COMPETITIVE AND SUSTAINABLE GROWTH (GROWTH) PROGRAMME

UNITE

UNIfication of accounts and

marginal costs for Transport Efficiency

Deliverable 2:

The Accounts Approach

Draft Version 2.1
30. October 2000

Authors: Heike Link, Louise H. Stewart (DIW),
Markus Maibach (INFRAS),
Tom Sansom, John Nellthorp (ITS)
with contributions from Partners

Contract: 1999-AM.11157
Project Coordinator: ITS, University of Leeds

Funded by the European Commission
5th Framework – Transport RTD

UNITE Partner Organisations
ITS/UNIVLEEDS (UK), DIW (De), NEI (Nl), CES/KUL (Be), TIS.PT (Pt), IWW/UNIKARL (De), VTI (Se), IER/USTUTT (De), CERAS/ENPC (Fr), HERRY (Au), EIET/ULPGC (Es), ISIS (It), STRATEC (Be), SYSTEMA (Gr), VATT (Fi), ECOPLAN (Ch), INFRAS (Ch), EKONO (Fi), EKI (Se)

UNITE

1999-AM.11157
UNIfication of accounts and marginal costs for Transport Efficiency

---

Deliverable 2: The Accounts Approach

This document should be referenced as:
Link H, Stewart L, Maibach M, Sansom T, Nellthorp J (2000) The Accounts Approach. UNITE (UNIfication of accounts and marginal costs for Transport Efficiency) Deliverable 2. Funded by 5th Framework RTD Programme. ITS, University of Leeds, Leeds, October 2000.

30 October 2000

Version No: 2.1

Authors: as above, with contributions from other UNITE partners

---

PROJECT INFORMATION

Contract no: 1999-AM.11157:
UNIfication of accounts and marginal costs for Transport Efficiency

Website: www.its.leeds.ac.uk/unite

Commissioned by: European Commission – DG TREN; Fifth Framework Programme

Lead Partner: Institute for Transport Studies, University of Leeds (UK)

Partners: ITS/UNIVLEEDS (UK), DIW (De), NEI (Nl), CES/KUL (Be), TIS.PT (Pt), IWW/UNIKARL (De), VTI (Se), IER/USTUTT (De), CERAS/ENPC (Fr), HERRY (Au), EIET/ULPGC (Es), ISIS (It), STRATEC (Be), SYSTEMA (Gr), VATT (Fi), ECOPLAN (Ch), INFRAS (Ch), EKONO (Fi), EKI (Se)

DOCUMENT CONTROL INFORMATION

Status: Draft for internal review
Distribution:
Availability:
Filename:
Quality assurance: <QA reviewer, organisation, date>
Coordinator's review: Chris Nash
Signed: Date:

Table of Contents **page:**

Executive Summary

The UNITE project is intended to provide appropriate methodologies and empirical evidence valuable to policy makers for setting charges for transport infrastructure use. A highly disaggregated system of information, with descriptions of marginal costs, fixed and variable transport costs and related revenues per country will be developed within UNITE. The research will be divided into two main sections: the development of transport accounts and the marginal costs case studies.

The purpose of this report is to describe the scope and aims of the accounts approach of UNITE. The basic valuation principles, the level of disaggregation and the methodology used to calculate transport accounts are described here. The accounts to be elaborated in UNITE will provide information about the present costs, charges and tax structure, as well as the groups who are bearing the costs and charges. They may also provide useful input data for studies of the effects of alternative pricing policies. They will not serve for immediate policy actions such as determining appropriate charges and taxes or shutting-down transport services/links. The accounts will rather be aimed at providing the methodological and the empirical basis for in-depth policy analysis.

The existing transport accounting practice in Europe is extremely heterogeneous. A review of existing transport accounts and accounting practice shows different aims depending on the existing institutional framework. For private and privatised entities financial monitoring within business accounts is used. On the other hand, social cost estimations have been attempted for many European countries. Different methods of estimating external transport costs have been used to describe price distortions in the transport sector. It will be challenging to unify and standardise present transport accounts for use in UNITE.

In order to create a standard methodology for the accounts, the accounting system will be developed into what is called the “ideal accounts” and the “pilot accounts”. The ideal accounts provide the basic structure and methodology to be used within UNITE. The pilot accounts are the actual, feasible accounts given the available data for the 18 countries contributing to UNITE. The Pilot Accounts to be elaborated in UNITE compare social costs and taxes/charges on a national level in order to monitor the development of total and average costs, revenues and their structure and the financial balance. The accounts can be seen as monitoring and strategic instruments at the same time. They will consider each country’s specific situation and institutional frameworks. The level of disaggregation and not the methodology is the tangible difference between the ideal and the pilot accounts.

The accounts are divided into six different sections, called cost categories (also called work packages and described in the Annex of this document), as follows:

1. Infrastructure Costs – Infrastructure costs are divided into capital costs and running costs. The main effects that influence the costs are the traffic load and mix, construction standards and maintenance requirements. The refined perpetual inventory model and, where this is not possible, the direct valuation of assets will be used to estimate the costs in this section. The required information on monetary costs will be obtained from private and public institutions. A sensitive issue is the allocation of common and joint costs to user groups and vehicle types. Arbitrary cost allocation will be avoided, which means mainly variable costs will be allocated.
2. Supplier operating costs – These costs are monetary costs paid by an operator for the provision of transport services. The main cost categories are vehicle related costs,

personnel related costs and administrative costs. The main cost drivers are the vehicle fleet structure, the service being offered and the wages of the employees. The required information will be obtained from private and public transport service operators. The Allport cost model will be used to evaluate the costs and revenues in this section. It is estimated that the available level of information disaggregation will fall short of the level described in the ideal accounts.

3. User costs – Time costs and operating costs have been identified as the main cost elements for user costs. Since total delay costs are both caused by and borne by transport users they are not included in the main part of the accounts. However, supplementary information is provided where possible both on total delays and on the revenue that would be produced by optimal congestion charging.
4. Accident costs – Accident costs can be divided into material damage, administrative costs, medical care, production losses and risk value. The cost drivers are the number of causalities and the number of accidents. Monetary costs will be taken from insurance companies and health department records. State-of-the-art studies will be used to estimate risk value. Many costs are joint costs, both because it is observable only on an aggregate level but also because two or more separate user groups are involved. These costs will not be arbitrarily allocated but recorded by victim. A scheme for information presentation has been developed which will allow a flexible interpretation of the cost allocation problem, including comparability with marginal costs. The 'system external' cost will be presented but also the total cost, which in addition enable estimates of the 'congestion type' accident externality.
5. Environmental costs – The approach used in UNITE to estimate environmental costs is a bottom-up approach (Impact Pathway Approach, based on ExternE-modelling) that allows accounting for specific locations and the calculation of damage costs for vehicle types, modes or the whole transport sector. The main costs are the effects on human health and damage to the environment. The major cost drivers are the specific emissions, the population density and the distance from the emission source.
6. Taxes, charges and subsidies – In this section the revenue side of the transport sector gains importance. Taxes, charges and subsidies are defined and data will be collected by vehicle, by mode of transport and by institution. The possibility of data overlaps and double counting between the sections is present and will be excluded by using the basic factor costs. Further more, attention has to be paid to subsidies which can be accounted for as cost reductions on the one hand and as revenues on the other.

The level of disaggregation for the accounts refers to: the functional dimension, to the dimension of modes and transport means, to the spatial/geographical dimension, to an institutional breakdown and eventually further to the specific requirements of each cost category. Out of these dimensions the most important decision for the pilot accounts is related to the functional and spatial differentiation since data availability with respect to these dimension will be limited. Furthermore, a general institutional breakdown for all modes will not be possible. The minimum data disaggregation for the pilot accounts will be:

- passenger transport and freight transport for all modes, further differentiated according to vehicle categories,
- public/private transport for road,
- differentiation for urban/suburban/rural areas in particular for public transport (buses, tramways, metro).

A list of basic physical data to be used in estimating many different cost items has been

compiled and will be used to ensure consistency throughout the accounts.

The method to be used to aggregate data has been developed and will be carried out by country and by Sector. It will be possible within the developed framework to compare costs and revenues and the percentage of costs that are fixed or variable costs for infrastructure and for the transport service provided.

1 Introduction

1.1 Study Context and Purpose of this Paper

The UNITE project is designed to support policy-makers in the setting of charges for transport infrastructure use by providing appropriate methodologies and empirical evidence. For achieving this aim UNITE has identified three core aspects which have to be elaborated, namely the transport accounts, the marginal cost estimation and the integration of both.

While the term marginal costs and at least the ideal methodological approach for estimating them is well defined there is less clarity with respect to the transport accounts to be elaborated within the UNITE project. Already the term „transport accounts“ is ambiguously used, and different people have different expectations on the purpose and the outcomes of transport accounts within UNITE. To elaborate a consistent methodology for the transport account, i.e. to define clearly the aims, the basic design, the structure and the categorisation and disaggregation of the transport accounts, is thus an essential step of the UNITE project.

This report deals with the methodological approach for the accounts. It focuses on the aims, scope, the basic valuation principles and the design of the accounts. A preliminary review of existing transport accounts is given in Deliverable 1: The Overall UNITE Methodology. A more detailed review of accounts can be found in the Annex of this document.

1.2 The Structure of this Report

This report starts in chapter 2 with reviewing and summarising the existing practice of transport accounts in Europe. This review and the findings of UNITE D1 feed in both for identifying the aims of accounts in UNITE and the basic methodological principles they should follow (chapter 3). Chapter 4 summarises the progress UNITE has made so far in defining the scope of the accounts, e.g. categorising costs and revenue elements to be taken into account in UNITE or not, and the level of disaggregation with respect to modes, transports means, functional and spatial differentiation.

Chapter 5 summarises the methodological approaches for each cost element considered, based on the interim reports IR 5.2 to IR 10.2.

Chapter 6 presents a template of the prototype design of the accounts and the basic steps for the elaboration. Chapter 7 concludes the decisive elements for further work.

2 Critical Review of the State of the Art

A thorough review of existing accounting practice with respect to underlying aims, methodologies and results is an important input for designing the UNITE accounts. From the review of accounting practice, which was started in D1 and has now been expanded in this report, we can draw the following conclusions:

We can distinguish three different aims of existing accounts. These aims depend on the existing institutional framework and the inclusion (or exclusion) of social costs.

1. Business approach - Financial monitoring. For private and privatised entities (ports, airports, some railways, some motorways), the business accounts compare costs and revenues according to the actual institutional framework. This framework usually does not consider all relevant capital costs (relief of past debts). Therefore some countries (i.e. Germany, Austria, Switzerland) estimate in addition capital values based on economic costs.
   For the road sector this business approach is in many countries rather virtual since the network is state owned. In order to present periodic financial performance, some countries developed road cost accounts based on economic costs (i.e. Germany, Austria, Switzerland).

2. Resource cost approach - Green accounting. Social cost estimations exist for many European countries, mainly for the road and the rail sector. Total cost balances are elaborated to have an overview of resource depletion of transport, used for green accounting purposes. Often these costs are compared with revenues in order to have figures for external costs. These approaches are extended in some cases to social account approaches considering as well distribution aspects (who pays, who suffers?).

3. External costs - Pricing. The resource cost approach is extended in order to have rough figures on price distortions in the transport sector. These estimations are carried out in different ways. Many countries just estimate external accident and environmental costs per person kilometre (PKM) and tonne kilometre (TKM) respectively. Some countries (like Finland) compare average variable costs with average variable user contributions. Based on the propositions of the Commissions approach of social marginal cost pricing, some countries elaborated bottom-up methodologies (not annual accounts) to estimate social marginal cost and – considering cost recovery – necessary price changes (for example the Netherlands).

The existing accounting practice in Europe is extremely heterogeneous. The most important reasons for this can be found in different institutional backgrounds for different types of infrastructure and traffic units on the one hand. On the other hand, cost estimation is done in order to serve different aims, namely i) pricing and ii) evaluation of projects (CBA). Only in those countries where infrastructure and/or transport operators are public-owned a public interest in elaborating accounts covering all modes on the national level does exist. Typical examples are the multi-modal German account and the road-infrastructure accounts in Switzerland. In most countries, however, a comparison of modes based on a consistent methodology is not a primary issue.

Several implications on the accounting practice result from the liberalisation process in particular in the aviation and the rail sector. A first implication is that these sectors have to turn to more service-orientation. This can be observed for example in the rail sector where the

EU draft directive of rail infrastructure charging distinguishes service-packages for the infrastructure starting with a minimum access package and offering in additional packages further services such as the use of electricity supply equipment, shunting, access to telecommunication networks etc.. As a consequence of this transition to service packages the delimitation between pure infrastructure (based on an asset definition) and services is more complicated to be drawn. The existing business accounts in these sectors are rather based on this new approach of defining service packages.

A second implication of the liberalisation process concerns the rail sector where privatisation „deals„ usually contain not only debt relief in form of relief from interest payments for infrastructure capital, but also re-valuation of infrastructure capital which was often aimed at presenting lower capital costs for the new rail companies than before the privatisation. Consequently, the costs within business accounts of rail companies mostly do not reflect any longer real economic costs. For example, while in Germany the capital devaluation left only 20% of the original asset volume and consequently depreciation and future re-investment are not covered, a recent analysis for Switzerland has shown, that the reconstruction of the 'economically right' capital value is not relevant for future resource allocation as long depreciation and future reinvestments are considered properly.

A third implication of the liberalisation process and the transition to business accounts is data availability. Formerly national companies are not anymore willing to provide all kind of data.

Furthermore, the state of the art review has shown that costs are easier to estimate than allocating revenues properly, since some taxes and charges have in many cases general fiscal aims grown in the history of financial policy. The definition of those taxes and charges which are related to transport and which can thus be compared with the cost side is therefore an essential and often heavily disputed step. For example, in Germany we can observe at present an ongoing debate whether fuel excise duties should be considered within the accounts. Another discussion is the consideration of VAT.

The review of existing accounts has shown that the most important aim of accounts is financial monitoring as it is the case for business accounts. Some accounts (like for example the Swiss road or railway accounts) are thus virtual business accounts which aggregate different financial accounts and consider new elements of valuation towards real costs.

Since the 80s an increasing awareness of environmental problems has lead to the development of social cost accounts which include external costs of environmental damages, climate costs and noise costs. In business accounts external costs are only addressed as long as they have a financial consequence. This was always the case with accidents insurance which is equally true for those accidents which cause additional environmental damages. Railways or airports for example consider as well future expenditures for noise protection measures or other measures which are at stake.
Thus the social accounts mainly serve as a monitoring tool of transport resource depletion (part of green accounting). The structure and the development of costs is more interesting than the level of cost coverage.

Given the heterogeneous situation of accounts to date it is the challenge of UNITE to create a harmonised basis for the future elaboration of accounts. The review however tells us, that only a rough structure might fit to all those issues covered in the present practice.

3 Aims and Principles for the Accounts

3.1 Aims and purpose

Starting point for creating accounts within the UNITE project are the key policy issues identified in Deliverable 1 (The Overall UNITE Methodology) as being relevant for UNITE:

- Identifying the structure and level of costs and charges for the provision and use of infrastructure,
- Identifying the relevant financial and social cost coverage considerations for determining charges, including current levels of cost coverage,
- Guaranteeing fairness and non-discrimination of charging.

Considering the history of accounts practice within the EU Commissions work, the first attempt based on the regulation 1108/70 was to get periodic information from the Member States on infrastructure costs for the purpose of financial monitoring. With the Green paper on Fair and Efficient Pricing and the subsequent White Paper on Fair Payment of Infrastructure Use, the aims of transport accounts can be expressed as follows:

- Enforcement of transport regulations: What is the development of costs and user contributions in the Member States, based on the relevant regulations (i.e. charging purposes)?
- Cost recovery and tax structure: Do the charges imposed recover the financial costs?
- Application of social marginal cost pricing: Does the level and the structure of charges and taxes fit to the principles of Social Marginal Cost Pricing?

The accounts to be elaborated in UNITE can contribute to these policy issues by providing the necessary methodological and quantitative information. However, they will not serve for immediate policy actions such as setting higher/lower prices and charges or shutting-down transport services/links in order to achieve cost coverage. The accounts will rather be aimed at providing the methodological and the empirical basis for in-depth policy analysis (monitoring tool).

This implies that the accounts are more a set of information than a precise product, in order to provide periodic answers to the questions raised above, but considering as well the different institutional background of the transport sectors within the Member States.

Based on the these aims and the existing practice, the following interpretation is of main importance and require specific information:

Coverage of financially relevant costs (both public and privately organised financing forms)
Do transport institutions cover the financially relevant costs? This question is relevant for infrastructure provision and use and for (subsidised) public transport in general (including transport services). In accounts which are designed to meet this aim the financially relevant costs are compared with the revenues from the transport sector. While the available business accounts consider this aim by definition, for not business oriented infrastructure accounting adequate approaches often have to be developed. Cost coverage and its development over time is the most important output for accounts with this aim. Since not all taxes and charges are specifically transport-related (but fiscally motivated, e.g. allocated to the general budget), it is not trivial to define the revenues to be compared with transport-related costs. Furthermore, the different methodologies of business accounting and national, macro-

economic accounting practice have to be brought together.

Information on resource consumption in the transport sector
Accounts serving for this aim deal with total social costs on a national level. Total and average costs per transport mode and cost category are the most important figures to be produced in order to monitor the development both of absolute levels and of efficiency measured in costs per transport unit. It is crucial to have a sound updating mechanism since the value of this output is only relevant if time series can be produced.

Price-relevant information on costs and charges („Are the prices right?„)
Accounts based on this aim relate to the approach of social marginal cost pricing and compare the structure and the level of existing taxes and charges (e.g. variable/fixed/differentiation according to other criteria like environmental performance etc.) with the social marginal costs of transport. This can be done by using a bottom-up approach (specific link based comparison for different situations) or by a top down approach, estimating fixed and variable costs per transport mode and comparing them with fixed and variable charges. Whereas the bottom up approach is very context-specific and will used when ever possible within the specific cost categories, the top down approach is derived from national averages and allows a rough periodic comparison.

The accounts have to provide the relevant information for the monitoring of these purposes. From a methodological point of view, the framework of the accounts has to be open enough to consider different institutional backgrounds, different purposes. In the following section, we try to develop the most important principles in order to provide a sound framework

Excursus: Integration in a macroeconomic accounting framework
The principles mentioned above are microeconomic oriented, i.e. the idea is to compare costs and related revenues of the transport sector. Nevertheless, there are several links to methods and even quantitative outputs existing already at this level. An example is the asset's value of infrastructure which is estimated by using the perpetual inventory approach. This method is a macroeconomic one and the results correspond to the gross fixed capital formation for industrial branches in the Systems of National Accounts (SNA). Nevertheless, within a macroeconomic context, the question arises, how these transport costs can be integrated in a general national accounting framework, in order to gain information on the relevance of these social transport costs in relation to gross national production. The tool to elaborate this is called the 'Social Accounting Matrix' SAM, which is an extended matrix based on current practice of Input-Output-Matrices. These matrices allocate inputs in the transport sector in order to show structure of income generated (intermediate inputs from various sectors plus net value added (labour, capital) plus profits plus interest/depreciation plus indirect taxes minus subsidies). A general SAM scheme is looking at the interdependencies of the following categories:

1. Goods and services (products)
2. Production (industries)
3. Generation of income (value added categories)
4. Allocation of primary income (institutional sectors)
5. Secondary distribution of income (institutional sectors)
6. Use of income (institutional sectors)
7. Capital (institutional sectors)
8. Fixed capital formation (industries)
9. Financial assets
10. Rest of the world

The SAM approach may be integrated in a table for satellite accounts which is used in several countries (e.g. USA). This satellite account considers a supply table (transport producers; distinction between market producers, non market producers and imports) and a use table (transport users; distinction between market producers, non market producers and exports).

