The adequate integration of sustainability into transport policy: some major dilemmas

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In this paper we discuss to what extent transport policy fails to integrate five types of external effects, and what kind of research needs follow from the objective to make transport sustainable. The discussion is a synthesis of the findings collected and synthesized in the framework of Focus Group 4 of the STELLA project. The assignment of Focus Group 4 was to draw up a set of recommendations for future transport policy-oriented research dealing with external effects, on the basis of a series of specialist workshops.
Five different kinds of so-called external effects of transport were identified beforehand, being environment, safety and security, public health, land use and congestion. Safety and security as well as congestion are external effects in the sense that they are not 'internalised' in the price of the transport service, but they do affect predominantly others within *the transport system. This means that with some delay the transport market still reacts to changes in the intensity of these effects, albeit biased or insufficient. The public goods character of both externalities however implies that public intervention is needed to attain better performance of these external effects, partly via internalisation of the external effects and partly via planning (i.e. by evaluating the trade-offs ex ante).*
The other external effects, however, are not only insufficiently internalised in the transport price, but they are also predominantly affecting parties outside the transport system. Consequently, changes in the intensity of these effects do not feed back directly into the transport market. In that case public intervention has even a more complicated task, since it takes more time and is more complicated to learn what are actually the right balances for the trade-offs between adequate access and, in turn, sustainability, spatial quality, and public health.

The presentations and discussions in Focus Group 4 all dealt, one way or another, with these tradeoffs. The represented approaches were about:

- *how to make the market (and public planners) better informed*
- *options to internalise various types of external effects*
- *comprehensive optimisation models for one or several trade-offs*
- *dilemmas between the economic, social, and environmental dimension of sustainability*
- *experienced and perceived policy implementation obstacles, amongst others, those following from social dilemma situations.*

In this short paper it is evidently impossible to discuss all the issues and findings from the seminars and synthesis papers produced during the project. Given the need to be selective amidst the plenty of topics this paper casts the discussion of the main findings into two themes, being:

1. *the decisive influence of the choice of sustainability paradigm*
2. *the problems regarding policy implementation*

We argue that both in science and in policy-making there is lack of consensus regarding the operationalisation of sustainability in transport and the consequent sense of urgency; hence there is an apparent need to move much closer to a consensus and preferably rather quickly. However, the lack of a comprehensive consensus does not need to hold hostage those sustainable transport measures about which specialists largely agree. The implementation of those scientifically undisputed measures is often inhibited by a belated and excessively instrumentalist consideration of the social dimension.

Keywords: transport, sustainability, security, globalisation

1. Introduction

In this paper we discuss to what extent transport policy fails to integrate five types of external effects, and what kind of research needs follow from the objective to make transport sustainable. The five different classes of so-called external effects of transport were identified beforehand, being (1) environment, (2) safety and security, (3) public health, (4) land use and (5) congestion.

Safety and security, as well as congestion, are external effects in the sense that they are not 'internalised' in the price of the transport service, but they do affect predominantly others *within* the transport system. This means that with some delay the transport market still reacts to changes in the intensity of these effects, albeit biased or insufficient. The public goods character of both externalities however implies that public intervention is needed to attain better performance with respect to these external effects, partly via internalisation of the external effects and partly via planning (i.e. by evaluating the trade-offs ex ante).

The other external effects are not only insufficiently or even barely internalised in the transport price, but they are also external to the transport system, that is, affecting in particular parties *outside* the transport system. Consequently, changes in the intensity of these effects do not feed back into the transport market. In that case public intervention has even a more complicated task, since it takes more time and is more complicated to learn what are

actually the right balances for the trade-offs between adequate access and, in turn, sustainability, spatial quality, and public health.

The above themes cover effects and processes that are at the core of the intertwined academic, political and public discourses on sustainability. Apart from unsustainable practices that affect the *welfare of current generations*, transport has also a growing share in the exhaustion of natural resources. The impacts of exhaustion typically threaten to reduce the *welfare of future generations*. The exhaustion issue is most prominent in climate policy, which can be expected to affect transport increasingly, but ecosystem integrity and bio-diversity will also conflict with transport policy regularly, at any geographical aggregation level. Furthermore, it should not be forgotten that sustainability has also a social dimension. For transport accessibility, and safety and security are probably the core elements of the social dimension. Yet, access has also an economic connotation. Enhancement of access is the core of transport policy in western countries. The quality of access differs however substantially over social groups and regions, and improving access for some groups may even diminish the access of third parties.

A number of technological responses have mitigated some impacts. For example, the introduction of catalytic converters and other technologies in new gasoline cars - together with some other actions such as the improvement of fuels - has reduced transport related pollutant emissions, with measurable benefits in many US cities, despite huge increases in motor vehicle use. Despite this achievement, poor air quality remains a major problem in European cities (EEA, 2000), and some new concerns, such as the health effects of very fine particles, have not been fully addressed.

Greenhouse gas emissions, notably carbon dioxide, cannot be "cleaned up" with add-on technology, whereas sequestration of carbon dioxide in oil and gas fields will be probably only applied in conjunction with stationary large scale emitters, if ever. Even though there are old - still mainly unused - inventions, such as electric cars and new inventions like cars driven by fuel cells, the overwhelming oil dependence of the transport sector is not expected to start to reduce globally in the next decade (e.g. IEA 2001a; IEA 2001b, Nakicenovic and Riahi, 2002). Although some building blocks of the future fuel economy are known, the basic question where the primary energy will be obtained in the long run remains unanswered (see also Fulton, 2004).

In the domain of traffic safety, societal learning plays an important role. Through regulatory, educational and emergency responses, and the adoption of "forgiving" vehicle and road technologies, societies learn to reduce the amount of trauma that used to increase so rapidly in the earlier stages of motorisation. However, the reduction of accidents and their effects needs continuous effort. Even though, it has proved possible to lower the absolute number of fatalities and serious injuries, the toll of accidents is still horrible. There are almost 40 000 deaths on the roads every year in the EU15, and a similar number in North America, although road transport fatalities per capita are higher in the US than in the EU (Himanen et al. 2004a).

