NEW VALUES OF TIME AND RELIABILITY IN FREIGHT TRANSPORT IN THE NETHERLANDS

Gerard de Jong
RAND *Europe* and ITS Leeds
Sjoerd Bakker
Marits Pieters
RAND *Europe*
Pauline Wortelboer-van Donselaar
AVV Transport Research Centre, Dutch Ministry of Transport, Public Works and Water Management.

1. INTRODUCTION

A research project has been carried out for AVV (Transport Research Centre) of the Dutch Ministry of Transport, Public Works and Water Management to establish monetary values for transport time and reliability in goods transport in The Netherlands. In The Netherlands, cost-benefit analysis (CBA) is considered an indispensable tool in evaluating transport infrastructure projects. A research programme on the effects of infrastructure (OEI) was launched in 2000, resulting in guidelines about the way CBA needs to be calculated and presented. The time savings from an improvement in transport infrastructure are an important direct effect in the cost-benefit analysis of an investment in infrastructure and in a recent evaluation of the OEI guidelines it was advised to further improve the quality of input values for the main direct effects. Reliability benefits are currently not included in the cost-benefit framework used in The Netherlands, but the possibilities of including these are being studied.

With this in mind, the Dutch Ministry of Transport, Directorate General of Freight Transport and AVV Transport Research Centre have initiated a study for updating the freight value of time (VoT), as the currently used values date from 1992. Apart from price indexation, the value attached to freight travel time and reliability of transport is expected to have changed as a result of logistic developments. Reliability is an increasingly important determinant for logistic choices and was studied in this project as well. The logistic developments include the further increase of containerisation, the increased importance of cargo volume instead of weight, and the developments in logistics production principles such as JIT and 3rd and 4th party logistics providers.

Also from a research point of view, developments have taken place since 1992. Considerable progress has been made in the development and application of techniques in behavioural experiments and modelling, such as Mixed Logit and RP/SP modelling, which may lead to a more detailed assessment and better interpretation of the value of time.

The paper presents information on the preparation phase for studying values of time and reliability in the Netherlands (chapter 2), the set-up of the combined stated preference (SP) and revealed preference (RP) surveys (chapter 3) and on the model estimation results for goods transport by road, rail, inland waterways, air and sea (chapter 4). New values of time and reliability for these modes will be given and compared to the international literature (chapter 5). Chapter 6 deals with guidelines for the users of values of time and chapter 7 of the paper contains a summary and conclusions. More details can be found in RAND Europe et al., (2004).

2. THE PREPARATION PHASE

In preparation for the main research activities as described in this paper, a Research Plan was developed (AVV, 2003) The plan was based on an extensive literature study and a workshop including an international panel of experts (TNO-Inro and MuConsult, 2002).

The literature study sketched the state of the art in freight VoT studies and provided a qualitative and quantitative comparison of outcomes from a large number of studies. It described the dynamic logistic background of the VoT in freight, including linkages between VoT and “value of reliability”. It explained the importance of understanding this logistics background for a correct interpretation of logistics costs and benefits in CBA. It also summarised the approach and intermediate results of the new freight VoT estimates in the Netherlands. Finally, recommendations were provided for further research and application of these new statistics in policy analysis.

A number of options for the main research were elaborated, from which the option of a factor cost analysis in combination with a comprehensive Stated Preference and Revealed Preference surveys was selected as the soundest approach. The factor cost method should be used to determine the unit costs of transport. In addition to this, extensive SP/RP research should be done to determine the trade-off between time costs and reliability of shippers and transporting companies. Also a proposal for the segmentation of values according to transport mode and commodity segment was put forward.

The next step initiated by AVV Transport Research Centre was an update on Dutch factor costs calculations (NEA, et al., 2003). An update of factor cost information was not only necessary for the VoT calculations, but for updating transport models and integration in several policy questions as well.

Factor costs have been defined as:

- Fixed costs (depreciation, vehicle taxes, interest, insurance);
- Variable costs (reparation, maintenance, tires, fuel);
- Labour costs (drivers wage, social security premiums, travel & subsistence costs);
- Specific transport costs (materials, inspections, licences, port costs etc);

- General company costs (wage other personnel, housing, ICT, etc).

