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External Benefits of Transport

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External Benefits of Transport by Jan Simons, Professor of Transport Economics at the Free University of Amsterdam and Director Transport and Traffic, Rotterdam Chamber of Commerce and Industry.

Introduction

It is striking that Dutch proverbs and sayings on the subject of "benefits" - such as "de kost gaat voor de baat uit" (literally: the cost precedes the benefit) or "baat het niet, dan schaadt het niet" (literally: if it doesn't benefit, it won't cause harm either) - do not have any exact equivalents in English. Though the English expressions "throw out a sprat to catch a mackerel" or "you must lose a fly to catch a trout" come fairly close to the first Dutch proverb, the second one cannot be found at all in the dictionaries [1]). In fact, English expressions about benefits, such as "benefits bind" and the (Arab) proverb "benefits make a man a slave" focus more on the consequences of the benefit rather than on the action taken to gain it. One would therefore expect that the Netherlands or - to take the foremost transport countries - the Benelux states would boast an in-depth and extensive know-how, research and literature on the benefits side of transport. Nothing could be further from the truth - as the author of this report discovered to his shock. Once the shock had passed, it even became clear that research would be needed to chart this tricky subject.

This then relates above all to that part of the presumed "benefits" which is not a directly "visible" result of the transport transaction.

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[1]) Van Dale Groot Woordenboeken Engels-Nederlands (Van Dale English-Dutch Dictionaries); Van Dale Lexicografie, Utrecht/Antwerp 1984.
The Penguin Dictionary of Proverbs; Rosalind Fergusson, Omega Books Ltd., Hertfordshire, 1986.

Freight prices, wage costs, investments and the derived macro-economic data about the transport activities etc.; that all can be calculated, they are "visible". But what "external" effects does that selfsame transport transaction have on, say, industry, trade or recreation, or the social fabric of a community?

In studies and research attention has primarily been paid to what are termed the negative effects of transport, specifically those of traffic and inland transport. Mostly, the suggestion given for goods transport is that the railways and inland navigation - the latter two possibly in combination with truck - would offer a solution for the future. These aspects are clearly reflected in recent Dutch Government policy papers, such as the Second Structure Plan for Traffic and Transport [2]), the Fourth Memorandum on Physical Planning Extra [3]), the National Environment Plan Plus [4]). During the policy-making process a greater need was felt - first unconsciously, but later explicitly - for attention also to be devoted to the opposite side of the coin, i.e. the positive external effects. As the laws of nature and economics indicate, action is followed by reaction, thus ultimately creating balance again. Considering one element in isolation may be very helpful in improving our understanding, but in the end we want to know the entire situation. In fact, to use the metaphor of a weighing scale, it is the weight on both scales, i.e. the totality, which has an effect; the weights placed

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[2]) Ministry of Transport and Waterways and Ministry of Public Housing, Physical Planning and Environmental Control: Tweede Structuurschema Verkeer en Vervoer, part I, Second Chamber, various years, number 20922 (in Dutch).

[3]) Ministry of Public Housing, Physical Planning and Environmental Control, the fourth Memorandum on Physical Planning Extra (VINEX), Second Chamber 1990/1991, number 21879, issues 1/2 (in Dutch).

[4]) Ministry of Public Housing, Physical Planning and Environmental Control, Nationaal Milieubeleidsplan (NMP), Second Chamber 1988/1989, 2137, issues 1/2; also Nationaal Milieubeleidsplan-plus, numbers 20-21, Second Chamber, parliamentary year 1989-1990 (in Dutch).

in both scales lead to the ultimate balance. A good insight into all effects, both negative and positive, is needed because this is the only way to present an objective viewpoint, not only in assessing the present transport situation but also for future policy.

As part of the National Traffic and Transport Account [5]) drawn up in the Netherlands in the late 1970s/early 1980s, a start was also made on giving the benefits side of transport the greater attention it deserved. Ultimately this part of the study was brought to a halt, they came up against a dead end!
Determining the utilitarian value to society, an intrinsic part of a completely integrated solution, still involves major problems because of the state of the science.
Similarly, the reactions received from the transport sector [6]) during the preparation of this report indicate that the situation has not changed much, though there are signs of renewed interest for research [7]) into the benefits attributable to transport.

One of the respondents - regardless of what one might think of his confidence in science - stated as follows: "It is a subject which, because of the many and varied opinions which exist about it, scarcely lends itself to a scientific, objectivising approach."

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[5]) Drs. J.G. de Wit, De nationale verkeers- en vervoersrekening, in Tijdschrift voor Vervoerswetenschap, no. 20/1:5-17 (1984) (in Dutch).

[6]) A number of branch-of-industry organisations, transport companies and research institutes were asked to supply documentation. I am pleased to express my thanks for their response.

[7]) See letter plus enclosure dated 9 December 1991 from the (Dutch) Minister of Transport and Waterways to the Second Chamber of the States-General relating to Motion No. 22 by Mrs. Rooser-van Pelt et al., in Proceedings of Second Chamber, parliamentary year 1991-1992, 22300 XII, no. 35 (in Dutch).

But does not the theory of cost-benefit analysis - or its variants such as multi-criteria analysis, although this basically takes the form of an incomplete cost-benefit analysis [8]) - provide at least some indications in this direction? Despite the extensive literature existing on this, Button [9]) has already stated: "there is evidence that the optimism once felt for cost-benefit analysis as the panacea for all transport investment appraisal problems has gradually evaporated and the confidence felt in the strength of cost-benefit analysis calculations no longer exists." Baum [10]) recently added his "Zweifel an der sachgerechten Anwendung der Nutzen-Kosten-Analyse und die sozial-ökonomische Rationalität der sich darauf stützenden infrastrukturpolitischen Entscheidung". His first point of criticism is the "unzulässige Verkürzung der Wirkungskette."

Consequently, fully aware that this tricky subject has been the downfall of many, it seems imperative to define the problem in simple terms: Is it possible - and, if so, to what extent - to indicate a starting point for a system which would enable transport in general, and if possible the separate transport modes, to be placed in a context which would reflect their positive contribution to social well-being?

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[8]) Algemene Transporteconomie (General Transport Economics), Prof. Dr. G. Blauwens, Dr. E. van de Voorde, published by Moderne Instructiemethoden N.V., de Berlaimontstr. 92, Deurne, Belgium, p. 140 (in Dutch).

[9]) K.J. Button, Transport Economics, Gower Publishing Company Limited 1986, Aldershot, p. 97.

[10]) Infrastrukturpolitik als Mittel zur Steuerung des Verkehrsträger-wettbewerbs, Prof. Dr. Herbert Baum, Cologne, Zeitschrift für Verkehrs-wissenschaft, 62. Jahrgang - 1991 - Heft 1, p. 15 and 16.

Whether we will move beyond the methodology and whether such a system, besides having a qualitative structure, can also be quantitative in nature, and then in absolute or relative terms, will provisionally depend on the progress of the investigation. In dealing with this problem we have to remain within the confines of Europe; there was not enough time to deal with everything exhaustively, let alone to place it in a broader context. We must therefore limit ourselves principally, but not exclusively, to the transport of goods and the transport techniques used for this. On the other hand, original and unconventional approaches should not be avoided. As already indicated, the routes taken so far have not led to satisfactory results. The favourable aspects of transport or of certain transport techniques still have no generally accepted "place of their own", even if they are seen in relation to the negative aspects of this sector of the economy. Why - to link up with Baum - should not the "chain relationship" within transport be further elaborated on; the successive interactions and dependencies both "upstream" and "downstream", such as those in production columns, might perhaps offer a solution. Why, then, should we not take a look at an activity which is related to transport? Close to home, in the Netherlands and Belgium, it appears that major, pioneering studies have been conducted into seaports and airports specifically relating to the positive effects of such activities. Perhaps these will provide the key to a systematic description of the various transport sectors.