The discussion here is based on a capita selecta of findings collected in the framework of Focus Group 4 of the STELLA project[1]. The presentations and discussions in Focus Group 4 all dealt, one way or another, with the tradeoffs between access and the external effects as well as with trade-offs among the external effects. The represented approaches were about:

[1] STELLA (Sustainable Transport in Europe and Links and Liaisons with the Americas) was a project financed by the European Commission DG TREN, with co-financing at the North-American side by both NSF through the STAR network and by Transport Canada.

- how to make the market (and public planners) better informed
- options to internalise various types of external effects
- comprehensive optimisation models for one or several trade-offs
- dilemmas between the economic, social, and environmental dimensions of sustainability
- experienced and perceived policy implementation obstacles, amongst others following from social dilemma situations.

In this short paper it is evidently impossible to discuss all the issues and findings from the seminars and synthesis papers produced during the project. Given the need to be selective amidst the plenty of topics this paper casts the discussion of the main findings into two themes, being:

1. the decisive influence of the choice of sustainability paradigm
2. the problems regarding policy implementation

The rest of the paper will first discuss the dilemma regarding the sustainability paradigm, then the dilemma of obstructions in policy implementation, followed by a brief review of how the two dilemmas affect the handling of various external effects. The paper finishes with conclusions and suggestions for further research as identified in the project.

During the project the reflections on the five themes involved altogether 85 research and policy experts from both sides of the Atlantic, who participated in three seminars: Helsinki in 2002, Québec in 2003 and Brussels in 2004. Each seminar consisted of invited and refereed papers with invited discussants from both the research and policy domains. Additional input was received from cross-group meetings, a one-day conference for senior policy advisors, and a four-day "Next Generation" workshop[2] in North America for advanced doctoral students and recently appointed younger academics. The main results of this process have already been published in:

- *European Journal of Transport Infrastructure Research,* vol. 2, no. 2/3, 2002;
- *Transport reviews,* vol. 24, no.6, 2004;
- *Transport Geography,* vol. 13, no.1, 2005.

In addition a book is under preparation scheduled to be published in 2006 by Elsevier.

2. Key dilemmas

2.1 The choice of a sustainability paradigm

Weak versus strong sustainability

The concept of sustainability is generally understood as the guideline that mankind should aim for a way of generating welfare for current generations that does not put at risk the possibilities of future generations to achieve at least the same welfare levels. Even though this definition as such does not include distribution of welfare within the same generation, the explicit inclusion of the social dimension next to the economic and ecological one, implies

[2] The NextGen intiative was organised by Martin Lee-Gosselin and Talia McCray from Laval University and included a four day workshop of a group of young scholars from North America.

that the criterion 'at least the same level of welfare' should also be understood at – at least some – level of disaggregation among groups, regions, etc.

Apart from the above mentioned dilemma of sustainability regarding welfare of current and future generations, there is the discourse, both within economics and between neo-classical economists and natural scientists, concerning *weak versus strong sustainability* paradigms (for a concise but comprehensive discussion see Neumaier, 1999). Adherents of weak sustainability do think that virtually all economically exploited services and products from nature can be somehow substituted either within nature or with the aid of man made goods and services. For example, the rising use of coal in Europe in the 19th century is not only interwoven with the success of the steam engine, but also with the exhaustion of wood resources. In contrast, those that adhere to strong sustainability think that the carrying capacity of ecological systems and of the entire Earth has absolute limits. Breaking through these limits leads to damage beyond repair: consequently, sustainability policy should be primarily guided by instruments derived from absolute limits concerning admissible environmental loads.

The weak sustainability view fits very well to conventional neo-classical views on trade and spatial-economic specialisation, and in current trade policies the conventional neo-classical view is still the predominant paradigm. The dominance of these conventional views in trade policy affects the extent to which freight transport can be addressed, whereas it also results in reluctance to design environmental policies for international transport.

Neither neo-classical inspired theories nor theories from ecological economics (which are closer to the strong sustainability view) have so far produced anything substantial regarding sustainability conditions for integrated land-use and transport development. Even though the so-called New Economic Geography (NEG; i.e. a comprehensive neo-classical explanation of spatial economic phenomena) is rapidly abounding, it has so-far mainly focused on economic sustenance of spatial patterns. Therefore, among the five types of external effects only congestion and congestion charging has been studied with urban NEG models (e.g. Verhoef, 2004 [3]). Similarly, ecological economic efforts with respect to land use tend to focus on global scale effects by applying various varieties of 'ecological footprints'. Hubacek and Giljum (2003) present a multi-country input-output system which includes land use claims by function. This can be of use for analysing environmental effects of international division of labour and hence trade, but is of too aggregate a nature for exploring regional and urban interactions between land-use and transportation. Another exercise on the ecological footprints by Wackernagel et al. (2002) compares the land area required to provide the resources and absorb the emissions of global society, and concludes that human resource use is currently some 20 percent above global carrying capacity. Yet, that exercise suffers from similar aggregation and impact conversion limitations as Hubacek and Giljum. The dynamic input-output model exercise by Julia and Duchin (2005) concerning agriculture, agricultural land use and climate change is already more specific and therefore slightly more robust when linking it to spatial models.

All in all, the juxtaposition of the 'strong' and 'weak' sustainability views is of critical importance regarding the composition of the policy instrument portfolio, also in connection with the various so-called external effects of transport. Yet, having said that, we have to

[3] In another paper Verhoef and Nijkamp (2003) plea for extending NEG applications towards comprehensive inclusion of sustainability. The article also includes some illustrative simulations regarding employment, commuting and congestion,

acknowledge the different views have produced applicable theories and preliminary results for only some of the identified problems. Larger problems can encompass, as described below, the ever increasing use of natural resources and its consequent testing of the resilience of eco-systems due to pollution. This is currently highlighted by non-fulfilment of (inter)national agreements such as the Kyoto Protocol and fears concerning fundamental mismatches in demand and supply for oil products.

The most crucial issue for transport is the availability of fuels. In the past few years the depletion of oil resources has come back as a hot issue in energy economics (e.g. Kemp and Kasim, 2005; Pastowksi, 2005; Skrebowksi, 2004; Danish Board of Technology, 2004). There is founded concern for a rising gap between the new additions to proven reserves (which are declining) and annual growth in global demand for oil products (notably for transport fuels). Interesting in this respect is the fact that the link between transportation and oil demand has self-perpetuating features as a significant part of global goods transport constitutes of oil transport (Pastowski, 2005).