The interesting extension within the context of social cost accounting is the integration of non market activities induced by the generation of external costs like accident or environmental costs. We consider this extension as a contribution to the integration of transport cost accounts into 'Green GDP' valuation approaches, which can be seen as one dimension of so called 'ideal accounts'. Within the accounting framework pursued here, the approach is very ambitious and affords high quality of disaggregated data. Thus it will be used and elaborated further with the Integration framework.

3.2 Some basic principles

Based on the aims of accounts defined above and considering the conclusions of D1, the following basic principles for the design of accounts are suggested. These principles will help to restrict the wide ranges of possibilities to elaborate accounts. At the same time however the approach has to consider different methodological views.

3.2.1 Consideration of costs and benefits

a) Consideration of internalised costs (external versus social costs)

Accounts which are based on top-down approaches can derive external costs only by comparing costs with user contributions.[1] Thus it is necessary to start with social costs. Here the question arises if private costs (which by definition are properly paid) should be included too. For this question two answers can be given which depend on the purpose of accounts:

1) For charging issues private costs are definitely not relevant. However, for a sound comparison of total resource consumption between modes, the consideration of private costs within the accounts would be useful. Detailed estimations however would not be necessary, since these costs are costs and payments at the same time.
2) The conclusions of D1 clearly indicate that fully internalised (private) costs, e.g. costs where the users both impose and bear the costs do not belong to the main body of the accounts.
3) It is also the case for the main accounts that costs imposed by one user on another within the same group should not be included as the cancel out within the overall category of costs in question. Examples of such costs (or benefits) are delay time, the Mohring effect and part of accident costs. These factors are very important for purposes of marginal cost pricing but not easily dealt with at the total level.
4) Because of its importance estimates of delay costs will be provided as supplementary information.

1 This is a difference to a bottom up oriented specific approach, where unit costs (i.e. for specific links) are elaborated.

b) Consideration and allocation of revenues

As already stated in chapter 2 the decision on which revenues are to be compared with costs in the transport accounts is a complicated one since the charging and taxation systems have evolved historically and are not always transparent. An example is the road sector where in many countries – in absence of specific charges such as tolls – fuel taxes were introduced (and increased) with the aim to generate revenues for road financing. However, the revenues usually got to the general budget and are often used for other purposes. While it is obvious that all revenues have to be considered which are specifically transport related such as

- direct charges relating to specific transport services (like vignettes for motor ways)
- earmarked taxes which are specifically transport related;

it is more complicated to deal with fuel taxes and other taxes such as VAT. There are two views:

1. Only those additional charges and taxes should be considered, which represent a specific transport burden (in comparison to other sectors). This principle is applied in German and Swiss transport accounts. That implies that VAT and other general taxes should not be considered. It is however not always clear which level (e.g. of fuel taxes) is a specific transport related tax burden.
2. All user contributions should be considered, in order to reflect total willingness to pay of the users.

If we define only earmarked taxes as revenues, we would finally end up with a comparison of costs with actual expenses (e.g. the earmarked parts of taxes) and not with user payments (revenues). It has to be stated that there is no clear scientific answer. The consideration of revenues and relevant cost recovery rate depends on the purpose. Thus the accounts within UNITE have to deliver this information in a rather general way, including all type of revenues and present a clear structure (i.e. earmarked, additional financial burden, other taxes, general taxes).

c) Supplier operating costs

In most sectors transport is organised in a way that a chain of different agents exists. Except private car driving, this chain leads from the infrastructure provider over the transport service supplier to the final user. Charges for the use of infrastructure affect thus only the private car driver directly as the final user while in other sectors such as public transport and aviation the service supplier as the direct user of infrastructure has to bear infrastructure charges and to pass them (partly or completely) through to the final user. Thus, the question arises whether and how to treat supplier operating costs in UNITE.

The original Commission terms of reference referred to „transport infrastructure use charging„. However, the statements already made and the experience from 4th Framework projects (PETS etc.) highlight major issues of:

– cost structures for supplier operating costs (e.g. where AC<> MC);
– mismatch between supplier operating costs & final user charges;

Therefore, the UNITE project will consider that the supplier operating costs and their related revenues as an important part of the general structure.

d) Treatment of subsidies

Particular attention has to be paid on a proper treatment of subsidies in the UNITE accounts, avoiding double counting. Although a detailed methodological proposal regarding this issue can only be derived after having a complete list of definitions and practice of subsidies per country we can suggest at this stage of the project that all subsidies should be shown in the accounts in a separate line as „additional information". Whether and to what extent subsidies have to be added to the total costs depend on whether they are already implicitly considered (for example if devaluated capital is considered with its „right" capital value). If possible this information should consider as well the purpose of the subsidies (i.e. general deficit coverage or payment of specific services, like P.S.O. in public transport).

e) Consideration of transport benefits

Within business accounts, the revenues are usually the benefits which can put in relation to costs. Within accounts considering as well social costs, the question arises if there are (besides charges and taxes) additional revenues to consider, like consumer surplus or the added value of transport to economy or society. A business entity usually starts drawing a social balance for these issues, and does not include such benefits into their annual business accounts. If one would enlarge the social accounts with additional benefits, one should include the costs (resource depletion) related to those added value as well. This is definitely another systems delimitation which is not relevant here. Thus, additional transport benefits should not be considered.

3.2.2 Valuation issues

a) Business versus social basis for accounts

D1 has clearly stated that the primary basis for both answering efficiency and equity question in UNITE will be a **social basis**. The advantage of this is that like-for-like comparisons across modes are possible even if modes face different institutional settings. However, in many cases UNITE will have to draw on information sources which stem from business accounts. As already stated in chapter 2 the accounts will have to treat country-specific the question how business information will be used and to what extent this information has to be revised in order to be in line with economic principles.

We can conclude that the UNITE accounts have to provide information on total social economic costs and not business costs. The relation to the business accounts used however should be made clear. A typical example might be infrastructure costs. Whereas the running costs will be derived from available business accounts, capital costs need specific estimation tools. The capital costs in the business accounts and the real (economic) capital costs should both be considered.

b) Costs versus expenditures

Based on the statements made above it is evident that not annual expenditures but costs (including opportunity costs for capital) should be considered. The capital costs should represent (as good as possible) future expenses for reinvestments.

The question arises if interest rates should be considered as well. There are two views:

1) Opportunity interest rates should be considered in order to reflect the opportunity costs of capital (treatment of infrastructure like other investments).
2) Financially relevant interest rates should be considered, since they are a product of a (democratic) 'deal' between the government and a private institution. Other interest rates do reflect historic costs which are not relevant for the future (treatment of infrastructure as a good which cannot be sold to third parties).

Keeping in mind that UNITE accounts should reflect economic costs which might differ from business costs[2], it is evident that interest rates should be considered for all types of capital and full opportunity costs[3] should be reflected. Thus opportunity interest rates should be derived.

c) Factor costs or market prices

Market prices include as well taxes and subsidies and does do not reflect true economic resource costs. Since the information within the accounts aims at providing the economic valuation of costs and revenues, it becomes evident to choose factor costs as the basic valuation principle for the accounts. This is specifically important for infrastructure and supplier operating costs which usually consider as well general income taxes and charges. Here it is suggested to add this information separately.
It has to be considered however that the approach has its limits. It is (for example) not trivial to derive factor costs for health services (relevant for accident costs) or for agriculture (relevant for environmental costs). Thus it is necessary to use a simplified approach (based on country values) to adjust according to official average tax values.

d) Cost allocation

If accounts are required to provide disaggregated results for user groups, traffic types and vehicle categories the problem of how to allocate costs to them occurs. This is a complicated and often politically sensitive issue since average costs (which is the essential cost category of accounts) contain common and joint costs which are by definition not linked to a certain type of user/vehicle. In the theoretical literature and in practice (in particular in the US rail regulation practice) various cost allocation methodologies have been proposed which, however, tend to be more or less arbitrary.[4] For the UNITE accounts we suggest to avoid as far as possible arbitrary cost allocation. However, we have to bear in mind that this has consequences for the level of disaggregation of the accounts. Since often already the separation of costs between passenger and freight transport operations is complicated (for example for infrastructure costs in the rail sector) the choice might than be either to produce only one aggregate figure or to allocate costs. We suggest therefore an approach which distinguish between fixed and variable costs since this is a necessary pre-step for the marginal cost estimation too. We suggest furthermore to apply country-specific allocation procedures based on some common basic principles (for example like those proposed in the HLG-paper for road) but with country specific values and parameters. As far as possible sensitivity

2 It has to be considered, that the allocation procedure of interest rates on a business level is usually very politically motivated and might differ from case to case. Thus a fair comparison between transport modes cannot be guaranteed.

3 It is useful to use an interest rate based on the refinancing costs of public capital (if possible standardised throughout Europe.

4 Most important are the principle of allocation according to use (e.g. acc. to vkm, axle-weight-km etc.) and the principle of 'additional costs' (e.g. road width according to the size of vehicles or specific features for specific means of transport (e.g. signalling systems for High speed rail).

analysis should be carried out in order to compare different procedures (as done in DIW 1998 for the road sector).

3.2.3 Issues of comparability

a) Comparability across modes

One of the concerns for the accounts in UNITE is to elaborate results based on comparable designs and methodologies across modes. Basic principles for meeting this requirement are:

- Definition of the same scope for each mode, e.g. the inclusion and treatment of consistent cost and revenue categories drawn from the same data set,
- Set-up of the same cost estimation basis, e.g. consistent approaches to estimation of unite values,
- In case of different institutional arrangements: elaborating a basic account with comparable definitions and methodologies additionally to specific accounts for the different institutional frameworks.

As already mentioned under point 3.2.1, private costs would not be considered within the accounts. This leads to a constraint of comparability since total social costs of public transport include as well supplier operating costs, whereas total social costs of private road transport regards these costs as internal. This issue has to be kept in mind if total costs recovery rates will be compared.

b) Comparability across countries

UNITE accounts have to consider national circumstances based on a generalised methodology. This is not an easy task since the existing practice, the existing charging systems and the existing cost estimations differ widely:

- We will use national statistics to derive actual amounts of transport volumes, accidents and emissions. In general the territorial principle will be applied. (Estimation of the costs and revenues drawn from the transport volumes within national frontiers). For international transport (air transport, short sea shipping) however, standardised methods will have to be applied (allocation to countries according to the number of take off and landings).
- The unit values for the estimation of social costs should be harmonised on a common methodological level. This is especially true for time values, values of statistical life, values per unit of emissions etc. However if national figures are available which are in line with the methodology chosen, national values will be applied. If these values are not available, default values will be provided, which should be adjusted according to a PPP approach.
- National circumstances (different institutional frameworks, different structure of taxes and charges) will be considered in the accounts template, in order to leave freedom for the interpretation of the results.

3.2.4 Elaboration and updating issues

a) Top-down versus bottom-up approaches

Since national transport statistics are usually developed quite well, the value of accounts is providing a national average. Top down approaches are able to provide this information. However the problem of cost allocation might arise. Within a bottom up approach, the cost allocation is easier, but the problem of aggregation arises. Thus both approaches have their advantages and disadvantages. We conclude to use both approaches enabling a comparison of results between them. This is especially true for the computation of environmental costs where the ExternE models are applying as well for the estimation of total costs a 'quasi bottom up' approach, which should be compared with other top down oriented estimates (for specific countries where those results are available, for example Switzerland).

b) Updating issues

It has to be considered that accounts are only useful if they can be repeated periodically in order to develop time series. Thus the expenses for updating should be reasonable. This implies a level of disaggregation which is not too deep. This also implies that the scope of ideal accounts is only relevant if the approach can be translated into practice, at least in those countries with a high level of data availability.

c) Treatment of major constraints

A first type of potential constraints on the accounts design is the fact that not all forms of charging for infrastructure and services all possible in all countries. To give a few examples it has to be mentioned that

- toll roads may be set by 30 year concession terms for toll roads,
- many rail fares are not determined by the state,
- governments have no control over air fares,
- governments have only limited control over air landing charges.

We suggest that these facts should not limit the scope of accounts nor prevent highlighting where big differences between social costs and charges occur.

A second type of constraints are related to availability and quality of data. Mainly to be mentioned are

- commercial confidentiality of data,
- variable quality of data,
- missing frequency of data provision.

These two factors imply that the exact design of the accounts for each country and mode must follow pragmatic considerations and will have to be data driven.

3.3 Conclusions

a) An open information scheme on cost and revenues

Based on the general consideration on accounting aims and on the basic principles identified in this chapter we can give a first definition of accounts:

The Pilot Accounts to be elaborated in UNITE compare social costs and taxes/charges on a national level in order to monitor the development of costs, the financial balance and the structure and level of prices. Accounts are thus monitoring and strategic instruments at the same time. They have to consider the country-specific situation and the institutional frameworks.

b) Ideal and pilot accounts

The open approach derived from the basic principles implies that there is no general methodological difference between ideal and the pilot accounts. Furthermore the differences relate to the scope and the in-depth analysis of costs and revenues. We will discuss these issues in the next chapter.

4 Summary of the Scope of Accounts

Based on the suggested principles and guidelines for the accounting work in UNITE we will now define our preliminary proposals on the scope of the accounts. When we refer to the term "scope of accounts" we mean the categorisation and differentiation of the accounts along the following dimensions:

- cost categories within and out the scope of UNITE,
- revenue categories within and out the scope of UNITE,
- traffic modes and means,
- functional differentiation of costs and revenue categories,
- spatial differentiation of infrastructure,
- institutional differentiation of infrastructure and service suppliers,
- further cost category-specific differentiation.

4.1 Categorisation of costs and revenues

As a starting point for the categorisation of cost and revenue elements which are considered to be relevant for the UNITE-accounts a set of categorisation criteria has been developed and can be seen in table 1.

Table 1: UNITE-account categorisation criteria

1. Relation of the cost/revenue element to transport function or to non-transport function;
2. Relation of the cost/revenue element to transport infrastructure or transport service;
3. Relation of the cost/revenue element to use or provision of infrastructure;
4. Relation of the cost/revenue element to link or node;
5. Interrelation to another mode;
6. Relevance of life-cycle problems (e.g. costs occurring in production of traction energy);
7. Link to final user or mode;
8. Necessity of an entry at costs or revenue side (for which user/agent);
9. Cost/revenue element: external or internal for user;
10. Cost/revenue element: fixed or variable;
11. Cost/revenue element: monetary or non-monetary;
12. Relation of the cost/revenue element to time periods (immediate occurrence, long term impact);
13. Geographical aspect (local, regional, national, global occurrence and impacts);
14. Relevant/necessary level of network disaggregation (cost differences, network relevance of certain charges);
15. Relevant/necessary level of disaggregation into user groups, vehicle types;
16. Necessity of further category specific disaggregation (e.g. technology of vehicles for the cost category: Taxes, Charges and Subsidies);
17. Possible overlaps with other cost categories (what type);
18. Importance of different institutional backgrounds for the cost/revenue elements in all cost categories; relevant disaggregation treatment;
19. Relevance of the cost element for accounts;
20. Relevance of the cost element for Marginal Costs;
21. Correspondence between entries in accounts and in Marginal Costs;
22. Practicability of quantification in the timeframe of UNITE;
23. What feedback between cost/revenue elements exists with supplier operating costs.

4.1.1 Cost categorisation

Based on the Interim reports from detailed cost category descriptions (see Annex), table 2 gives an overview of the categories and elements to be included on the cost side of UNITE accounts, identifies the overlaps with other categories and makes suggestions where overlaps between the categories have to be treated.

Table 2: Cost categories and cost elements within and without the scope of UNITE

Cost category/element	**Ideal Accounts**	**Pilot accounts**	**Out of scope of UNITE**
1. Infrastructure Costs			
1.1 Capital costs for existing Infrastructure	V	V	
1.1.1 Depreciation	V	V	
1.1.2 Interest for infrastructure assets and real estate	V	V	
1.1.3 Interest for past debts	V	V	V (optional)
1.2 Running costs			
1.2.1. Ongoing maintenance of infrastructure	V	V	
1.2.2 Operation of infrastructure (signalling, lighting, cleaning etc.)	V	V	
1.2.3 Administration			
- Overheads of infrastructure providers (airport authorities, port authorities)	V	V	
- Traffic police	V	V	
- Traffic control	V	V	
- Car parks			V
- Cost of transport ministries, municipal transport department, car registration offices etc.			V
Cost category/element	**Ideal accounts**	**Pilot accounts**	**Out of scope of UNITE**
2. Supplier operating costs			
2.1 Vehicle-related costs			
- annual depreciation of equipment	V	V	
- fuel	V	V	
- maintenance, repairs	V	V	
- consumables	V	V	
All costs related to essential personnel required for the operation of vehicles (drivers, mechanics, etc.)	V	V	
2.2 Service-related costs (All costs directly related to the transport service)			
- catering	V	V	
- cleaning	V	V	
- ticketing	V	V	
- all personnel required for service to passengers and freight: stewards, inspectors, ticket sellers etc.	V	V	
2.3. Administration and commercial costs			
- rental payments for buildings or offices	V	V	
- consumables	V		

- advertising	V	V	
- all personnel assigned to administration.	V	V	
2.4 Insurance and Financial costs			
- all insurance payments on policies linked to the transport activity (civil responsibility, accidents, etc.)	V	V	
- financial costs which can be considered as fixed (e.g. interest on general loans, debt and other financial institution's fees)	V	V	
2.5 Costs linked to the **use** of infrastructure	To be documented under Revenues and be shown here as supplementary information		
- payments associated with facilities for parking vehicles (garages, hangars, etc.)	V	V	
- tariffs and prices paid for the use of basic infrastructure (tolls, port tariffs)	V	V	
2.6 Maintenance of infrastructure (Costs related to ordinary maintenance operations performed on infrastructure and assumed by the operator) such as cleaning, minor repairs	V	V	
Interests on loans for acquisition of vehicles			V
Payments linked to leasing of vehicles			V
Taxes on profits			V
VAT, Taxes on inputs etc.	V	V	
Cost category/element	**Ideal accounts**	**Pilot accounts**	**Out of scope of UNITE**
3. User Costs			
3.1 User time costs due to road congestion			
- Waiting time costs	V		
- Delay time costs	V	V	
- Crowding costs	V	V	
- Search time costs	V		
3.2 User operating costs due to road congestion			
- Fuel consumption	V	V	
- Driving and handling personnel	V		
- Depreciation /Capital costs	V		
- Vehicle wear and tear	V		
- Administrative costs	V		
3.3 User time costs due to PT congestion			
- Queuing time costs	V		to be included in crowding costs
- Crowding costs	V	V	
3.4 User time costs due to PT scarcity			
- Waiting time costs	to be included in delay time costs		
- Delay time costs	V	V	
- Search time costs	V		
3.5 Effects on non-motorised transport participants (cycling, pedestrians)			
-Separation effects in urban areas	V	V	
Scarcity-effects on PT operating costs	Will be included in Supplier Operating Costs		

Mohring benefits (only relevant for marginal costs)			V
Traffic delays due to accidents	Will be included in Accident Costs		
Traffic delays due to operational problems of transport suppliers	Will be included in Supplier Operating Costs		
Psychological impacts due to congestion			V
Noise and exhaust fume exposure of traffic users in congestion			V
User benefits due to the congestion-indicated extension of traffic infrastructure			V
Congestion due to bad weather conditions			V
Traffic delays due to infrastructure maintenance activities			V
Cost category/element	**Ideal accounts**	**Pilot accounts**	**Out of scope of UNITE**
4. Accident costs			
4.1 Material damages to public and private property			non-reported road accidents
- vehicles	V	V	
- road-side facilities	V	V	
- buildings	V	V	
4.2 Administrative costs			
- police	Information from Infrastructure Costs to be shown here as supplementary information		
- justice	V	V	
- insurance system	V	V	
4.3 Medical costs			
- First aid and ambulance	V	V	
- Accident and emergency	V	V	
- In-patient treatment	V	V	
- Out-patient treatment	V	V	
- Non-hospital treatment	V	V	
- Aids and appliances	V	V	
4.4 Production losses			
- Replacement costs	V	V	
- Current and future net lost output	V	V	
- Additional delay costs	To be documented in User Costs		
4.5 Risk costs			
- Costs of suffering and grief	V	V	
Accidents which not involve any motorised element, suicides and working accidents, as well as the cost of risk avoiding behaviour			V
Expenses for safety measures related to infrastructure, for example crash barriers	To be documented in Infrastructure Costs		
Expenses for safety measures of service suppliers	To be documented in Supplier Operating Costs		
Environmental costs due to accidents	To be documented in Environmental Costs		
Cost category/element	**Ideal accounts**	**Pilot accounts**	**Out of scope of UNITE**
5. Environmental costs			
5.1 Air pollution			
- human health	V	V	

- natural environment	V	V	
- building materials	V	V	
- Emissions due to congestion	V	V	
5.2 Global warming	V	V	
5.3 Noise impacts	V	V	
5.4 Nature and landscape	V	V	
- eco-systems and biodiversity	V	V	
- landscape	V	V	
5.5 Soil and water pollution	V	V	
5.6 Nuclear risks	V	V	
5.7 costs of vehicle production, maintenance and disposal	V		
5.8 other environmental effects (visual intrusion, vibration)			V

4.1.2 Definition of revenues/subsidies

After having presented a preliminary structure for the cost side of the accounts, the next step now required is to define user contributions in form of taxes, charges, tariffs, fares etc. which form the revenue side of the accounts. This step is highly complicated for several reasons:

- Different actors are involved with the several financial flows that comprise taxes, charges and subsidies. These actors can be payers and recipients of these flows at the same time. It depends on the institutional framework and on the level of disaggregation of the accounts, whether an entry at the cost side or at the revenue side has to be made.
- In particular subsidy flows are often difficult to detect (problem of hidden subsidies). They can affect the cost side (for example reducing the costs) or the revenue side (for example increasing revenues).
- As already stated in chapter 2 and 3 the taxation and charging systems have developed historically and include some transport-related taxes (for example the fuel tax) which serve general fiscal aims.
- The definition of the relevant financial flows as revenues that are to be compared with the costs depends on the type of the account product. There are several solutions, as discussed in chapter 3.