The subdivision of this report is as follows: chapter I contains some theoretical considerations about the social benefits of transport as a contribution to social well-being. Chapter II first recalls the place and qualities of the various transport techniques and then gives the "visible" figures from Dutch practice. A number of recent studies are discussed in chapter III. Chapter IV then gives an overall review and sets out the ultimate conclusions. May this report lead to fruitful

discussions [11]) and, if generally accepted, encourage further practical implementation.

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[11]) At the time when the copy for this report was ready, a similar appeal was published by Willeke in Kommentar zur Verkehrs-politik: die externe Nutzen des Verkehrs, Zeitschrift für Verkehrswissenschaft, 62 Jrg, 1991, Heft 4, p. 191. We both prepared with these articles, the discussion on this subject for the ECMT-Round Table in June 1992 in Lyon, France.

Chapter I

Some theoretical considerations

In this chapter a number of fundamental questions are discussed, some of which have been dealt with previously by others in part or in full. The conclusions from these, together with the "analogue" studies described in chapter III, form the basis for the possible systematic approach.
In defining the problem the explicit aim is described as the contribution of transport and its sub-systems to social well-being. Well-being - a sense of being contented - is more comprehensive than welfare. It specifically encompasses those facets, including such things as safety, physical planning, the environment [12]) which cannot be classed as part of the economic scarcity facet of the welfare concept. Welfare involves the relationship between needs and the scarce resources available to satisfy those needs, whilst well-being goes further and includes what are (now) still abundant resources. But these may change from abundant to scarce; quickly or over the longer term. European society, certainly in the West, has long been motivated by its needs for well-being and no longer exclusively by its welfare wishes. The choice made in the Netherlands, and in a broader context in the Brundtland report [13]), in favour of a "sustainable society" as a criterion for policy [14]) is a striking example of this. It is future-oriented because

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[12]) In an article entitled "De optimale samenstelling en omvang van het vervoer" (Optimal composition and size of transport), in Economische-Statistische Berichten, 20-2-1991, p. 201 ff., the authors A. Heertje and J.B. Polak also indicate that a wider interpretation of the Paretian welfare concept must be taken as a working basis: transport movements in the personal sphere and other non-material welfare effects. (in Dutch)

[13]) World Commission on Environment and Development, Our Common Future, Oxford, 1987.

[14]) Tweede Structuurschema Verkeer en Vervoer, part d, p. 8 (in Dutch).

it also devotes attention to ensuring that the needs of future generations can continue to be satisfied.

Generally, it is assumed that the traffic and transport sector, which comprises the various transport techniques, influences the facets of society's efforts to achieve well-being. But this also takes place in the opposite direction, whether or not in the form of policy, which means that a dynamic interaction exists. In the case of the physical planning facet, the relationship is easy to picture and can at least be described in terms of quality. But what does this look like, say, in the socio-cultural facet of society? Making this visible, let alone quantifying the influence of the traffic and transport sector, is - as far as I know - still unexplored territory. However, this does not mean that interaction in this area is negligible. To give another topical example: in environmental problems not only the adaptation of standards in the traffic and transport sector should be examined, but full allowance should also be made for the properties of eco-systems such as self-cleansing power, buffer capacity and regeneration capacity [15]). This digression is mainly aimed at demonstrating that, in studying the contribution of transport and its sub-systems to the well-being of society, an integral approach is required. Such an approach also makes it possible for all effects of the traffic and transport system to be equally and conveniently included in the considerations, even if they are (as yet) unquantifiable. (See also Diekmann [16]), Van der Kolk [17])).

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[15]) By reference to R. Huetings et al., "Methodology for the calculation of sustainable National Income", Central Bureau of Statistics, Statistische Onder-zoekingen (M-reeks), Voorburg, as formulated in NRC Handelsblad of Thursday, 9 January 1992, O en W, p. 3 (in Dutch).

[16]) Dr. A. Diekmann, Kosten en Baten van de auto, (Nutzen und Kosten des Automobils - Vorstellungen zu einer Bilanzierung, 1989), translated and edited by Stichting Weg, in Mobiliteitsschrift July/August 1991, p. 37-45, published by Stichting Weg, The Hague (in Dutch).

As regards the effects of the traffic and transport system - without being limitative - we should first of all consider the effect of the traffic or transport activity itself. This can be positive or negative. The negative effects relate to the influence on the facets mentioned earlier: environment, physical planning, safety, etc. Positive effects are then the creation of income, production value and employment. Yet this transport activity is not conducted in isolation but is only possible thanks to the available infrastructural network. Consequently, there is a causal link between the existence of the infrastructure and the transport activity; a negative one through, say, wear-and-tear; and a positive one through, say, taxes or levies. But the existence of the transport system itself in turn creates effects elsewhere in society, such as a higher degree of distribution, improvement in living conditions, emergency services, to mention just a few examples alongside the derived consequences in other sectors in terms of income, production, employment or improved quality. Provided that a causal link exists, the effect may be attributed to the transport activity.

It should also be remembered that the value of a transport system is more than just the sum of the various transport techniques. The synergetic effect of the transport system alone enables logistic processes, vertical-chain thinking, combined transport possibilities and, even more abstractly, "the free choice of transport mode by the the shipper". This synergy of the system is therefore the reason why there is much discussion in this report of the transport system as such.

A system which fully integrates both the favourable effects (= benefits) and the unfavourable effects (= costs) of transport at all levels, in all sectors and in all its facets can form the starting point for an attempt to quantify the effects using a standardised norm. The next

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[17]) Drs. H.L. van der Kolk, Benefits and burdens of car ownership and use: the issues weighed - a summary, The Hague 1990, Institute for Research on Public Expenditure: "Lack of clarity on the positive externalities does however not detract from the fact that they could well exist".

stage can then be to draw up a balance sheet which, whether positive or negative, will indicate the direction for an effective policy either in general terms or focused on specific areas. For it is in fact not only a question of minimising the social costs but, in the end, of maximising the net social benefit.

If the system of differentiating between internal and external effects is adopted, then it is found that there is a great lack of knowledge [18]), particularly about the external benefits. In fact, the existence of these benefits is even denied. If the internal benefit (or cost) is considered to be that consequence of the transport activity which exclusively brings benefits (or costs) for the parties operating in the market (with its regulatory effect towards an optimal allocation of production factors), then the external benefits (or costs) are the consequences for the other parties (private individuals, institutions or businesses) within society.

But, as was recently stated in a study by Planco Consulting [19]), the existence of external benefits is attributable to the "Umdeutung der in der ökonomischen Literatur gebräuchliche Begriffe "externe Effekte" oder "soziale Zusatzkosten und Zusatznutzen", followed by the denial that, say, effects on productivity and supply or potentially possible uses could be the source of external benefits [20]).

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[18]) See also Willeke, loc. cit., footnote 11).

[19]) Planco Consulting GmbH, Essen, Intermodaler Wettbewerb zwischen der Bahn und den mit ihr konkurrierenden Verkehrsträgern im Güterverkehr, Essen, December 1990, page 2-72.

[20]) On page 2-72, loc. cit., it is stated, however, that in certain cases a waterway may yield ecological and/or water-control benefits.