The sustainability issue in its present form was raised by the Club of Rome[4] as one of the first in the early 1970's (see Meadows et al., 1972) followed by many other publications in futures studies, e.g. by King and Schneider (1991). The original work from 1972 was updated by Meadows et al. in 1992 and again in 2004. According to the latest book, the limits of growth are already overrun and therefore corrective actions regarding i) population growth; ii) wasteful, inefficient growth in consumption and iii) pollution are very much needed. Similar conclusions are also brought forward by various other adherents of strong sustainability, for example Daly and Cobb (1989). The recommendations of Meadows et al refer to well orchestrated global actions, which go well beyond the width and ambition level of e.g. the Kyoto Protocol. The work of Meadows et al is however not undisputed, not only by strict adherents of neo-classical economics (and hence weak sustainability), but also by environmental economists that acknowledge the need for revisions in the (traditional) neo-classical paradigm (see e.g. Pezzey and Toman, 2003).

It is fair to say that regarding the discourse on 'weak versus strong sustainability' quite some intermediate points of view can also be found, i.e. admitting that – with regional variations – some absolute limitations do exist, at least for some subsets of natural capital, whereas a vigorous push for strict generic limits on many natural resources may just as well lead to cut-throat competition and policies. For example, Ruttan (2003) shows that still the neo-classical paradigm can be 'stretched' substantially, among others with respect to innovation and learning. Similarly Sinisalco (1999) and Proops (1999), though starting from different stances, see also plenty of scope for mutual rapprochement (convergence) of the two views.

Consequences for transport policy

Transportation enables people to increase their access to a wider variety of better or cheaper products and services, to work places and social and leisure activities. Henceforth transportation (i.e. the actual use of access) is usually seen as a vital component for the generation of welfare. In mainstream (neo-classical) economic modelling better access is unilaterally related to cost reduction potentials (in transport and in production generally) and increased sales potentials. The flipside of better access, namely the external effects, is harder to include in such models and as a consequence the model based assessments of transport enhancing policies tend to be optimistically biased towards net benefits for society. The

[4] The Club of Rome is an informal, international group of distinguished businessmen, statesmen, and scientists.

political ramifications of this insufficiently remedied bias are that accessibility is understood as meriting enhancement wherever possible.

The largely unchallenged position of accessibility can be summarised in two postulates underlying conventional transport policies of most countries. The first covers the supply side, the second the demand side:

1. Everybody should have sufficient access to transport services, implying that transport should be both affordable and physically available (sufficiency of capacity);
2. Any person or cargo is in principle entitled to access to any location it is destined to go to.

The first postulate has been – and in most countries still is – an obstacle to the internalisation of external effects at the operational level, despite the fact that specialists have already indicated how it could be done. Various contributions to the STELLA project indicated that, next to the commonly known problems with assessment of the unit-cost of environmental effects, the intricate interaction between spatial development and infrastructure is still poorly understood. This postulate also provides a main argument for subsidising public transport and various forms of infrastructure. The bottom line is that in many areas transport performance is allowed to attain levels that are neither economically nor environmentally sustainable.

The second postulate relates to the conflicts of interest that arise from the attempts to accommodate any transport need that arises, regardless whether the willingness to pay covers all cost, while perceiving negative spill-over effects to third parties as compensable side effects. In nature areas unlimited access affects bio-diversity and appreciated landscapes, while in built-up areas the spill-over effects affect the value and quality of neighbourhoods, some positively and other negatively. Various forms of advanced infrastructure often imply improvement of the accessibility for the users, but worsening of the accessibility for non-users (i.e. those using other systems facing barriers created by the advanced systems). With expanding capacities and a rising share of the global population living in urbanised and sub-urbanised areas the negative spill-over effects tend to grow faster than the positive ones, but the political incapacity to internalise the external effects (out of fear to deviate from the affordability postulate) heavily curtails the possibilities to correct the mismatch.

The dilemma of transport policy design of how to integrate sustainability, the ‘weak’ versus ‘strong’ dispute translates in transport policy into a choice between:

a. *a gradual policy*, i.e. attempting to make transport sufficiently eco-efficient, with usually only marginal/indirect interventions towards transport volume and speed, or
b. *a radical policy*, i.e. directly or indirectly putting caps on transport volumes and speeds as a consequence of climate policies and other sustainability objectives

The default gradual policy approach may in some cases entail rigorous measures, but will refrain from a comprehensive approach. Instead, each of the external effects is in principal addressed separately. Possibly, in a later stage, e.g. under pressure of needs for efficient policy management, the various measures may be brought into some kind of framework. A radical policy would try to address the sustainability challenge for transport in its entirety. This would mean that, a priori, the manoeuvring space for enhancement of access seems much more curtailed since policy makers would wish to ensure that the sustainability objectives are met. The challenge is obviously whether, nevertheless, sufficient access can be ensured for all and in such a way that it does not seriously curtail material welfare (in return immaterial welfare is supposed to improve in such a sustainability-oriented approach). A first attempt to explore a sustainability based normative access level by region was presented by Black (2002) as part of the discourse in Focus Group 4.

As mentioned above, the lack of willingness to act more decisively is most obvious in international transport (e.g. the so far 'successful' opposition to the taxation of bunker fuels, and the troubles in many countries regarding the regulation of air traffic noise). Similarly, intervention in domestic freight traffic is usually limited, for example attempts to influence the modal split have been mostly cautious. On the other hand, road safety is often an accepted basis for stricter intervention. Yet, for example, as Anderson et al. (2005) showed, regulatory policy with respect to urban logistics does not have to upset the cargo system, but it can if regulations are poorly designed. Still more intervention is allowed with respect to passenger traffic, as can be seen in the differences in tax levels related to commercial and private vehicle ownership and use.

Regardless of the kind of consensus about a sustainability paradigm that may arise for transport policy, there is a considerable leeway with respect to the sharing of burden between sectors, and sustainable transformation pathways that can be chosen. For example, in the Focus Group 4 meeting discussions most participants seemed to agree that for most segments of the transportation system it holds that unit-cost of abatement easily becomes higher than in many other sectors. This observation supports the tendency to favour sustainability strategies in which transport is granted some time before radical changes are to be implemented. However, such a strategy of granting some time requires the input of sufficient research effort in order to ensure that radical renewal is possible within a time span of three to four decades. Besides 'granting some time' should by no means be equated with passivity. Apart from stepping up research and development (and demonstration), earlier steps can be taken in various segments.