At the present stage of the project we can suggest some preliminary guidelines and categorisations on how to treat taxes, charges and subsidies:

1. Specific money flows from one or more actors inside the transports sector to the government (for example: fuel tax).
2. General funds to one or more actors inside the transport sector (for example: transport specific subsidies).
3. Financial flows within the transport sector (for example: service providers charge final users).
4. Guaranties and insurance for companies if the financial flows are visible.

Out of the scope of UNITE are:

1. General taxes, for example income taxes.

2. Revenues from fully commercial service suppliers (such as cargo operators or Airlines).[5]

In particular for the latter category (out of scope of UNITE) further discussion in the course of the project seems to be necessary. If, for example, an Airline company is fully commercial and does not receive any subsidies in one country, this must not be true in another country. An example for this country difference might be United Airlines on the one hand and Air France on the other hand. Whether or not revenues from service suppliers are to be excluded from UNITE depends obviously on the country specific situation. Table 3 summarises the revenue side of the accounts

Table 3: Revenue within the scope of UNITE

Cost category/element	Ideal accounts	Pilot accounts	Out of scope of UNITE
Revenues			
6. Taxes, Charges and Subsidies			
6.1 Charges	V	V	
- infrastructure access	V	V	
- freight tariffs	V	V	
- public transport fares	V	V	
- vehicle insurance payments			
6.2 Taxes	V	V	
-Annual vehicle registration taxes	V	V	
-Airline passenger or seat tax	V	V	
-Fuel duty	V	V	
-VAT on fuel duty	V	V	
The following taxes, when the rates differ in the transport section from the standard tax rates			
-Sales tax	V	V	
-Income tax	V	V	
-Social security contributions	V	V	
-VAT	V	V	
-Insurance premium tax	V	V	
6.3 Subsidies			
- discounted fares	V	V	
- public/private transport provision	V	V	

4.2 Level of disaggregation

As already stated the disaggregation level of accounts refers to the functional dimension, to the dimension of modes and transport means, to the spatial/geographical dimension, to an institutional breakdown and eventually to further to the specific requirements for each cost

5 That implies as well that the related costs (for transport businesses which do not receive subsidies) are not considered, since they are defined as private costs.

category. Out of these dimensions the most important decision for the pilot accounts is related to the functional and spatial differentiation since data availability with respect to these dimension will be limited. Furthermore, a general institutional breakdown for all modes will not be possible. We suggest the following “musts” for the pilot accounts:

- passenger transport and freight transport for all modes, further differentiated according to vehicle categories,
- public/private transport for road,
- differentiation for urban/suburban/rural areas in particular for public transport (buses, tramways, metro).

Table 4 contains these differentiation requirements which are “musts” for the pilot accounts, and the optional differentiation mainly required by the specific estimation procedures within the defined cost categories. It should be noted that all these proposals refer to the pilot accounts. Since the pilot accounts will mainly use a top-down approach and will rely on national transport statistics it is evident that the usual classifications by modes and means of transport have to be used. The focus is here on a sound and pragmatic differentiation based on the statistical material without further problematic assumptions. This means also that combined transport will not be a specific issue since there are no multimodal statistics available. For ideal accounts certainly a further differentiation is desirable.
It should be borne in mind that the differentiation will consider the relevance of disaggregation. In order to have information for the EuroVignette for example, it is very helpful to have information on HGV road costs for motorways.

Table 4: Scope of UNITE-accounts: Level of disaggregation

Dimension	**Essential Differentiation for the pilot accounts**	**Optional Differentiation (ideal accounts) (depends on data availability)**
Cost categories	- categories as indicated in table 2 - Fixed costs and variable costs - Financial relevance of costs (Infrastructure costs, supplier operating costs only for public transport, rail, urban P.T.)	Differentiation acc. to specific cost categories (see table 2)
Revenue categories/ User contributions	- categories as indicated in table 2 - Earmarked charges, additional taxes as transport-related, specific burdens, - VAT	
Traffic modes and means and user breakdown 1)	**1. Road:** Motorcycles, Cas, Buses, Coaches, HGV, LGV **2. Rail:** Passenger, Freight **3. Urban public transport** Bus, Tramways, Metro **3. Inland waterways** Freight **4. Short sea shipping** Ports, overseas **5. Commercial aviation** Airports, flights	**1. Road:** · type of infrastructure (Motorways, other roads) · engine type (Gasoline/Diesel, Euro-norms) · Weight differentiation **2. Rail:** · type of infrastructure (High speed lines, main lines, minor lines) · train type (High-speed trains, IC/EC, freight trains) · traction type (Diesel/Electric traction) Terminals of combined transport **3. Inland waterways** · type of infrastructure (channels, other waterways) · type of vessels **4. Short Sea shipping** type of ports, type of vessel **5. Aviation** type of airport, short range, domestic flights, international flights
Functional differentiation	See traffic modes	Scheduled/non-scheduled (User Costs and Benefits)
Spatial differentiation	See traffic modes	Further differentiation of spatial desegregation and crosstabs with modes, esp. urban/interurban
Institutional differentiation	See traffic modes	evtl. in Infrastructure Costs: separate treatment of a private motorway company
1) Depends on available statistics and relevance in respective countries		

4.3 Excursus: How can the level at which costs are allocated be shown?

The level of disaggregation depends clearly on data availability and the final decisions on cost allocation procedures. As has been stated in chapter 3, it is not useful to have a full allocation of all costs and revenues to a specific functional form of means of transport, since cost allocation of fixed costs will only be done if there are sound methodologies or practices available. Thus the accounts should clearly show the level at which costs may be sensibly attributed (sector, sub-sector, ... individual vehicle).

As an example of the sorts of disaggregation that may be possible, Annex 1 shows the disaggregations being used by ITS in a parallel study for the British Department of Environment, Transport and the Regions and shows as an example, how different levels of costs can be allocated at different levels within the rail sector.

5 Summary of the methodological approaches for cost and benefit estimation

In the following methodological chapter we will summarise the general estimation approaches for the ideal accounts and for the pilot accounts. This will be done for the following items:

- cost elements and cost drivers,
- estimation approach (basic methodologies) and cost allocation approaches,
- valuation issues,
- implication of different institutional arrangements,
- treatment of overlaps between categories,
- treatment of uncertainty and sensitivity tests,
- data requirements.

This chapter is organised by summarising the main ideas per cost category for each of the above items. This will enable a comparison of methodological approaches used in the specific cost categories in order to achieve an integrated approach for the UNITE-accounts, based as far as possible on comparable methods, valuations, data base etc.

5.1 Main cost elements and cost drivers

In this report, the term cost drivers means: the main factors that influence transport costs. Transport cost elements and the corresponding cost drivers will be documented for each cost category in this section.

5.1.1 Infrastructure costs

The cost elements of infrastructure are the following for all modes:

1. Capital costs for
- new investments
- replacement of assets

2. Running Costs for
- maintenance
- operation
- administration

The importance of the two main components “capital costs” and “running costs” differs from mode to mode and from country to country. It depends on the investment history, but also on the spending behaviour (for example neglected maintenance might lead to a lower share of running costs in one year). To give an indication, we can state for Germany that in 1997 about half of rail infrastructure costs, but 70% of road infrastructure costs were capital costs (DIW 2000). An European comparison of road infrastructure costs in 1994 has shown that the share of capital costs in total infrastructure costs ranges from 49% to 82% (see DIW et. al. 1998).

Table 5 summarises for the infrastructure cost elements the main cost drivers. Apart from some mode-specific „specialities„ we can see that the main cost drivers are the traffic load (traffic volume, traffic mix and weights), construction standards, the wage and price levels, maintenance standards and maintenance cycles, weather conditions.

Table 5: Main cost drivers for infrastructure costs

Costs	Cost Drivers
1. **Capital costs**	
• Depreciation	Life-expectancy of assets
• Interest	Interest rates, depending on the institutional background
• General for capital costs	Construction standards (legal obligations for safety, degree of technical progress applied to infrastructure construction, special standards for mountainous areas or ecological sensitive areas)
	Type of infrastructure: construction and maintenance (motorways/other, high-speed train lines/other, tunnels/bridges, underground system/above ground system, canals)
	Level of wages and prices per country
	Expected traffic mix and occupancy
	Weather and climate
	Depreciation method
	Population density (land costs)
2. **Running costs**	
• Ongoing maintenance	Traffic volume, traffic mix, weights
	Infrastructure quality, construction standards
	Maintenance cycles
	Maintenance standards
• Operation	Level of service required
	Price and wage levels
• Administration, Overheads, Police	Institutional status of infrastructure
	Price and wage levels
Source: IR 5.2	

5.1.2 Supplier Operating Costs

Supplier operating costs have been defined in IR 6.2 as all monetary costs paid by the operator for the provision of a transport service, which can be considered as ordinary and directly generated by the production and delivery of the service to the general users.
The main costs can be categorised into: vehicle related costs, costs of personnel and administrative costs. The main cost drivers are the vehicle fleet structure, the service that is offered and the regulations and company practice that govern wage payment.
The costs and the corresponding cost drivers are shown in table 6.

Table 6: Main costs and cost drivers for Service Operating Costs

Cost component	Cost Drivers
Wear and tear	• Market value of the vehicle (current purchase cost, actualised historical cost) • Vehicle age • Expected lifetime of the vehicle • Intensity of vehicle use (vehicle.km per year) to be related to average vehicle uses in the company and/or the sector • For road, operating conditions, e.g. structure of the city (hilly, plain, intermediate) and service conditions (peak/off-peak, delay costs)
Tyres and other consumables	• Fleet size and composition • Vehicle age • Vehicle.km • Operating conditions
Net fuel costs	• Type of vehicles • Vehicle age • Vehicle/km • Operating conditions • Net fuel prices
Car cleaning and servicing	• Vehicle.km • Operating conditions • Legal prescriptions • Current cost of cleaning and servicing
Repair and maintenance	• Fleet per vehicle type • Vehicle age • Intensity of vehicle use (vehicle.km) • Operating conditions • Repair and maintenance records • Legal prescriptions • Current cost of repair and maintenance
Wear and tear of other operating equipment	• Market value of the equipment • Age • Expected life time equipment • Intensity and conditions of use
Other operating costs	• Current and planned company activities • Company size and structure
Wages of drivers and related staff	• Vehicle hours • Staff categories • Labour laws and collective agreements • Current payment practices in the company • Other company-specific circumstances such as pregnancies, formation
Additional payroll expenses for drivers and related staff as well as wages and payroll expenses for additional operational staff	• Activities of the company • Vehicle hours • Staff categories • Labour laws and collective agreements • Current payment practices in the company • Other company-specific circumstances such as pregnancies, formation • Other fringe benefits (e.g. additional insurance)
Total personnel costs of administrative staff	• Activities of the company • Vehicle hours • Staff categories • Labour laws and collective agreements • Current payment practices in the company • Other company-specific circumstances such as pregnancies, formation • Other fringe benefits (e.g. additional insurance)
General administration	• Companies activities • Company size and structure • Company assets
Source. IR 6.2	

5.1.3 User costs

The estimation of total delay costs is intended in order supply supplementary information for the Pilot accounts. It is not suggested, that a complex and time consuming estimate is made.

Time costs and operating costs have been identified to be the main cost elements of user costs. Out of these, the most important user cost element are time costs:

- Time costs are relevant for all types of transport services.
- Time costs are directly varying with the Level-of-Service of a transport system.
- Time costs represent by far the greatest cost block (e.g. around 87% of total delay-related costs in Switzerland (INFRAS 1998).

Additionally to time and operating costs, demand-side factors have a strong influence on the user costs since user costs are:
(1) generally internal to the transport sector and
(2) the mutual interference of users leads to strongly progressive cost functions.
The most important demand-side factors are the purpose for travel, the network density and the modal alternatives.

The identification of the relevant user cost components depends strongly on the type of service. Table 7 summarises the main cost elements and the driving factors for them along market segments such as the questions whether the transport type is individual, commercial or public (collective). The reason for this is, that one of the most important explanatory variables of user costs is the economic framework under which a certain transport activity is carried out. The three following questions: whether the user is charged for the current costs which the operator has to bear, the type of calculation done by the operator and finally the valuation basis of the user himself, are very important.

Table 7: Main cost drivers for user costs by market segment

	Individual transport		**Commercial transport**		**Public Transport**	**Demand-side drivers**
	Time costs	**Operating costs**	**Time costs**	**Operating costs**	**Time costs**	
Infrastructure occupancy	x	x	x	x	X	
Vehicle occupancy/loading factors	x		x		X	
Travel purpose	x		x		X	x
Commodity type			x			
Vehicle type/characteristics	x	x	x	x	X	
Company profile				x		
Network density						x
Modal alternatives						x
Source: IR 7.2						

5.1.4 Accident costs

Two categories of 'primary' cost drivers can be identified; the number and severity of casualties and the number of accidents. The lost productive capacity, risk value, medical and non-medical rehabilitation is linked to the number of casualties while damage to property and administrative costs is more linked to the number of accidents. Behind these 'primary' cost drivers are other cost drivers that influence the number of accidents and casualties. We propose (in line with the marginal cost approach) the following 'secondary' cost drivers; vehicle type, infrastructure type, driver characteristics, weather and climate, traffic volume (Q) and legal and insurance system. Furthermore, another set of cost drivers affects the cost, such as the wage rate. The wage rate (or income) affects the resource cost for the administrative cost, lost production and part of the medical cost. The income also affects the risk value Table 8 summarises the main cost drivers for the elements of accident costs.

Table 8: Main cost elements and cost drivers of accident costs

Cost	Cost elements	Cost drivers
Material damages	Property, Infrastructure	no. of accidents Number (and type) of vehicles involved (incl. train, ship etc), goods transported (value and risk for environmental damages) and the affected surrounding
Administrative costs	 Police Justice Administration	Number of accidents for all elements Police: the average duration of the accident treatment, the average number of officers involved, their average wage rate and the consumables used. Justice: legal system and public cost. Insurance system: legal system and administrative costs
Medical care, rehabilitation, reintegration	First aid and ambulance Accident and emergency In-patient treatment Out-patient treatment Non-hospital treatment Aids and appliances	Number of casualties and their severity, cost of treatment and age of victim ; for all elements
Production losses	Replacement costs Current and future net lost output	Number of casualties and their severity Victims average income Age of victim Duration of temporary loss of the victims working power
Risk costs	Own risk value Suffering and grief of friends and relatives	Total number of casualties Severity of damages to human health and life
Source: IR 8.2.		

5.1.5 Environmental costs

The environmental external effects of transport, that will be assessed in UNITE cover a wide range of impacts: air pollution, noise emission, global warming, nuclear risks, soil and water pollution and the effects on landscape and nature. The main environmental cost drivers are the population density and distance from emission source. Cost drivers and cost elements are summarised in Table 9.

Table 9: Main cost elements and cost drivers of environmental costs

Cost	Cost elements	Cost drivers
Air pollution	Human health impact Environmental damage Damage to building structures	Population density Distance from emission source Type and amount of pollutants Geographical location of emissions
Global warming	Climate change Impact on agriculture Impact on energy use Impact on water supply and water management	Greenhouse gases emitted Population density and structure
Noise	Human health impact Annoyance	Population density Distance from emission source Intensity of transport activities Level of background noise
Nature and Landscape	Loss of habitat Deterioration of biodiversity Landscape change	Barrier effect due to traffic infrastructure through ecologically sensitive areas
Soil and water pollution	Soil quality deterioration (contamination) Water quality deterioration (drinking water contamination)	Existing soil and water quality Infrastructure type Weather conditions Distance from emission source Intensity of transport infrastructure and transport activities Transport accidents Vehicle speed Vehicle age, type and condition Fuel type
Nuclear risks	Human health impact Environmental damage over large areas	Population density Distance from emission source Type of electricity production Consumption of electricity
Visibility, Vibration, further environmental effects	Human health impact Environmental damage Damage to building structures	Population density Distance from emission source Type and amount of pollutants Geographical location of emissions
Source: IR 9.2.		

5.1.6 Taxes, Charges and Subsidies

The cost category Taxes, Charges and Subsidies differs from the other categories because most of the costs are instruments implemented by governments and not resource costs. The cost drivers are difficult to identify because they have a historical background (tax legislation and government policy) and are different for each country.

The criterion for determining the relevance of an individual category is its relevance to the overall accounts approach. One of the basic purposes of the accounts is to examine the balance between total social costs and total revenues paid by the end user. There are then two reasons for including an individual revenue category:

1. **It is appropriate to set it against the total social costs of transport** - in some way the financial flow is specific to the transport sector, as opposed to an item of general taxation; or,
2. **There is no offsetting cost item** – the financial flow does not cancel immediately with a corresponding cost item (e.g. charge for a service is much less than the resource cost of service provision).

