VALUE OF FREIGHT TRAVEL-TIME SAVINGS

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Abstract

The monetary value of travel time savings in freight transport can be used to include travel-time benefits in cost-benefit analysis and to compute generalized travel costs in traffic forecasting models. Several methods have been used to attach a monetary value to freight travel-time savings, including revealed and stated preference methods. In this chapter, an overview of these methods and of the main numerical outcomes is given, as well as an example of a recent application.

1. INTRODUCTION

The value of freight travel time is mainly used for two different purposes. On the one hand, it is an input into the cost-benefit analysis of infrastructure projects, facilitating the comparison of the time savings for freight, as caused by the project, against other attributes, such as the investment cost (also see chapters 18 and 26). On the other hand, the value of travel-time savings (VTTS) in freight transport is also used in traffic forecasting models, in which one of the explanatory variables is a linear combination of travel time and cost, called 'generalised cost'. This chapter will deal with the value of freight travel-time savings (as opposed to time losses). In many cost-benefit analyses, the main benefits from the infrastructure project are the time savings, both for passengers and freight transport.

Unlike the passenger VTTS, which is often expressed in terms of money units per minute, the freight VTTS is practically always expressed in terms of money units per hour. This difference is due to the larger average transport times in freight transport, which results from larger distances, but also from lower average speeds compared to passenger transport. Other differences between passenger and freight transport, which are very relevant for VTTS research, are described below.

The decision-maker in passenger travel is, in most cases, the traveler himself or herself or a group of travelers. In freight transport the goods cannot decide; different persons may be involved in decision-making at various stages. The shipping firms (producers or traders of commodities) have a demand for transport services, in most cases for sending the products to their clients (in some cases the transport is organized by the receiver). Part of this demand is met by shippers themselves (own account transport). The remainder is contracted out to carrier firms or intermediaries (hire and reward transport). Important choices in transport, such as the choice of mode, can be made by managers of the shipping firm, the carrier and/or the intermediaries. Interviews in the transport market have indicated that for mode choice the shipping firm is the most important decision-maker. Route choice is mainly determined by the managers of the firm actually carrying out the transport. In the case of road transport, lorry drivers may have some freedom to choose the route or to change route as a reaction to unexpected events (e.g., congestion).

There is considerable heterogeneity in passenger transport, but even more in freight transport. The size of the shipment may vary from a parcel delivered by a courier to the contents of an oil tanker. The value of a truckload of sand is vastly different from a load of gold blocks with the same weight. This does not imply that the value of freight travel time savings is so heterogeneous that it can not be established. Heterogeneity can be taken into account by applying a proper segmentation (e.g., by mode, type of good) and proper scaling (e.g., using a value for a typical shipment size or a value per tonne).

A specific problem in finding the VTTS for freight, as opposed to the passenger VTTS, is that some of the information in goods transport, especially on transport cost and logistic cost, may be confidential. Firms in freight transport may be reluctant, for obvious reasons, in sharing this information with client, competitors and the public. Also, there are only limited data on actual choices (e.g. mode and route choice) in freight transport; there are much more travel surveys than shippers surveys.

2. CLASSIFICATION OF THE METHODS USED IN FREIGHT VTTS RESEARCH

Freight VTTS research tries to find the proper values to be used in evaluation or forecasting. The methods used can first of all be classified into factor-cost methods and modeling studies (Figure 1).

FIGURE 1 ABOUT HERE

The factor-cost method tries to find the cost of all input factors that will be saved in case of travel time savings, or the cost of additional inputs if travel time is increased. A decrease in travel time could release production factors (e.g. labor, vehicles) to be used in other shipments. Studies that have been applying this method usually include labor cost and fuel cost among the time-dependent cost. These items can be calculated using data on wages and vehicles. There is no consensus on the issue whether fixed cost of transport equipment, overheads and non-transport inventory and logistic cost should be included. This could be analyzed using the other type of methods, i.e., the modeling studies. Some researchers argue that not all labor and fuel cost should be used in the VTTS, since some of the time gains can not be used productively. This too can be analyzed by modeling decisions in freight transport and focusing on the implied time-cost trade-offs. The issue of which cost items to include also depends on the time horizon: in the long run, more items will be time-dependent and the VTTS will be higher. Another difficulty, which is most prominent when applying the factor cost method, is the distinction between the impact of transport time itself and the impact of transport time reliability. In a model it is possible to separate out the cost related to the average transport time and the extra cost of longer than average transport time, especially of delivering too late (possibly also of delivering too early). It must be said however that many models do not make a clear distinction on this.