It is important to note that aspects of factor costs for shippers (profits of transport company, additional taxes and stock costs) are not included in the above and were addressed in other ways in the main research. Cost aspects which are of importance for chain logistics considerations but not from the point of travel time valuation, are the costs of pre- and on carriage and transshipment.

3. THE SP/RP SURVEYS

The population that was interviewed consists of shippers and carriers in freight transports taking place in The Netherlands (including international flows). Targets were defined for the number of interviews by transport mode and commodity group (e.g. containerised versus non-containerised). The market research organisation Veldkamp/NIPO carried out the interviews. The firms to be interviewed were selected from two existing monitor surveys of NIPO (a general one and one for shippers) and additional registers for transport by inland waterways and rail (because it turned out to be very difficult to get enough observations for these modes). The selected firms were approached first by phone (screening, asking for participation), and the actual SP/RP interview was carried out at the firm's premises as a Computer-Assisted Personal Interview (CAPI).

The SP/RP questionnaire was programmed in WinMINT and consisted of several sections:

- Questions about the firm (location, size, own account transport or contracting out, vehicles, sidings, modal split);
- Questions about typical transport number 1 (origin, destination, weight, value, handling, transport costs, time, reliability, damage, frequency);
- Determination of the RP choice for typical transport number one, including the attribute levels of available but non-chosen alternative modes (if the respondent did not know these, default attribute values, based on NEA et al., 2003) were suggested;
- A within-mode SP experiment on typical transport number 1. Here two alternatives are presented on a screen (a choice situation), that both refer to the same mode;
- A between-mode experiment on typical transport number 1 (only if the respondent has indicated that apart from the mode used, another mode from the list road, rail, inland waterways, sea and air transport was available);
- Questions about typical transport number 2;
- Determination of the RP choice and attribute values for typical transport number 2.

The attributes presented in both SP experiments are:

- Transport costs (or freight rates for shippers that contract out transport activities to carriers);
- Transport time (door-to-door);
- Percentage not delivered on time (or within the specified time window);

- Probability of damage;
- Frequency.

Each choice situation consists of two choice alternatives, each described in terms of attribute values on four attributes. 'Costs' and 'time' were always included. The attribute 'percentage not delivered on time' was only used for shipments that have to be delivered at a specific time or within a specified time window. If this attribute was not included, both 'probability of damage' and 'frequency' were presented; otherwise it depends on the commodity segment which of those two attributes was used.

In the SP experiments, the attribute levels were varied by changing the observed levels for the selected shipment by specified proportions (both up and down, changes up to 50%). The maximum number of repetitions (pairwise comparisons) in each SP experiment was 16.

The sample of successfully completed interviews that resulted is composed as follows (see Table 1).

Table 1. Number of successfully completed interviews

	carriers	shippers	Total
Road transport	59	135	194
Rail transport	13	23	36
Inland waterways transport	29	24	53
Sea transport	26	78	104
Air transport	11	37	48

4. MODEL ESTIMATION

On the basis of these interviews, discrete choice models have been estimated. Including interaction variables for characteristics of the firm ('observed heterogeneity') did not lead to significant interaction coefficients. Mixed logit models, that allow for taste variation between respondents ('unobserved heterogeneity') have been tried as well, but these did not significantly outperform the standard logit models. To account for the repeated measurements problem in the SP data (multiple observations on the same respondent, which in the standard logit model are assumed to be independent) and possibly other errors, the Jackknife method[1] was applied. SP models (within-mode only and between-mode only), RP and SP/RP models have been estimated. In the models on the between-mode SP data

[1] The Jackknife method re-samples from the original sample by deleting a small number of observations each time. For each re-sample, statistics (e.g. estimated coefficients and standard errors) are calculated. The Jackknife estimates are computed as averages of the re-sample statistics.

only, many important coefficients were not significant (even before Jackknifing). The same goes for the models on the RP data only. On the one hand this has to do with the limited number of between-mode and RP choice observations that were obtained from firms that used road transport for the typical transports. Only few of these indicated that other modes would have been available. For typical transports using the other modes, considerably more SP between-mode and RP choice observations were collected, but here too, many attributes did not get significant estimated coefficients. For the remaining attributes, no distinction could be made between commodity groups and modes (except for mode-specific constants). The same conclusions were reached after discarding the non-traders (e.g. the ones always choosing the mode that was used in practice) from the between-mode SP data. In the end we decided that for the calculation of the values of time and reliability, we should only use the between-mode SP data. The use of the mode choice context apparently does not contribute to proper trade-off situations between time, costs and reliability; this context seems to be too specific and constraining. The estimation results for the model on all the SP within-mode data, after having applied the Jackknife to correct for the repeated measurements problem, are presented in Table 2.