The above-mentioned convergence between mainstream and alternative views of sustainability will come with changes in key economic concepts. In particular, the specification of the utility function of individuals and society at large may change, implying a wider basis (more arguments) for the description of the development of welfare. Such a change in a core concept of economics may also assist in the better inclusion of the social dimension when assessing the trade-offs.

2.2 Impediments to policy implementation

There are many elements of a supposedly comprehensive sustainable transport policy about which specialists and policy makers by and large agree, at least technically. For those elements the challenge is not any more in basic or strategic research, but in adequate implementation and acceptability. About the latter two aspects however specialists and policy makers may have different visions, and a wide range of views are also found within those groups.

We have noticed above that many experts agree – based on scenarios and modelling studies – on the main features of the policy packages necessary for making cities more sustainable. These main features include transport policies making car travel less attractive and public transport more attractive, and land-use policies to increase, selectively, urban density and mixed land-use. However, these policy packages are not implemented because, in the current constellation in which the measures are suggested, the public and therefore policy-makers accept only the last part of the above transport policies, namely improving public transport. The other half, aimed to restrict car travel, is rarely accepted under current circumstances. Similarly, from land use policies, only mixed land-use is accepted but increase of density

usually not. In addition, the improvement of public transport stays limited because of shortages in financing.

When the packages are based on theoretical exercises, it remains open how accurate are the estimated impacts and what other or secondary impacts could be expected in a real world situation – where people use their intelligence and other resources for executing their daily activities. While people may oppose any restrictions on their way of life, they may also invent surprising new ways of behaving.

It can be inferred from the FG4 synthesis discussions and post-meeting discussant evaluations that the organisation of (policy) research, planning and decision making for transportation is rather fluid. The fluidity concerns both the involved parties, i.e. researchers, planners, policy implementers, users, the business community, tax payers, and public interest groups, and the distinction between phases, i.e. inception, planning, implementation, etc. For the sake of discussion and initial clarification one needs to resort to basic distinctions between involved groups and between phases, but to get a better understanding of planning and decision-making processes various other angles and delineations are needed.

One conceptual approach to understanding this is the 'transport intelligence framework' (TIF), which is summarised in figure 1 (see also Annex 1). In that framework, information collection, representation and exchange exercised by the constituent elements of the transport system is depicted against a background of a variety of influencing factors. The significance of these factors usually varies over time. This varying relevance of factors relates among other things to changes in the overarching governance philosophies. Even if – technically speaking – specialists and policy makers agree on the potential effectiveness of certain policies, the prevailing governance philosophy may severely limit the practical feasibility. For example, marginal cost pricing combined with internalisation of external effects has better chances for sensible implementation in a vertically integrated monopoly, than in a system with separated infrastructure and operators, where the latter are exposed to competition. The environmental policy instruments in transport need retooling to be effective in different market settings. Similar observations can be made about social equity policies in transport.

Over the course of the three FG4 meetings, we noticed that experts draw their inspiration from available technology – today especially from ICT – or from user feedback, as well as from broad goals such as sustainability. The information on environment, safety, public health, land use and congestion originates directly from the transport system itself, be it as a feedback from users directly to the system providers or filtered through the policy-making process based public opinion (see again figure 1). Currently policy-making has had much to do with the lack of implementation of solutions to which experts aspire due to acceptability problems. On the other hand, in many cases users have used their intelligence for counteracting implemented policy measures.

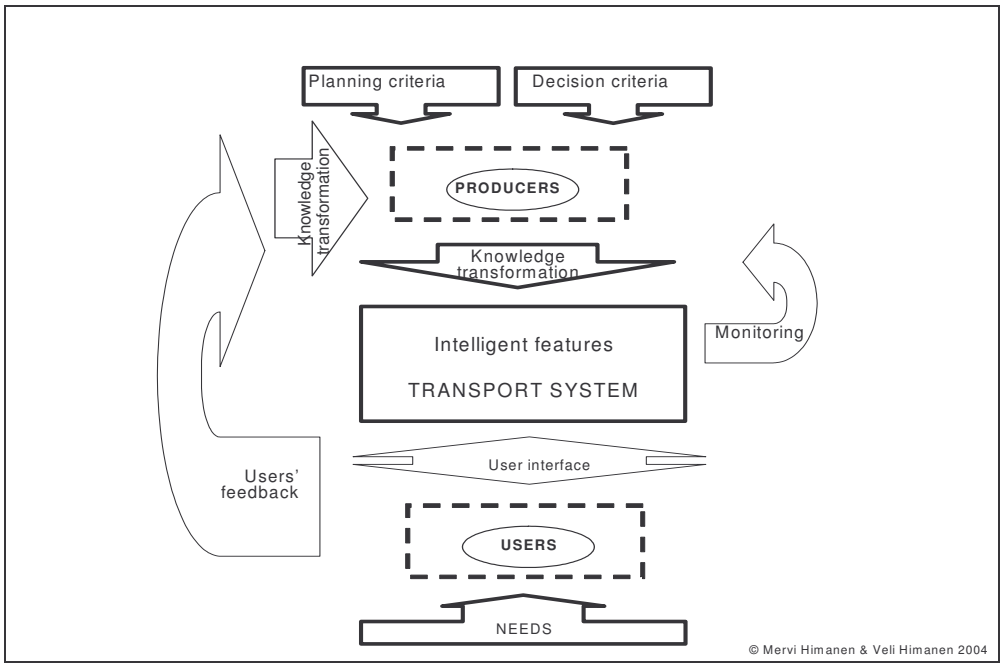

Figure 1. Transport intelligence framework

Feitelson and Salomon (2004) point out that techno-economic feasibility (as a model outcome) is a poor forecast of the likelihood of societal acceptability. They divide societal acceptability into social acceptability and political acceptability. They regard social acceptability as a function of *popular perceptions* regarding effectiveness and distributional justice, whereas political acceptability is largely a function of distribution of power (for the matter at hand). Feitelson and Salomon could show that road pricing was much less acceptable, both socially and politically, than e.g. light rail. This difference explains the scarce implementation of road pricing – despite its argued economic benefits – compared to the wide implementation of light rail, often with minor economic gains.