Depending on the type of data used, the modeling studies can be classified into revealed preference (RP) studies and stated preference (SP) studies (see chapter 8). Joint RP/SP models are also possible in freight, but have been very few so far. RP studies in freight use data on the actual behavior of shippers, carriers, intermediaries or drivers. A number of situations can be thought of in which these decision-makers have to trade off time against cost:

- mode choice between a fast and expensive mode and a slower and cheaper mode;
- choice of carrier, or between own account transport and contracting out;
- choice between a fast toll route and a congested toll-free route; and
- choice of supplier.

These choices can be modeled and the model estimates can be used to find the freight VTTS values implied by the actual decision-making outcomes. Many models follow a linear specification in time and cost, in which the value of time can simply be calculated as the ratio of the time coefficient to the cost coefficient. Most RP freight VTTS studies have been based on mode choice data (e.g. road versus rail, rail versus inland waterways).

The RP studies can further be classified into aggregate (e.g. using data on mode shares for different regions in a country) or disaggregate (e.g. using a shippers' survey) studies. In Figure 1 there are two types of aggregate models: the aggregate modal split models (or: aggregate logit models, e.g., Blauwens and Van de Voorde, 1988) and the neoclassical aggregate models (e.g. Oum, 1989). The first type of models is not based on behavioral theory; the mode share in the transport of a commodity between two regions is explained here by using characteristics of transport between the regions by different modes (and possibly also by using other characteristics of the regions or of the goods). The neoclassical aggregate models on the other hand are based on cost-minimizing behavior of firms according to the neoclassical economic theory of the firm. Within the disaggregate models there are also two distinct types of models: behavioural models (e.g. Winston, 1981) and inventory models (e.g. McFadden et al., 1985). In the first type, the emphasis is on the single mode choice decision; in the second the mode choice decision is studied in connection with other decisions the firm has to take, especially within the larger framework of inventory and logistic policy.

SP models are primarily relevant in the calibration of disaggregate models. In an SP freight VTTS study, decision-makers (in practice: shippers or carriers) are asked to elicit their preferences for hypothetical alternatives constructed by the researcher. These hypothetical alternatives refer to transports and will have different attribute levels for transport time and cost, and possibly also for other attributes of the shipment. The setting of the SP experiment can be that of mode choice (e.g. repeated pair-wise choices between a road and a rail alternative for the same shipment: between-mode experiment) or route choice, as in the RP. Good experience in freight VTTS research however has been obtained in abstract time versus cost experiments in which all alternatives that are presented refer to the same mode and the same route. In an abstract time versus cost experiment the alternatives have different scores on travel time, travel cost and possibly other attributes, but the alternatives are not given a mode or route label, such as “rail transport” of “motorway with toll”.

SP data has some advantages in the case of freight modeling, in particular as it may be possible to obtain data (e.g., on costs and rates) which would be difficult to acquire by other methods (also see Fowkes et al., 1991). The drawback of SP data is its hypothetical nature: these are stated responses to hypothetical choices, not actual decisions. This problem can be minimized using carefully designed SP surveys in which the respondents are asked to choose between alternatives relevant to their own circumstances (Contextual Stated Preference). In computer-based SP experiments decision-makers, such as logistics managers, can be presented with the choice between alternatives for a specific consignment. The alternatives are defined using previous answers from these respondents; the attribute levels are based on the observed levels for the selected consignment. This method offers a high degree of flexibility, capable of dealing with the heterogeneity of freight transport. Practically all SP surveys in freight transport have been carried out as computerized interviews, which can provide the highest degree of customization.

A difficult issue is who to interview (e.g., in SP surveys). Massiani (2005) argues that shippers will only give the time value of the cargo itself (related to interest on the inventory in transit and stock-out costs), whereas the willingness-to-pay of carriers will reflect all the components of the value of time. Booz, Allen, Hamilton and Institute for Transport Studies (2003) note that especially for operators it might be difficult to separate between a change in time and a change in cost. Hensher et al. (2005) have carried out stated preference experiments with interactions between various agents.

3. SUMMARY OF OUTCOMES FOR ROAD TRANSPORT

Table 1 contains outcomes for the freight VTTS for road transport from different studies. Not all these studies were specific VTTS studies; some focused 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.