Table 2 Jackknife model results on within-mode SP data (all attributes: observed attribute level=100)

Segment: Road, raw and semi-finished materials	Estimated coefficient	t-ratio	Trade-off ratio against cost
Transport cost for low-value goods	-0.0307	-10.9	1.00
Transport cost for high-value goods	-0.0247	-3.9	1.00
Transport time for low-value goods	-0.0241	-1.9	0.79
Transport time for high-value goods	-0.0241	-1.9	0.98
Percentage not on time for low-value goods	-0.0042	-2.9	0.14
Percentage not on time for high-value goods	-0.0042	-2.9	0.17
Frequency for low value goods	0.0066	2.8	-0.21
Frequency for high-value goods	0.0066	2.8	-0.27
Probability of damage for low-value goods	-0.0156	-2.2	0.51
Probability of damage for high-value goods	-0.0064	-3.7	0.26
Number of observations	1029		
Loglikelihood value	-671.3		

Segment: Road, final products and containers	Estimated coefficient	t-ratio	Trade-off ratio against cost
Transport cost for containers	-0.0212	-2.6	1.00
Transport cost for final products	-0.0220	-4.4	1.00
Transport time for containers	-0.0176	-2.5	0.83
Transport time for final products	-0.0176	-2.5	0.80
Percentage not on time for containers	-0.0081	-7.8	0.38
Percentage not on time for final products	-0.0081	-7.8	0.37
Frequency for containers	0.0040	2.4	-0.19
Frequency for final products	0.0040	2.4	-0.18
Probability of damage for containers	-0.051	-3.0	0.24
Probability of damage for final products	-0.051	-3.0	0.23
Number of observations	1499		
Loglikelihood value	-1000.8		

All road segments together	Estimated coefficient	t-ratio	Trade-off ratio against cost
Transport cost	-0.0241	-13.0	1.00
Transport time	-0.0192	-2.8	0.80
Percentage not on time	-0.0060	-6.2	0.25
Frequency	0.0043	4.5	-0.18
Probability of damage	-0.0062	-5.4	0.27
Number of observations	2528		
Loglikelihood value	-1680.6		

Segment: Rail and inland waterways transport	Estimated coefficient	t-ratio	Trade-off ratio against cost
Transport cost for rail	-0.0182	-3.0	1.00
Transport cost for inland waterways	-0.0355	-2.9	1.00
Transport time for rail	-0.0130	-3.0	0.71
Transport time for inland waterways	-0.0130	-3.0	0.37
Percentage not on time for rail	-0.0053	-2.0	0.29
Percentage not on time for inland waterways	-0.0085	-3.4	0.24
Frequency for rail	0.0069	2.7	-0.38
Frequency for inland waterways	0.0069	2.7	-0.19
Probability of damage for rail	-0.089	-2.6	0.49
Probability of damage for inland waterways	-0.089	-2.6	0.25
Number of observations	1214		
Loglikelihood value	-788.6		

Segment: Sea transport	Estimated coefficient	t-ratio	Trade-off ratio against cost
Transport cost for containers	-0.0639	-7.5	1.00
Transport cost for non-containers	-0.0232	-2.8	1.00
Transport time for containers	-0.0056	-2.4	0.09
Transport time for non-containers	-0.0056	-2.4	0.24
Percentage not on time for containers	-0.0065	-4.3	0.10
Percentage not on time for non-containers	-0.0065	-4.3	0.28
Frequency for containers	0.0035	2.3	-0.06
Frequency for non-containers	0.0035	2.3	-0.15
Probability of damage containers	-0.0121	-3.4	0.19
Probability of damage for non-containers	-0.0121	-3.4	0.52
Number of observations	1465		
Loglikelihood value	-911.8		

Segment: Air transport	Estimated coefficient	t-ratio	Trade-off ratio against cost
Transport cost	-0.0244	-4.8	1.00
Transport time	-0.0137	-3.9	0.56
Percentage not on time	-0.0111	-2.6	0.45
Frequency	0.0056	2.1	-0.23
Probability of damage	-0.0209	-6.3	0.86
Number of observations	648		
Loglikelihood value	-410.3		