Steg and Gifford (2005) have mapped Quality-of-Life (QoL) indicators related to human well-being. The QoL approach also addresses equity issues in public decision-making. They argue that sustainable transport plans will be strongly opposed when users believe the plans will significantly reduce their well-being. They also noted that in every day life changes are normally met with initial resistance, because people are not sure of positive consequences. After implementation, people soon adapt their behaviour and thus, support for transport plans may be higher after they have been implemented. This fact is one of the reasons to implement plans in stages, starting with demonstration projects.

Apart from the problems discussed above regarding acceptability of policy measures, the actual results of implemented measures deviate often much more than could have been reasonably expected. A fundamental reason for the continuous occurrence of unintended effects and non-attained environmental targets may be that little attention is given to behavioural aspects and social processes during the strategic planning stages in transport policy making. This situation is very similar to that of other problem areas, for example energy efficiency and conservation policies (Shove and Wilhite, 1999). In other words, despite ever more sophisticated research, and the reaching out of technology and economic

development work towards behavioural aspects, transport problems and identified measures are in the first place framed as technical-economic problems or challenges. Subsequently, behavioural responses are presented in terms of obstacles and deviations from an 'ideal' pattern. This 'ideal pattern' is however usually defined in a predominantly rational and uniformly informed world, instead of in a world with numerous disjunctions between convictions and practices, floating preferences, etc.
In summary, many of the barriers to the effective implementation of sustainable transport policies arise from the imperfect understanding of the probable implications of change. This applies, as the TIF suggests, at both the user and the producer level. In the latter case. insofar one wishes to prepare decision making for transport policy by means of integrated assessment systems, it means that the valuation attributes revealed by Feitel and Salomon should be integrated in a broader based utility function (as mentioned in the previous section), which in fact gets near to a convergence of utility (welfare) and quality of life as employed by e.g. Steg and Gifford. Research results suggest that this would be a step in the right direction, towards fundamentally integrating the social dimension at an early stage of a policy's preparation.

3. Interactions with and among the external effects

3.1 Interactions between environment, safety, public health, land use and congestion

The five impact domains are interrelated. For example, human health impacts result from the cumulative effects of both traffic accidents and environmental impacts (see figure 2).

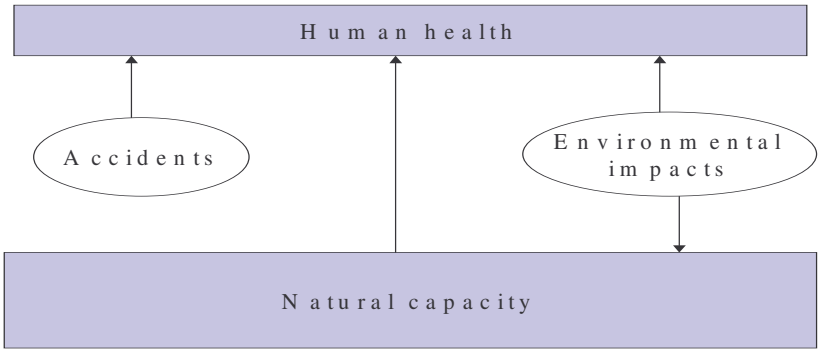

Figure 2. Inter-relationships between accidents, environment and health

Traffic congestion is not itself an impact like accidents or air pollution. In principle, it means, e.g. that travel times are getting longer and/or more difficult to predict. This may then also have impacts on the number and type of accidents, and on environmental quality. A general assumption is that policy packages restricting car use and improving public transport will also alleviate congestion (Himanen et al., 2004a). In practice, traffic management (also incorporating traffic monitoring) is used by the producers for controlling congestion. Even though congestion and sustainability form together the core of post-modern transport problem, their relationship is coincidental: both emerged at the same time. Based on the

access-enhancement paradigm, transport policy makers tend to focus on congestion policies of which the emission reducing effect is then seen as a 'bonus'. Yet, people seem to suspect congestion pricing systems, and only agree if the net benefits are really evident, predictable and broadly shared. From behavioural economics is known that people dislike complicated pricing systems, even if it can be shown that for example time-of-day tariffs would overall be cheaper for them (Train et al., 1989). This is another example of the importance of including the social dimension in the early stages of policy preparation.

In line with the framework in figure 1, land use gives options to the users on the places where they can satisfy their needs. The Information Age has somewhat loosened the earlier tight links between land use and transport by freeing a part of work from fixed workplaces. Also, globalisation has made it more difficult to assess consequences of public policies. In addition to possible changes in localisation of human activities inside a country or a region, places situated quite far awayalso have to be considered. Impacts of globalisation and regional integration will be further discussed in section 4.4.

3.2 Safety and security

The number of road transport fatalities in 2001 varied from 6 to 18 per 100 000 inhabitants in different countries in the EU15 (EC, 2003). However, this did not make any impact on the differences between life expectances in those countries. This can likely be explained by the minor share of traffic deaths among all deaths, which ranged from 770 to 1090 per 100 000 inhabitants in the EU15 member states in 2001 (www.unece.org).

Furthermore, next to safety, *security* can be added as an item notably in public transport and cycling where elderly, women and children are reported to avoid these modes during certain times of the day due to – perceived – risks for their personal security (i.e. due to assault). Actually the rate of recorded violent crimes in 2000 varied from 62 in Austria to 534 in England and Wales per 100 000 population (see figure 3), when the average rate for the EU15 was 261 (www.unece.org). This is almost as high as the rate of road accidents involving personal injury at the same year, 341 (EC, 2003). When comparing figures in 1990 with 2000 it can be noticed that the rates for violent crimes had increased in all except three countries: Denmark, Finland and Spain, but the rates for road accidents had gone down in all except four countries: Greece, Ireland, Italy and Spain.

In recent history, there have been four cases – the Gulf war, the 11th September 2001, the Iraq war and SARS – when security reasons have clearly reduced the number of air flight passengers. When considering the hierarchy of needs as depicted by Maslow (Huitt, 1998) we may argue that in these cases the need for safety has for many people outweighed other needs related to the activities requiring travelling. According to Stead (2004) 68% of the interviewed Europeans were worried about urban problems such as traffic, noise and pollution in 1999 and 27% were very worried. How much this has influenced their behaviour remains open - at least motorised transport is still increasing. In psychology it has been noticed that different needs can outweigh each other, e. g. animals take unusual risks in order to feed themselves when they are very hungry (cf. LeDoux, 2002, 354). It can be considered that leaving out one or two airline trips did not greatly inhibit one's activities, but in order to maintain daily activities needed to satisfy all personal needs, it is necessary to travel in spite of possible worries on traffic.

