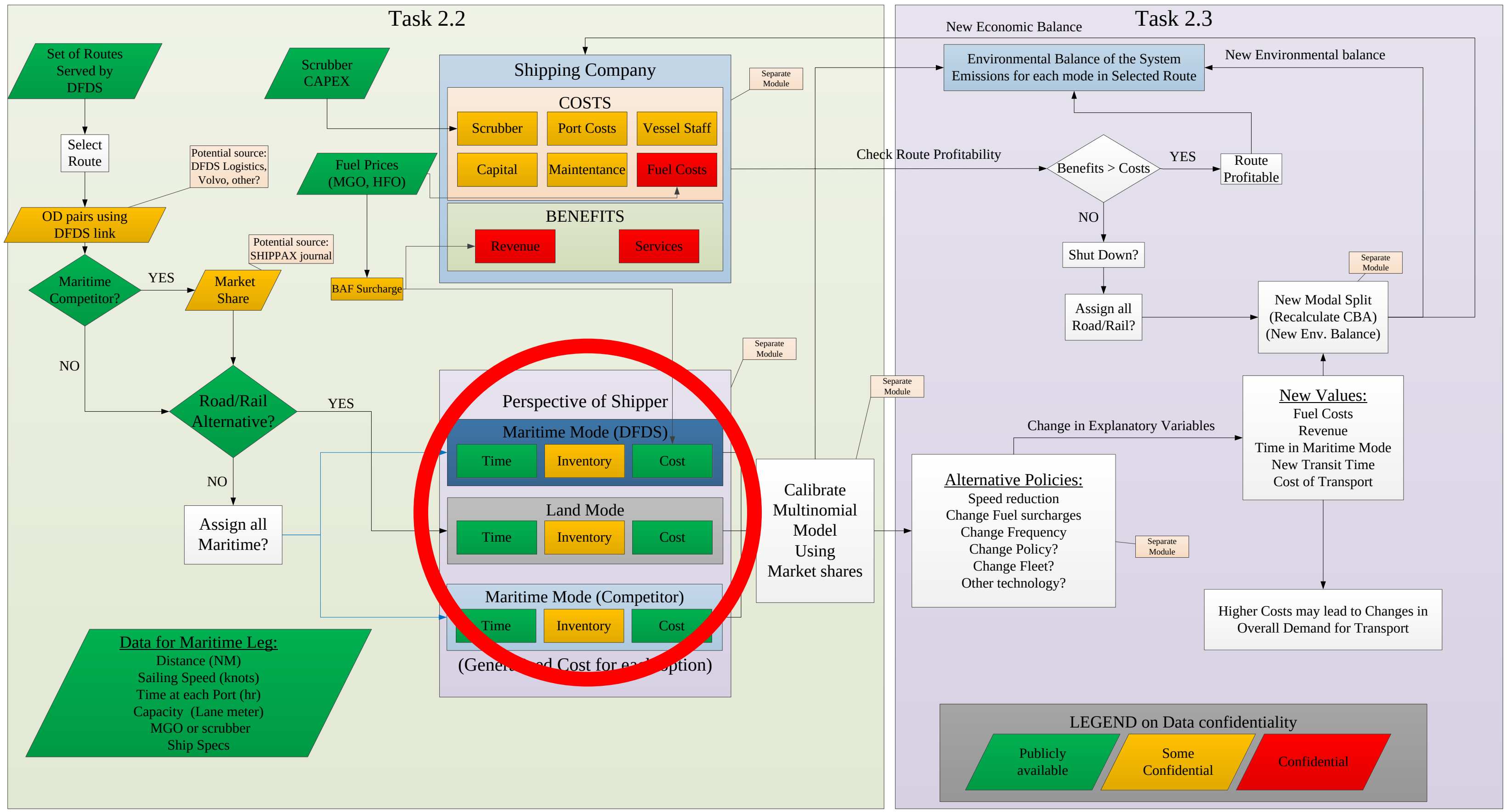
Volume

- The selected routes account for approximately 43% of the total DFDS lane meters capacity