TABLE 1 ABOUT HERE

A group of studies arrives at road freight values in a range between 30 and 50 Euro: the first Dutch freight VTTS study (de Jong al., 1992), the study for the International Road transport Union (described in de Jong et al, 1995), the 1994/1995 UK VTTS study (Accent and HCG, 1999), the Storebælt study (Fosgerau, 1996), Fowkes et al. (2001), the second national Dutch freight VTTS study (de Jong et al., 2004) and Hensher et al. (2005). Puckett and Hensher (2006) have found considerable variation in the VTTS when taking account of different strategies that transporters and shippers might use for processing the attributes presented in the SP (such as exclusion or aggregation of attributes). Values between 30 and 50 Euro 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 VTTS for the United States. 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 VTTS is dependent on the absolute level of transport time. Also, the studies that arrive at 30-50 Euro per road transport per hour include both the operating cost component of the VTTS as well as the component related to the cargo itself (such as the capital costs of the inventory in transit). Some other studies, such as the review by Bruzelius (2001), focus on the cargo component of the VTTS, which for most shipments will be quite small, unless the goods have a very high value, deteriorate very quickly or are badly needed in a production process.

The new Dutch VTTS (de Jong et al., 2004) for road freight transport per tonne per hour (4.7 Euro) exceeds the values up to 1.5 Euro per tonne per hour that Fowkes et al. (1991) and Kurri et al. (2000) obtained.

4. SUMMARY OF OUTCOMES FOR OTHER MODES

For other modes than road transport, fewer values are available from the literature. When looking at the outcomes for rail or combined transport, the Swedish VTTS again is positioned at the lower end of the range (Table 2).

TABLE 2 ABOUT HERE

The study by Fowkes et al. (1991) concerned transport by road and rail. Given the fact that for road we expect and find a higher VTTS than for rail the outcomes by Fowkes et al. (1991) suggest a lower VTTS for rail only than the studies by de Jong et al. (1992) and Vieira (1994). Vieira estimated a model on a combination of RP and SP data, using explicit functions for the logistic cost. He also used ordered response models to capture more of the information given by the SP answers. In his SP experiment, managers were faced with two transport alternatives (A and B) at a time. As in many other SP surveys, the interview program did not just ask which option they preferred, but asked them to choose between 'definitely A', 'probably A', 'not sure', 'probably B' and 'definitely B'. Vieira found an implied discount rate on the goods in transit of 240% per year, very much higher than the interest rate. 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 VTTS'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). Roberts (1981) only gave a minimum value for non-perishable goods without emergency shipments and safety stocks. Blauwens and van de Voorde (1988) used an aggregate model for mode choice in Belgium between road and inland waterways.

5. A WORKED-OUT EXAMPLE: THE SECOND NATIONAL DUTCH VTTS STUDY

This study was carried out in 2003/2004 by RAND Europe, SEO and Veldkamp/NIPO for the Transport Research Centre (AVV) of the Dutch Ministry of Transport, Public Works and Water Management to update the outcomes of the 1992 national freight VTTS study. Details can be found in de Jong et al. (2004).

5.1 Recruitment and segmentation

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).

5.2 The questionnaire

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 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; and
- 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; and
- 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 sixteen.

The sample of successfully completed interviews that resulted is composed as follows (Table 3).

TABLE 3 ABOUT HERE

5.3 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 (see Massiani (2005) for an application to the freight VTTS), 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 (see Cirillo et al., 1996). 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 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 observations for the RP and between-mode SP compared to the within-mode SP. On the other hand, the use of the mode

[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.

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. We decided that for the calculation of the values of time and reliability, we should only use the within-mode SP data.

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 are based on all observations. The estimated models provide trade-off ratios between transport time and transport costs (and between reliability and transport costs of time).

5.4 Outcomes

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

TABLE 4 ABOUT HERE

The value of time for road transport in Table 4 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.

The new VTTS's for road transport are slightly higher than the old (1992) Dutch values (all road transport: old VTTS: 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).

6. VALUE OF FREIGHT TRAVEL TIME SAVINGS IN THE LONG RUN

Infrastructure projects usually lead to decreases in freight transport time. The direct benefits for goods transport are lower transport costs. The evidence collected in the above-mentioned value of time studies, which nowadays are mainly SP surveys, suggests that these benefits are proportional or almost proportional to the decrease in transport time. In exceptional cases there may also be extra benefits related to the decline in the value of goods during transport (perishable goods, long delays) or extra inventory and pilferage costs for goods in transit (very high-valued goods, long delays). These direct benefits are reflected in the nationally recommended values of time. For large and lasting changes in travel time, there might be additional indirect benefits.