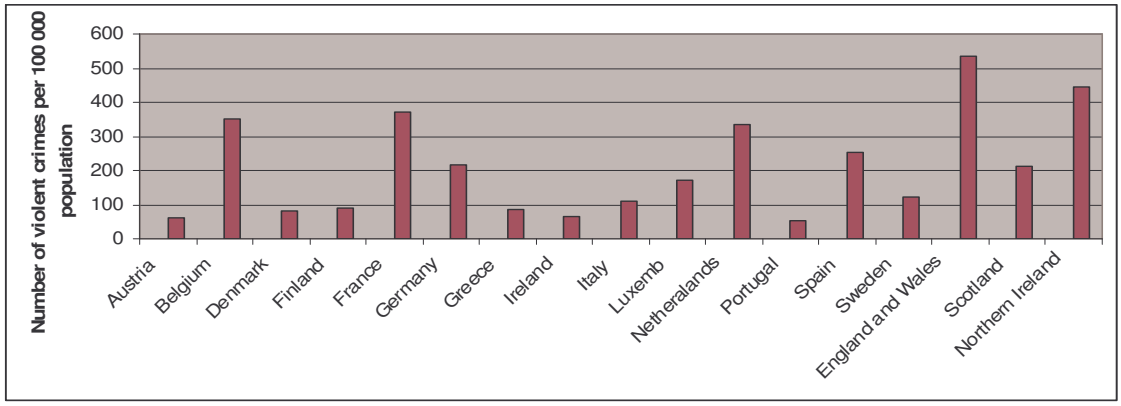

Figure 3. Rate of violent crimes (serious assault, robbery and violent theft) per 100 000 population in 2000 in EU15 (source: www.unece.org)

Safety and security constitute probably the only category of external effects for which, even within the conventional transport policy paradigm, more radical measures are possible, despite the otherwise prevailing tendency for gradual policies. What does happen however, is a certain extent of selectivity. Safety policy and publicly funded R&D for safe transport has a very strong focus on motorised road transport, but pays often much less attention to non-motorised traffic. Only very gradually is it appreciated that safer non-motorised transport may make it easier to convince people to switch modes (for environmental reasons and/or to reduce congestion).

3.3 Trade and freight

Sustainable transport issues are more discussed in connection to person transport than to freight. According to the authors' recent paper (Himanen et al., 2004a), stakeholder interests and the prevailing trade paradigm are probably most important causes why (comprehensive) studies on sustainable freight transport are rather scarce. When considering world trade and related freight transport we can notice two trends with conflicting impacts on sustainability. One is globalisation which means increasing trade between Far East, Europe and North America with consequently longer haulages. The other consists of regional integration arrangements (such as EU, NAFTA and ASEAN) that encourage trade between members with relatively short distances to cover. The impacts of these two forces can be discussed through three major regional integration arrangements[5] (see table 1). The EU15 has much more internal trade than the others, which is inter alia explained by its long integration history. Therefore it is no wonder that globalisation overpowers regional integration and the share of internal trade goes down especially during the last years. In North America integration is ongoing, but it started from a lower level than in Europe. However, regarding imports to North America globalisation has got the upper hand during recent years. In ASEAN integration is also ongoing, but it started from a very low level, and regarding exports globalisation has already overcome the integration process in the recent past.

[5] APEC covers a very large part of the globe, and it currently owes more to the globalisation process than to regional integration

Table 1. Merchandise internal trade of three regional integration arrangements in 2003

Regional integration arrangements	Intra-exports (per cent of total exports)			Total exports (bl $)	Intra-imports (per cent of total imports)			Total imports (bl $)
	1990	1995	2003	2003	1990	1995	2003	2003
EU15[1]	64,9	64,0	61,9	2901	63,0	65,2	61,7	2920
NAFTA[2]	42,6	46,0	56,1	1162	34,4	37,7	36,8	1715
ASEAN[3]	20,1	25,5	23,3	451	16,2	18,8	23,3	389

[1] Austria, Belgium, Denmark, France, Finland, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden and United Kingdom;
[2] Canada, the United Mexican States, the United States of America;
[3] Brunei Darussalam, Cambodia, Indonesia, Laos, Malaysia, Myanmar, Philippines, Singapore, Thailand, Vietnam.
source: www.wto.org

With respect to the European policy efforts to motivate shippers to use more rail instead of road, it is interesting to witness that there is indeed a growing alternative for road within Europe. It is however not rail, but short-sea shipping.

One of the key issues on sustainable transport can be compounded in the term '*decoupling*', meaning that the increase of welfare should not anymore be accompanied by the similar increase in transport performance (in pkm and tkm). When considering global trade transport, we could notice conflicting trends above. Regarding transport inside one of the above regional integration arrangements: in the EU15, we can see some decoupling in passenger transport since the early 1990's, and at least a turning point in freight transport in late 1990's (figure 4). However up to now the decoupling has been only in relative terms. If policies would be stepped up and absolute ceilings on emissions (caps) would be introduced the total level of emissions should not grow any or even reduce. In this respect it is good to realise that in the current explorative long term climate policy studies abatement percentage amount to about 60% by 2050 and get even tighter after that (e.g. Bannister et al., 2005).

Another as yet barely researched effect of international goods transport is the effect on world prices of natural resources. In the discussion of weak versus strong sustainability one of the argued issues is the absence (with some exceptions) of long term rises of real prices of natural resources. Temporary price shocks, such as for oil, occur, but in the long run such prices fall back to lower levels again. Adherents of strong sustainability assert that it is simply a matter of myopic markets. However, it could be that the unification of regional (national or continental) markets into a world market has implied a rearrangement of the merit order of production (extraction) facilities. In that case the steady improvement of global access on the basis of the conventional transport policy paradigm would have prevented the rises of prices of natural resources. However, beyond a certain quality level of global access the offsetting effect of optimised global transport will level off, after which scarcity of natural resources will indeed (gradually) start to kick in.