Vessel Type and Technology

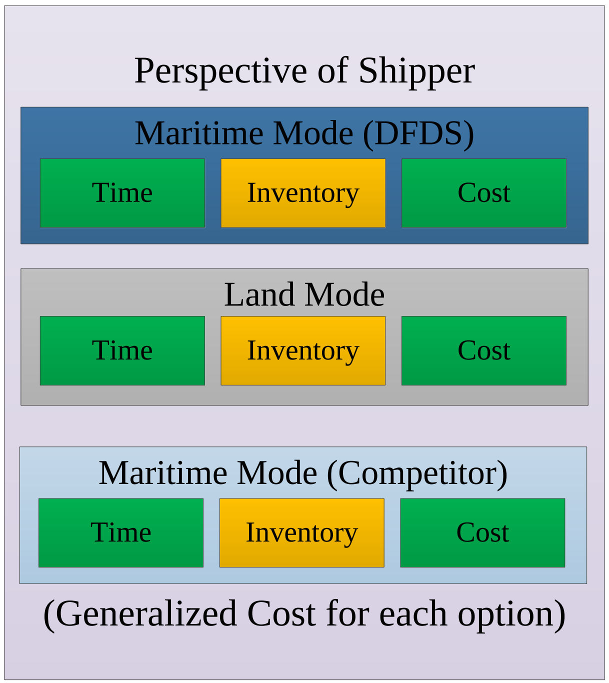
- 2 Cruise Ships (1 MGO, 1 scrubbers)
- 8 Ro-Ro (3 MGO, 5 scrubbers)
- 6 Ro-Pax (4 MGO, 2 scrubbers)

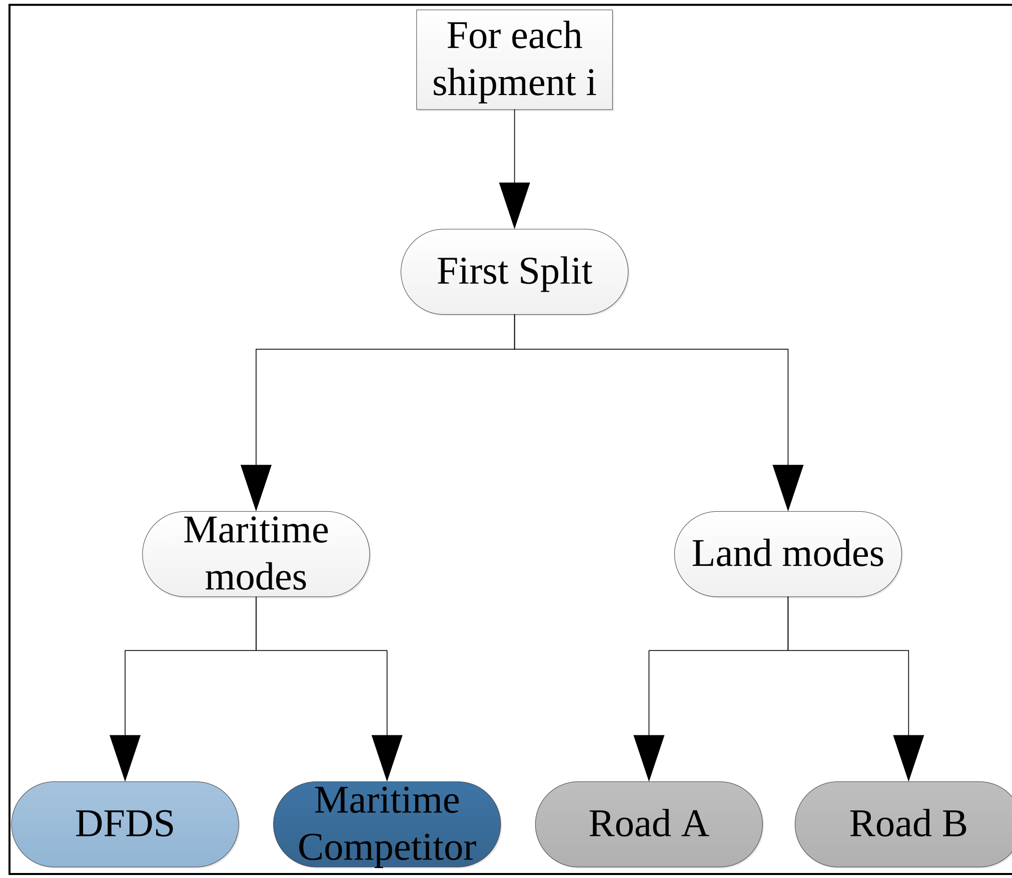
Modal split model development and calibration