Similarly, during a Dutch Colloquium in 1991, a paper [21]) was presented with the conclusion that "road traffic and transport are in practice linked only in very specific cases with external benefits (and slight ones at that) ..." "The existence of such effects is in fact largely in conflict with the principle of benefit maximisation for individual goods." These statements are based on an individualisation of the transport activity. However, if an integral approach is taken to the question, attention will have to be paid specifically to the transport system with all its related and non-related components. Generally speaking, for example, the individual provision of a transport service simply cannot take place without the collective "infrastructure" asset in addition to the individual means of transport. Besides, the interaction described in the introduction between other economic sectors and facets of social well-being calls for a minimum of disaggregation. Furthermore, in the event of a dispute about the classification of a certain benefit as internal or external - the causality of the transport system is at that moment no longer disputed - this benefit component always forms part of the aggregate total of social benefits. In brief, the differentiation between internal and external benefits - though perhaps useful for implementing separate calculation methods - is and remains merely a tool to arrive at that aggregate total of benefit components which we can refer to as the social benefits.

In the introduction mention has already been made of a possible approach to the benefits question via the "chain relationships". Because of the interlinkages and mutual dependencies, the effects of a cause (in this case transport) may occur in unexpected places. If the consequence, which may or may not have been paid for, immediately affects the market

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[21]) H.A. van Gent, J.M. Vleugel - Autoverkeer en -vervoer; Externe baten?? (Road Traffic and Transport; External Benefits??), in P.T. Tanja (ed.) "Colloquium Vervoerplanologisch Speurwerk - 1991-. De prijs van mobiliteit en van mobiliteitsbeperking (The price of mobility and mobility limitation), Delft, C.V.S. 1991 (in Dutch).

participant on the demand side, then it can be classified as "direct". If the relevant effects are derived (or "induced"), then they can be described as "indirect", i.e. they do not influence one market participant but have an impact on others in society who, by definition, have not paid for them. However, would not such a split into "direct" and "indirect" lead in turn to the same problems linked to individualisation as did the previous differentiation into internal and external? It seems very likely that it would, which is why another approach will also be examined.

Bearing in mind the essence of "chain relationships", i.e. the mutual links and interdependencies, the scenario that emerges is one of "loss risks". Taken to extremes, this then means imagining a society without transport, at least in the form that we know today [22]). Wolters states that "particularly where there is a high degree of interrelationship with other activities and where there are no or hardly any conceivable alternatives, there is reason to assume that the integral importance of a sector of industry (or a part of it) is high for the entire economy". With regard to transport he then translates this into the statement that "its disappearance would bring all economic life to a standstill". The complex structure of European society, plus the objective of achieving the standard of well-being and not merely the standard of welfare, prevent this issue from being dealt further in this report, even if that were at all possible.

Incidentally, the previously quoted Planco study [23]) cannot see this scenario providing an answer. But perhaps - if a study is made into this - it might shortly be possible to ascertain empirically what impact the

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[22]) See also Wolters in Drs. T.J.J.B. Wolters, Een macro-economische blik op de transportsector (A macro-economic view of the transport sector), Tijd-schrift voor Vervoerswetenschap 21/2: 100-116 (1985), Rijswijk, p. 101 (in Dutch).

[23]) loc. cit., p. 101.

absence of an effective transport system has had in, say, present-day Cuba and (compared with its present situation) in the ex-GDR. The relatively limited size of these societies and their isolation from the outside world will certainly reduce the degree of complexity compared to (West) European societies.

However, one variant of this scenario, viz. the relative application of the "loss risk", does offer prospects [24]). On the basis of the "Oyevaar method" this was once applied in the Dutch seagoing shipping sector via the hypothesis whereby the required transport was taken over in full by foreign shipowners. More than 70% of the production value of 1985 was lost as a result.

The hypothetical replacement of one transport sector by another - obviously as far as is technically conceivable (such as long-haul road transport by, say, railways or inland shipping) and if the other conditions and objectives remain unchanged - leads to cost differences in money terms (e.g. extra investments and personnel costs) which in the event of a positive result can be allocated to the replacement transport technique as an already existing benefit component. It is then a question of cost-savings calculations.
A minimum value of the social benefits of a specific - here, a replacement - transport technique is, provided it is positive, the net balance in money terms of the known social costs and the known income, including the above-mentioned hypothetical cost saving. The aggregate of these balances then yields - again as a minimum - the total of the benefits of the transport system, at least in so far as it concerns the various transport techniques. However, if the balance expressed in money terms is negative, then this should no longer be included in the

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[24]) From: Drs. P. Melissen, MERC, "De betekenis van de zeescheepvaart voor de nationale economie" (Importance of seagoing shipping for the national economy), Tijdschrift voor Vervoerswetenschap nr. 1/92 (still unpublished) (in Dutch).

appraisal. If it were, duplication might occur because the same amount would be booked again as a benefit component in the transport technique which has been replaced in this case.

Another method of calculation might involve an identical comparison of all transport techniques with an (as yet) hypothetical mode of transport, suitable for carrying all goods, with many fixed internal costs and few "indirect external" costs.
Through the use of such a "constant" the mutual relationship of all existing transport techniques can then be derived, the size of the "hypothetical cost-saving" benefit component can be determined and perhaps ultimately, through the use of key ratios, the social net benefit.
The above-mentioned (as yet) hypothetical transport mode is a (vacuum) high-speed tunnel transport system, also known as "underground flying" [25]).
"Underground flying" is the idea of using pipelines with guide rails - ultimately with a vacuum because of the then negligible resistance and highly economical use of energy - to transport goods (and passengers) in capsules at high speeds (on average, 540 km per hour). Modern drilling techniques - which still have to be perfected - enable construction at a depth of thirty metres of a coarse-meshed, widely branched network within Europe. The project, which is officially under way in the Netherlands under the name "High Speed Tunnel Transport" (HSTT), has been subjected to an economic feasibility study (Dutch acronym: Mecenas) [26]) for the lines Rotterdam-Munich (1) and Amsterdam-Paris (2) with a

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[25]) This term originates from the Transport Studies Department of the Netherlands Ministry of Transport and Waterways.

[26]) Eerste raming van de marktomvang van Hogesnelheidstunneltransport (Initial estimate of the market size for High Speed Tunnel Transport), A.H. Perrels, L.P. Schippers, Economic and Social Studies Institute, Amsterdam Free University, 5 June 1991 (in Dutch).

number of intermediate stations, technically located on parallel branch lines at intervals of at least 150 km. A strong market position seems to exist above all for distances in excess of 250/300 km. Even at a commercial interest rate of 7.5%, which is unusual in social cost-benefit analyses, there are prospects of an operating profit which, since a large proportion (75-80%) of the costs are fixed, may also increase annually.

Table 1: Summary of annual operating costs (millions of guilders) for HSTT Lines 1 and 2 [27])

	real (5%)	nominal (7.5%)
Capital	1,961	2,599
Maintenance (90% of variable costs)	560	560
Energy	38	38
Organisation	29	29
Total	2,588	3,226
Balance: low-tariff situation (Fl. 0.14 per tonne/km)	+ 802	+ 164
Balance: high-tariff situation (Fl. 0.20 per tonne/km)	+ 1,024	+ 386

with a goods transport which, depending on the tariff-setting, amounts to between 6.6% and 8.3% of the total market of 300 million tonnes in the year 2010, i.e. 20-26 million tonnes.
Source: Perrels and Schippers, Market Size HSTT.

On the assumption that feeder transport at both ends will be above ground and in view of the slight substitution of the classic transport sector by HSTT for cargo and passengers over the country as a whole, the report itself assumes a very modest environmental impact, but for the purposes of our "hypothetical" replacement, we have assumed complete substitution so as to keep the methodology simple. Later on, however, a

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[27]) loc. cit., p. 50.

substitution coefficient will also have to be introduced in the calculation in this respect.

In view of the many other calculation difficulties (e.g. estimating the change in productivity in the transport mode if the quantity of cargo to be transported is increased), the "loss risk approaches" will in any event remain balanced and integrated on the basis of already known data which are certainly comparable with each other. One example of the environmental cost components already known in the mutual relationship is given in the following table which on the one hand has been slightly abridged (solely version 1) and on the other has been slightly expanded, viz. to include "underground flying without feeder transport at both ends" and which is also taken from a recent Planco study [28]) commissioned by Deutsche Bundesbahn.