For road, rail and inland waterways transport, the time coefficients are based solely on observations for carriers and shippers that transport the shipments themselves (own account). They benefit from shorter travel times because staff and vehicles might be used elsewhere. All other coefficients for these modes are based on all observations. In initial estimation we had found that for shippers that contract carriers for the typical shipments studied, time had a value that was not significantly different from zero. For them, the issue is whether the shipment is picked up (senders) or delivered (receivers, maybe also for senders, since it affects their clients) on time. The duration of the transport is of limited importance, since the interest value on the goods in transit is usually very low for these modes. Changes in the percentage not on time (reliability) are of importance to shippers without own transport.

For typical transports by sea and air, all observations, including those for shippers that contract out, have been used for all coefficients. Here, initial estimation runs revealed that shippers without their own transport had values of time similar to those of carriers and shippers with own account transport. For air transport, the capital costs on the inventory in transit are high, due to the high-value nature of the goods; for sea transport the interest costs are often high because of the long transport durations (often several weeks).

These estimated models provide trade-off ratios between transport time and transport costs and between reliability and transport costs of time, which in combination with the factor costs give the monetary values of transport time and reliability.

The trade-off ratios that were found in the SP/RP survey for road transport vary between 0.79 and 0.98, depending especially on the commodity segment. This implies that an increase in transport time of for instance 10% is regarded as having the same disutility as 8-10% higher total transport costs. This shows that the respondents do not see all transport costs as variable with changes in transport time. The trade-off ratios more or less correspond to the share of the labour cost of the drivers, the distance dependent cost (especially fuel) and the fixed transport cost (especially depreciation on vehicles) in the total transport costs (86%). The trade-off ratios of 0.79 – 0.98 do not mean that respondents will take exactly these cost items fully into account and will not include any other cost items in their valuation of transport time. It is more likely that the trade-off ratios found imply that the respondents do not include these three cost items fully in the value of time, and that they add costs that are related to the commodity itself or the distribution system in a broader sense, if relevant. Such additional costs can be production losses, interest lost, and less efficient inventory and distribution logistics than would be possible at shorter transport times. On average the contribution of these aspects to the value of time of the respondents will not be very high, but they can play a role. Furthermore, these aspects are of importance in the valuation of transport time reliability.

The new time versus costs trade-off ratios for road transport are slightly lower than those of 1992: when compared to transport time, transport cost has become relatively more important in the past decade (increased competition on costs, adoption of activity-based costing).

The 2003 trade-off ratios between reliability and costs for road transport are between 0.14 and 0.38: a 10% increase in the percentage not on time (e.g. from 10% to 11% not on time) is equivalent to 1.4 – 3.8% higher transport costs.

For the other modes of transport, for which labour and fuel cost are relatively less important, lower trade-off ratios were found than for freight transport by road. The trade-off ratios range from 0.09 (sea transport, containers) to 0.71 (rail).

5. OUTCOMES ON THE VALUE OF TIME

5.1 New outcomes for The Netherlands

Outcomes on the value of time
Using the trade-off ratios from the SP/RP survey and the factor costs from NEA, et al. (2003), the following values of time (VoT) for freight transport in The Netherlands are obtained.

Table 3. New values of time for goods transport in The Netherlands

Segment	Value of time (Euro 1-1-02) per transport per hour	Value of time (Euro 1-1-02) per tonne per hour
Road transport:		
Low value raw materials and semi-finished goods	38	
High value raw materials and semi-finished goods	49	
Final products, loss of value	38	
Final products, no loss of value	36	
Containers	42	
Total road transport	38	5.28
Other modes:		
Rail (train load)	918	0.96
Inland waterways (barge)	74	0.046
Sea transport (short + deep; ship)	73	0.016
Air transport (full freight carrier)	7935	132.24

The value of time for road transport refers to one truck load. The value of time per transport for rail refers to a complete train load (not a wagon); the value for inland waterways refers to a complete barge; the value for sea to a complete sea ship and the value for air transport refers to a complete freight carrier. For comparison, values of time per tonne per hour have been included in the table as well.