Perspective of the Shipper

- General Case – Hierarchical Structure





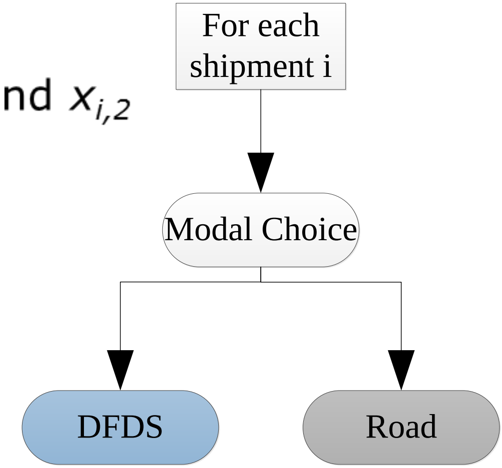
Perspective of the Shipper

- Transport Option for scenario *i*
- For each Option j:
  - Monetary Cost
  - Travel Time
  - Inventory Cost
  - Waiting times

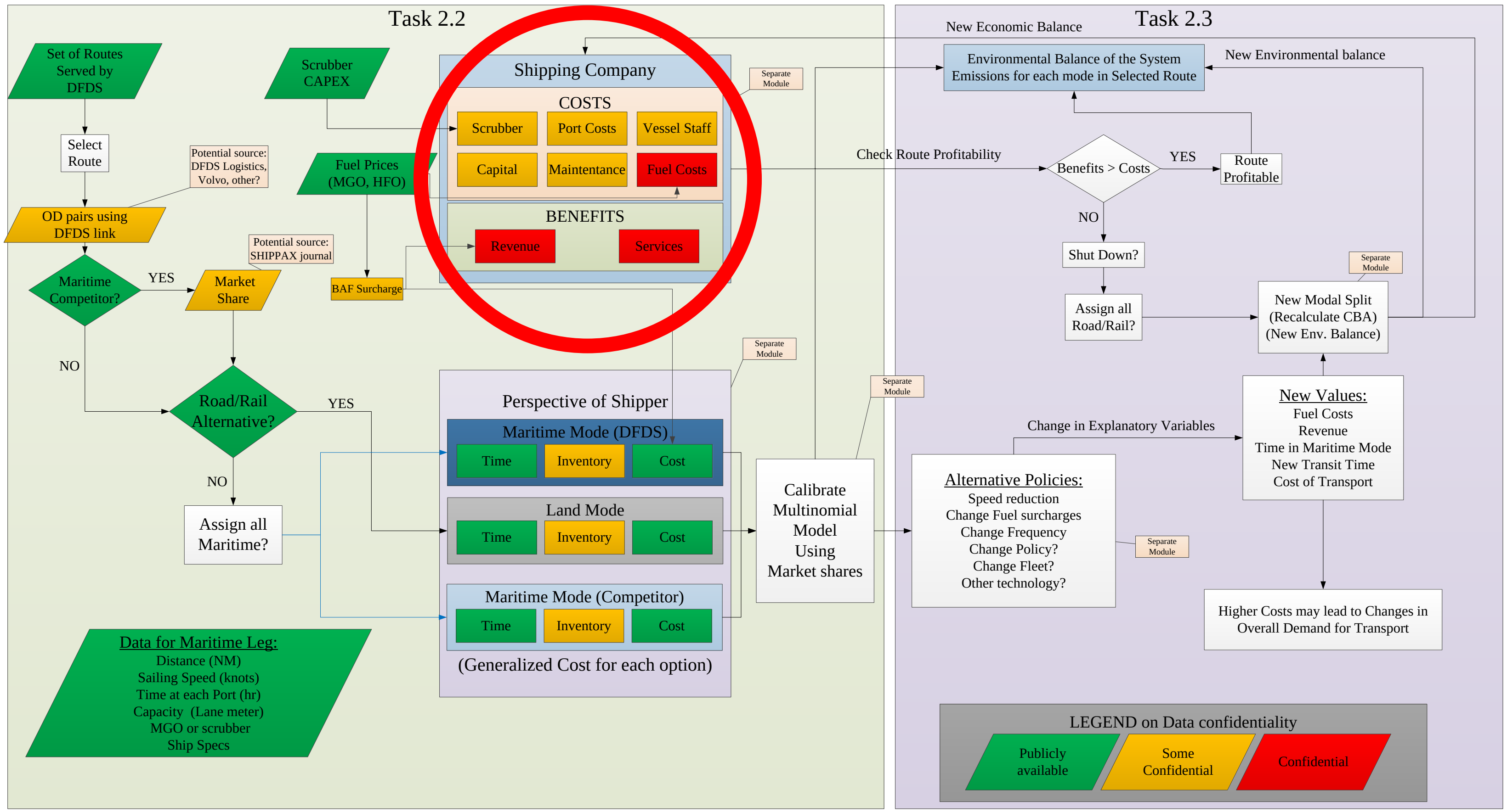
Generalized Cost $C^{g}_{i.j}$

- Identify market share (%)
  For example, the simplest binary case (sea vs land): $x_{i,1}$ and $x_{i,2}$

- Calibrate Model $x_{i,1} = \dfrac{e^{-\lambda \cdot C^{g}_{i.1}}}{e^{-\lambda \cdot C^{g}_{i.1}} + e^{-\lambda \cdot C^{g}_{i.2}}}$ $\longrightarrow$ estimate λ
