COMPUTATION OF A PERCEPTION INDEX IN INTERMODAL TRANSPORT

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1. INTRODUCTION

The share of intermodal transport is still insignificant compared to traditional unimodal road transportation. The main reasons invoked by users relate to price competitiveness, flexibility/reliability and the cost of investment. Tomorrow's intermodal offering can be an answer to increasing road congestion and its social/environmental consequences and may be a significant contributor to enhance European industries competitiveness by providing additional values to European supply chains.

STRATEC has been commissioned by the European Commission in collaboration with PriceWaterhouseCoopers to design the perception index characterised as the European quantitative index which enables to measure and monitor intermodal competitiveness versus full road transport. The perception index is intending to assist :

- logistic services suppliers in their long term decisions and investments in inter modality development
- policy makers in assessing the likely impact of intermodality promoting policies

The perception index has been defined based on the construction of a quantitative utility function of shippers of intermodality:

- using the Stated Preferences methodology
- based on a sample of shippers, representative of main types of supply chains
- measuring their propensity to use intermodal transport, given well defined alternatives
- facing modal choice along a couple of representative corridor, where several intermodal alternatives are available

The methodology has been applied to compute a perception index software prototype based on five geographical corridors, four industrial sectors and three intermodal alternative modes to road.

2. METHOD

The study is mainly based on the Stated Preferences survey technique. The design is based on a preliminary survey carried out by interviewing hauliers about their present practice in the selected corridors concerning prices and level of service of the supply for the different alternative modes (travel time, frequency, tracking and tracing,..). The questionnaire has been customised by mode and origin-destination.

The main survey has consisted of shippers' interviews. It has been carried out in two steps:

- a screening has been conducted by phone to select the shippers
- the Stated Preferences survey itself was then realised on the base of a mail-back questionnaire with phone assistance.

Models have thereafter been calibrated to enable to predict changes in intermodal market share in relation with modifications of services characteristics and of shippers' localisation.

2.1 Shippers' sample

The selection of segments to be considered in the prototype has been realised according to the actual intermodal transport supply as well as the European Commission requests. Table 1 hereafter provides the definition of the segments which are the base of the perception index software prototype which is the object of this paper.

Table 1 : Definition of the segments

Segment	Corridor / Route	Industrial sector	Alternative mode
Seg 1	Antwerp-Bilbao	Chemicals	Short Sea (SS)
Seg 2	Antwerp-Milan	Automotive & Machineries	Rail (R)
Seg 3	Antwerp-Milan	Heavy Metals	Rail (R)
Seg 4	Rotterdam-Basel	Chemicals	Inland Waterways (IW)
Seg 5	Rotterdam-Basel	Fast Moving Consumer Goods	Inland Waterways (IW)
Seg 6	Rotterdam-Vienna	Fast Moving Consumer Goods	Rail (R)
Seg 7	Rotterdam-Vienna	Heavy Metals	Rail (R)
Seg 8	Bilbao-Antwerp	Fast Moving Consumer Goods	Short Sea (SS)
Seg 9	Lyon-Antwerp	Automotive & Machineries	Rail (R)
Seg 10	Milan-Antwerp	Automotive & Machineries	Rail (R)
Seg 11	Basel-Rotterdam	Fast Moving Consumer Goods	Inland Waterways (IW)
Seg 12	Vienna-Rotterdam	Heavy Metals	Rail (R)

A preliminary survey has been achieved in winter 99. For each segment, a list of 4648 shippers was put together based on information from the European Kompass database and/or information from the relevant Chambres of Commerce. The list of shippers was including some information on the size of the company (turnover or number of workers).

Telephone contacts have been initiated on the basis of a random selection covering the whole ranges of sizes. A screening was conducted over the phone to select those shippers which were satisfying the following criteria : the selected shippers were active in the relevant industrial sector and based within 150 km of the corridor origin; more over they were exporting within the relevant corridor full loads of non-hazardous and non-refrigerated goods.

The contact initiation has been stopped when the number of positive answers has reached a level deemed to be sufficient to obtain the required number of questionnaires (30 questionnaires per segment) or when the list of contact was exhausted.

1761 shippers did not fill the required criteria. 1289 shippers have been chosen to participate to the survey.