There is a vast array of financial flows between institutions that are relevant for UNITE. These are classified into three cost element categories and are defined as follows:

- **Subsidies**: by a government for which it receives no products or services in return. The purpose of such payments is to make a particular service or product available at a price that the public can readily afford, when the service or product cannot otherwise be profitably supplied at this price.
- **Charge**: a levy which requires a direct and clear service in proportion of the payment on the part of the government. An entrance fee to a museum is a charge, since as a service, the payer is allowed to enter the museum. User charges are often used as environmental policy instruments e.g. emission charges: fees related to the quantity of discharged pollutant.
- **Tax**: a levy that must be paid with no discernible service required from the government or a service that is not in proportion to the payments. Taxes include e.g. income tax, sales tax, property tax, corporate tax, inheritance tax and excise tax. Custom duties and tariffs are both taxes levied on imported products.

It should be noted, that these cost categories represent costs and revenues for one or more actors.

5.2 Estimation approaches and cost allocation procedures suggested

5.2.1 Infrastructure costs

The main methodological issues for infrastructure costs estimation are:
- capital valuation and the derivation of capital costs,
- cost allocation.

Capital valuation is important since
- in some modes capital costs represent a high share of total costs,
- different methodological approaches lead to a considerable range of results,
- institutional backgrounds play an important role (capital devaluation due to privatisation process, different valuation methods for public/private infrastructure).

Wherever possible, we suggest to use a social accounting approach (macroeconomic) in contrast to simply taking capital values from business accounts. The results of both, however, should be reported and compared and the differences should be discussed. If the data situation (long investment time series) allows, the preferred approach for capital valuation is the perpetual inventory approach - with deriving the depreciations within this approach and calculating interests by applying the interest rate of public loans to the net capital value. This is the preferred approach since it is based on economic principles and since it can be elaborated and updated with a reasonable expense of labour and time. If any long investment time series do not exist but a good cross-sectional data base for one year is available, the synthetic method should be applied for capital valuation. Capital costs should then be calculated by annuities. If neither the perpetual inventory approach nor the synthetic method can be applied, a transfer of capital values per km from other countries is a possible approach. For some modes capital values from business accounts will be the only possible solution. In order to gain an idea of the differences between capital values from business accounts and those derived using the perpetual inventory approach, a comparison of German accounts, where both values do exist, would be helpful. The methodology for estimating infrastructure costs is summarised in table 10.

Table 10: Estimation approaches for infrastructure costs in the ideal and in the pilot accounts

Cost element	Ideal approach	Approach for pilot accounts
Capital value	Refined Perpetual inventory model (PIM): - use of probability functions for written-down assets - based on initial value of infrastructure (derived within an asset inventory) and on long investment time series	1) if data available (long investment time series) see ideal approach 2) if data for PIM not available but good data for a given year(detailed cross-sectional data for a given year): synthetic method of detailed asset inventories 3) use of capital values from business accounts if data for 1) and 2) are not available
Capital costs	1) if PIM used for capital valuation: depreciation calculated within PIM, interest rate of public loans to be applied on net capital value 2) if synthetic method used for capital valuation : annuity calculation	see ideal approach
Maintenance costs	public statistics and information from road authorities, rail infrastructure operators, port/airport authorities etc. maintenance expenditures with a life-expectancy of >1year have to be capitalised	see ideal approach
Costs of infrastructure operation	public statistics and information from road authorities, rail infrastructure operators, port/airport authorities etc	see ideal approach
Administration/Overheads/Police	public statistics and information from road authorities, rail infrastructure operators, port/airport authorities etc	see ideal approach
	costs of traffic police have to be separated from general police expenditures	see ideal approach
Source: IR 5.2		

A second major methodological issue for infrastructure costs is cost allocation. This is a methodologically complicated and at the same time politically sensitive issue due to the fact that infrastructure costs contain high shares of common and joint costs which per definition can not be directly allocated to user groups and vehicle types. The sensitivity calculations in DIW et. al. 1998 have shown that different allocation procedures yield a considerable variety in the cost shares allocated to certain vehicle groups.

5.2.2 Supplier Operating Costs

The recommended methodology to be used for the ideal and the pilot accounts is the cost model defined by Allport (1981). This method relies upon the analysis of disaggregated cost information provided by the transport operator. Each cost category is allocated directly without the possibility of joint allocation. A single model average cost is defined for each technical parameter and time scale of escapability.

The Allport model is designed for strategic economic decisions, it permits the comparative evaluation of several modes. The model comprises a:

- technical dimension. The model unit costs are related to five parameters, three variable in the short/medium term: peak car requirements, vehicle hours and car kilometres and two fixed in the short/medium term: average kilometres and the number of vehicles.
- Temporal dimension. The temporal dimension in which the escapability of costs in the short medium and longer term are defined, allows a quantification of the relevant marginal costs.

The disaggregation level and cost categories depend on the mode and categories in the operator's accounts.
Theoretically, the supplier operating costs should include every item of the costs incurred by the supplier in its operation. The list of required economic data must be seen as the ideal situation – the real availability and possibilities of following this categorisation criteria will be confirmed by the pilot accounts. The estimation approach is described in table 11.

Table 11: Estimation approaches for supplier operating costs in the ideal and in the pilot accounts

Cost element	Ideal approach	Approach for pilot accounts
All cost elements	Use of transport company accounts: Allport cost model, costs are divided by category and by time (short term, long term etc.)	Use of transport company accounts plus estimations for missing data for Allport cost model
	Division into fixed and variable costs from the start of data collection	Costs that cannot be divided into fixed or variable costs (wages) allocate to variable costs
	Calculation of cost components	See ideal approach
Source: IR 6.2		

The wear and tear of vehicles used only in cities or on one specific kind of infrastructure and vehicles used in peak or off-peak periods needs to be documented. Estimates, based on company operating experience will have to be made where this information is not available.
The costs of renting or leasing of vehicles and other major equipment are not considered to be running costs and are to listed only as additional information.

5.2.3 User costs

There are several ways in which an estimation of costs due to traffic delays can be measured. For the accounts approach, neither congestion costs nor Mohring benefits will not be included in the main accounts as the are internal to the sector as a whole However, given the importance of the issue, two measures of delay costs will be included as supplementary information where possible.

These are:

- Total user delay costs, determined as the total delays based on reported statistics.
- External user costs, defined by the expected tax proceeds from the introduction of a internalisation fee.

It should be noted, that the cost items are not congestion costs as defined by the economic welfare theory.

The approach developed to determine external user costs for different modes and transport markets is shown in table 12.

Table 12: Estimation approaches for user costs per market segment for the pilot accounts

Transport Sector	**Approach for Pilot accounts**
Inter-urban transport	
Road	Police records of traffic jams by length and duration
Rail	Delay statistics by station + affected travellers
Air	Late arrivals by airport
Waterborne traffic	Late arrival by port
Urban Transport	
Road	Average speed in peak / off peak
Public transport	Average speed + loading factors in peak / off-peak
Non-motorised modes	Not considered
Source: IR 7.2	

For road traffic and rail transport, cost allocation using the cost generator principle for vehicle type and by travel purpose is straight forward and will be used. The costs are the sum of all user costs which compete for capacity on a commonly used infrastructure plus the addition of allocation factors. These PCU factors are taken from state-of-the-art studies.

For air traffic landing rights and the status of the aircraft (private, military, commercial etc.) are the main factors, that determine the handling of the planes by air traffic control, the average passenger value of time and the occupancy rate of the plane. The cost generator principle can be used here and requires the quantification of the relationship between average aircraft size and handling time. Through use of size indicators for different segments of air traffic, indicators similar to PCU factors can be developed. The required information for applying the cost sufferer principle is available when the average values of time per traveller and their share per aircraft are known.

When looking at waterborne transport, cost allocation needs to distinguish between delay at locks and delay in ports. In the first case the situation is similar to road transport because ships do not use pre-allocated slots. Cost allocation factors per unit should depend on the ship size for example a number of small boats may be processed at once while large vessels need a single treatment.

For ports the ship size is only of relevance in the case of loading and unloading processes. In general passenger and freight shipment do not interact because they usually use different ports or port sections. Thus, cost allocation is rather straightforward.

Urban transport is to be treated as road traffic with the two following considerations: Firstly, the value of time of a public transport vehicle should only take into consideration the uncrowded time costs of the passengers, as crowding costs are an internal cost of public transport users as a whole. Crowding cost can be caused by PT, but only to other PT users. Secondly, public transport running on separate lanes does not cause or experience congestion to or from other infrastructure users.

5.2.4 Accident costs

The valuation of material damages is rather straightforward and actual expenses for reported accidents will be used. Non-reported accidents are typically minor and will not be included. The approach to ignore the unreported accidents related to damages means; i) we will underestimate the total costs, ii) underestimate the internalised costs but iii) make a proper estimate of the system external cost.
The identification of administrative costs on a disaggregated level is difficult. If available statistics on public expenditures are detailed enough to determine the share of transport-related administrative costs, it is proposed to use total actual costs and observed shares of total costs related to traffic accidents. For practical reasons, however, the estimation of the costs of the police, the legal system and the insurance system could be based on average cost values per accident or per victim by degree of severity. This is a type of simple cost allocation and its consequences should be discussed. Non-reported accidents will not be included with the same consequences as above
The medical costs including rehabilitation and reintegration represent actual expenses by the health sector. Therefore, if detailed statistics are available no indirect cost estimation is needed. However, it should be remembered that UNITE aims to record costs rather then expenditure. Consequently, the current and all future medical cost of the victims during one year should be recorded.
The valuation of the replacement costs is rather straightforward, as it is the real expense of the victims' employer is less unequivocal. The production potential will be used for the valuation of current and future gross lost output. Separately the current and future lost consumption will be presented. These two categories together constitute the current and future net lost output.
Risk value will be valued using the willingness to pay approach. This approach will also be used in the cost category Environmental Costs.
The externality of accidents consists of two different elements; i) the system externality, i.e. costs not born by any transport user (within a system), and ii) the 'congestion type externality' which arises if the marginal cost differs from the average cost. Given a certain system delimitation (transport system, modal system etc) the former category is possible to distinguish in an account. Which will be done in the UNITE account. The 'congestion type externality' is by definition already internalised by all users within the system. The externality arises as some users increase the risk for other users in the same way as the congestion externality arises because some users increase the travel time for other users. This is a purely marginal cost (MC) phenomenon and is best treated with a MC approach. However, with information on the total cost, appropriate disaggregated by user category, this information can be used to monitor also this 'internal' externality. To achieve this, the five main cost categories have been classified into total social costs, internalised and system external costs.

In Interim Report 8.2 (table 1) internal and external cost categories are listed for Accident costs.

Table 13 gives an overview of the suggested estimation approaches for each element of accident costs.

Table 13: Estimation approaches for accident costs in the ideal and in the pilot accounts

Cost element	Ideal approach	Approach for pilot accounts
Material damages	use of insurance company accounts if necessary use of average cost figures per accident (unit costs)	see ideal approach: use of insurance company accounts for road the same for other modes, with averaging over the years due to low accident rates
Administration costs		
police	average wage rates * man-hours spent on treatment of accidents	1st best approach = ideal approach 2nd best approach = average costs per accident or severity by degree of severity
justice	comparison of fees paid and of costs of the legal system	see above
administration	annual reports of insurance companies	see above
Medical care, rehabilitation, reintegration	real expenses of health sector for accidents „hidden„ accident-related health costs estimates	1st best approach = ideal approach, e.g. information of health or liability insurance companies on real accident-related health expenses 2nd best approach: average unit costs per casualty from past or from other countries
Production losses		
replacement costs	no. of steadily impaired or killed victims*costs of replacement	unit costs of replacement to be taken from national expert studies: for employed victims only
Current and future gross lost output	no. of killed victims and their average age	see ideal approach: for all victims of employable age
	duration of the temporary loss of victims working power and application of the net production potential method	
Future consumption costs	To be subtracted from lost production power	Average future consumption per capita
Risk costs	risk value by WTP-concept, based on revealed preference studies	multiplication of casualties and WTP by degree of severity risk value from INFRAS/IWW 2000
Source: IR 8.2.		

Cost allocation is very difficult when two or more vehicles are involved in an accident. Arbitrary allocation between actors (the victim, the guilty party) is possible, but due to the

different legal systems the data would not be comparable. Another allocation method used is the division of the costs between different vehicle classes at a pre defined percentage rate.
For the allocation of the UNITE accounts the following method has been developed. Accidents will be recorded by victim (e.g. a car user), but if the injurer belongs to another category (e.g. a HGV) the information will included in this category as well. The number of victims will also be included in other categories (e.g. bicyclists) where the relevant category (i.e. cars) is the injurer.
First, this means that we will have an overview of intra- respectively intersystem accidents for each category. Second, the information can easily be aggregated to the total number of victims by category, and this information can, without double-counting, be aggregated to the total number of victims. Third, if anyone believes that they have a defendable system to allocate the accident cost between victims and injurers (e.g. 5% to the car and 95% to any injurer), this can be done. However, at an aggregated level, we will not provide detailed information on the different categories of injurer. Fourth, the structure proposed may open a possible link between accounts and MC studies.

5.2.5 Environmental costs

Most previous studies on transport externalities have followed a top-down approach, calculating total costs for a geographical area and then allocating them to different sectors according to their share in total pollution or activity. This kind of cost allocation assumes that the share of pollution corresponds to the damage caused and neglects the fact that impacts are highly site-specific. Air pollution and noise pollution tend for example, to have an impact on the population on a local or regional scale. Nuclear risks and global warming are categories, that effect the environment on a global scale.
The methodology used in UNITE is based on the *Impact Pathway Approach* (IPA) developed in the ExternE project series. In theory, it is capable of accounting for specific locations and allows to calculate damage costs of vehicle categories, modes or the total transport sector using spatially disaggregated information. Separate allocation procedures are not required, as the costs can be calculated for each subsector of the transport sector.
In practice, it is not possible to use this approach for all cost categories, because of data and model constraints. These cost categories will be estimated with the traditional top-down methods.
The valuation of nature and Landscape changes due to transport infrastructure can be carried out in several ways. A review of existing literature shows four different methods:

1. The repair cost approach,
2. The compensation approach,
3. WTP approach
4. No valuation carried out

Further work needs to be completed within this section, to decide on the valuation method to be used.

Table 14 summarises the estimation approaches for environmental costs.

Table 14: Estimation approaches for environmental costs in the ideal and in the pilot accounts

Cost element	Ideal approach	Approach for pilot accounts
Air pollution	bottom-up, impact pathway approach (priority impact pathways)	see ideal approach, total costs= costs on regional and local scale 1) regional: aggregated emission data from CORINAIR emission inventories 2) local: 2 approaches: a) MC/km for 2 or more location types, b) total emissions per location type
Global warming	damage cost approach assumption of linearity between greenhouse gases and costs	see ideal approach additionally avoidance cost approach
Noise	bottom-up, impact pathway approach	Top down: use of existing estimates. Impact and cost models
Nature and Landscape	Perpetual inventory approach	Method remains under discussion
Soil and water pollution	bottom-up, impact pathway approach	Use of shadow prices within the repair cost methodology
Nuclear risks	bottom-up, impact pathway approach	Shadow price
Transport upstream and downstream processes	Complete vehicle and infrastructure life cycle costs	Costs of the direct impact of vehicle usage
Source: *IR 9.2*,.		

5.2.6 Taxes, Charges and Subsidies

The key issue here is to find how the underlying cost structure of marginal and fixed costs is reflected in the charging structure, in order to provide a better understanding of the way the components of the accounting system relate to one another on the cost and revenue sides.
Current accounts are too aggregated to provide the insights needed to study these relations. This means that in the “ideal accounts” we may advance procedures and methods to establish the above relationships, but the empirical “pilot accounts” will certainly fall short for this aim since information gaps are likely to occur. The following figure (table 15) illustrates the level of disaggregation for ideal accounts.

Table 15 : Ideal accounts: Taxes, Charges and Subsidies

Category of Instrument	Criteria for disaggregation	Who pays	Who receives
Subsidies	Per vehicle		
	Per Mode		
	Per institutional category		
Charges			
Taxes			
Other instruments (e.g. cross subsidisation from general budget or other sectors)			
A ZERO SUM EXERCISE FOR AGGREGATED NATIONAL ACCOUNTS, SINCE TOTAL REVENUES SHOULD MATCH TOTAL COSTS,		PROVIDES INFORMATION ON FINANCIAL FLOWS AND ENABLES MONITORING	

Each instrument should be analysed following this conceptual table. The current situation in each country will highlight the existing gaps and provide insight into the final structure for "ideal accounts" in the cost categories taxes, charges and subsidies.

Most categories in this section are monetary, so the emphasis is on the collection of available data and not on estimations. However, it might well be, that aggregated tax returns or revenues from charges have to be traced back to their payers, for example a breakdown of the paying users might be needed, and in some cases, possible from the empirical point of view[6]. The basis for all the required data should be preferably on a factor cost basis or if not possible on a market price basis.

The allocation of aggregate data to vehicle types is dependant on the quality of secondary data available. For allocation to individual countries an institutional split by country can be used.

The main "valuation issue" to check is whether the item is presented on a factor cost or market price basis. In order to avoid double counting (and overlap with other cost categories) basic factor cost is recommended, which is also in line with the treatment proposed in the System of National Accounts of the United Nations.

6 An example is track access charging, where for Germany only, an aggregate is available but allocation to payers is possible.

5.3 Valuation issues

Problems of valuation occur in three dimensions:

1. Non-monetary costs have to be monetarised, for example methods of valuation have to be applied.
2. For monetary costs, for example for costs which represent real financial flows, a decision with respect to real or nominal valuation has to be taken and a common price base has to be defined.
3. For missing values for certain countries or certain years value transfer procedures will have to be agreed upon.

In order to produce cost estimates which can be integrated and compared over all cost categories it is essential to solve the valuation problems in a consistent way on a common basis.

5.3.1 Monetary costs

In UNITE we deal **completely with monetary costs** in:

- Infrastructure Costs: all cost elements of infrastructure costs,
- Supplier Operating Costs: all cost elements of supplier operating costs.
- Taxes, Charges and Subsidies: all taxes, charges and subsidies cost elements

To a minor part we treat monetary costs in:

- User Costs and benefits: increased operating costs such as fuel costs etc.
- Accident Costs: Real financial flows in case of material damages, of administrative costs, of medical costs and of employer's replacement cost for steadily impaired accident victims.

For all these elements the cost figures have to refer to the base year 1998 which has been agreed upon for the UNITE accounts. Preferably, costs should be expressed in real terms (e.g. constant prices) for the year 1998. This is in particular an issue for capital valuation by the perpetual inventory method which should use investment time series at the constant prices of 1998. The running costs of infrastructure and supplier operating costs will be expressed as actual costs for the year 1998 and can therefore be added to capital costs without any problem. For eventually necessary value transfer procedures see table 16.

5.3.2 Non-monetary costs

Non-monetary costs have to be valued in the following cases:

- User Costs and Benefits: Time costs
- Accident Costs: Risk costs
- Environmental Costs: All environmental costs

To start with time costs as the main component of user costs, we can state that in an ideal case revealed preference studies should be used. For the pilot accounts it is suggested to use national stated preference studies as far as available. It is not recommended to use the pragmatic procedure to estimate the economic value of an average (working) hour by dividing the GNP by the total number of working hours or by the total number of inhabitants and hours per year. The valuation has to take into account the following principles:

- Values of time are distinguished between the purposes: business, commuting (not air transport) and private trips.
- In-vehicle values of travel time distinguish between non-congested (road) or non-crowded (public transport) and congested / crowded travel times.
- Out-of-vehicle waiting times are values independently from travel times.
- Separate determination of travel values of time per mode.
- Additional walking time of pedestrians to cross arterial roads in urban areas is assessed by the value of walking time.