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[28]) Planco-Consulting GmbH, Externe Kosten des Verkehrs: Schiene, Straße, Binnenschiffahrt (External Costs of Transport: Rail, Road, Inland Waterways), Essen, 1991, p. 22 (in German).

Table 2: Spezifische externe Kosten im Güterverkehr

Güterverkehr (Kosten in Dpf je tkm)

Kostenart	Schiene	Straße	Binnen-schiff	Unterirdisch Fliegen gleich Differenz	Differenz zur Schiene	
					Straße	Binnen-schiff
Luft-verschmutzung - version 1	0.19	1.37	0.20	0.00	+ 1.18	+ 0.01
Boden-Wasser-belastung	0.00	0.40	0.00	0.00	+ 0.40	+ 0.00
Lärm	0.68	0.35	0.00	0.00	- 0.33	- 0.68
Unfälle	0.12	1.78	0.01	0.00	1.66	0.11
Trennwirkungen	0.00	0.06	0.00	0.00	0.06	0.00
Flächen-verbrauch	0.02	0.06	0.00	0.00	+ 0.04	- 0.02
Total Version 1	1.01	4.02	0.21	0.00	+ 3.01	- 0.80

Source: Planco-Consulting, 1991, plus own supplement ("underground flying").

Another clear example of the possibilities, certainly on the cost components side, is a "benefits overview" [29]), much propagated by the inland navigation sector.

[29]) Sources: Levende Wegen, Royal Educational Fund for Shipping Foundation (KOF), Amsterdam 1986; also Ons Vakblad, Rotterdam, December 1988, p. 31; also Heft 1, Binnenschiffahrt und Umwelt, Bundesverband der Deutschen Binnenschiffahrt e.v., Duisburg, not dated.

Table 3: "Benefits overview" propagated by inland navigation sector

- To transport a cargo of 1,775 tonnes which fits inside 1 inland waterway vessel of 95 metres length, the following equivalents would be needed: by rail: 60 wagons, train length 600 metres; by road: 90 lorries, a convoy of 1,000 metres in length.

- Distances covered with 5 litres of fuel per tonne:

Inland waterway vessel:	500 kms
Rail:	333 kms
Road haulage:	100 kms
Air freight:	6.6 kms.

- Tractive motor capacity per kg:

Road:	150 kg
Rail:	500 kg
Inland waterway vessel:	4,000 kg

The validity of these "promotional" figures may perhaps be open to a lot of argument [30]), but both tables show that all sorts of comparisons - which are certainly uniform in their mutual relativity - can be made.

The next chapter discusses the question of whether it is important to highlight so explicitly the specific characteristics of the various transport sectors. The chapter also contains some macro-economic data on transport techniques applicable for the Netherlands.
A number of current added-value studies, mainly in the seaports sector, are also dealt with in Chapter III to find out whether they include further systems or statistical methods which might prove useful.

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[30]) For example, an issue of "Die Bundesbahn" 1/1991 likewise gives a comparison of the energy consumption which, on the basis of coal-equivalents, shows that for goods transport per 100 tonne/kms, rail transport (1.1) is more economical than inland waterway (1.8) and road (8.2), but this is again denied in Bericht der Regierungskommission Bundesbahn, Dezember 1991, page 52 and table 11.1, page 53.

Chapter II

Place and Quality of (and macro-economic data on) transport modes

The title of this chapter indicates the object of the exercise: descriptions of transport modes and the effects of the transport transaction - i.e. the effects "visible" to the parties and valued in money terms. Wherever possible, a split by transport mode will be made. The distinctive characteristics of the various transport techniques have meant that for different types of transport certain techniques sometimes even hold a dominant position as regards the preference of shippers. Recently, the overview of the sub-systems in goods transport drawn up by De Wit/Van Gent [31]) was supplemented by Drs P.J.M. de Groot [32]) in his July 1991 publication on the transport of goods by pipeline.

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[31]) De Wit, Drs. H.A. van Gent, Vervoer en Verkeerseconomie (Transport and Traffic Economics), H.E. Stenfert Kroese B.V., Leiden, Antwerp 1986, p. 130 (in Dutch).

[32]) Drs. P.J.M. de Groot, Goederenvervoer per pijpleiding (Goods transport by pipeline), Economic Institute for the Building Trade, Amsterdam, July 1991 (in Dutch).

Table 4: Overview of the subsystems in goods transport

distance	continental transport		intercontinental transport
Characteristics of the goods	shorter distance	longer distance	
higher-value, more perishable or more vulnerable	road transport	road transport	seagoing shipping
	rail transport	rail transport air transport	air transport
lower-value	road transport	inland shipping	seagoing shipping
	inland shipping rail transport	road transport rail transport	transport by pipeline
	transport by pipeline	transport by pipeline	

Source: J.G. de Wit and H.A. van Gent, supplemented by P.G.M. Groot.

In this table, which is clear in itself, the underlined transport mode represents the "dominant" transport technique - in terms of tonnage transported - in the relevant sector. In the sectors which are characterised on the one hand by the nature of the goods to be transported and on the other hand by the distance, transport by pipeline is still included in the lower-value goods sectors. This, however, is a reflection of the existing situation. The question is whether this will remain so over the longer term. In the Netherlands, for instance, there had already been forecasts as long ago as in 1972 [33]) and also in 1982 [34]) but to a

[33]) Announcement by Prof. Ir. R.J.P.A. van de Hoorn in Algemeen Dagblad, 11 January 1992, O en W, pag 11 (in Dutch).

[34]) H.H. van den Kroonenburg, Hydraulische capsuletransport (Hydraulic capsule transport), in Tijdschrift voor Vervoerswetenschap 1982/2, pages 180 to 190 (in Dutch).

more intensified extent in recent months [35]) about the transport of goods via pipeline capsules in the sense we described above, albeit in the distant future.

The previously mentioned feasibility study into HSTT (underground flying) also dealt with the characteristics for goods transport, obviously including HSTT itself, in the form of the following, self-explanatory table 5: [36]).

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[35]) Publication by General Building Trades Confederation (Algemeen Verbond Bouwbedrijf - AVBB), Ondergronds Bouwen aan de Infrastructuur (Building the Infrastructure underground), October 1991, The Hague (in Dutch).
Mr. A.P. Nouwen, "Het Dilemma van Mobiliteit, Milieu en Economie" (The Dilemma of Mobility, Environment and Economy), Third Bernard Mandeville Lecture, 23 January 1992, Erasmus University Rotterdam.

[36]) loc. cit, p.16.

transport mode	rail	road	inland waterway	air	HSTT
characteristic					
speed	reasonable	reasonable	low	high	high
infrastructure	crude, too few terminals	very dense	coarse-meshed	coarse-meshed	HSTT - coarse-meshed
international linkage	poor, e.g. no cooperation	good	good	good	very good
price	reasonable, esp. with fixed contracts	fairly high to high	low	high	?
punctuality	varies	reasonable, growing congestion	moderate, lengthier delays	varies	very good
security	reasonable	good, load supervised by driver	reasonable	good	good
loading capacity	medium to big, bulk	small to big	medium to big, bulk	small to medium	small to medium
flexibility	poor, mainly standard goods transport	very good, individual shipments	poor, mainly bulk goods	reasonable	good
frequency	reasonable, scheduled services	good	low	good for regular destinations	very good
accessibility	poor, bureaucratic organisation	good, customer-oriented	reasonable to good, customer-oriented	good, customer-oriented	good?

Table 5: Characteristics for goods transport. Source: see footnote 26), Perrels and Schippers.