2.2 The mail-back survey

From the shippers sample that was completed in the preliminary survey, 1289 shippers have been selected to take part in the mail-back survey.

This questionnaire was composed of two parts.

The purpose of the first part was to improve the knowledge of the shipper's characteristics (company identification), of the characteristics of the transported flow to be used as reference in the Stated Preferences survey, (description of the exported flow on the corridor, detailed description about a transport flow : origin, destination, transport mode, shipping unit and size, door to door delivery time, door to door price per ton) and qualitative questions about the expectations in intermodal transport services.

The second part of the questionnaire was devoted to the Stated Preferences experiments. To make the proposed options as realistic as possible, the questionnaire had been customised according to origin and destination of the proposed transports and to the selected modes.

The Stated Preferences experiments have been designed as sixteen trade-off between two - intermodal and road - transport alternatives regarding distance, door to door delivery time (hours), door to door transport price by equivalent trailer, tracking information delay and number of arrivals per week.

302 of the 1289 mailed questionnaires were sent back and usable.

2.3 Weighting of the sample

The sample has been weighted to represent all the shipment realised in the basic year within the here above mentioned five geographical corridors, four industrial sectors and three intermodal modes.

The weighting has been computed in two steps. On one hand, the sample has been weighted to represent the turnover observed within the universe of companies exporting the related goods in the related corridors the flows transported within the corridors. On the second hand, a corrective coefficient has been computed in order to match the flows transported within the corridor.

2.4 Prototype model

Logit models have been estimated using the Hielow software. Separate models have been estimated for the three intermodal alternative modes including sensibilities related to the geographical corridor, to industrial sector, to the shippers and to the product.

2.5 Limitation of the prototype model

The prototype model is based on the following hypothesis : the dispersion of the shippers' behaviour is the same in the survey as in the reality. Generally, this hypothesis is not verified. A scaling factor reproducing the actual dispersion of the shipper's behaviour is assessed, calibrated, based on revealed preferences data : observation of actual choices in the reality.

The prototype is a first run of potential investigation : in-depth analysis would allowed to get really more precise results; for example, the pilot analysis did not consider a segmentation by type of good transported by the industrial sector of the shipper. The experience shows that a finer typology of goods should be adopted.

3. VALUE OF TIME

Stated Preferences data has enabled to estimate values of time.

Value of time for shippers appears to vary according to the transport mode, to the origin and destination, and to the industrials sector. They are provided in Euro per hour by equivalent trailer at tables 2, 3 and 4 hereafter.

Table 2 :Value of time in rail-road transport (Euro per hour by equivalent trailer)

	Antwerp-Milan	Milan-Antwerp	Lyon Antwerp	Rotterdam-Vienna	Vienna-Rotterdam
Automotive	13.56	38.33	38.33	5.02	5.02
Heavy Metal	5.02	-	-	5.02	-

Table 3 :Value of time in inland waterways-road transport (Euro per hour by equivalent trailer)

	Rotterdam –Basel	Basel- Rotterdam
Chemicals	1.62	-
FMCG	1.62	3.95

Table 4 :Value of time in short sea-road transport (Euro per hour by equivalent trailer)

	Antwerp-Bilbao	Bilbao-Antwerp
Chemicals	8.27	-
FMCG	-	8.27

These values are similar to freight long distance transport values of time in Europe already estimated in other study.

4. THE YIELD MANAGEMENT SOFTWARE

The objective of the study was to develop and provide the prototype of an easy to use software tool that would enable to assess policies aimed at increasing intermodal transport usage : it should be able to predict the impacts on the perception of intermodal transport of changes in the fares level and/or level of service.

This software prototype comes under the form of an EXCEL 7.0 notebook. Values for the action parameters that characterise a strategy to be assessed are defined on an input data screen. Simulation results are available on a results screen. Curves can be drawn in order to represent responses variations to variations of action parameters.

4.1 Input data screen

The software deals with two types of possible strategic measures. It has to predict shippers' reactions to :

- level of service modifications;
- fare level changes.

Level of service can be changed through modifications to door-to-door transfer time, information delay (hours) and the number of arrival per week.

Shippers locations modification and/or new terminal implementation can be considered by a modification of the "number of shippers close to a terminal" variable.

The input data screen is provided hereafter.