The indirect or reorganization benefits of transport time savings consist of opportunities to reorganize the distribution and logistic process; opportunities which are presently lost because of longer and unreliable transport times. These long-run effects will probably not be included in the trade-offs that respondents make when comparing within or between-mode alternatives in SP experiments. In a study into the economic cost of barriers to road transport (Hague Consulting Group, 1998) these effects were investigated (interviews with shippers and carriers, literature survey and expert interviews). The main conclusion was that the most important lost opportunities of barriers to road transport are related to depot structure and inventory size. The relative magnitude of the indirect cost varies greatly from company to company. For some firms the possibilities to reorganise if the impediments were lifted are small and the total costs of the impediments comprise nearly 100% of transport cost. For other firms, the opportunities to save on inventory cost or to change the depot structure are enormous, and the indirect costs (greatly) exceed the direct cost. By and large, the interviews with the industry experts confirm that indirect costs (lost opportunities) do exist: on average the total (direct and indirect) costs to industry of the impediments to road transport are about twice the direct costs.

7. CONCLUSION: STATE-OF-PRACTICE VERSUS STATE-OF-THE-ART

The dominant state of practice in freight VTTS research now contains the following elements:

- The data come from contextual, highly customized (hypothetical alternatives for a typical transport based on actual attribute levels) SP computer-interviews with carriers and shippers, who are asked to compare pairs of alternatives.
- The analysis uses logit models with linear utility functions.

A number of possible improvements to this state of practice is given below. Some of these have already been tried by ‘pioneers’.

- The use of an explicit logistic cost theoretic framework;

- The use of ordered response models to make better use of five points, or more points, scale data;
- The use of more flexible functional forms, such as the Box-Cox transformation and the WAD model;
- The use of random coefficients models (as a form of mixed multinomial logit models, MMNL) to account for unobserved heterogeneity in the preferences of shippers and carriers;
- The use of Jackknife and Bootstrap methods. The estimated coefficients and their t-ratios are based on multiple observations for the same individuals (more than 1 choice per respondent). Consequently, the logit t-ratios will be overstated. More reliable estimates for the t-ratios can be obtained by using jackknife or bootstrap methods. This problem of repeated measurements can also be tackled by using individual-specific components in MMNL models.
- The use of SP experiments with interactions between shippers and carriers, as well as including the respondents' strategies in processing the SP attributes in the modeling.

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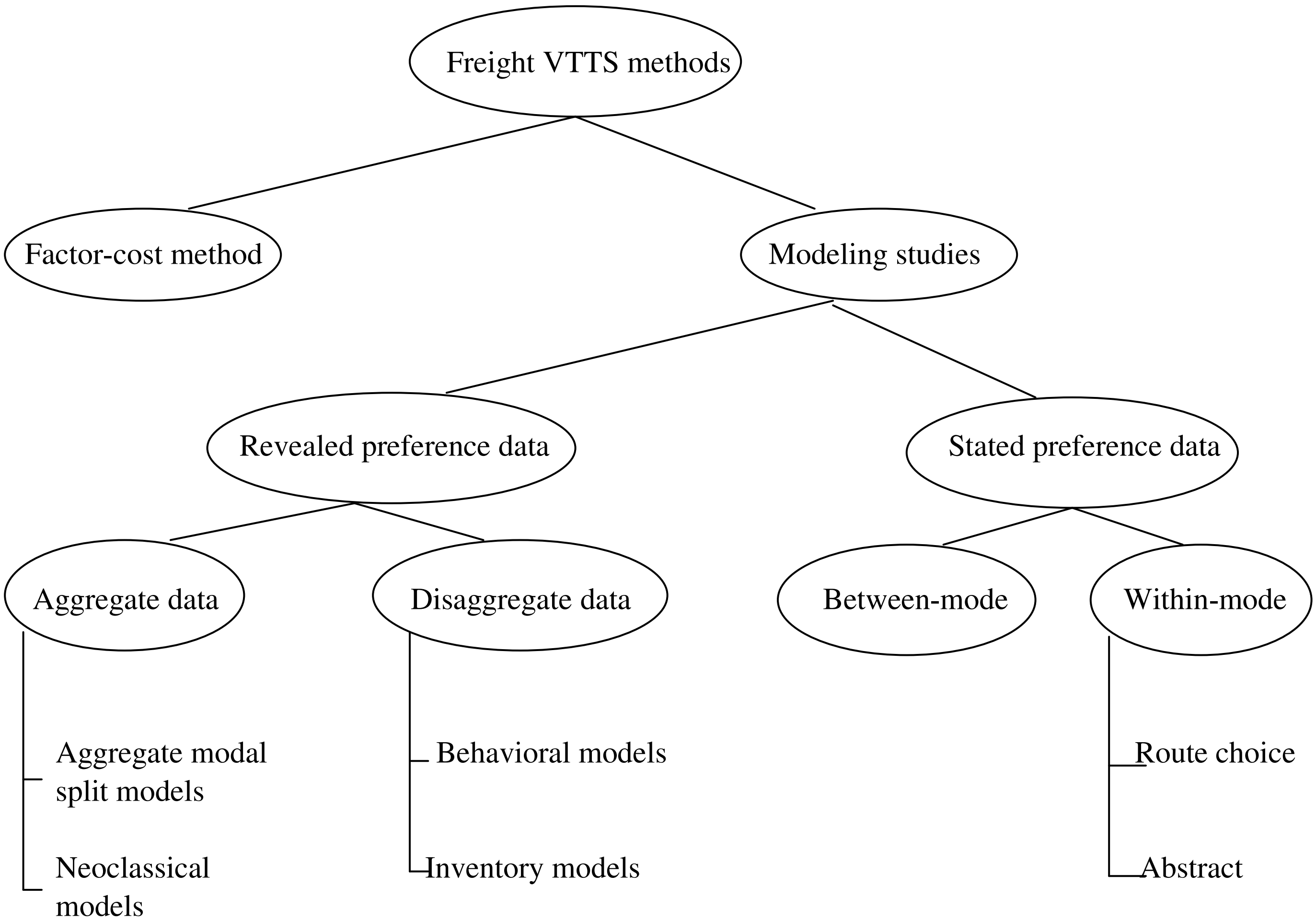