There are two cost categories which have to use WTP for the valuation of cost elements. This concerns the valuation of risk costs for accidents and the costs of air pollution. Since both cost categories refer to the willingness to pay for avoiding injuries, impairment or even death of human beings they should be based on the same principles in both cost categories.
Because of model limitations when calculating trans-boundary effects, an average European value for transfer between countries has been suggested for the valuation of air pollution and noise. If the use of GDP/head at PPP is possible, (within the model), this valuation, which is consistent with the other cost categories, will be used. This is issue remains open at the present time.

The requirement of applying comparable concepts for the risk value and for the WTP-values used for environmental cost valuation holds true for the value transfer procedures between years and countries.
Valuation issues for all cost categories are summarised in table 16.

Table 16: Valuation issues per cost category and cost element

Cost category/element	**Type of cost**	**Valuation method**	**Value transfer procedure**	
			Between years	**Between countries**
1. Infrastructure costs				
Capital costs	monetary	constant prices 1998	price index of transport infrastructure construction	PPP's
Running costs	monetary	constant prices 1998	price index of transport infrastructure construction	PPP's
2. Supplier operating costs				
Vehicle-related costs	monetary	use of actual costs	Item opportunity costs	no transfer recommended
Service-related costs	monetary	use of actual costs	Item opportunity costs	no transfer recommended
Administration and commercial costs	monetary	use of actual costs	Item opportunity costs	no transfer recommended
Insurance and financial costs	monetary	use of actual costs	Item opportunity costs	no transfer recommended
Costs for use of infrastructure	monetary	use of actual costs	Item opportunity costs	no transfer recommended
3. User costs				
Time costs	non-monetary	Values of travel time Ideal: Revealed preference survey Pilot accounts: National SP-studies	use of British regression study (increase of 1% p.a. or elasticity to GDP=0.5)	GDP/capita weighted with PPP's
Operating costs	monetary	Same as in 2		
4. Accident costs				

Material damages	monetary	1) use of actual costs 2) alternatively average costs values per type of accidents	1) no transfer procedure 2) inflation rate	PPP's
Administration costs	monetary	1) use of actual costs 2) alternatively determination of costs on basis of past experience	1) no transfer procedure 2) inflation rate	PPP's
Medical care, rehabilitation, reintegration	monetary	use of actual costs	Growth of GDP/capita	GDP/capita weighted with PPP's
Production losses	monetary (for replacement costs)	net production potential	Growth of average income or of GDP/capita	PPP's
Risk costs	non-monetary	WTP Ideal: Revealed preference survey	Growth of average income or of GDP/capita	PPP's
5. Environmental costs				
Air pollution	non-monetary	Damage cost approach based on dose-response factors using WTP (for VSL) to measure human health	Growth of average GDP/capita	1) Health costs: GDP/cap or European average 2) buildings: PPP's
Global warming	non-monetary	Damage cost approach and avoidance costs	consumer price index	see air pollution
Noise	non-monetary	Top down allocation of existing data	Growth of average GDP/capita	GDP/cap or European average
Nature and Landscape	non-monetary	compensation or repair costs per hectare of impaired natural resources	Growth rate of GDP	PPP's
Soil and water pollution	non-monetary	Repair cost approach	consumer price index	PPP's
Nuclear risks	non-monetary	Shadow price	consumer price index	Damage costs are estimated
6. Taxes, Charges and Subsidies				
Cost and revenue	monetary	Basic factor cost	Use of relevant years	No estimate transfers between countries

5.4 Implications of different institutional arrangements

5.4.1 Infrastructure costs

The principles and the procedures for valuating capital stock differ between private or semi-private businesses and public financed infrastructure. In particular the periods and methods of depreciation, the profit expectations and other methods of calculating capital values vary. The UNITE accounts will apply a social accounting basis but capital values from business accounts will be needed as a starting point.

5.4.2 Supplier Operating Costs

Neither simple statistical cost analysis nor econometric analysis or transportation models enables exact determination of costs in alternative local contexts, where labour practices and

legislation, wage rates, traffic conditions, technology used, etc. are often different in their monetary representation as well as in their underlying principles. Default or transfer values from other countries or modes are not recommended.

5.4.3 User costs

As no time-sensitive modelling approach towards the estimation of total delay costs is recommended, the existence and variability of present road delay charging systems can be ignored in all modes of transport.

5.4.4 Accident costs

For the calculation of the total accident costs the role of different institutions are irrelevant. When external accident costs have to be calculated, then the legislation framework of liability insurance companies gains importance. The amount of insurance money paid to victims or to the health care sector is the internal social cost of accidents. When medical costs are covered by public funds, then these costs remain external.

5.4.5 Environmental costs

The role of different institutional arrangements is not relevant for most of the environmental costs. The environmental costs of transport accidents involving hazardous goods that result in soil and/or water pollution are covered in most countries by insurance policies. Countries must acknowledge if this coverage is or is not present. For nuclear risks, the country specific liability insurance and other insurance agreements have to be considered for each country.

5.4.6 Taxes, charges and subsidies

This is a field which is slightly dependant on institutional frameworks. In order to have transparency between countries it should be clear from the data presented, where revenue comes from and where revenue goes to. Basic classifications are: transport infrastructure providers, transport service providers, transport users and government.

5.5 Treatment of overlaps between categories

In order to ensure that costs are correctly allocated, overlaps between cost categories have been identified and are shown in table 17. The overlapping costs will be allocated to the cost category in the corresponding row (not column). The costs should however, always be noted as extra additional information in the categories where they will not be allocated.

Table 17: Treatment of Overlaps Between Cost Categories[1]

	Infrastructure costs	Suppler Operating costs	Transport user costs	Accident costs	Environmental costs	Taxes, charges and subsidies
Infrastructure costs		Infrastructure (bus stops etc.)		Accident prevention facilities traffic police	Environmental protection facilities	
Supplier Operating costs	Ticket selling facilities, halls for parking + repairing vehicles		Scarcity effects on PT operating costs Traffic delays due to operational problems of transport suppliers	Expenses for safety measures related to service suppliers		
User costs	Delay costs due to road maintenance activities[2]					
Accident costs			Delay caused accident costs Travel delays due to accidents			Taxes on insurance payments
Environmental costs			Delay caused environmental costs	Accident caused environmental costs		
Taxes, charges and subsidies		Taxes on fuel, other taxes on inputs	Taxes on fuel, other taxes on inputs			

[1] Overlapping costs are to be allocated to the row of costs that they are shown in. Costs will not be allocated to the column they appear in but should be shown as additional information when ever possible.

[2] If delay costs due to maintenance activities can not be separated from general delay costs, they will not be treated separately.

5.6 Treatment of uncertainty and sensitivity tests

5.6.1 Infrastructure costs

The most sensitive steps of identifying infrastructure costs have been identified as:
1 capital valuation and
2 cost allocation

For capital valuation the following sensitivity tests are suggested:

- Comparison of the perpetual inventory concept and the direct valuation of assets (if the data situation allows)
- Comparison of simple perpetual inventory models with perpetual inventory models using survival functions
- Comparison of capital costs derived within the perpetual inventory concept with those calculated using annuity equations
- Sensitivity tests for the parameters: Life expectancies of assets, type of survival function, level of interest rates

Different existing cost allocation should be compared to existing data for the road sector (DIW et al. 1998). Also the outcomes of the case studies should be compared to the with existing cost allocation practice in European countries.

5.6.2 Supplier operating costs

The main areas where sensitivity tests are recommended are:

- Ownership (public, private, mixed) and regulation: depreciation
- Public Service Obligations
- Passenger/freight mix
- Demand/Capacity
- For road transport geo-morphology of area of operation (e.g. in rough terrain, SOC tend to aggravate)
- Energy use efficiency (technological characteristics of the fleet)

5.6.3 User Costs

Short delays play a large role in time cost estimates. The minimum delay time (in minutes) that is considered to be congestion varies from country to country. Estimates from Switzerland show for example, that delays of less than 5 minutes increase time cost estimates by 50%. The minimum time used to define congestion must be recorded and compared for each country.

In order to estimate traffic flow by time segments when appropriate data is not available equivalency factors are to be used. Because of the non-linearity of time and fuel costs functions to traffic volume the following sensitivity tests with alternative allocation mechanisms are to be considered:

- The share of working day traffic in an average peak hour (7%- 12%)

- Number of working days per year (240 – 270)
- Number of vacation days and holiday traffic (10 – 20)
- Restrictions for heavy traffic or for aircraft movements (night/weekend)
- Difference of schedules by weekdays (Saturday, Sunday)

5.6.4 Accident costs

The risk value or the social WTP for saved human life and health is an important factor for cost estimation here and in the environmental costs section. As values stated in recent studies vary by a factor of six a sensitivity test applying different risk factors is necessary.
Production loss definitions and different measurement of the contribution of an average accident victim to the production power differ. The effects of these differences must be analysed.
The costs of non-reported material damage (which is small compared to the damages to human health and life) is to be neglected.

5.6.5 Environmental costs

The implementation of the impact pathway approach with computer models, essentially represents a compromise between applicability (input data and run time) and level of detail. Dispersion models have been tested against more complex models and measurement data, which would be impossible to use in an integrated assessment tool. The results are acceptable in view of the overall uncertainties involved in the whole process of estimating costs due to airborne pollutant and noise emissions.

Results of the estimation of external costs consist of a range rather than a single value. Most of these uncertainties are attributable to an insufficient knowledge of the physical phenomena associated to the various impact chains. The uncertainties arise from a number of sources, including:

- the variability inherent in any set of input data used for estimating external costs;
- extrapolation of data from the laboratory to the field;
- extrapolation of exposure-response data or results from contingent valuation studies from one geographical location to another;
- assumptions regarding threshold conditions;
- lack of detailed information with respect to human behaviour and tastes;
- assumptions like the selection of discount rate;
- the need to assume some scenario of the future for any long term impacts.

Generally speaking, the largest uncertainties are those associated with impact assessment and valuation, rather than quantification of emissions and other burdens. Furthermore, there are gaps, i.e. damage categories, where information, for example on monetary valuation or exposure-response-relationships is lacking, so that no external cost estimated can be provided. This means that the outcome of the use of the methods described here is not one specific value describing the external costs with certainty, but rather a range, within which the true value lies with a certain probability.
This however, make the figures difficult to handle and confusing. Therefore costs will be reported as “best estimates”, based on a set of assumptions, which appear reasonable and are

clearly explained.

Regional scale costs due to transport sector airborne emissions are calculated as difference of costs between with and without traffic. Similar model runs will be performed for other sectors to explore whether the cost structure is comparable for all sectors.

The costs of habitat losses and biodiversity are sensitive to the cost approach selected (compensation / avoidance / repair / no valuation). This issue remains open at the present time.

Sensitive cost factors for soil are the assumed value of unsealing repair costs and soil purification/decontamination costs for impaired soil within a certain range along traffic infrastructure. The repair costs for water are sensitive to the assumed volume of contaminated water per time unit and the amount of estimated average water purification costs per unit value.

The estimated nuclear risk costs are stronger influenced by the estimation of maximum damage costs due to an accident than by the probability of occurring. Whether or not the liability insurance that reflects the costs of a certain risk is also reflecting the market price is a sensitive factor. Thus, for countries not applying a market price based liability insurance the approach is not feasible and a mean shadow price has to be assumed.

5.6.6 Taxes, charges and subsidies

Uncertainty in the obtained estimates should be evaluated. Gaps in data due to confidentiality etc. are to be expected.

5.7 Data requirements

Data requirements can be divided into two main classes: data required for more than one cost category and specific data for each of the cost categories. It is important that there is a consistency of recurring data between cost categories. A summary of data requirements is given in table 18. Table 18 is not intended to give a complete review of data requirements, but to give an idea of the volume of data necessary for the pilot accounts.

Table 18: Summary of Data Requirements

Data required for more than one cost category	
Basic economic data	Population, GDP, GDP growth rate, Consumer price index, PPP
Basic environmental data	Climate and weather conditions, geographical description
Basic Vehicle Data: Road	Number and type of vehicle by category (weight, fuel, function, axle number, occupancy, mileage, freight value, VOT, travel purpose)
Basic Vehicle Data: Rail	Number and type of vehicle by category (weight, speed, class, fuel, function, passengers, occupancy rate, tonnage, mileage, freight value, VOT, travel purpose)
Basic Vehicle Data: Air	Number and type of aircraft, passengers and occupancy rates by category (weight, fuel, function, occupancy, tonnage, mileage, freight value, VOT, travel purpose) number of starts and landings
Basic Vehicle Data: Inland waterways	Number and class of vessel by category (cargo weight, size, function, tonnage, mileage, freight value, VOT, travel purpose)
Basic Vehicle Data: Marine transport	Number and type of vessel by category (cargo weight, size, function, mileage, freight value ,VOT, travel purpose)
Basic Vehicle Data: inter-urban road	Number and type of vehicle by category (weight, fuel, carrying capacities, occupancy, tonnage, mileage, freight value, VOT, travel purpose)
Basic Infrastructure Data: Road	Road length [km], average vehicle speed and volume (peak/off-peak), vehicle km per vehicle class by category (National Motorways with and without separated carriageways, State roads (trunk roads) with and without separated carriageways, Regional roads (Provincial roads) with and without separated carriageways, Urban roads), number of lanes, tunnel length, bridge length, pavement etc.
Basic Infrastructure Data: Rail	Track length (cargo, high speed etc), train km, tkm, tunnel length, bridge length
Basic Infrastructure Data: Air	Airports, runways, air corridors
Basic Infrastructure Data: Inland waterways	Harbours, length of waterway, locks etc.
Basic Infrastructure Data: Marine transport	Harbours, length of waterway
Basic Infrastructure Data: inter-urban road	Public transport route length (bus, tram etc.)
Basic tax, charges and subsidies data	In all cost categories: taxes, charges and subsidies should be recorded as additional data: by country, by mode and by class of actor involved
Specific Data required for Infrastructure Costs	
Depreciation, Interest	Depreciation for infrastructure under construction and replacement Interest in land value, infrastructure, debts
Annual expenditure	By mode of transport, by type of expenditure, by type of asset (30 – 40 years data required for capital valuation model)
Network characteristics	Basic vehicle and infrastructure data as above plus road width, age of infrastructure, life expectancies of asset types, running costs etc.
Specific Data required for Supplier Operating Costs	
Vehicle-related costs	Basic vehicle data for supplier as above plus wear and tear of vehicles, depreciation, consumables, fuel/energy costs, wages of drivers/pilots etc., vehicle upkeep, liability costs, other operating costs
Service-related costs	General service wages and salaries, external services (catering, cleaning), handling costs
Administration and commercial costs	Infrastructure rental (administration), consumables, advertising, administrative personnel costs
Insurance and financial costs	Insurance policies, fixed financial costs
Infrastructure-use related costs	Leases and facilities (warehouses etc.), charges to the infrastructure provider (landing fees etc.)
Maintenance of infrastructure	Building maintenance
Specific Data required for User Costs and Benefits	
Cost Values (for all modes of transport)	Cost value for travel, waiting time, delay time, crowding, search time (business, commuting, private etc.), energy costs
Cost functions	Speed-flow relationships, speed-fuel relationships,

Traffic data	As above plus speed during congestion, least acceptable speed
Congestion data: road	For urban and inter-urban: length (km or vehicles), duration, number of lanes, traffic mix, cause Average daily inter-urban traffic, population in urban study areas
Congestion data: rail, air, waterborne	Distribution of arrivals over time, connection times, delay probabilities, demand (passengers and goods for working days and weekends)
Specific Data required for Accidents	
Accidents and casualties	Total number of accidents in severity classes, number of non-reported accidents
Public bodies	Administrative costs (police, legal sector, health sector), average time per accident and sector
Insurance data	All payments from insurance (damages, legal cost, health, gratification), administrative costs of insurance
Economic data	As above plus production potential, per capita consumption, employment rate, average replacement costs, WTP (Risk value)
Traffic data	As above plus length and duration of delay situations due to accidents, normal traffic situation
Specific Data required for Environmental	
Transport data	NUTS III level for road transport, NUTS for road, rail, inland and marine waterways, administrative units for air transport
Noise	Estimates of noise exposure
Nature and Landscape	Infrastructure as above plus infrastructure per biotope or habatat
Nuclear Risk	Country-specific electricity mix, country-specific plant mix, risk potential of existing power plants and country-specific liability systems
Specific Data required for Taxes, Charges and Subsidies	
Subsidies	All government subsidies by transport mode (grants, loans and guarantees at less than commercial rate of interest etc.)
Charges	All user charges by vehicle and infrastructure (tolls: weight related, infrastructure related, emissions related etc.) Charges for infrastructure use (airport fees etc)
Taxes	All taxes levied by vehicle and by infrastructure (VAT, Circulation tax, fuel tax, insurance tax etc.)

6 Prototype Design of the Structure and Content of Accounts

6.1 Basic structure and design for the pilot accounts

The previous chapters have outlined that the UNITE accounts are primarily an open information scheme for cost and revenues, which can be used for different purposes. Within this chapter we will present the basic design of the accounts and some guidelines for the presentation of the results.

Since the specific transport sectors have different characteristics, it is necessary to show the basic design for each mode separately (see tables 19 – 23).

Table 19: Road transport

<table>
<tr><th>Costs</th><th colspan="2">Revenues</th></tr>
<tr><th></th><th>Direct allocable revenues</th><th>Other revenues</th></tr>
<tr><td>Infrastructure costs
- Fixed costs
- Variable costs</td><td>Infrastructure charges
- fixed
- variable</td><td rowspan="3">Transport specific general charges (i.e. not earmarked fuel tax)

Additional Taxes (i.e. Eco-taxes, others)</td></tr>
<tr><td>External Accident costs</td><td>-</td></tr>
<tr><td>Environmental costs</td><td>-</td></tr>
<tr><td>Additional information:
• Delay costs (expressed as excessive time costs, delays)
– internal part
– external part
• Internal accident costs
• Relief from interest payments
• (Other private costs)</td><td>Insurance premiums</td><td>VAT</td></tr>
</table>

This template should be used as an aggregation for the road sector and for all means of transport addressed in table 3 in chapter 4. Allocating fixed infrastructure costs requires a sound methodology.

The presentation of infrastructure costs depends on the institutional framework in a specific country. If private motorway companies exist, their part of infrastructure costs has to be separated from other types of roads. In such cases, interest that has not been paid or interest and old debt taken over might be relevant and should be presented as optional additional information.

Accident and delay costs should be separated into
- internal costs (for accidents paid by individual insurance)
- transport internal (paid by the transport sector)
- external (paid by the public)

Table 20: Rail Transport

Costs	**Revenues**	
	Direct allocable revenues	**Other revenues**
Infrastructure costs -Fixed costs -Variable costs	Rail track charges - fixed - variable	Additional Taxes (i.e. Fuel taxes, Eco-taxes, others)
Supplier operating costs	Tariff revenues	
External accident costs	-	
Environmental costs	-	
Additional information: • Delay costs (expressed as delays) • Internal accident costs • Relief from interest payments	Insurance premiums	Non transport specific revenues of additional services of railways Subsidies[1] – specific subsidies (e.g. PSO) – general deficit payments VAT
[1] Construction subsides are considered as capital costs at the cost side		

In contrast to the road sector, rail transport accounts include revenues from other services which are not transport related. This depends on the systems boundaries and the institutional framework. Furthermore non-paid interest and specific subsidies should be shown separately. In countries with transparent separation of infrastructure and services, the related entities should be addressed separately.