4.2 Available results

The available results are composed of :

- The intermodal transport market share resulting respectively of the current intermodal supply characteristics and the characteristics of new service to be tested, for both low value and high value products
- The resulting intermodal perception index (IPI), calculated as follows:

$$IPI = \frac{\text{Market Share of Intermodal Transport (new service)}}{\text{Current market share of Intermodal Transport}}$$

The output data screen is provided hereafter.

4.3 Prediction modelling method

Weighted sample enumeration has been completed under the form of an Excel worksheet. The shippers characteristics and supply features which are requested by the prediction models have been listed in the table.

Supply features have been connected with the input data screen so as to enable the table to predict the impacts of possible strategic policies. Intermodal market share of the current situation and the new service supply as well as the perception index have been linked to the results screens. These results are available by industrial sector, by country, by corridor for low and high value products.

Input data screen

SEGMENTS	Mode	Route	Industrial	Intermodal transport current characteristics				
				Price	door-to-door	information	number of arrival	% of shippers
			Sector	EURO / trailer	transfer time (hour)	delay (hours)	per week	close to a terminal
2	Rail	Antwerp-Milano	Automotive	1050	48	18	5	77%
3	Rail	Antwerp-Milano	Heavy Metal	1100	60	18	5	85%
6	Rail	R'dam-Vienna	FMCG	1400	44	18	3	39%
7	Rail	R'dam-Vienna	Heavy Metal	1200	44	18	3	59%
9	Rail	Lyon-Antwerp	Automotive	950	46	18	5	53%
10	Rail	Milano-Antwerp	Automotive	1150	60	18	5	78%
12	Rail	Vienna-R'dam	Heavy Metal	1100	44	18	4	72%
4	Barge	R'dam-Basel	Chemistry	800	108	1	5	48%
5	Barge	R'dam-Basel	FMCG	750	108	1	5	13%
11	Barge	Basel-R'dam	FMCG	850	96	1	5	26%
1	Shortsea	Antwerp-Bilbao	Chemistry	1250	140	24	1	31%
8	Shortsea	Bilbao-Antwerp	FMCG	1250	140	24	1	73%

Segment	Mode	Route	Industrial	Intermodal transport characteristics to be tested				
				Price	Door-to-door	information	number of arrival	% of shippers
			Sector	EURO / trailer	Transfer time (hour)	delay (hours)	per week	close to a terminal
2	Rail	Antwerp-Milano	Automotive	945	43	10	3	77%
3	Rail	Antwerp-Milano	Heavy Metal	990	54	10	3	85%
6	Rail	R'dam-Vienna	FMCG	1260	40	10	3	39%
7	Rail	R'dam-Vienna	Heavy Metal	1080	40	10	3	59%
9	Rail	Lyon-Antwerp	Automotive	855	42	10	3	53%
10	Rail	Milano-Antwerp	Automotive	1035	54	10	3	78%
12	Rail	Vienna-R'dam	Heavy Metal	990	40	10	3	72%
4	Barge	R'dam-Basel	Chemistry	720	100	10	3	48%
5	Barge	R'dam-Basel	FMCG	675	100	10	3	13%
11	Barge	Basel-R'dam	FMCG	765	88	10	3	26%
1	Shortsea	Antwerp-Bilbao	Chemistry	1125	126	10	3	31%
8	Shortsea	Bilbao-Antwerp	FMCG	1125	126	10	3	73%