Figure 1. Classification of methods for establishing a freight transport VTTS

Table 1. Value of time in goods transport by road (in 2002 Euro per transport or tonne per hour)

Publication	Country	Data	Method	VTTS
				Per transport per hour
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
de Jong et al. (1992)	Netherlands	SP	Logit	35
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
de Jong et al. (1995)	Netherlands	SP	Logit	38-40
de Jong et al. (1995)	Germany	SP	Logit	31
de Jong et al. (1995)	France	SP	Logit	32
Fosgerau (1996)	Denmark	SP	Logit	29-67
Bergkvist and Johansson (1997)	Sweden	SP	Logit/WAD/ bootstrap	3-7
Accent and HCG (1999)	UK	SP	Logit	34-45
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	40
Inregia (2001)	Sweden	SP	Logit	0-32
Booz Allen Hamilton and ITS (2003)	UK	SP	Logit	2-93
de Jong et al. (2004)	Netherlands	SP	Logit	36-49
Hensher et al. (2005)	Australia	Interactive SP	Mixed Logit	25-50
				Per tonne per hour
Fowkes et al. (1991)	UK	SP	Logit	0.08 – 1.18
Kurri et al. (2000)	Finland	SP	Logit	1.53
De Jong et al. (2004)	Netherlands	SP	Logit	4.74

Table 2. Value of time in goods transport by rail, inland waterways and air transport (in 2002 Euro per transport or tonne per hour)

Publication	Country	Data	Method	VTTS
				Per transport per hour
Rail transport:				
Transek (1990)	Sweden	SP	Logit	1 (wagon)
Inregia (2001)	Sweden	SP	Logit	0 (shipment)
de Jong et al. (2004)	Netherlands	SP	Logit	918 (train)
Air transport:				
Inregia (2001)	Sweden	SP	Logit	13 (shipment)
de Jong et al. (2004)	Netherlands	SP	Logit	7935 (full carrier)
				Per tonne per hour
Rail transport:				
Fowkes et al. (1991)	UK	SP	Logit	0.08 – 1.21
De Jong et al. (1992)	Netherlands	SP	Logit	0.81
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
De Jong et al. (2004)	Netherlands	SP	Logit	0.96
Inland waterways:				
Roberts, 1981	USA	RP	Cost model	>0.05
De Jong et al, 1992	Netherlands	SP	logit	0.20
Blauwens and Van de Voorde, 1988	Belgium	RP	Logit	0.09
de Jong et al. (2004)	Netherlands	SP	Logit	0.05

Table 3. 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

Table 4. Freight VTTS for The Netherlands (in 2002 Euro)

Segment	Value of time per transport per hour	Value of time 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	4.74
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