It could be argued that the freight VoT of shippers (without own transport) and the VoT of carriers should be added to get the overall VoT for use in CBA. This would be the case if the shippers without own transport would only include reductions in the costs of the inventory-in-transit and the increase in shelf life of the goods in their VoT and carriers would only include reductions in the costs of carrying out the transport in their VoT (shippers with own account transport might include all components). Under these assumptions, the VoT for sea and air transport would become about twice as high as in Table 3. The VoT for the other modes would not be affected, since the time values for shippers without own account transport were found to be not significantly different from zero here.

The new VoT's for road transport are slightly higher than the old (1992) Dutch values (all road transport: old VoT: 35 Euro of 1-1-2002 per transport per hour, new value: 38). This is not caused by higher trade-off ratios (these are often slightly lower than in 1992), but by bigger average transport volumes (in tonnes per transport unit).

Values of reliability
In this project, the valuation of reliability has been studied as well. The model analyses show that a 10%[2] change in reliability (measured as the percentage not delivered on time) is equivalent to the following costs:

- 1.01 Euro per road transport for low value raw materials and semi-finished goods;
- 1.31 Euro per road transport for high value raw materials and semi-finished goods;
- 2.67 Euro per road transport for final products with loss of value;
- 2.51 Euro per road transport for final products without loss of value;
- 2.85 Euro per road transport for containers;
- 1.77 Euro per road transport for total freight transport by road;
- 898.08 Euro per train load;
- 62.53 Euro per inland waterways barge;
- 930.60 Euro per sea ship (short and deep sea);
- 15429.36 Euro per freight aircraft.

5.2 International comparison of outcomes on the value of time

The following table contains outcomes for the freight VoT for road transport from different studies. Not all these studies were specific VoT studies; some focussed on the value of several service attributes, others were designed for predictive purposes. In order to produce these tables, assumptions with regard to average shipment size, shipment value, transport cost and times had to be made and exchange rates and price index numbers were used to convert to 2002 Euros. The values should therefore be merely regarded as indications of the outcomes of the studies quoted.

A group of studies arrives at road freight values in a range between 30 and 50 Euro: the old Dutch VoT study (HCG et al., 1992), the study for the International Road transport Union (HCG, 1992), the 1994/1995 UK VoT study (Accent and HCG, 1995), the Storebælt study (Fosgerau, 1996) and the

[2] The percentage used here (10% change) is an arbitrary example.

Table 4. Value of time in goods transport by road, in 2002 Euro

Publication	Country	Data	Method	VoT
				Per transport per hour, Euro of 1-1-2002
McKinsey, 1986	Netherlands	Fuel costs, wage rates	Factor costs	23
Transek, 1990	Sweden	SP	Logit	2
NEA, 1991	Netherlands	Fuel costs, wage rates	Factor costs	24
HCG, et al. 1992	Netherlands	SP	Logit	38-40
HCG, 1992	Germany	SP	Logit	31
HCG, 1992	France	SP	Logit	32
Transek, 1992	Sweden			3
Widlert and Bradley, 1992	Sweden	SP	Logit	7
Fridstrøm and Madslien, 1994	Norway	SP	Box-Cox logit	0-65 (mean: 7)
Fridstrøm and Madslien, 1995	Norway	SP		0-8
Accent and HCG, 1995	UK	SP	Logit	34-45
Fosgerau, 1996	Denmark	SP	Logit	29-67
Bergkvist and Johansson, 1997	Sweden	SP	Logit/WAD/ bootstrap	3-7
Fehmarn Belt Traffic Consortium, 1999	Germany-Denmark	SP+RP	Logit	20
Small *et al*., 1999	USA	SP	Logit	174-267
Kawamura, 2000	USA	SP	Logit+OLS	22-25
Bergkvist and Westin, 2000	Sweden	SP	Logit+WML	1
Bergkvist, 2001	Sweden	SP	Logit+WML	3-47
De Jong *et al*., 2001	France	SP+RP	Logit	5-11
Fowkes *et al*., 2001	UK	SP	Logit	60-273
Inregia, 2001	Sweden	SP	Logit	0-32
RAND Europe, 2004	Netherlands	SP	Logit	36-49
				Per tonne per hour in Euro van 1-1-2002
Fowkes *et al*., 1991	UK	SP	Logit	0.08 – 1.18
Kurri *et al*, 2000	Finland	SP	Logit	1.53
RAND Europe, 2004	Netherlands	SP	Logit	4.74