Table 21: Urban Public Transport

Costs	**Revenues**	
	Direct allocable revenues	**Other revenues**
Infrastructure costs - Fixed costs - Variable costs		Additional Taxes (i.e. fuel taxes, Eco-taxes, others)
Supplier operating costs	Tariff revenues	
External accident costs	-	
Environmental costs	-	
Additional information: • Delay costs (expressed as delays) • Internal accident costs • Relief from interest payments	Insurance premiums	Non transport specific revenues of additional services of urban P.T. Subsidies – specific subsidies (e.g. PSO) – general deficit payments VAT

Urban Public Transport services are, in contrast to rail, more difficult to separate into infrastructure and operation services. Depending on the institutional set-up, a further separation of costs according to specific services, busses (diesel, trolley), urban rail and metro services should be envisaged.

Table 22: Inland Waterways and Short Sea Shipping

Costs	**Revenues**	
	Direct allocable revenues	**Other revenues**
Port infrastructure and service costs - Fixed costs - Variable costs	Port charges – fixed – variable	Additional Taxes (i.e. fuel taxes, Eco-taxes, others)
Other services	Related revenues	
External accident costs	-	
Environmental costs	-	
Additional information: • Internal accident costs • Relief from interest payments	Insurance premiums	Non transport specific revenues of ports Subsidies – specific subsidies for ports – specific subsidies for vessels VAT

Because inland waterways transport is usually a private business, the infrastructure business account information is most important. Supplier operating costs of vessel navigation and related private services can be omitted. A major problem is the distinction of different transport services on the cost side, if there is no access to specific cost information.

Table 23: Aviation

Costs	**Revenues**	
	Direct allocable revenues	**Other revenues**
Airport infrastructure and service costs - Fixed costs - Variable costs	Landing charges and related charges	Additional Taxes (i.e. airport charges)
Air Traffic Management services	ATM-charges (EUROCONTROL)	
External accident costs	-	
Environmental costs – LTO (around airports) – Bunker fuels	-	
Additional information: • Delay costs (expressed as delays) • Internal accident costs • Relief from interest payments (for airports)	Insurance premiums	Non transport specific revenues of additional services of airports Subsidies (for specific airlines) VAT on domestic flights

The value chain and the institutional framework of the aviation industry allows a rather clear distinction between different services. Since airlines usually operate without specific subsidies, supplier operating costs and revenues from airline services can be omitted. Specific subsidies (paid irregularly to some airlines) however should be shown.

6.2 Extensions for ideal accounts

a) Differentiation according to social and regional criteria

The ideal accounts seek further differentiation on the cost and revenue side. Considering the ongoing debate in European transport policy, the social dimension is most interesting. We can distinguish the individual view (differentiation according to income groups) and the regional view (differentiation according to different type of region, i.e. urban, suburban, rural, remote areas). Information on these issues is usually – if at all – only partly available. Most interesting is the differentiation for road and rail transport, since water and aviation transport has by definition a more international scope.

Based on the design shown above, this dimension can be added according to its relevance, for example as templates for different regions. An additional step is the differentiation of costs and user contributions by type of transport (i.e. internal, import/export and transiting traffic).

The individual view (differentiation according to income groups) can only be used for specific questions, for example traffic use and related contributions, based on specific surveys.

b) Differentiation according to user groups

By including a row for each impact group each positive revenue entry has a corresponding negative revenue entry elsewhere in the table. For example, charges for rail track access appear as revenues in the Infrastructure provider row, and as a cost entry for the Service operator: The "Community" row allows for wider impacts (e.g. environmental costs imposed on the general public) to be recorded. This design proposal is an extension of the templates produced in the chapters above.

Table 24: User group differentiation

	COSTS					REVENUES			
	Infra-structure	Service operation	Accidents	Environment	TOTAL	Tax	Charges paid	Revenue received	TOTAL
Infrastructure Operators									
Service Operators									
Users									
Government									
Community									
TOTAL									

6.3 Guidelines for the interpretation

The templates presented above are open templates. We do not address specific products on purpose, since there is no scientific consensus on cost allocation. However the information allows different conclusions to be drawn for the monitoring purposes mentioned in chapter 3. Thus it is helpful to provide some guidance in how to use this information for specific questions. In this section we present three different products for the accounts.

6.3.1 Total cost information

a) Development of social costs

For the purpose of green accounting, it is interesting to monitor the development of different costs over time. Most interesting is the development of some external costs like accident and environmental costs. As an indicator of the service quality of the network, the development of delay costs is relevant.

b) Comparison between modes

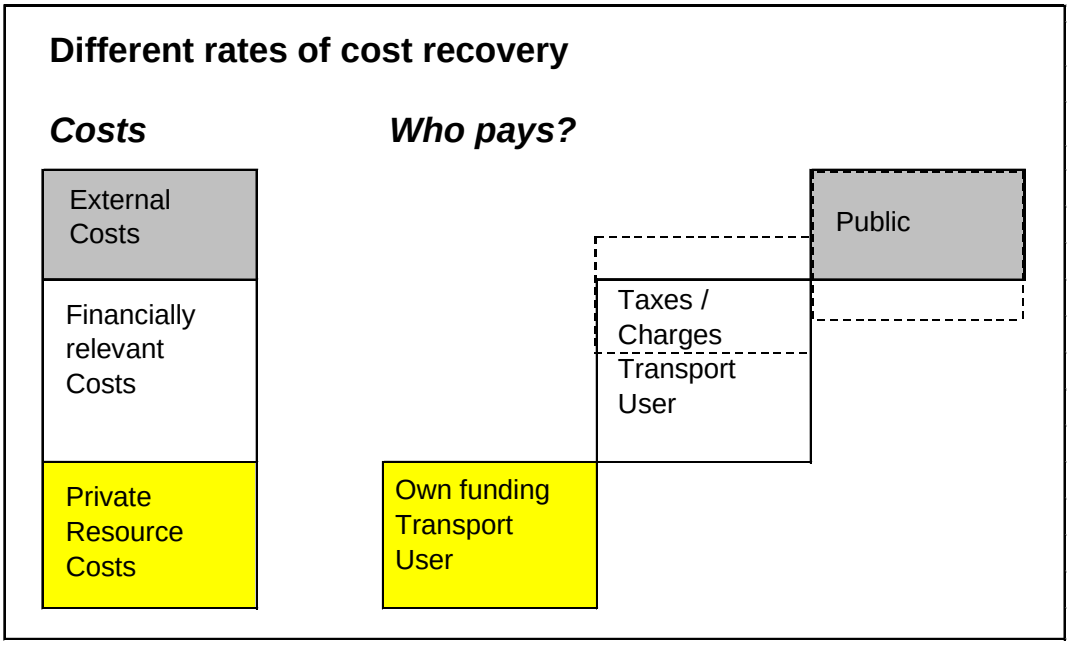
A traditional approach is to compare total and average costs across transport modes. It must be considered however, that due to the omission of some costs like private costs, the total is not the same across all modes. Thus it is useful for the purpose of comparison to restrict this comparison to those costs which are most interesting. These are external accident costs, environmental costs and delay costs (see above). The latter however can not easily be compared since there is a distinction between scheduled and non scheduled transport. Therefore it is useful to treat them separately.

A transparent comparison of modes is only possible if a common denominator can be found. For passenger transport, the adequate indicator is passenger kilometres, being very traditional for these kind of comparisons. For freight transport however, a comparison is more difficult, since the available indicators (esp. tonne kilometres) do not address a similar value for transport. This is especially true if for example air freight is compared with rail freight.

6.3.2 Cost recovery issues

The most important information of strategic value is that on which groups pay each category of costs (on different levels). Figure 1 provides an overview.

Figure 1: Different levels of recovery of transport costs



a) Cost recovery of financially relevant costs

Financially relevant costs are those costs which have to be paid in financial terms. They consist of

1. The costs for infrastructure provision and related environmental/accident protection measures.
2. The costs of transport service provision (as far as they are not private resource costs).

Since these costs are not all paid by the users (subsidies) and/or are not paid via direct charges according to usage (like it is the case for road transport), this comparison is the most obvious one for accounts. However there are still two levels of questions:

- Do the transport operators fulfil their service obligations[7]: This is especially related to business oriented institutions (like privatised railway companies)?
- What do publicly provided transport related services (infrastructure and transport services) really cost in economic terms and how are they recovered by transport specific charges and taxes?

a1) Cost recovery of infrastructure provision

Aim

Infrastructure provision is usually the most important provision financed (at least initially) by public money. For all modes, infrastructure can be clearly defined and the institutional background should (at least theoretically) allow a separation of costs and revenues. This is at least true for air and waterborne transport. However, in case of (the still) vertically integrated companies detailed research and empirical work is required to separate infrastructure from operations. For rail it depends on whether railways have carried out a vertical separation and whether they have published separate accounts. A bit more difficult is the allocation of infrastructure services within road transport. Nevertheless in this product infrastructure costs and related revenues can be compared.

Result

Infrastructure related costs compared with infrastructure related revenues and other sources of finance.

Interpretation

The allocation of non specified transport user contributions must consider the primary aim of the levy. If there is no national consensus on allocation of revenues to infrastructure, sensitivity testing may help to overcome the scientific gaps.

a2) Cost recovery of public transport services

Aim

This second element considers **all** financially relevant transport costs. We also include here figures based on the business accounts for transport services. The private costs (own funding mechanisms) however are not relevant. Within the pilot accounts, the main focus is on public transport modes which are heavily subsidised (urban public transport, railways).

7 Explicit Public Service Obligations, explicit 'deals' between the business units and the government.

Result
Infrastructure costs and supplier operating costs of rail and urban public transport services in relation to revenues in relation to revenues.

Interpretation
The result is only an extension of the infrastructure cost accounts described above. Thus the methodological problems remain the same. In addition there is the problem of allocation of non transport related services (like rents of housing, travel agency services) which is only possible when the specific information is available.
The allocation of supplier related revenues (by services) should be rather simple since the sources are usually business accounts. More difficult is the allocation of costs and revenues to different means of transport, when there is no separate division of accounts.

b) Social cost recovery

The consideration of all relevant social costs raises the question of the expected interpretation. Firstly not all costs are charging relevant and secondly the total/average or average variable costs are only more or less indirect proxies for charging issues.

Aim
The focus is on external cost components (i.e. not or not directly paid by the users). Several costs (like private costs, delay costs and internal accident costs) are therefore not directly relevant. However all cost information is interesting for the purpose of 'green transport accounting'. Information on these internal cost components is optional.
On the revenue side all revenues from transport related tariffs, charges and taxes are considered.
In order to have a broad overview of the structure of the costs and revenues, related to social marginal cost pricing, the costs and revenues will be distinguished between fixed and variable parts.
Note that comparing social costs with revenues is not of direct relevance for pricing.[8] However they can be used as additional information. Two ratios are of interest:

- The ratio between not directly paid costs and related revenues, as an indicator for equity in the transport sector.
- The ratio between fixed and variable costs and fixed and variable charges (structural comparison).

Result

- Infrastructure costs, supplier operating costs, external accident costs and environmental costs.
- Comparison of fixed costs and fixed revenues and variable costs and variable revenues and other sources of finance.

Interpretation
The comparison of social costs with revenues is a structural output and a level output at the same time. Note that this output is not directly linked to the principle of social marginal cost pricing, due to different cost functions and to the following reasons:

8 Since private costs are not considered, the 100% of costs of private and public transport are not equal, since supplier operating costs (and related revenues) are considered for public transport.

- Average variable infrastructure costs are only a proxy for marginal infrastructure costs, since the cost function (infrastructure costs in relation to vkm and weight etc.) is not linear.
- Total (and average) delay costs are completely different to marginal external delay costs. Thus it is easier to omit delay costs within social recovery rates.
- Marginal noise costs are lower than average noise costs, due to a degressive cost function.

Thus the social cost comparison can be seen as a rough proxy for a structure and level check of transport prices and charges. A sound check of the fit of the existing charging system according to the principle of Social Marginal Cost Pricing is only possible with a detailed (bottom up based) link wise approach of Social Marginal Costs and related user contributions which is not foreseen within the UNITE accounts.

Glossary of terms

Accident Cost	Cost mainly related to vehicle repair and medical cost and the cost of „suffering“ associated with accidents.
Accident Insurance	Voluntary or mandated insurance against the risks of accidents (property and health). The premiums serve to partly internalise external costs.
Actors	Social groups appearing as (1) cost generators by using means specific means of transport and (2) as actual payers by paying for vehicle operation, providing infrastructure or bearing the external effects caused by transport.
Administrative and Commercial Costs	Costs incurred by administrative and commercial activities of the supplier. They can be considered as fixed cost or variable only at large intervals (discrete distribution).
Amortisation	See *Depreciation*
Asset Valuation	This is the process by which the economic value of the infrastructure is calculated. There are two basic methods of asset valuation: ‘replacement cost’ and ‘historic cost’. In broad terms, there should be a certain degree of equivalence (and comparability) between them and the choice between methods should be largely determined by practical data availability considerations. The ‘replacement cost’ method combines an inventory of asset quantities by asset type with corresponding unit costs for replacing them in their current condition. In contrast, the ‘historic cost’ method relies on data on year-by-year investment figures for a long period of time, taking account of depreciation in value and adjusting to changes of prices over time. While the replacement cost method is also sometimes referred to as the “synthetic method”, the “historic costs” method is applied by using the Perpetual Inventory Model.
Average Costs	(→ marginal costs) Average costs are the simple result of dividing total (fixed + variable) costs by the number of subjects involved in its generation.
Charge	A charge is a levy which requires a direct and clear service in proportion of the payment on the part of the government.
Commercial Transport	On-demand transport services offered by non-official transport suppliers. It is a business activity were the final users are considered as the operator's customers getting charged. The full range of operating costs is recorded by business accounts.
Contingent Valuation Method	Valuation technique method that asks people directly how much they are willing to pay / to accept for improving / deteriorating environmental quality. The method is based on the stated preference approach; it is the only method that allows the estimation of existence value.
Cost Benefit Analysis	(CBA) Denotes the comparison of the costs and revenues associated with the implementation of a particular infrastructure project or other policy measures.

Cost Categories	Different types of costs consisting of particular properties concerning variability, financial relevance, carriers and procedures of estimation.
Cost Driver	The variable which denotes the key cause of various transport costs (e.g. axle weight).
Cost Generator	Those social groups or means of transport, who are responsible for the use of resources and hence for the generation of real costs.
Costs	Periodic value for use of resources (→ resource costs). One can distinguish current costs which are equal to current expenditures and opportunity costs for the resource depletion of investments.
Delayed Costs	(→ variable costs) Costs which occur not at the same time as the cost-driving factor is caused. A typical example is air pollution, where health costs or building damages are occurring due to a cumulative effect of exposure and costs might occur in the near future. In terms of financing, these costs can be regarded as fixed costs, because they are not directly influenced by changing traffic volumes. However, if applying the "polluter-pays-principle", where each actor should pay for the damage caused, the origin of these costs is variable (e.g. the emitted amount of NO_X, SO_2 or vibrations. Costs related to long-term effects which are caused by vehicle emissions, are therefore changed from "fixed" to "variable".
Depreciation (Economic)	Depreciation refers to the annual loss in value of assets over time due to their physical deterioration. The economic definition of this term relates to the expected life span of the asset, and depreciation may be calculated on the basis of an equal loss in value in each year (linear depreciation) or as a percentage of the asset value at the start of each year (declining balance depreciation). Note that the economic definition of this term seeks to distinguish it from that used in accountancy or taxation practice - where, for example, the depreciation period may differ from the likely life span of the asset.
Dose-Response Function	Used more or less synonymously with „exposure-response function“ even though what is meant is, the response to a given exposure of a pollutant in terms of atmospheric concentration, rather than an ingested dose.
Earmarking	Direct interlinkages between the financial source and the financial purpose, in order to secure financial resources. For example earmarking road pricing revenues to finance road infrastructure or environmental measures).
Exposure-Response (E-R) Function	Functional relationship relating changes in human health, material corrosion, crop yields etc. to unit changes in ambient concentrations of pollutants. Used more or less synonymously with dose-response function.

Financial Costs	(→ opportunity costs, → shadow prices) A number of social costs allocated to transport are not directly associated with monetary payments (e.g. the willingness-to-pay for better air quality, time losses in traffic jam or less accident risks). These costs accordingly are called "opportunity" costs. In contrast, "financial" costs can be related to financial flows and hence can be accounted for much more precisely than opportunity costs, which have to be estimated.
Fixed Costs	(→ variable costs) Fixed costs are those costs, which do not change with traffic volume. It is necessary to distinguish short and long run perspectives. Important elements of fixed costs in the short run are capital costs for traffic infrastructure or of the vehicle stock of a collective transport operator. In the long run however, all costs are variable.
Full Costs	Full costs are those costs caused by the whole transport sector of an urban area. For analytic reasons and to get a more precise insight in the cost structure of a municipality, full costs are presented by vehicle types or actor groups responsible, by time of day or by actual payers. Full costs can be classified into → fixed and variable costs or into → financial and opportunity costs.
GDP	(= Gross Domestic Product). The GDP is the sum of all goods and services produced within a country and a year. GDP per capita can be regarded as the relative economic power of a country per inhabitant.
Government	public sector (state and municipality).
Impact Pathway Approach (IPA)	Methodology for externality quantification developed in the ExternE project series. The phrase „impact pathway“ simply relates to the sequence of events linking a „burden“ to an „impact“. It follows the chain of causal relationships from pollutant emission via dispersion (including chemical transformation processes), leading to changes in ambient air concentrations from which impacts can be quantified using exposure-response functions. Damages are then calculated using monetary values based on the WTP approach.
Injurer	In a collision accident, the injurer is the transport user that is not hurt in the accident. The injurer does not have to be the guilty party in the accident.
Individual Transport	Transport performed on the own account of users with their own vehicle for private reasons.
Infrastructure Cost	Cost mainly related to damage cost (maintenance and repair), some services and operation.
Infrastructure Suppliers	are defined as the total of public and private enterprises which finance the provision and maintenance of the transport infrastructure for all modes (road, rail and water) within the urban area analysed

Infrastructure-Related Supplier Operating Cost	Costs incurred with infrastructures. In this case, the cost could be considered to be a fixed cost.
Insurance / Guarantee	These instruments cover risks. Money will only be transferred when repayment of loan is not possible or profitability of investment is not enough to cover the costs. The payment of the government can in theory be either fixed or variable.
Interest Cost	A part of (→ capital costs); it denotes the opportunity costs of capital.
Internal Costs	(→ external costs) According to the definition of → external costs, internal costs denote those cost elements, which are caused and carried by the same actor. When this happens due to policy instruments (e.g. pricing), costs are internalised.
Internalisation	Incorporation of an externality into the market decision making process through pricing or regulatory intervention. In the narrow sense internalisation is implemented by charging the polluters with the damage costs of the pollution generated by them according to the polluter pays principle.
Levy	A payment collected by the government (→ Tax).
Marginal Accident Cost	Incremental costs of an accident borne by society at large, including family and friends. It can also include costs borne by the victims of an accident.
Marginal Costs	(→ average costs) Marginal costs are equal to additional costs per additional unit. In transport they reflect those costs occurring, when an additional subject (or unit) is entering a system. In the terminology of the Real Cost Scheme (RCS), common units are additional passenger - or ton kilometres. Marginal costs usually are not constant, but dependant on the number of subjects, who already are in the system. While in classical economic theory the curve of marginal costs is growing progressively with the number of users in a system, in some cases (e.g. traffic noise) marginal costs even fall with increasing traffic load. For reasons of practicability, the RCS approaches real marginal costs by determining the "average variable cost" of passengers of goods. This assumes, that the current traffic load of roads or railway tracks remains constant, being considered to be sunk costs. Marginal costs can be determined in the short run (as it has been done above) or in the long run. In the latter case, also those fixed costs, which do not remain unchanged in long terms due to changing transport demand, are added.