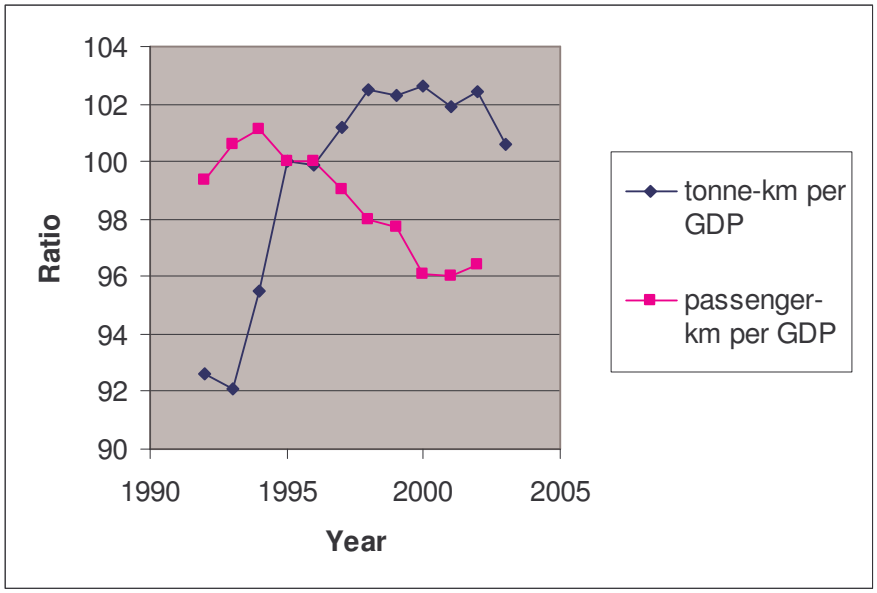

Figure 4. Ratios of freight[6] and passenger[7] transport performance to GDP
source: www.europa.eu.int/comm/eurostat/

3.4 Climate change

The most significant policy impact on transport in the nearby future is most probably coming from climate policies. Up to now transport, notably international transport, was left relatively unburdened, including in countries that ratified the Kyoto Protocol. Yet, the substantial increases of greenhouse gas emissions from transport in many countries makes more stringent emission policies for the transport sector ever more likely. It is obvious that the measures in transport sector alone cannot curb the risks of climate change. As an example of an acute climate change, Keller et al. (2004) point out a (temporary) slow down or even halting of the Atlantic thermo-saline conveyor in the next 40 years with the consequent climate *cooling* effects in the Nordic countries and climate *heating* effects in parts of the tropical belt.
A reflection on recent trends in CO_2 emissions is illuminating regarding the problems various countries have with committed targets implied by the Kyoto Protocol and the EU Burden Sharing agreement (figure 5). Three member countries of the EU15, Germany, Luxemburg and the UK, have succeeded to decrease their CO_2 emissions substantially when comparing

[6] This indicator is defined as the ratio between tonne-kilometres (inland modes) and GDP (in constant 1995 EUR). It is indexed on 1995. It includes transport by road, rail and inland waterways. Rail and inland waterways transport are based on movements on national territory, regardless of the nationality of the vehicle or vessel. Road transport is based on all movements of vehicles registered in the reporting country.
[7] This indicator is defined as the ratio between passenger-km (inland modes) and GDP (Gross Domestic Product in constant 1995 EUR). It is indexed on 1995. It is based on transport by passenger cars, buses and coaches, and trains (but not by air). It should be noted that the passenger air travel within the EU has been rising significantly since the crossover of these curves in 1995, apparently enough to reduce the slope but not to reverse it. All data was asked to be based on movements on national territory, regardless of the nationality of the vehicle. However, data collection methodology is not harmonised at the EU level.

2002 with the 1990 levels. Three member states, France, Sweden and Denmark, achieved modest reductions in that period. This may suffice for Sweden and France (with targets that equal the 1990 level), but it means that Denmark (with a -20% reduction target) is way off target. All other EU15 member countries have slightly (Austria, Belgium, Finland, Netherlands) or strongly (Italy, Spain, Ireland, Greece, Portugal) increasing emissions. All these countries seem to have at least some problems to achieve their targets, with particular troublesome developments in Spain and Italy. In Spain for example, the growth of greenhouse gas emissions was to a significant extent caused by a very high growth of motorised transport both of passengers and goods. This has coincided with a significant expansion of the Spanish motorway system. In the US CO_2 emissions had increased by 17 per cent at the same time reaching 20,1 tonnes per capita in 2000 compared to 8,4 in the EU15.

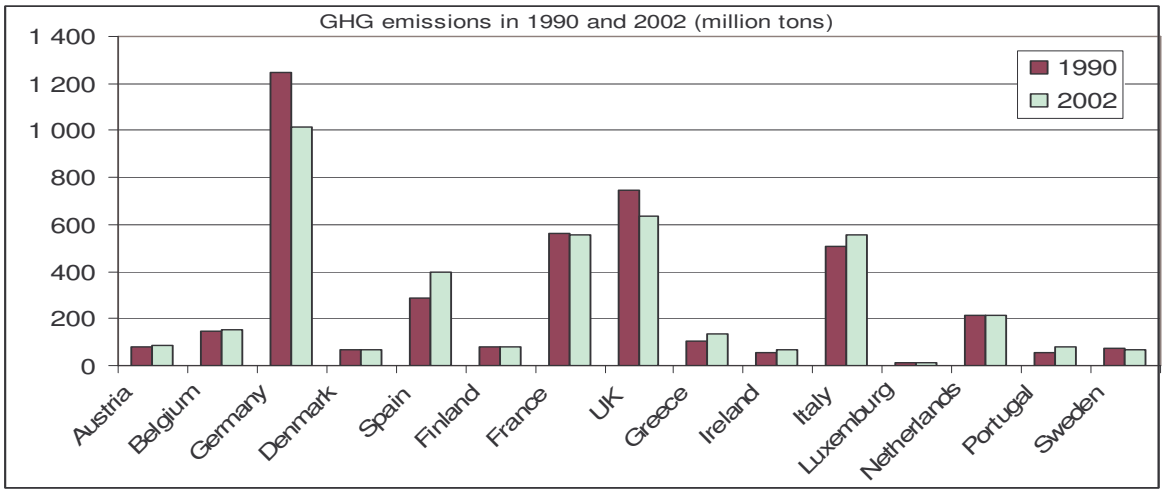

Figure 5. Trends in GHG emissions in EU15 1990-2002
source: European Environmental Agency / Statistics Finland

When considering transport's share of the above overall CO_2 emissions, we have to remember different circumstances between countries. In northern countries like Finland and Sweden a lot of energy is needed for heating, while these countries have also an industrial structure biased towards energy intensive sectors, therefore the share of road traffic in total energy consumption was only16-19 per cent. In contrast in southern countries like Italy and Spain transport covers almost 30 per cent of gross inland energy consumption in 2000 (www.unece.org). These figures can be compared to 33 per cent in the US highlighting a very different transport/land use system (see also Himanen et al., 2004a).