From the Dutch statistics not only the number of persons employed in the sectors of relevance can be derived, but also a great wealth of other data expressed in money terms.

Table 6: Some data from Dutch Statistics 1987 about Transportsectors

1987, amounts in millions of guilders	no. of employees	%	wage costs	%	tax on cost price	%	gross Value Added	%	gross invest-ments in fixed assets
Railways	27,393	11	1,738	11	12	4	899	4	735
Tram and bus services	25,910	10	1,612	10	21	6	267	1	251
Taxi businesses	17,770	7	327	2	4	1	556	3	155
Group transport & touring car businesses	5,720	2	236	2	11	3	347	2	105
Goods haulage by road	82,370	32	4,584	30	202	58	7,155	35	1,926
Inland shipping businesses	14,150	5	452	3	4	1	980	5	290
Pipeline businesses	210	0	20	0	1	0	226	1	*)
Road haulage-related businesses	1,340	0	36	0	2	1	80	0	34
Inland shipping-related businesses	1,010	0	54	0	1	0	102	0	27
Ocean shipping	8,350	3	677	4	7	2	897	4	391
Coastal merchant shipping	5,070	2	314	2	-	-	542	3	134
Ocean shipping-related businesses	16,460	6	1,451	10	27	8	2,367	12	464
Airlines	24,860	10	1,963	13	38	11	3,038	15	738
Airline-related businesses	2,930	1	229	2	3	1	339	2	222

Bonded stores & warehousing businesses	4,950	2	346	2	10	3	768	4	246
Despatchers, ship-brokers & charterers	19,700	8	1,231	8	5	1	1,543	8	329
Weighing & measuring businesses	1,380	1	104	1	0	0	127	1	*)
TOTAL TRANSPORT (excl. travel agencies & communications businesses)	259,573	100	15,374	100	348	100	20,293	100	6,047

*) = data not available

Source: Zakboeken Verkeer- en vervoersstatistieken (Pocket books Traffic and Transport Statistics), 1986 and 1990, Central Bureau of Statistics, The Hague, Sdu/uitgeverij/CBS publications 1986 and 1990.
Tables A.3 to A.10 and own calculations by H. van Gent.

Incidentally, these figures show that the road haulage and airfreight businesses, the transport modes which have a negative image from an environmental point of view, certainly make the biggest contribution to these economic criteria, at least as far as the Netherlands is concerned.

The two above tables mainly deal with the demand side of the transport market and were in fact compiled in that particular context.
But quality diagrams have also been drawn up with a view to the supply side of this market. Kuiler came up with the following table [37]):

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[37]) H.C. Kuiler, Inleiding tot de vervoers- en haveneconomie (Introduction to transport and seaport economics), compiled and edited by J.M. Verhoeff, Universitaire Pers Rotterdam, p.19 (in Dutch).

Table 7: Kuiler's quality diagram of transportmodes

No.	size	speed	accessibility	variability	flexibility
1.	seagoing ship	aircraft	lorry	train	lorry
2.	pipeline	train	train	barge	barge
3.	barge	lorry	barge	lorry	seagoing ship
4.	train	seagoing ship	seagoing ship	seagoing ship	aircraft
5.	aircraft	barge	aircraft	aircraft	train
6.	lorry	pipeline	pipeline	pipeline	pipeline

The author also saw a copy, whose only source reference was NVI [38]), containing the following quality groupings in the various sub-systems.

Table 8: NVI Quality groupings various subsystems

	transp. costs	transp. time	pene-tration	capa-city	capability = ability to adjust batch size	reli-ability	flexi-bility
road	5	2	1	5	3	3	1
rail	4	3	2	4	2	4	5
inland waterway	3	4	3	3	3	4	4
pipeline	1	6	6	1	1	1	6
air (continental)	6	1	5	5	3	2	2
sea (coastal merchant shipping)	2	5	5	2	3	4	3

Source: NVI

In the first table showing the sub-systems in goods transport we have already seen the dominant position of road transport. Apparently, this technique has a number of characteristics which meet the wishes. By definition, goods do not have wishes (though they do have requirements),

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[38]) NVI = Nederlands Vervoerswetenschappelijk Instituut (Netherlands Institute for Transport Science) has since 1988 formed part of the Stichting NEA, Transport research and education, 2280 DZ Rijswijk, the Netherlands.

but, by contrast, man as an organiser has all the more wishes; in practice this is usually the shipper, recipient, forwarder or logistics operator. A great deal has been published about their preferences [39]).

All possible factors of relevance have been mentioned and evaluated in these publications. In addition, the constraints on making changes in the modal-split have been dealt with in depth: besides bringing strongly increasing search costs, this would also only be possible for a limited market segment, since a large part of the transport market is "captive", i.e. is by necessity performed by one transport mode. In my view, however, this is due to change quickly because of the emergence of goods in different forms, e.g. in containers. In this way the goods are presented in an increasingly standardised form on the market in units "made-to-measure" for all transport techniques. As a result of containerisation, for instance, general cargo has now returned to the inland waterway vessel, despite the fact that this is essentially a bulk mode of transport. This emphasises the fact that a modal-split evaluation will have to take place at the level of the individual shipments. For the purposes of our subject, therefore, it makes no sense to compare the various transport modes with each other as to their characteristics and then to attribute values to these which would ultimately have to lead to a comparative benefits calculation. We would then have become bogged down in "stated preference" research, whilst the real benefits research ought to be "revealed", i.e. based on actual practice. In the case of the scenarios with hypotheses mentioned in chapter I, "revealed research" also remains possible provided that the hypothesis is based on conditions and circumstances which have been observed in practice.

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[39]) For an enumeration, see report Vervoerwijzekeuze in het Goederenvervoer (Transport Mode Choice in Goods Transport), revised version - NEI/NEA, Rotterdam, December 1990, pp. 28 ff. (in Dutch).

Back to the statistical material; might the "Added Value" - an aggregate of balance values - perhaps help us further on our way? There have been a number of recent studies on this which - though largely dealing with seaports and airports - do make attempts to express this value in money terms in great detail. Perhaps this will help us further with our methodology.

Chapter III

Added Value Studies

In this chapter a description is given of three studies which attempt to ascertain the added value of certain transport activities - notably seaport activities. These are: (a) a Dunkirk study dating from 1989, (b) a study in Rotterdam which is still under way and (c) a study into the Flemish seaports which, though completed, has not yet been released. This latter study also commented on inland waterways shipping and road transport and is therefore of direct importance for the subject we are dealing with.

a) In 1989 the port authority of Dunkirk, France, commissioned a study (which, incidentally, has not been published) into the added values which the seaport and its related activities generate for the community. For this purpose Prof. Gamblin developed a method which can be summarised as follows:

An indissoluble symbiosis exists between the seaport, the relevant city, region and hinterland. Three effects of the relevant port activities can be distinguished: direct, indirect and induced effects. The first relate to the effects of the services (including fishing activities) supplied to the ship or to the goods transported by the ship. Also included in this category are the parties which act as intermediaries between ship and cargo, e.g. for insurance, inspection and valuation, but also the port authority, and even a section of the Chamber of Commerce, customs and excise, employers' associations and trade unions, plus trade

brokering such as Bourse activities, commodity futures markets and ship chandlers. The second - indirect - effects comprise the industrial activities related to the port and all transport activities linked to the above-mentioned activities; for the Dunkirk seaport Gamblin did not apply what he terms the "Antwerp definition" [40]), viz. that only the industry which is actually established in the port should be studied. It is not so much the location as the link with seagoing shipping that is important. In this way he arrives at five types of industry, regardless of where they are located (ship repairs, fishing, supply businesses, maintenance, and industral activities which are dependent on large quantities of water, e.g. a power station). He also touches on - but does not include in his study - the activities which are attracted by the "seaport mentality", by the higher standard of its transport infrastructure, skills training, maintenance and commercial equipment. The transport activities relate to the feeder transport for incoming and outgoing cargo as well as to the transport generated by the industrial activity. The third category of effects - the "induced" effects - are interpreted by him to mean those services and commercial activities which are supplied to individual households and to the foregoing activities, as well as parts of the public administration services and a part of the tax revenue. Territorially there is hardly any restriction either. Where he feels it is appropriate, he looks not only within the municipality of Dunkirk, but also in the Dunkirk urban district, in the Nord-Pas de Calais region, indeed even in the rest of France, and occasionally even in the rest of the world.