Result screen

Segmentation		Intermodal transport market share						Perception Index		
		Current intermodal			Intermodal supply					
		Supply characteristics			characteristics to be tested					
		All	Low	High	All	Low	High	All	Low	High
		Products	Value	value	Products	value	value	Products	value	value
Per sector	Automotive	38.3%	52.2%	30.2%	55.2%	70.3%	46.5%	1.44	1.35	1.54
	Heavy Metal	48.1%	65.4%	36.2%	66.9%	81.2%	57.0%	1.39	1.24	1.58
	FMCG	40.9%	62.4%	38.7%	56.0%	74.0%	54.2%	1.37	1.19	1.40
	Chemistry	80.8%	83.6%	79.6%	90.7%	93.9%	89.2%	1.12	1.12	1.12
Per Corridor	Antwerp-Milano & Milano-Antwerp	40.3%	50.8%	34.2%	61.0%	70.8%	55.3%	1.51	1.39	1.62
	Lyon-Antwerp	33.8%	51.2%	28.3%	49.1%	67.4%	43.3%	1.45	1.32	1.53
	R'dam-Vienna & Vienna-R'dam	55.4%	70.4%	41.2%	73.9%	84.7%	63.7%	1.33	1.20	1.55
	R'dam-Basel & Basel-R'dam	53.9%	66.1%	52.8%	60.5%	73.7%	59.4%	1.12	1.11	1.12
	Antwerp-Bilbao & Bilbao-Antwerp	74.3%	84.4%	69.1%	89.5%	94.8%	86.7%	1.20	1.12	1.25
Per Country	Belgium	63.4%	71.2%	58.6%	79.3%	85.5%	75.5%	1.25	1.20	1.29
	The Netherlands	55.2%	71.0%	50.5%	66.0%	83.6%	60.7%	1.19	1.18	1.20
	France	33.8%	51.2%	28.3%	49.1%	67.4%	43.3%	1.45	1.32	1.53
	Italy	55.1%	64.8%	40.7%	72.1%	80.2%	60.1%	1.31	1.24	1.48
	Switzerland	53.5%	43.9%	54.4%	58.4%	49.5%	59.3%	1.09	1.13	1.09
	Austria	35.7%	49.3%	31.4%	58.8%	72.2%	54.5%	1.65	1.46	1.74
	Spain	49.0%	77.5%	48.2%	74.9%	92.2%	74.4%	1.53	1.19	1.54

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5. RESULTS

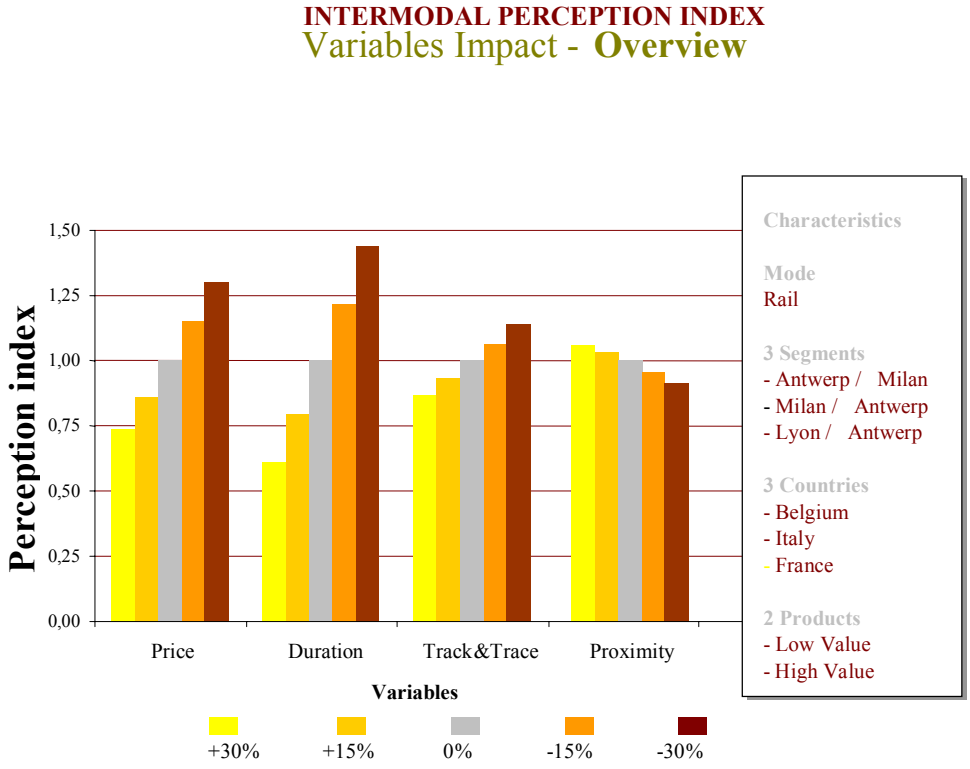
The IPI software should be used by transport authorities as well as by 3PLS, as a help decision making tool respectively for supply action plan and demand action plan.