Marginal Costs (Short and Long Term)	Costs related to a small increment in demand (e.g. an extra vehicle-kilometre driven). The distinction between short and long term marginal costs is important with respect to infrastructure costs. Whereas short-term marginal costs do not consider capacity increases and are related to the costs of additional traffic using the existing infrastructure, long-term marginal costs include the capacity expansion needed to service increased traffic demands.
Marginal Social Cost Pricing	According to this → pricing principle, prices (both in private and public transport) are set equal to the → marginal costs arising to society from consuming transport facilities. Regarding the condition: price = marginal cost, this form of collecting → user contributions is expected to lead to the best possible allocative efficiency. Its functional quality and practical feasibility depend on a proper calculation of the total costs and on the existence of techniques that are capable to differentiate the → cost generators according to the magnitude of their cost generation (e.g. peak versus off-peak, polluting versus non-polluting, noisy vs. low-noise, high vs. low abrasion etc.).
Means of Transport	Different modes of transport and types of vehicles which are characterised by use of infrastructure and by the actor groups using them.
Mode of Transport	Means of transport. UNITE distinguishes between road, rail, inland waterways, maritime and aviation.
Opportunity Costs	(→ Financial costs, → shadow prices) The expressions "opportunity costs" and "shadow prices" are used synonymously within the Real Cost Scheme. They determine the value added for an individual in case a good would not have been bought or built or in case negative effects of transport would not be present. Opportunity values are used for the evaluation of investments (capital costs), lost lives (statistical value of human life) or for the assessment of noise nuisance.
Out-of-Pocket Costs	Monetary vehicle operating costs which are directly borne by the transport user and which are visible to him. Usually out-of-pocket costs refer to the fuel costs and road toll payments in private motorised road transport.
Partial Cost Component	(→ Main Cost Category) (= PCC). PCCs are a further subdivision of MCCs by equal cost properties or subjects.
Passenger Car Unit	(= PCU) PCU is used in order to standardise vehicles in relation to a passenger car. Speed and lengths differentials are most common.
PCC	→ Partial Cost Component.
Pkm	Passenger kilometre.

Prevention Approach	Technique for estimating externalities whereby the costs of preventing damage are used as a proxy for the cost of the damage itself for society.
Pricing Principles	Several options are given to set the prices to be paid by transport users (or, in case of infrastructure usage, by operators) according to pricing principles that take into consideration different variables; e.g. → marginal social cost pricing, → Ramsey pricing, → two part tariffs → average cost pricing.
Pricing Relevant Costs	The question "what is relevant for determining transport prices" strongly depends on the attitude of the municipality or the transport operator. For example, shall infrastructure costs be fully covered by the transport system itself, or is infrastructure provision regarded as the duty of the state or municipality? In recent economic theory, there are several viewpoints concerning the composition of pricing relevant costs. Most common is the welfare approach of marginal cost pricing. This principle has been translated to EU policy: The White-Paper of the European Commission on Fair and Efficient Infrastructure Pricing recommends the application of short-run marginal cost pricing, which intends to minimise the social costs of transport and thus to achieve a sustainable structure of transport demand. According to the theory of social welfare, pure marginal prices only regard "short-run" marginal costs, while fixed costs are totally excluded from the price fixing. In order to address practical restrictions of infrastructure suppliers and transport operators, in [PETS 1998] in contrast to the pure marginal cost pricing, a second-best variant including long-run marginal costs is proposed. Expressed in the terminology of the RCS this means, that pricing-relevant costs include marginal as well as average fixed costs. If full cost recovery is the aim behind pricing transport, total pricing-relevant costs are equal to financing-relevant costs. It should be noted that the pure amount of pricing relevant costs has no implication on the value of marginal prices, as for their adjustment the functional interdependency of traffic volume and costs must be taken into account.
Production Loss	The production losses are the added sum of replacement costs and human capital costs that occur to an economy through accidents with human casualties.
Public (Scheduled) Transport	The transport of an additional person or unit of goods does not cause additional vehicle kilometres in the short run, as scheduled vehicles are running anyway. In the long run, due to increased capacity use, additional or larger vehicles have to be scheduled. In the former case the marginal costs are zero, in the latter case the marginal costs are the costs per vehicle kilometre divided by the capacity use.

Public Transport	PT subsumes all services that are supplied according to a pre-defined timetable in passenger and freight transport. The final user here pays an average fare. Typical PT is rail, bus, air and ferry services.
Purchasing Power Parity	(= PPP) The purchasing power parity describes the amount of goods or services, which can be bought in a particular country compared to a reference country. The PPP necessarily must be expressed relative to a particular currency.
Ramsey Pricing	According to this → pricing principle, prices are set with consideration to the dedicated payers' price elasticities. Since the latter are to be measured based on empirical observations, this form of collecting → user contributions finally considers the → willingness to pay of the priced actors (in this case: car drivers, public transport passengers or operators paying for infrastructure use).
Real Costs	Real Costs are the sum of all cost components mentioned above (i.e. individual and social cost). They express that not only financial, but also opportunity costs are evaluated for urban transport. They can be expressed as total costs or marginal costs. The handbook will provide methodologies and guidelines to calculate all real costs. What is left to the reader to decide is which of the MCC/PCC are relevant or not for its own town, given its level of development.
Receptor	Person, animal, plant or building exposed to an environmental burden.
Regional Scale	Covering Europe.
Reintegration	The steady loss or reduction of an accident victim's participation in the working process.
Replacement	Real expenses experienced by an accident's employers when an accident victim has to be replaced.
Resource Costs	(→ transfer payments) Resource costs in general denote the monetary equivalent of resources used by an actor. In the case of transport, resources may denote physically measurable goods, such as fuel, wages, time or taxes as well as public goods, e.g. clean air, silence or safety. In the first case, i.e. whenever resources are used and paid by the same agent, we talk of internal (resource) costs, otherwise of external costs.
Revealed Preference	Valuation technique wherein consumers' choices are revealed in the marketplace (e.g. by the purchase of a good).
Risk Value	A term often used instead of VOSL to emphasise the origin of the value; i.e. a statement about the WTP for risk-reduction. This term is also applicable to non-fatal accidents.
Service-Related Supplier Operating Cost	Costs incurred in activities related to the services provided by suppliers, weather they are physically outside the vehicles or inside, if they are not directly related to the actual functioning of the vehicle.

Shadow Prices	Shadow price is the marginal opportunity cost of the use of a resource (i.e. the loss of benefits caused if this resource cannot be used for the next best purpose).
Social Benefits	Social benefits denote (positive) effects on society, which are caused by transport. Besides the direct benefits (mobility, access, time gains etc.), there are indirect benefits. Examples would be increases in rent prices due to the connection to the public transport system or technological transfers from vehicle construction to other sectors of the economy. Whereas direct social benefits are at least equal to direct (internal) costs, indirect social benefits of transport are not considered in the Real Cost Scheme, because their definition is very diffuse and hence their valuation in monetary terms is extremely vague.
Social Costs	($\rightarrow$ real costs, $\rightarrow$ social benefits) , Sum of internal and external costs. Generally spoken, social costs are economic resource costs imposed on society. The simple value of social costs, which are generated by a particular agent does not contain the payments borne by him in order to compensate these costs.
Social Marginal Cost Pricing	A pricing scheme, which charges marginal costs (e.g. infrastructure use, congestion, and environmental externalities). This scheme is proposed in the EU White Paper on 'Fair Payment of Infrastructure Use' (1998). It is based on a differentiated Road Pricing.
Stated Preference	Valuation technique where monetary estimates are derived from hypothetical statements by individuals about their preferences. The typical method used is a questionnaire approach (e.g. contingent valuation method).
Subsidy	A subsidy is a conditional payment to individuals or business by a government for which it receives no products or services in return.
Sunk Costs	Costs which are paid and therefore not relevant for future decisions. Marginal costs do therefore not consider sunk costs. Typical examples are capital costs of infrastructure investments.
Supplier Operating Cost	Costs mainly related to the costs incurred by a supplier in its operations.
Target Group	The group towards which the government policy is addressed.
Tax	A tax is a levy that must be paid with no discernible service required from the government or a service that is not in proportion to the payments. Taxes include e.g. income tax, property tax corporate tax etc..
The Service Providers or Transport Operators	Those actors performing transport for collective transport users. However, while the latter have been summarised into one user group within the Real Cost Scheme, it is sensible to distinguish between passenger services, run by collective passenger transport operators, and goods distribution services, which are supplied by collective goods transport operators.
Tkm	Tonne kilometre.

Traffic Mode	Category of means of transport (road, rail, aviation, shipping, etc.).
Traffic Pattern	Composition of traffic flow regarding travel purpose and travel mix.
Transport User Cost	Cost mainly related to the use of the transport network resulting in congestion, scarcity etc.
Users: Individual Transport Users	There are individual transport users and collective transport users. The users of individual (motorised) transport are characterised by operating their own vehicle fleet without any kind of operator running the vehicles. Individual transport users can further be diversified into private and commercial.
Variable Costs	(→ Fixed costs) Full costs can be subdivided into fixed costs and variable costs. Fixed costs remain constant with varying use of a transport system (e.g. supplier or capital costs for road and rail networks or administrative costs). The expression "fixed" in the way it is used in the Real Cost Scheme means "fixed in the short run" (without consideration of new infrastructure), as in the long run infrastructure supply costs also vary with the traffic demand. In the long run all costs can be considered to be variable. Variable costs depend on the amount of users and the traffic volume performed by then. This simple subdivision does not clarify to which degree or to which vehicle group these costs vary. For example, road maintenance costs vary with the fourth power of axle loads, and hence can be regarded as invariant to the number of private road users.
Vehicle-Related Supplier Operating Cost	Costs incurred in the actual functioning of the vehicle. In limit situations, a supplier without vehicles would not incur in these costs.
VLYL	Value of a life year lost.
VSL	Value of a statistical life.

References

Aberle G and Holocher KH (1984) Vergleichende Wegerechnungen und Verkehrs-infrastrukturpolitik, Gutachten im Auftrag des Verbandes der Automobilindustrie e.V. Schriftenreihe des Verbandes der Automobilindustrie e.V. (VDA) No. 46. Frankfurt a.M.

AEA Technology (1997) Economic Evaluation of Air Quality Targets for CO and Benzene. Interim report prepared for the European Commission DG XI, Harwell, UK.

Arbeitsgruppe Wegekosten im Bundesverkehrsministerium (1969) Bericht über die Kosten der Wege des Eisenbahn-, Straßen- und Binnenschiffsverkehrs in der Bundesrepublik Deutschland. Schriftenreihe des Bundesministeriums für Verkehr Heft 34, Bad Godesberg.

Bast (1999) Volkswirtschaftliche Kosten der Personenschäden im Straßenverkehr; Bundesanstalt für Straßenwesen, Heft M 102, Bergisch-Gladbach, Januar 1999.

Bast 1994: Dunkelziffer Dunkelziffer bei Verkehrsunfällen mit Personenschäden. Info letter 14/94 of the Highway Research Institute (Bast). Bergisch Gladbach, 1994.

Bauer PW (1990) 'Recent Developments in the Econometric Estimation of Frontiers'. Journal of Econometrics 46 (1/2) pp39-56.

Baumol WJ, Panzar JC, Willig RD (1988) Contestable Markets and the Theory of Industry Structure.Harcourt Brace Jovanovich,San Diego.

Bemelsmans-Videc ML., Rist RC, Vedung E (1998) Carrots, sticks and sermons, policy instruments and their evaluation, Transaction Publishers, New Brunswick, New Jersey (USA)

Bergstrom, C.T. (1982). When is a man's life worth more than his human capital? In Jones-Lee(ed) ; The value of life and safety, North-Holland Pub.Comp.

Berndt ER, Khaled MS (1979) 'Parametric Productivity Measurement and Choice among Flexible Functional Forms'. Journal of Political Economy 87 pp1220-1245.

BFE (1996) Ökoinventar für Energiesysteme, Bundesamt für Energie, Swiss Federal Office of Energy (Editor), Bern 1996.

BFS (Bundesamt für Statistik) (1985) Bericht über die Neugestaltung der Strassenrechnung. Bericht der interdepartementalen Arbeitsgruppe für die Neugestaltung der Strassenrechnung. Bern.

Bickel, P., Friedrich, R. (1995): Was kostet uns die Mobilität? – Externe Kosten des Verkehrs. Berlin, Heidelberg, 1995.

Bickel, P., Schmid, S., Krewitt, W., Friedrich, R (eds.) (2000) External Costs of Energy Conversion – Improvement of the ExternE Methodology and Assessment of Energy-Related Transport Externalities ("ExternE Core/Transport"), Final Report to the European Commission, Contract No. JOS3-CT97-0015, Stuttgart.
Blomquist, G. (1988) 'The Value of Human Life: An Empirical Perspective, Economic Inquiry, 19, January.

BMV (1969) Bericht über die Kosten der Wege des Eisenbahn-, Straßen- und Binnenschiffsverkehrs in der Bundesrepublik Deutschland. Schriftenreihe des Bundesministers für Verkehr, Heft 34, Bonn.

BMV/DIW (1997) Verkehr in Zahlen 1997. Berlin/Köln 1997.

BMVBW (1999): Verkehr in Zahlen 1999; Berlin, Hamburg 1999.

BMW (1997): Abschätzung der volkswirtschaftlichen Verluste durch Stau im Strassenverkehr; Internal working paper, Munich.

Bosch and Partner (1993) Faktische Grundlagen für die Ausgleichsabgabenregelung (Wiederherstellungskosten), research commissioned by BFANL (BfN), 1993.

Braeutigam RR (1980) An analysis of fully distributed cost pricing in regulated industries. The Bell Journal of Economics Vol. 11 No. 1 pp 182-196.

Brimson JA (1991) Activity accounting: an activity-based costing approach. John Wiley & Sons, New York.

Brossier MC (1996) Mise à jour du rapport n° 91 - 105 relatif à la nouvelle étude de l'imputation des coûts d'infrastructure de transport routiers.

Bureau of Industry Economics (1988) Characteristics and Cost Structure of the Buls Shipping Fleet, Occasional Paper 93, Camberra (Australia).

Bureau of Industry Economics (1992) Road Freight: International Performance Indicators, Research report 46, Camberra (Australia)

Canadian Transport Commission (1984) Railway Costing: State of the Art, November, mimeo prepared for the World Bank

Cantos P, Pereira R, Kiosseoglou A and Poveda J (1995) The allocation and charging of interurban road infrastructure in Spain. Financing Transport Infrastructure. Proceedings of Seminar L held at the PTRC European Transport Forum.

Caves DW, Christensen LR, Tretheway MW (1984) 'Economics of Density versus Economics of Scale: Why Trunk and Local Service Airline Costs Differ'. Rand Journal of Economics Vol. 15, No. 4, winter, pp471-489.

CE (1998) Centre for Energy Conservation and Environmental Technology: Bleijenberg A. N., Davidson M. D. and Wit R. (authors), The price of pollution, Delft, NL.

CEC (1998) White paper, Fair Payment for Infrastructure Use: A phased approach to a common transport infrastructure charging framework in the EU. COM(98) 466 final. European Commission, Brussels.

Christensen LR, Jorgensen DW, Lan LJC (1973) 'Transcendental Logarithmic Production Frontiers'. Review of Economics and Statistics, February pp28-45.

Cline, W.R. (1992) The Economics of Global Warming, Institute for International Economics, Washington, D.C.

COWI (1989) Subsidiering i Trafiksektoren 1989, Kopenhagen.

COWI (1994) Subsidiering af Godstransport 1994, Kopenhagen.

CSERGE, IOS-NLH, IVM, CAS and DAE-UoV (1999) Benefits transfer and the Economic Valuation of Environmental Damage in the European Union. With Special reference to Health, Centre for Social and Economic Research on the Global Environment (CSERGE), University College London and East Anglia ; Depart of Economics and Social Sciences, Agricultural University of Norway (IOS-NLH), Institute for Environmental Studies (IVM), Free University, Amsterdam; Centre for Applied Studies (CAS), Catholic University of Portugal; Department of Applied Economics, University of Vigo (DAE-UoV).

De Borger B (1992) 'Estimating a Multiple-Output Generalized Box-Cox Cost Function: Cost structure and Productivity Growth in Belgian Railroad Operations 1950-1986'. European Economic Review 36 pp1379-1398.

Department of Economic and Social Affairs - Statistical Office of the United Nations (1968) A System of National Accounts. Studies in Methods Series F No. 2 Rev. 3. New York.
Department of Economic and Social Affairs - Statistical Office of the United Nations (1977) Provisional International Guidelines on the National and Sectoral Balance-sheet and Reconciliation Accounts of the System of National Accounts. Statistical Papers. Series M No. 60. New York.

DHV/Tebodin (1992) Kosten op het spoor - Kosten infrastructuur ns-goederenvervoer: Een afleiding op basis van concurrerende vervoerwijzen. On behalf of Ministerie van Verkeer en Waterstaat - Directoraat-General voor het Vervoer. Amersfort/Den Haag.

Diewert, WE (1971) 'An Application of the Shepherd Duality Theorem: a Generalised Leontief Production Function'. Journal of Political Economy May-June pp.481-507.

DIW (1987) Erweiterung methodischer Ansätze zur Wegekostenrechnung und Erarbeitung eines Konzeptes für eine Gesamtkostenrechnung des Verkehrs. Gutachten im Auftrage des Bundesministeriums für Verkehr. Berlin.

DIW (1996) Ermittlung der Wegekosten und Wegekostendeckungsgrade des Eisenbahn-, Straßen-, Binnenschiffs- und Luftverkehrs in der Bundesrepublik Deutschland für das Jahr 1994. Gutachten im Auftrage der Deutschen Bahn AG, Berlin.

DIW (2000) Wegekosten und Wegekostendeckungsgrade des Straßen- und Schienenverkehrs in Deutschland im Jahre 1997. Berlin.

DIW, INFRAS, HERRY, NERA (1998) Infrastructure capital, maintenance and road damage costs for different heavy goods vehicles in the EU. Berlin.

Dorfwirth H (1979) Nutzenkostenuntersuchung im Straßenbau – Berechnung des Mengengerüstes von Straßennetzen. Wien.

DsK (1985) Kostnader och avgifter inom trafiksektorn. Kommunikationsdepartementet. Stockholm 1985.

Dubin, J. A. and Rothwell, G. S. (1990) Subsidy to nuclear power through the Price-Anderson liability limit, Contemporary Policy Issues 8: 73–79, quoted in Zweifel and Umbricht 2000.

DVWG (1994a): Verkehr und Umwelt – Gesamtwirtschaftliche Bewertung von Maßnahmen zur Verringerung von Luftschadstoffemissionen des Verkehrs. Publication Series of the German Society of Transport Research no. B 166. Bergisch Gladbach, 1994.

DVWG (1994b): Staubrobleme im Verkehr – Ursachen und Lösungsansätze. Publication Series of the German Society of Transport Research no. B 167. Bergisch Gladbach, 1994.

DVWG (1998): 9. DVWG Workshop über Verkehrsstatistik; Innovative Konzepte und Methoden - dringlicher denn je. Publication Series of the German Society for Transport Research no B 217. Bertsch Gladbach, 1998.