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[40]) This must refer to the M.I.D.A. (Maritime Industrial Development Area) studies by Prof. Dr. M. Anselin - Ghent University, Belgium, who in 1985 had already conducted a study into the "value" of seaport transhipment, incl. that in Antwerp, Havennieuws Gent? (HN-88070430); no further references are available; source: Letter from Terneuzen Chamber of Commerce to Rotterdam Chamber of Commerce, 26 February 1991.

To calculate the gross added value he uses different formulas, depending on the category or sub-sector. In the case of companies this is based on production less intermediate consumption, excluding depreciation. In the case of institutions (établissements) it is only possible to give a pro rata percentage, preferably based on the total payroll cost than on the number of employees. In the "sector public", i.e. the production of public-sector services, the gross added value comprises the total payroll plus the value of the buildings and the expenses required for operating purposes. In the case of the professions it comprises the fees and the turnover, less bought-in goods and services. For the present report it is further of importance to note that the gross added value attributable to this region from inland transport modes could only be determined in a fragmentary form and therefore did not produce much result.

b) Rotterdam has also carried out its fair share of added value calculations, or at least studies into them. Since 1989 work has been under way on a method for measuring the annual added value development of seaport activities in macro-economic terms. An initial phase has been completed and relates to the calculation of the direct added value per seaport activity per year [41]).
Here we shall by-pass the additional complication that the statistical material at regional level had to be compiled separately. Since this meant that assumptions had to be used, no fixed and absolute level can be attained, though it is possible for the aim of the comparison to be derived from the annual development. An input-output table for the Rotterdam region (Rijnmond) was successfully developed. Instead of the volume of

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[41]) Port of Rotterdam, final report on First Phase of the added value study, Rotterdam, 17 April 1991 (in Dutch).

production or the number of businesses or employees, the added value criterion was chosen so that the spin-off in the subsequent phases could also be ascertained, i.e. not only the direct but also the indirect effects of the port activities. In fact, with the aid of the above-mentioned input-output table and the direct added value which is already known, it must be possible to calculate the indirect added value.
This is done using multipliers [42]) which relate to both the upstream and downstream [43]) impact of sectors of industry on the other links in the business column, both inside and outside the Rijnmond region. The fact that this must definitely be considered feasible can be deduced from the findings of a similar calculation that was made for a Physical Development Plan involving an updated airport to the North of Rotterdam, known as the "Integral Plan Northern Margin" (Dutch abbreviation: IPNR). Summarised: [44]).

Table 9: Economic Effects of IPNR on Economy of Zuid-Holland Province

	direct effect	indirect effect		total effect
		upstream	downstream	
Investment phase (non-recurrent)				
Production (x mln. guilders)	2,600	1,180	-	3,780
Added value (x mln. guilders)	1,030	530	-	1,560

[42]) For the Rijnmond region these were computed in "Rotterdamse Economische Verkenningen" (Rotterdam Economic Explorations), drawn up by NEI/ETAS for the Municipality of Rotterdam (not published, in Dutch).

[43]) Here, too, a warning is given against duplications as regards the down-stream effect and the direct effect; loc. cit. p.17.

[44]) Kwantificering Economische Effecten IPNR ("Quantifying the Economic Effects of the IPNR"), NEI and ETAS, Rotterdam/Hilversum, February 1991, p.24 (in Dutch).

Employment (man-years)	14,480	7,790	-	22,270

Operating phase (annual)

Production (x mln. guilders)	3,590	570	580	4,740
Added value (x mln. guilders)	1,990	320	310	2,620
Employment (man-years)	18,740	6,040	3,840	28,620

Source: NEI/ETAS, see footnote 44).

The "trickle-down effect" - consumer spending of income earned in the port - can also be calculated with the aid of "spin-off coefficients" (multipliers).
Of the further proposals for studies, it is also worth mentioning in relation to our subject that, besides the calculation of some key ratios - like value added per employee, per hectare or per tonne of cargo, which can already be calculated as these parameters are known - reference is also made to a future calculation of the added value per unit of "peripheral condition", such as investment or the environment.

Lastly, two tables taken from the report [45]) are set out below in a highly abridged form to give an idea of the results of this first phase.

Table: 10 Gross added value at factor costs per port sector Rijnmond region 1989 in billions of guilders (current prices)

Maritime Product Rijnmond	9,942.8
- Seaport industry	4,049.2
- Transport sector	5,130.9
- Commercial service industries	166.6
- Social service industries (incl. public sector)	596.1

Source: NEI/ETAS, see footnote 44).

[45]) loc. cit., pages 13 and 14.

Table: 11 Key ratios Gross Added Value (AV) per goods sector, in relation to transhipment, land-use, number of employees

Wet bulk sector:	
- AV per employee	Fl. 190,000
- AV per hectare	Fl. 1,550,000
- AV per tonne transhipped	Fl. 25.50
Dry bulk sector:	
- AV per employee	Fl. 130,000
- AV per hectare	Fl. 2,650,000
- AV per tonne transhipped	Fl. 7.50
Full-container sector:	
- AV per employee	Fl. 110,000
- AV per hectare	Fl. 2,250,000
- AV per tonne transhipped	Fl. 23.00
Other general cargo sector (incl. RoRo):	
- AV per employee	Fl. 105,000
- AV per hectare	Fl. 3,250,000
- AV per tonne transhipped	Fl. 28.40

c) Belgium has really reached a highly advanced stage in developing an operational analysis method for evaluating the macro-economic significance of transport sectors (and how! - until further notice this is described by the Belgians as a "world first"!). At the time of writing this report the study had not been released by the government authorities who commissioned the work. The description

Source: NEI/ETAS, see footnote 44).

that follows is therefore as accurate a reflection as possible of the information given about this during a symposium [46]).
Unlike a cost-benefit analysis, which enables a comparison between socio-economic rates of return, this Flemish Economic Impact Study opens up the possibility of measuring the direct contribution of large-scale public projects to the Gross National Product - being the parameter of welfare. This study, which works solely with market prices - and thus enables the calculation of the resultant "flow-back to the community" from both direct and indirect activities - covers seaports, inland waterway shipping and road haulage. (Author's note: it is striking that the railways have not been included, despite the fact that detailed statistics are in fact available within the industry. Is the rail industry perhaps frightened to face the truth?).

Here - just as in the Rotterdam study - we shall quickly by-pass the difficulties in obtaining recent input-output tables. Now that both studies have succeeded in reaching a result, it is clear that both a bottom-up approach to the statistical material (using individual business data obtained via surveys) and a top-down approach as chosen by Rotterdam (moving from general to specific via allocation keys) can produce useful input and output data. The theoretical preference for the bottom-up method - due to the fact that it measures the actual added value - is cancelled out because of the difficulty of fitting it in the input-output tables which are in turn required for calculating the indirect effects, and also for reasons of comparability with other sectors.