- Assume an increase in $C^{g}_{i.2}$ $\longrightarrow$ then $x_{i,1}\uparrow$ and $x_{i,2}\downarrow$

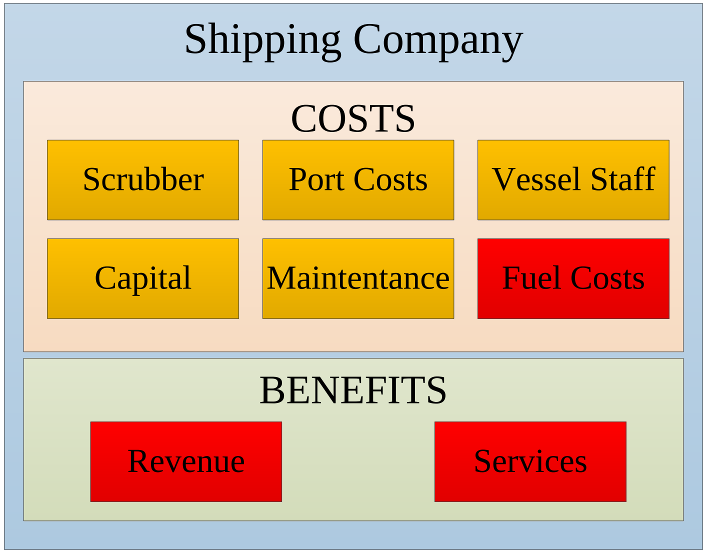


Perspective of the Shipping Company



Perspective of the Shipping Company

- Identify Revenue with a given Transport Demand
  - Passengers
  - Freight Rate for Cargo
  - Miscellaneous (Food, Drinks, Casino etc.)
- Identify Costs
  - Fuel
  - Port
  - Staff
  - Maintenance
  - Other
- Formulate Profitability Function
  - If Route non-profitable, consider shut down
  - Re-run modal split



Ahead

TO JUNE 2016

- Finalize & calibrate model
- Gather additional data
- Make runs for selected routes
- Workshop (stay tuned)