With the above software tool, composition and evaluation of scenarios become endlessly well-to-do to manage level of price with respect to the provided level of service and for fine-tuning of pricing policies.

First results have emerged from the evaluation of some general scenarios with the prototype software which has been developed. The first conclusions that came into view are as follows.

5.1 IPI elasticity to price, duration, track and trace level of service and concentration of localisation

The figure 5 hereafter shows the elasticity of intermodal rail-road transport market share to price, duration, track and trace level of service and concentration of localisation of the shippers to an intermodal terminal for the "rail-segment" as defined on the figure.



If the fare level is increased, the IPI decreases; at the opposite, if the fare level is reduced, the IPI increases. Moreover, for a given percentage of fare level variation, the absolute variation of the IPI is lower in case of a fare level reduction than for a fare level increase. The same conclusion is valid concerning changes in door to door transfer duration and in shippers concentration around the terminals.

Similar results respectively for low value and high value products show that elasticity of intermodal market share to price, duration and Track &Trace facilities is higher for high value products than for low value products.

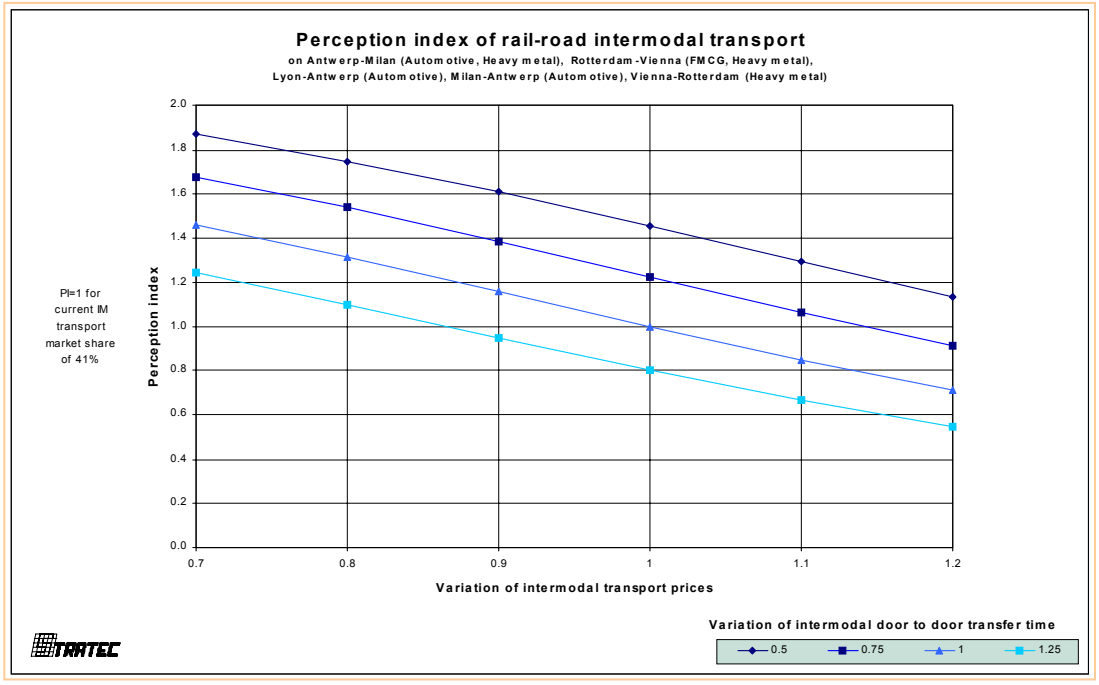
Similar results have been also drawn by different origin-destination.

Similar graphics have been drawn for inland-waterways-road transport and short-sea shipping-road transport.

5.2 Interaction between IPI elasticity to price and IPI elasticity to door to door transfer duration

Evaluation of scenarios concerning possible improvement of the level of service in combination with level of fare changes led to interesting conclusions.

The figure 6 hereafter concerning rail-road transport shows that the more the level of service is improved the lower the price elasticity of the IPI.



Moreover it came into view that if the fare level is increased by 10% with respect of the basic situation, the level of service has to be improved by 18% in door to door transfer time reduction, to keep the IPI at the level of the basic situation one.

Similar graphics have been drawn for inland-waterways-road transport and short-sea shipping-road transport.

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