ECMT (1993): Marketing and Service Quality in Public Transport; Round Table 92. Economic Research Centre of the European Conference of Ministers of Transport. Paris, 1993.

ECMT (1998): User Charges for Railway Infrastructure; Round Table 107. Economic Research Centre of the European Conference of Ministers of Transport. Paris, 1998.

ECMT (1999): Traffic Congestion in Europe; Round Table 100. Economic Research Centre of the European Conference of Ministers of Transport. Paris, 1999.

Elvik (1993) 'Ökonomisk verdesetting av velferdstap ved trafikolykker' TÖI rappport 203/1993, Oslo.

European Commission (1994) Common Market Expert Group, The Economic Cost of Traffic Accidents, COST 313.

European Commission (1995) Green Paper "Fair and Efficient Pricing in Transport". Brussels.

European Commission (1998) Transport Research – Fourth framework Programme. QUITS: Quality Indicators for Transports Systems, Office for Official Publications of the European Communities, Luxembourg.

European Commission (1999) JOULE Programme. ExternE: Externalities of Energy – Volume 10 – National implementation. EUR18528

European Conference of Ministers of Transport (ECMT) (1998) Efficient Transport for Europe, OECD publications Service, Paris.

EUROSTAT (1983) Stock of Fixed Assets in Industry in the Community Member States: Towards Greater Comparability. Studies of National Accounts No. 2.

Fankhauser, S. (1994a) The Social Costs of Greenhouse Gas Emissions: An Expected Value Approach, The Energy Journal 15, 157-184.

Fankhauser, S. (1994b) The Economic Costs of Global Warming Damage: A Survey, Global Environmental Change 4 (4):301-309.

FGSV (Forschungsgesellschaft fuer Strassen- und Verkehrswesen) (1997) Empfehlungen fuer Wirtschaftlichkeitsstudien an Strassen (EWS), Bad Godesberg.

FISCUS – Cost Evaluation and Financing Schemes for Urban Transport Systems. (1999) 4th Framework Program – European Comission, project co-ordinator TIS.PT, Lisbon, Portugal

Forschungsgesellschaft für Straßen- und Verkehrswesen (1986) RAS-W. Richtlinien für die Anlage von Straßen, Teil: Wirtschaftlichkeitsuntersuchungen, Nr. 115, Köln.

Forschungsgesellschaft für Straßen- und Verkehrswesen (1997) Kommentar zum Entwurf „Empfehlungen für Wirtschaftlichkeitsuntersuchungen an Straßen“ (EWS), Aktualisierung der RAS-W’86, Köln 1997.

Grabowski R, Mehdian S (1990) ‘Efficiency of the Railroad Industry: A Frontier Production Function Approach’. Quarterly Journal of Business and Economics. Vol. 29 Issue2 Spring pp26-42.

Greene, D.L.; D.W. Jones and M.A. Delucchi (eds.) (1997) The Full Costs and Benefits of Transportation: Contributions to Theory, Method and Measurement, Springer-Verlag, New York

GVF (1996) Externe Kosten des Verkehrs 1993. GVF News, Nr. 36, Bern.

GVK (1982) Schlussbericht der Kommission zur Überprüfung der Strassenrechnung. Bern.

Haavisto J (1997) Road Cost Account for Heavy Goods Vehicles in Europe. Helsinki.

Hansson L (1993) Traffic User Charges in Swedish Policy. University of Lund.

Hansson L (1996) Kostnadsansvaret för trafikens externa effekter - En jämförelse mellan vägtrafik och tågtrafik. The International Institute for Industrial Environmental Economics at Lund University, Lund.

HCM (1950) Highway Capacity Manual. Bureau of Public Roads. 1st edition. Washington, D.C.

HCM (1965). Highway Capacity Manual. Highway Research Board. 2nd edition. Washington, D.C.

HCM (1985). Highway Capacity Manual. Transportation Research Board, Special Report 209. Washington, D.C.

Herry M, Faller P, Metelka M and Van der Bellen A (1993) Wegekostenrechnung für die Verkehrsträger Strasse in Österreich. Wien.

Heyes, A. and Heyes, C. (2000) An empirical analysis of the Nuclear Liability Act (1970) in Canada, Resource and Energy Economics 22: 91–101, quoted in Zweifel and Umbricht 2000.

Highway Research Board (1961) The AASHO-Road-Test - History and Description of Project, Special Report 61 A, Washington D.C.

Hohmayer, O., Ottinger, R. Rennings, K. (ed.) 1997: Social costs and Sustainability; Berlin, Holocher, K.H. (1988) Wegerechnungen für Strassen. Giessener Studien zur Transport-wirtschaft und Kommunikation. Giessen.

Infraconsult (1998) Kosten und Nutzen von Massnahmen im Bereich Natur und Landschaft. Draft paper, Bern, 1998. Cited in: INFRAS/IWW 2000.

INFRAS (1996) Infrastructure Costs and Revenues in EUR 17, Paper prepared for the ECMT Task Force on Social Cost of Transport, Zurich.

INFRAS (1997) Reduktionspotentiale beim motorisierten Strassenverkehr.

INFRAS (1998), Staukosten im Strassenverkehr; study for the Swiss Office for Road Transport (ASTRA), Bern, 2000.

INFRAS, HERRY, PROGNOS (1994) Einzel- und gesamtwirtschaftliche Wegekosten-rechnung Strasse/Schiene in Österreich und der Schweiz. Zürich/Wien/Basel.

INFRAS, IWW (1994) External Effects of Transport. On behalf of UIC. Zürich/Karlsruhe/ Paris.

INFRAS/Econcept/Prognos (1996) Die vergessenen Milliarden, Externe Kosten im Energie- und Verkehrsbereich, Zurich 1996.

INFRAS/IWW (2000), External Costs of Transport. Study carried out for the UIC (International Railway Union), Paris, 2000.

IOO (1995) The Price of Mobility in the Netherlands in 1990. Den Haag.

IOO (1996) De prijs van mobiliteit in 1993. Den Haag.

IRF (1998) World Road Statistics ’98, Geneva 1998.

IWW (1998) Entwicklung eines Verfahrens zur Aufstellung umweltorientierter Fernverkehrskonzepte als Beitrag zur Bundesverkehrswegeplanung. R&D activity no. 10506001 of ther German Environmental Agency. Final report, Karlsruhe, March 1998.

Janson, J.O. Lindberg, G. (1997) ”PETS - Pricing European Transport Systems - Pricing Principles” European Commission 1997.

Jansson J.O. 'Marginal Cost Pricing of Scheduled Transport Services' Journal of Transport Economics and Policy vol. XIII no. 3, pp 268-294.

Johansson P, Nilsson J-E (1998) An Economic Analysis of Track Maintenance Costs. Paper no. 881 presented at the 8th World Conference on Transport Research, Antwerp.

Johansson, O (1996), Welfare, externalities, and taxation; theory and some road transport applications. Gothenburg University.

Johansson, P-O. (1995), Evaluating health risks. An economic approach. Cambridge University Press, Cambridge.

Jones-Lee, M.W. (1982) The value of life and safety' North Holland Publishing Company, 1982.

Jones-Lee, M.W. (1989) The economics of Safety and Physical Risk. Oxford, Basil Blackwell.

Jones-Lee, M.W. (1990), The value of Transport Safety, Oxford Review of Economic Policy, Vol 6, No 2, pp 39 -58.

Jones-Lee, M.W. (1991) Altruism and the value of other people's safety", Journal of Risk and Uncertainety, 4, 213 - 219.

Jones-Lee, M.W. (1992) Paternalistic altruism and the value of statistical life, Economic Journal, 102, 80-90.

Keeler, T.E (1974) 'Railroad Costs, Returns to Scale and Excess Capacity'. Review of Economics and Statistics Vol. 56 pp201-208.

Kidholm, K. (1995) 'Assessing the value of traffic safety using contingent valuation technique: The Danish survey

Kommission der Europäischen Gemeinschaften (1969) Bericht über die Musteruntersuchung gemäß Artikel 3 der Entscheidung des Rates Nr. 65/270 EWG vom 13. Mai 1965, SEK (69) 700 endg., Brüssel.

Kommunikationsdepartmentet (1987) Den tunga vägtrafikens kostnader. Ds K 1987:11.
Lardner, D (1850) Railway Economy: a Treatise on the New Art of Transport. Dts Management, Prospects and Relations. A.M. Kelley, New York (1968 reprint).

Litnam, T. (1998) Transportation Cost Analysis: techniques, estimates and implications, Victoria Transport Policy Institute (British Columbia, Canada)

Littlechild SC, Thompson GF (1977) Aircraft landing fees: a game theory approach. The Bell Journal of Economics Vol. 8 No. 1 pp. 186.

Lorenz, MO (1916) 'Cost and Value of Service in Railroad Ratemaking'. Quarterly Journal of Economics 21 pp205-218.

LT Consultants Ltd. Cost Coverage of Road Traffic in Different Vehicle Categories (published only in Finnish: Tieliikenteen ajoneuvoryhmittäinen kustannusvastaavuus.)

Markandya, A. and Hunt, A. (2000) Economic Valuation, Sustainability Indicators and Alternative Assessment Techniques. In: Bickel et al. (2000), pp 97-131.

McCubbin, D.R. and Delucchi, M.A. (1996) The Social Cost of the Health Effects of Motor-Vehicle Air Pollution, Report #11 in the Series: The Annualised Social Cost of Motor-Vehicle Use in the United States, based on 1990-1991 Data, UCD-IST-RR-96-3 (11), Davis, California, US.

McKinsey & Co. (1986) Afrekenen met files. Amsterdam, The Netherlands.

Ministerio de Fomento Carreteras Planificacion Recomendaciones, Para la Evaluacion Economica. Coste-Beneficio des Estudios y Proyectos de Carreteras

Ministerio de Obras Publicas, Transportes y Medio Ambiente (1994) Balance Contable de la Carretera: Documento Sintesis Direccion General de Carreteras.

Ministry of Transport (1968) Road Track Costs HMSO. London.

Ministry of Transport (1992) Danish Highway Investment Evaluation Model, Updated 1994/95.

Mishan, E.J. (1971), Evaluation of life and limb: a theoretical approach. Journal of Political Economy, vol. 79, pp.687 - 705.

MOTC (1996) Inventory of Assets in the Purview of the Ministry of Transport and Communications.

Nash C, Sansom T (1999) Calculating Transport Congestion and Scarcity Costs. Final Report of the Expert Advisors to the High Level Group on Infrastructure Charging (working group 2). Leeds, May 1999.

NEA (1989) Study of Road Infrastructure Costs Applicable to Heavy Goods Vehicles in the European Community. Project for the EC/DGVII, Rijkswijk.

NEA (1997) Filekosten Op Het Nederlandse Hoofdwegennet in 1996. Rijswijk.

Needleman (1976), L. Valuing other people's lives. Manchester School, vol. 44, pp 309 -342.

NEI (1993) De lasten van de kosten - Effecten van doorberekening van infrastructuur- en externe kosten aan het goederenvervoer. On behalf of Ministerie van Verkeer en Waterstaat - Directoraat-General voor het Vervoer, Rotterdam.

Newbery, D.M. (1988) Road User Charges in Britain, Economic Journal, vol 98, pp 161 - 76.

Newbery, D.M. (1990) Pricing and Congestion: Economic principles relevant to pricing roads, Economic Journal, Oxford Review of Economic Policy, Vol 6, No 2, pp 23 -38.

Newbery, D.M. (1995) Reforming Road taxation, Automobile Association.

Nordhaus, W.D. (1991) To Slow or Not to Slow: The Economics of the Greenhouse Effect, Economic Journal 101, 920-937.

Nordhaus, W.D. (1994) Expert Opinion on Climate Change, American Scientist 45-51.

Nordhaus, W.D. (1994) Managing the Global Commons: The Economics of Climate Change, The MIT Press, Cambridge.

OECD-IRTAD (1994) 'Under-reporting of road traffic accidents recorded by the police, at the international level. Spec.Report: H.Hvoslef, Oslo.

Oum TH, Waters WG (1998) Recent developments in cost function research in transportation. In: Nash C; de Rus G, eds (1998) Recent developments in transport economics. Aldershot.

Pearce, D.W., W.R. Cline, A.N. Achanta, S. Fankhauser, R.K. Pachauri, R.S.J. Tol and P. Vellinga (1996) The Social Costs of Climate Change: Greenhouse Damage and the Benefits of Control, In: Bruce, J.P., H. Lee and E.F. Haites, (Eds.) Climate Change (1995: Economic and Social Dimensions – Contribution of Working Group III to the Second Assessment Report of the Intergovernmental Panel on Climate Change, pp. 179-224. Cambridge: Cambridge University Press.

Peirson, J. Skinner, I. and Vickerman, R. (1994) The microeconomic analysis of the external costs of road accidents. Discussion Paper 94/6, CERTE, May 1994

Persson, U.(1992) "Three economic approaches to valuing benefits of traffic safety measures", Lund University.

Persson-Cedervall (1988) 'Vägtrafikolyckornas personskadekostnader' University of Lund. Lund 1988.

Persson-Cedervall (1991) 'The value of riskreduction: Results from a Swedish sample survey' IHE Working Paper 1991:4. Lund.

PLANCO 1990: Externe Kosten des Verkehr Schiene – Straße – Binnenschiff; Study on behalf of the Deutsche Bundeshabn, Essen 1990.

Pratt (1994) Risk Aversion in the Small and in the Large, Econometrica 32/1994.

PROGNOS (1988) Alternative Methods for Calculating Harmonised Vehicle Taxes. Project for the EC/DGVII, Basle.

PROGNOS (1996 a) Wegeausgabenrechnung 1993 für Deutschland nach Verkehrsträgern - Bericht, in Zusammenarbeit mit dem Institut für Verkehrssystemplanung der TU Wien im Auftrag des Bundesministeriums für Verkehr. Basel.

PROGNOS (1996 b) Wegeausgaben in Deutschland 1994 - Ergebnisband, im Auftrag des Bundesministeriums für Verkehr, Basel.

Proost, S., Van Dender, K., De Borger, B., Vickerman, R., Peirson, J., O'Mahony, M., van den Bergh, J., Verhoef, E., Roson, R., Kapros, P. (1999) TRENEN II STRAN – ST 96 SC 116, Final report for publication, Leuven, Belgium.

Railtrack (1999) Structure of rail access charges; summary of asset usage cost research. London.

Ricci R (1984) La Tariffazione per L'Uso delle Infrastructure Stradali. Ministerio Trasporti, Roma.

Ripley WZ (1923) Railroads: Finance and Organisation. Longmans, Green and Co., New York.

SAMPLAN (1995) Översyn av samhällsekonomiska kalkylvärden för den nationella trafikplaneringen 1994 – 1998. Stockholm.

Schmuck A, Ressel W (1994) Wirtschaftlichkeitsvergleich für unterschiedliche Bauweisen. Untersuchungsbericht im Auftrag der European Asphalt Pavement Association, München.

Schwab Christe,G.N.; Soguel,C.N. (1995) Contingent valuation, transport safety and the value of life. Kluwer Academic Publishers.

Secretary of Transportation (1982) Final Report on the Federal Highway Cost Allocation Study - Report on the Secretary of Transportation to the United States Congress, Washington D.C.

Snizek et al. (1988) Snizek S, Steierwald G, Steinbach J, Pöschl F, Stottmeister V, Schlosser F, Fußeis W Anforderungs- und Leistungsprofile von Straßen (ALS). Wien .

SOU 89:15 (1989) Storstadstrafik 2 - bakgrundsmaterial (Big citie's traffic part 2 - background material). Ministry of Communications, Stockholm.

Talvitie AP, Sikow C (1992) 'Analysis of Productivity in Highway Construction using Alternative Average Cost Definitions'. Transportation Research-B Vol. 26B No.6 pp461-478.

Tengblad Å. (1993) National Wealth and Stocks of Fixed Assets in Sweden 1981 - 1990. The Review of Income and Wealth, Series 39, No. 2, pp.159-175.

Tengblad Å., Westerlund N (1976) Capital Stock and Capital Consumption Estimates by Industries in the Swedish National Accounts. The Review of Income and Wealth, Series 22, No. 4, pp.331-344.

Thorsson, J. (1975)'Long-term effects of traffic accidents' Berlingska Boktryckeriet, Lund 1975.

Titus, J.G. (1992) The Costs of Climate Change to the United States, In: Majumdar, S.K., L.S. Kalkstein, B.M. Yarnal, E.W. Miller and L.M. Rosenfeld, (Eds.) Global Climate Change: Implications, Challenges and Mitigation Measures, pp. 384-409, Pennsylvania Academy of Science, Easton.

Tol, R.S.J. (1995) The Damage Costs of Climate Change – Towards More Comprehensive Calculations, Environmental and Resource Economics, 5, 353-374.

Tol, R.S.J. (1999a) New Estimates of the Damage Costs of Climate Change, Part I: Benchmark Estimates, D99/01, Institute for Environmental Studies, Vrije Universiteit, Amsterdam.

Tol, R.S.J. (1999b) New Estimates of the Damage Costs of Climate Change, Part II: Dynamic Estimates, D99/02, Institute for Environmental Studies, Vrije Universiteit, Amsterdam.

Tol, R.S.J. (2000) Global Warming. In: Bickel et al. (2000), pp 133-150.

TRANSEK (1990) Lind G and Lindquist E Avgifter i trafiksystemen (User-charges in transport systems).

TRL/Sir Alexander Gib and Partners Ltd. (1996) Preliminary assessment of a revised methodology fo the determination of road track costs. Crowthorne.

Turvey R, Anderson D (1977) Electricity Economics, published for the World Bank, The John Hopkins University Press, Baltimore/London.

UBA (1996): Mobilität um jeden Preis? – Expertenworkshop zu externen Kosten des Verkehr und den Möglichkeiten sie zu verringern; Fortbildungszentrum Umwelt- und Gesundheitsschutz Berlin e.V. im Auftrag des Umweltbundesamtes; Berlin, September 1996.

UIC (1996) International Union of Railways, Railway Statistics, Paris 1996.

UN (1993) System of national accounts 1993. New York.

UPI (1997): Externe Gesundheitskosten des Verkehrs in der Bundesrepublik Deutschland; Stucy on behalf of Greenpeace Germany; Heidelber, June 1997.

Vejdirektoratet (1994) Oversigt over vejudgifterne i 1994, Danemark.

Vejdirektoratet (1995) Tal om vejtrafik 1995, Danemark.

Viscusi, W (1993). Fatal Tradeoffs. Public & Private Responsibility for Risk., Oxford University Press, NewYork.

Willeke, R. (1996): Mobilität, Verkehrsmarktforschung, externe Kosten und Nutzen des Verkehrs. Publication series of the Verbandes der Automobilindustrie e.V. (Association of the Automotive Industry) Nr. 81. Frankfurt, February 1996.

World Health Organisation (WHO) (1999) Health Costs due to Road Traffic-related Air Pollution – An impact assessment project of Austria, France and Switzerland, Synthesis Report, published by Federal Department of Environment, Transport, Energy and Communications – Bureau for Transport Studies, Bern, Switzerland.

Zweifel, P. (1994) Die Berücksichtigung der Risikoaversion in Schätzungen der externen Kosten nuklear erzeugter Elektrizität, Zurich 1994.

Zweifel, P. and Umbricht, R. D. (2000) Verbesserte Deckung des Nuklearrisikos – zu welchen Bedingungen? commissioned by the Swiss Federal Office of Energy, Zurich July 2000.