2ND YEAR

- Examine mitigation measures & policies

WP3 Measures to mitigate or reverse modal shifts

- *Task 3.1 Measures from the Ro/Ro operator*

- Speed reduction
- Service frequency and schedule reconfiguration
- Fleet and network reconfiguration
- Alternative fuels such as LNG
- Other technical measures such as scrubbers
- Appropriate pricing policies

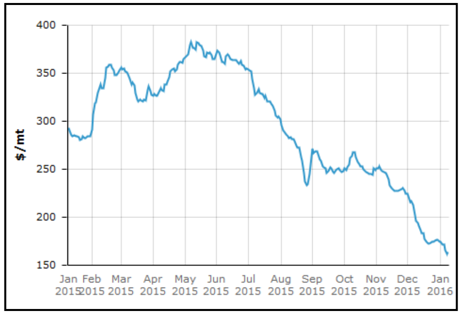
- *Task 3.2 Measures from policy makers*

- Full or partial internalization of external costs, all modes
- Easing of port dues/fairway dues/ ice dues for relevant shipping
- Public funding or subsidies
- Any potential policy measure recommended by the ESSF and its subgroups

Challenges

○ **How to isolate effect of sulphur legislation from that of other developments that happened in parallel**

- Precipitous drop of fuel prices



- Russian economic crisis

○ **Lower fuel prices may induce higher speeds and hence more CO_2!**

Library

(click on title to download)

Algaba, O. B. (2014). Impact study of the new sulphur regulations on a North Sea short-sea route (Master's thesis). DTU, Department of Transport, Kongens Lyngby, Denmark.

Bosch, P., Coenen, P., Fridell, E., Åström, S., Palmer, T., & Holland, M. (2009). Cost benefit analysis to support the impact assessment accompanying the revision of directive 1999/32/EC on the sulphur content of certain liquid fuels. Didcot, England: AEA report to European Commission.

Cullinane, K., & Bergqvist, R. (2014). Emission control areas and their impact on maritime transport. Transportation Research Part D: Transport and Environment, 28, 1–5.CrossRef

EMSA. (2010). The 0.1% sulphur in fuel requirement as from 1 January 2015 in ECAs—An assessment of available impact studies and alternative means of compliance. Technical report of the European Maritime Safety Agency

International Series in Operations Research & Management Science ISOR 226

Harilaos N. Psaraftis *Editor*

Green Transportation Logistics

The Quest for Win-Win Solutions

This book examines the state of the art in green transportation logistics from the perspective of balancing environmental performance in the transportation supply chain while also satisfying traditional economic performance criteria. Part of the book is drawn from the recently completed European Union project SuperGreen, a three-year project intended to promote the development of European freight corridors in an environmentally friendly manner. Additional chapters cover both the methodological base and the application context of green transportation logistics.

Individual chapters look at the policy context; the basics of transportation emissions; Green Corridors basics; the concept of TEN-T (Trans-European Network); Benchmarking of green corridors; the potential role of ICT (Information and Communication Technologies); Green vehicle routing; Reducing maritime CO_2 emissions via market based measures and speed and route optimization; Sulphur emissions; Lifecycle emissions; Green rail transportation; Green air transportation; Green inland navigation; and possible areas for further research.

Throughout, the book pursues the goal of "win-win" solutions and analyzes the phenomenon of "push-down, pop-up", wherein a change in one aspect of a problem can cause another troubling aspect to arise. For example, speed reduction in maritime transportation can reduce emissions and fuel costs, but could require additional ships and could raise in-transit inventory costs. Or, regulations to reduce sulphur emissions may ultimately increase CO_2 elsewhere in the supply chain. The book takes stock at the various tradeoffs that are at stake in the goal of greening the supply chain and looks at where balances can be struck.

Business/Economics

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Psaraftis *Ed.*

Green Transportation Logistics

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Operations Research & Management Science

Harilaos N. Psaraftis *Editor*

Green Transportation Logistics

The Quest for Win-Win Solutions

Springer

Thank you

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