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[46]) Paper presented by Prof. W. Winkelmans at the "First Flemish Seaport Symposium", 13 September 1991 - de Politiek-ekomische betekenis van een Economische Impact Studie en haar resultaten (the political-economic significance of an Economic Impact Study and its results), Cabinet of the Flemish Minister for Public Works and Transport, Press & P.R. Dept.
The study, commissioned by the said Flemish Minister, was conducted by the Policy Research Consulants study bureau of Prof. Dr. A. Verbeke; Weekblad Schuttevaer, 21 September 1991; and also Nieuwsblad Transport, 14/9/91 (in Dutch).

The basic premise of the study is the incorporation of all direct (and also indirect) effects provided that they are causally linked to the activity being studied, regardless of where the indirect effect occurs (just as in Gamblin's method). The study thus calculates the effect of a government investment in the said sectors in relation to the expenditure (total capital investment by the government in the activity) and the impacts, consisting of the additional, causally linked added value [47]) plus the flow-back to the government [48]).

In 1989 it was found that the multiplier for the extra added value was 1.37 in the seaport sector, for employment 1.28 and for the operating surplus 11.34 (!?).

Furthermore, the following data have a great bearing on our subject. Since the multiplier - as a purchase indicator - reflects the dispersion power, it is thus possible to calculate the dispersion sensitivity, i.e. the capacity indication, by relating this to the multiplier for the economy as a whole.
This latter multiplier is 84% for the seaports, -25% for inland waterway shipping, and 71% for road transport.
The fact that inland waterway shipping has a lower dispersion sensitivity than the economy as a whole is due partly to the high market participation of foreign inland waterway businesses (which are therefore not included in the calculation), and partly to the strong competition from road transport and other sectors.

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[47]) The components of this are: gross wages and salaries, social security premiums of employee, employer's social security contributions, net operating surplus, and depreciation. The approach could also be based on job-equivalents.

[48]) Comprising the following components: social security premiums of employee, income tax paid by employee, social security contributions by employer, taxes on production, and corporation tax.

Lastly, as regards the flow-back to the government, the average during the 1986-1989 period for an actual production of B.Frs. 100 was as follows:

B.Frs. 17 for the transport sector as a whole
B.Frs. 17 for the seaports sector
B.Frs. 27 for inland waterway shipping
B.Frs. 18 for road haulage.

Descriptions are given above of three recent studies (one of which is still in progress). Hopefully, these will provide a starting point for the tricky study into the benefits of the transport sector and its sub-systems. In the next chapter we shall combine the conclusions from these studies with the theoretical elements from the first chapter so as to arrive at a final statement in response to the problem we are facing.

Chapter IV

Conclusion

This chapter should provide an answer to the basically methodological problem set in this report - finding a starting point for a system to determine the positive contribution of transport to social well-being.

We can now do that by combining the theoretical considerations from the first chapter and the insights given in chapter II about the place and quality of, and the known data on the transport modes, with the specimen studies described in the third chapter. The answer will prove to be that such a system can in all probability - if it does not already exist in the form of the Flemish Economic Impact Study - be drawn up by starting from what is referred to as a "Causal Added Value Model". This is made clearer below.

It is beyond dispute that transport activities have effects on society - both because of the transport system as a whole and because of the sub-systems in each separate transport mode. This applies in particular to the negative effects; in this context the environment is often mentioned. These effects can then be translated into costs. But the positive effects, part of which (i.e. the external positive effects) are regarded by some as not being a calculation component, must also be taken into consideration in making a value judgment. These represent the benefits side of the activities.
As fragmentation inevitably leads to the loss of completeness and accurate system application, it is obvious that an integral approach is needed both to the negative effects (to be evaluated as costs) and the positive effects (to be evaluated as benefits), especially as this enables the drawing up of a balance sheet to determine the ultimate net benefit of the transport sector and its component parts. As long as a split into direct, indirect, internal or external and so on can be avoided, it will be all the more possible to work with "revealed preference".

Within the integral approach a number of routes can then be taken. However, the characteristic of all of them is that they are based on - or "paved with", to put it more metaphorically - "chain relationships", i.e. the causal interlinkages and interdependencies which may have an effect upstream or downstream in the chain.

Applying the "loss risk" scenario in its full extent to a society is unfeasible in the complexities of actual practice, even though interesting possibilities do exist for certain geographical sub-areas.

The comparative application of the "loss risk" scenario - based either on a real possibility or on a hypothetical one using a future transport mode for which all social costs are largely already known - and with the cost savings being converted into a benefit can in itself yield a minimum value for the benefits. None the less, some uncertainties, such as the unknown productivity change in the event of an increased or reduced cargo supply for the transport service, do not offer us the scientific foundation we are looking for.

Even the most simple and obvious route based on the quality characteristics of supply and demand of transport services and the macro-economic data known on this does not lead immediately to the final goal, though it does provide a source for the ultimate and, as it now appears, "opportunity-rich" choice of routes. "Opportunity-rich", because one study in 1989 and two very recent ones mainly into seaport activities show that, by linking up with an "Added Value" concept, it is possible to arrive at a result.

The "Added Value" is the difference expressed in money terms between the production value and the value of consumption, in this case that of the transport sector or, if you wish, its component parts such as the separate transport modes; to put it differently: the total reward for the production factors which, depending on their composition, is a gross or net value (less depreciation) and which may be expressed as market prices (preferred here in connection with realistic tax calculations) or as factor costs as well as in terms of constant or (preferably) current prices. Whatever choice is made, it will have to be the same for each input in the calculations. Such an added value can then be used to calculate still unknown "relationships" by reference to certain known

key ratios such as those per employee, per hectare, per tonne of cargo but also per investment, per environmental category.

In the case of the "spin-off and welfare" effects of the transport activities, multipliers should be used to evaluate the inputs made by the transport activities into the chain relationship - hence the "causal" qualifier used in the name of the model. The place where the spin-off and welfare effects occur, whether geographical or whether downstream (creating conditions for other production) or upstream (supplies) in the business column, is irrelevant provided that the causal link with the transport activities can be proved - either directly, or indirectly in the sense of induced.

As was attempted in the Dunkirk study, a meticulous enumeration of effects and their relationship with transport, transport modes and their attendant infrastructure will be required for this. Apparently the still unpublished Flemish Economic Impact Study has already succeeded in doing this, not only for seaport activities but even for the inland waterway sector and road transport.

After that, only two simple steps remain to be taken: first of all, the result of such a Causal Added Value Study should be considered as a social benefit. This calls for some explanation. The Added Value is a parameter for determining the importance to society of a specific sector in relation to other sectors in the economy. It gives an indication of and is a determining factor in income formation. The Added Value in itself therefore already indicates the possibilities or, if you wish, the benefits of, in this case, transport activities; consequently, in absolute terms, it indicates "benefits".

From a macro-economic viewpoint the Added Value is used on a comparative basis; alertness is therefore required to prevent duplications, so that the same item is not included on both sides of the equation.

In using the Added Value for our purpose, i.e. the calculation of benefits, it is by definition impossible for duplications to occur because we are not working on a comparative basis. It is in fact irrelevant whether the induced effect of a transport activity is also recorded in other economic activities. Provided that the causal link with transport has been proved, it forms part of this model.

The second and final step is then to correlate this benefit result to the already known social costs, thus leaving us with the net benefit of transport for social well-being, possibly also specified further on the basis of separate transport activities.

With this starting point for a system to determine the positive contribution of transport, which we would call the "Causal Added Value Model", we believe we have answered the problem we set out to solve. Within the framework of this report we did not get round to the implementation of the model for the various transport modes, as the title would suggest. The methodology required all our attention.
May this article and the discussions on it lead to a definite insight into and understanding of the ultimate "benefit of transport" in all its component parts.

Prof. Dr. Mr. J.G.W. Simons
Rotterdam, 2 april 1992

List of tables

Literature

- Algmeen Verbond Bouwbedrijf (AVBB), **Ondergronds Bouwen aan de Infrastructuur**, 's-Gravenhage, oktober 1991.