new Dutch VoT study (RAND Europe et al., 2004). These values are somewhat higher than those from (Dutch) factor cost methods, which only take into account fuel cost and wages for the drivers. Fehmarn Belt Traffic Consortium (1999) and Kawamura (2000) arrive at values per transport per hour that are comparable to those factor cost studies. Small et al. (1999)

present a much higher VoT. In sharp contrast, the values for road in Sweden (Widlert and Bradley, 1992; Bergkvist and Johansson, 1997) and Norway (Fridstrøm and Madslien, 1994) are much lower. In the Norwegian study this is partly the result of the non-linear Box-Cox transformation. Logit models on the same data gave much higher values. The Swedish studies used the same methods for gathering data as the group of studies mentioned above. Widlert and Bradley (1992) used the same model (logit) as well; Bergkvist and Johansson also used the probit model, the semi-parametric WAD-estimator and the non-parametric bootstrap method. Many of the transports in the Swedish studies are for long-distance bulk transport, as opposed to the Dutch, English and Danish studies. The average transport time in the Swedish study is 18 hours, whereas it is between 1 and 2 hours in The Netherlands. The outcomes suggest that the VoT is dependent on the absolute level of transport time.

The new Dutch (RAND Europe et al., 2004) VoT for road freight transport per tonne per hour (4.7 Euro) exceeds the 0.6 to 1,5 Euro per tonne per hour that Fowkes et al. (1991) and Kurri et al. (2000) obtained.

For other modes than road transport, fewer values are available from the literature. The outcomes are in Table 5. The new Dutch value of 918 Euro per hour per train or 0.96 euro per tonne per hour is clearly higher than the values found in Sweden and Finland. The Dutch value comes reasonably close to rail VoT's obtained in the UK, the USA and France (be it that they are closer to the upper bounds for France and the UK than the lower bounds).

For inland waterway transport, the values found by Roberts (1981), Blauwens and van de Voorde (1988) and RAND Europe et al. (2004) are rather close to each other (0.05 – 0.09 Euro per tonne per hour).

6. INTERPRETATION OF THE VOT INDICATORS: STANDARDS AND CONTROVERSIES

From the literature scan in the Research Plan the conclusion was drawn that quite some attention has been devoted to the calculation of freight value of time, but on the other hand there is very little guidance on the interpretation.

For a widely supported CBA, practical guidelines for a proper and consistent application of the values are as necessary as the indicator values themselves, even more so in freight transport. Compared to passenger transport, the travel time benefits in freight transport are more difficult to interpret. Unlike the equivalent in passenger transport (passengers), the decision maker is not the transported product, but might consist of several actors (carriers, shippers), each with their own value of time.

Table 5. Value of time in goods transport by rail, sea and air transport

Publication	Country	Data	Method	VoT
				Per transport per hour, Euro of 1-1-2002
Rail transport:				
Transek, 1990	Sweden	SP	Logit	1 (wagon)
Inregia, 2001	Sweden	SP	Logit	0 (shipment)
RAND Europe (2004)	Netherlands	SP	Logit	918 (train)
Air transport:				
Inregia, 2001	Sweden	SP	Logit	13 (shipment)
RAND Europe (2004)	Netherlands	SP	Logit	7935 (full carrier)
				Per tonne per hour in Euro van 1-1-2002
Rail transport:				
Fowkes *et al.*, 1991	UK	SP	Logit	0.08 – 1.21
Vieira, 1992	USA	SP/RP	Ordered Logit	0.65
Widlert and Bradley, 1992	Sweden	SP	Logit	0.03
Kurri *et al*, 2000	Finland	SP	Logit	0.09
De Jong *et al.*, 2001	France	SP+RP	Logit	0.25-1.10
RAND Europe (2004)	Netherlands	SP	Logit	0.96
Inland waterways:				
Roberts, 1981	USA	RP	Cost model	>0.05
Blauwens and Van de Voorde, 1988	Belgium	RP	Logit	0.09
RAND Europe (2004)	Netherlands	SP	Logit	0.05

Therefore, the deliverables of this research project consist of a "User Guide" (SEO and RAND Europe, 2004), in addition to the technical research report on the SP/RP survey and models (RAND Europe, SEO and Veldkamp/NIPO, 2004). The objective of the User Guide is to provide a standard in VoT figures which will help in providing consistency between projects. The User Guide is a tool in disseminating the latest in information on freight values of time. In addition to this, AVV has assembled the most common questions and theoretical controversies when applying (or, in the case of policy makers, interpreting) VoT figures in CBA. The User Guide also provides answers to those questions.

What kind of questions about VoT do we see returning at regular intervals?

- Is reliability of transport included in the VoT or should additional calculations be made?
- Is there a regional segmentation in VoT (related to intensity of congestion, economic activity of the region)?
- What is the impact on VoT if the frequency of the transport service is changed?

- Is there a difference between values of time for national or international transport?
- Is value of time a continuous value (is the VoT for 1 vehicle x 60 minutes identical to 60 vehicles x 1 minute)?
- What is the relationship between the VoT and total trip length (is a 10 minutes saving on a total trip length of 30 minutes more valuable than 10 minutes on a trip length of 4 hours)?
- Which VoT should be used in case of modal shift?
- Which value should be used for the calculation of future travel time savings?
- How to deal with delivery time windows in city centres?
- Etc., Etc.

An example of how these questions are addressed in the User Guide is:

Question:
Is segmentation in values according to time of day necessary?

Answer:
It can be assumed that road transport VoT during evenings, nights, weekends and festive days is higher than on working days during day time. This is because wage levels will be higher due to overtime compensation. It is recommended for projects influencing road freight transport to use a 15% higher valuation during evenings and nights, on Saturdays a 25% higher valuation and for festive and Sundays a 50% higher calculation. These percentages are based on collective labour agreements. Other modes of transport often have trip durations longer than a few hours. Here it is assumed that valuations for non-working hours are already integrated in the "standard" value of time.

From: SEO and RAND Europe (2004).

In short, the user guide emphasizes not only the accurate figures of value per unit of time. The study also provides a practical guideline for the proper application and interpretation of freight VoT.

7. SUMMARY AND CONCLUSIONS

The 2003/2004 main freight value of time (VoT) study in The Netherlands consists of revealed preference (RP) and stated preference (SP) interviews among shippers and carriers. Interviews were carried out, first among 194 shippers and carriers in road freight transport and later among 241 shippers and carriers using rail, inland waterways, sea or air transport. The interviews include both within-mode SP experiments (choice between pairs of alternatives that all refer to the same mode) and between-mode SP experiments (choice between two modes).

In these interviews, attribute values for two typical shipments for both the chosen mode and other available modes were asked (RP information), and two SP experiments (within-mode SP for the observed mode of transport and between-mode SP for this mode versus another available mode) were included.

On the basis of these interviews, discrete choice models have been estimated. These estimated models provide trade-off ratios between transport time and transport costs and between reliability and transport costs of time, which in combination with the factor costs give the monetary values of transport time and reliability.

The outcomes for the VoT per transport per hour in road transport are slightly higher than those found in The Netherlands in 1992, due to an increase in the vehicle loads. The new values generally are in line with the international literature, but closer to the upper bounds than the lower bounds of the literature.

With the main research being finished, the initiatives of the Dutch Ministry of Transport on freight VoT now wishes to communicate the findings of research to policy makers, researchers and lobby groups. The various parties involved were already invited to workshops during the research and are now being provided with the User Guide and will receive a mailing containing the User Guide. On the website of AVV-Transport Research Centre www.rws-avv.nl the User Guide and Technical Research Report are available as downloads (in Dutch, technical research report with English summaries). AVV, in its role as 'knowledge centre' for Dutch guidelines on cost-benefit analysis and economic evaluation, also aims at publishing an annual update with current price levels of both freight VoT and passenger traffic VoT.

From a methodological point of view, some issues are still pending and may need to be addressed in the future. Travel time savings remain a difficult subject. The user guides offers pragmatic solutions which enable consistency between projects, but are -in some cases- not completely satisfying from a theoretical point of view. Questions about exactly what factor costs need to be taken into account in time valuation, and aspects of shipper's valuation of time, still need further attention.

The research has also offered innovations in the valuation of reliability. The newly developed indicators will need to be tried and tested in practice. It is expected that additional research is necessary on how to combine values of reliability with traffic forecasts and estimations of changes in reliability.

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