- Prof. Dr. M. Anselin, Rijksuniversiteit Gent, **M.I.D.A. (Maritime Industrial Development Area) studies**; al tenminste in 1985 studie over de "waarde" van de havenoverslag o.a. van Antwerpen, Havennieuws Gent? (HN-88070430), verdere referenties niet voorhanden.

- Prof. Dr. Herbert Baum, Köln, **Infrastrukturpolitik als Mittel zur Steuerung des Verkehrsträgerwettbewerbs**, Zeitschrift für Verkehrswissenschaft, 62 Jahrgang - 1991 - Heft 1, Seite 15 und 16.

- Prof. Dr. G. Blauwens, Dr. E. van de Voorde, **Algemene Transporteconomie**, uitgave van Moderne Instructiemethoden N.V., de Berlaimontstr. 92, Deurne, België, blz. 140.

- Brundtland rapport **World Commission on Environment and Development, Our Common Future**, Oxford, 1987.

- K.J. Button, **Transport Economics**, Gower Publishing Company Limited 1986, Aldershot, blz. 97.

- Verslag International Seminar **"prospects for East-West European Transport"** van de CEMT d.d. 6-7 december 1990, blz. 556 en 557.

- Van Dale Groot Woordenboeken Engels-Nederlands; Van Dale Lexicografie Utrecht/Antwerpen, 1984

- Dr. A. Diekmann, **Kosten en Baten van de auto** (Nutzen und Kosten des Automobils-Vorstellungen zu einer Bilanzierung, 1989); vertaling en bewerking van Stichting Weg in Mobiliteitsschrift juli/augustus 1991, blz. 37-45, uitgegeven door Stichting Weg, Den Haag.

- Rosalind Fergusson; **The Penguin Dictionary of Proverbs**, Omega Books Ltd., Hertfordshire, 1986.

- H.A. van Gent, J.M. Vleugel - **Autoverkeer en -vervoer; Externe baten??**, in P.T. Tanja (red.) Colloquium Vervoerplanologisch Speurwerk - 1991 - **De prijs van mobiliteit en mobiliteitsbeperking**, Delft, C.V.S. 1991.

- Drs. P.J.M. Groot, **Goederenvervoer per pijpleiding**, Economisch Instituut voor de bouwnijverheid, Amsterdam, juli 1991.

- A. Heertje en J.B. Polak, **"De optimale samenstelling en omvang van het vervoer"**, Economisch Statistische Berichten van 20-2-1991, blz. 201 e.v.

- Prof. Ir. R.J.P.A. van de Hoorn, **mededeling over transport van goederen via pijplijncapsules**, Algemeen Dagblad, 11 januari 1992, O en W, pag. 11.

- R. Huetings e.a., **"Methodology for the calculation of sustainable National Income"**, Centraal Bureau voor de Statistiek, Statistische Onderzoekingen (M-reeks), Voorburg; zie ook NRC Handelsblad van 9-1-'92, O en W blz. 3.

- Drs. H.L. van der Kolk, **Benefits and burdens of car ownership and use: the issues weighed** - a summary, The Hague 1990, Institute for Research on Public Expenditure: **"Lack of clarity on the positiv externalities does however not detract from the fact that they could well exist".**

- H.H. van den Kroonenberg, **Hydraulisch capsuletransport**, Tijdschrift voor Vervoerswetenschap 1982/2, pg 180-190.

- H.C. Kuiler, **Inleiding tot de vervoers- en haveneconomie**, samengesteld en bewerkt door J.M. Verhoeff, Universitaire Pers Rotterdam, blz. 19.

- Drs. P. Melissen, MERC, **"De betekenis van de zeescheepvaart voor de nationale economie"**, Tijdschrift voor Vervoerswetenschap nr. 1/92 (nog te verschijnen).

- Ministerie van Verkeer en Waterstaat en Ministerie van Volkshuisvesting, Ruimtelijke Ordening en Milieubeheer, **Tweede Structuurschema Verkeer en Vervoer deel I**, Tweede Kamer, diverse jaren, nummer 20922.

- Ministerie van Verkeer en Waterstaat, **Tweede Structuurschema Verkeer en Vervoer, deel D**, blz. 8.

- Brief + bijlage van de (Nederlandse) Minister van Verkeer en Waterstaat van 9 december 1991 aan de Tweede Kamer der Staten-Generaal inzake **Motie nr. 22 Mevrouw Rooser-Van Pelt c.s.** in stukken Tweede Kamer, vergaderjaar 1991-1992, 22300 XII, nr. 35.

- Ministerie van Volkshuisvesting, Ruimtelijke Ordening en Milieubeheer, **Nationaal Milieubeleidsplan-plus**, nummers 20-21, Tweede Kamer, vergaderjaar 1989-1990.

- Ministerie van Volkshuisvesting, Ruimtelijke Ordening en Milieubeheer, **de Vierde Nota over de Ruimtelijke Ordening Extra (VINEX)**, Tweede Kamer 1990/1991, nummer 21879, nummers 1/2.

- NEI/NEA, **rapport Vervoerwijzekeuze in het Goederenvervoer**, herziene versie, NEI/NEA, Rotterdam, december 1990.

- Mr. P.A. Nouwen **"Het Dilemma van Mobiliteit, Milieu en Economie"**, Derde Bernard Mandeville-lezing, Erasmus Universiteit, 23 januari 1992.

- A.H. Perrels, L.P. Schippers, **Eerste raming van de marktomvang van Hogesnelheidstunneltransport**, Economisch en Sociaal Instituut, Vrije Universiteit Amsterdam, 5 juni 1991.

- Planco Consulting GmbH, **Intermodaler Wettbewerb zwischen der Bahn und den mit Ihr konkurrierenden Verkehrsträgern im Güterverkehr**, blz. 2-74, Essen, december 1990.

- Planco Consulting GmbH, **Externe Kosten des Verkehrs: Schiene, Strasse, Binnenschiffahrt**, blz. 22, Essen, 1991.

- Port of Rotterdam, **eindrapportage Eerste Fase van het toegevoegde waardeonderzoek**, Rotterdam, 17 april 1991.
- IPNR, NEI en ETAS, **Kwantificering Economische Effecten IPNR, NEI en ETAS**, Rotterdam/Hilversum, februari 1991, blz. 24.

- Prof. R. Willeke, Köln, **die externe Nutzen des Verkehrs**, Zeitschrift für Verkehrswissenshaft, 62 Jrg, 1991, Heft 4, blz. 191.

- Prof. W. Winkelmans, voordracht op de eerste Vlaamse Havendag, 13 september 1991 - **de Politiek-Ekonomische betekenis van een Economische Impact Studie en haar resultaten**, Kabinet van de Gemeenschapsminister van Openbare Werken en Verkeer, Pers- en P.R.-dienst.
  De studie is in opdracht van genoemde Vlaamse Gemeenschapsminister gemaakt door het studiebureau Policy Research Consultants van Prof.Dr. A. Verbeke; Weekblad Schuttevaer van 21 september 1991 alsmede Nieuwsblad Transport 14/9/91.

- Drs. J.G. de Wit, **De nationale Verkeers- en Vervoerrekening**, Tijdschrift voor Vervoerswetenschap 20/1: 5-17 (1984)

- Drs. J.G. de Wit, Drs. H.A. van Gent, Vervoer- en Verkeerseconomie, **overzicht van de subsystemen van het goederenvervoer**, H.E. Stenfert Kroese B.V. Leiden, Antwerpen 1986, blz. 130.

- Drs. T.J.J.B. Wolters, **Een macro-economische blik op de transportsector**, Tijdschrift voor Vervoerswetenschap 21/2: 100-116 (1985), Rijswijk.