As regards the choice of policy approach it seems that in the short run it is relatively expensive to reduce emissions significantly in transport. For a start fuel efficiency could get more attention. In the longer run only radical switches to new fuel systems not based on fossil fuels will provide more lasting solutions. So, initially the policy for transport could be gradual, as it would cause mainly extra cost without much effect on emissions. However the long term prospect should be radical, which necessitates a stepping up of research efforts and the willingness to subsidise market introduction of alternative fuels on the basis of learning curve guidelines.

3.5 A social-historical stratification of external effects

The above interaction between the various external effects and between the external effects and the conventional transport policy driven by access enhancement can also be depicted as overlaying strata of transport problems expressing the social-historical driving forces behind the external effects (see also Dugonjic et al., 1993). For this purpose transport problems are subdivided into three strata: *traditional, modern and post-modern*.

The traditional transport problem - how to get from one place to another - is related to the nature of human activities based on various human needs. The current-day solution for the traditional problem has been the provision of large-scale transport networks with huge volumes of circulating vehicles. This has resulted in a modern transport problem with massive numbers of accidents, and substantial but dispersed environmental impacts. So, the modern transport problem mainly conflicts with safety needs. When planning in the sphere of the traditional transport problem it is important to know people's needs and the places and times where these will be satisfied. Here feedback from users is most important, as well as the quality of user interface. The modern transport problem moves interest to the transport system itself, from which monitoring provides valuable information.

The post-modern transport problem can be characterised by two dimensions: the rate of congestion and the degree of sustainability. In densely populated societies it is ever more difficult to provide new capacity for heavily used transport systems, i.e. current congestion cannot be alleviated by traditional means. The post-modern congestion problem can also be seen as a conflict between two countervailing desires. Policies under the "enhance access" paradigm encourage the "customer" to expect a high level of transport service, providing unlimited access to activities, goods and services wherever he wishes, and at no notice. At the same time, he expects the transport system to behave in a predictable manner, regardless of what every other "customer" decides to do at the same time. This eventually makes it difficult to predict peak demands and handle them (eco)efficiently. Meanwhile, growing demands for sustainable development have expanded the scope of environmental impacts that are attributed to transport - from earlier local nuisances or health and accident risks - to include global issues related to the future of the human condition. As well, research has thrown new light on some of the local impacts, such as the serious health effects of very small particles. When considering the framework (see figure 1), it is obvious that alleviating of congestion can, at least partially, be dealt with using monitoring connected to management systems. However, sustainability, which deals with general conditions to satisfy human needs today and in the future, cannot be determined by the producers or users. It must come from outside sources and be then be embedded in planning and decision criteria: and from there, it influences the actions on the transport system.

4. Conclusions and challenges for policy and research

In order to integrate sustainability notions better into transport policy design, focused research efforts are needed to clarify how comprehensive sustainability guidelines and indicators can be developed and operated which are compatible with the transition towards an overall sustainable society. These efforts are preferably undertaken in an international co-operative setting, including Trans-Atlantic liaisons. Since the understanding of what a sustainable society constitutes has also normative elements, it would appear productive to

encourage consensus-seeking, without compromising scientific rigour. The process can be expected to entail a kind of synthesis of insights from both the weak and strong sustainability viewpoints.

The key to a genuine sustainable transport policy is in the understanding and handling of the concept of *access*. A new understanding of access will also emanate outside the transport policy area, and affect among others spatial and economic policy.

Considering the achievements of transport policy with respect to a transition towards sustainability, a rather mixed picture emerges. The prevailing approach of gradual changes by type of external effect has achieved relative improvements, in other words the eco-efficiency of transport operations has in many cases gone up. Furthermore, localised problems have been solved to some extent, even though they often emerge again in other places, e.g. in rapidly growing cities in developing countries. Sustainability is, however, an all-encompassing concept and also includes global phenomena, such as climate change. When the achievements of transport policies are assessed against such a background one can only conclude that *overall* transport policy has achieved a rather mediocre performance. For example, the following observations can be made:

- reductions according to the Kyoto Protocol in CO_2 emissions seem mostly not to be reached, and in many countries falling under the Protocol the transport sector has been steadily emitting more greenhouse gas emissions, whereas it should be realised that emissions from rapidly growing international transport are not even included in these accounts;
- transport policies that enhance a more sustainable transport are offset by the impacts of globalisation, increasing world population, and increasing consumption per capita;
- in many cases probably effective measures aimed to reduce external effects cannot be executed because of acceptability problems, i.e. people are not willing to accept change if they see only restrictions on their daily activity patterns;
- in some cases the implemented policy measures produce results that differ from the forecast ones, i.e. people use their intelligence to adjust their travelling in unexpected ways.

In other words, it is obvious that the post-modern transport problem cannot be solved purely inside transport sector. However, there is still a lot to do with the traditional and modern transport problems. In these efforts, we can profit from intelligent features of transport systems cooperating with new telecommunication devices used more and more in everyday life and business.

Finally, transport policymakers do not have to hold up action until there is a comprehensive solution for sustainable transport. For example, , there is already a substantial consensus on the do's and don'ts for urban transport, and in the vexed area of motor vehicle use, the enhancement of fuel efficiency can be regarded as a no-regrets policy.

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Annex 1 – The Concept of Transport Intelligence

Transport Intelligence

Intelligent transport is often understood to be the same as the application of information and communication technologies (ICT) in transport systems (also called transport telematics) ranging from CAD (Computer Aided Design) and to navigation systems with GPS (Global Positioning System). Rather common is to call a device, material or technology intelligent, if it is able to adopt information from its environment, to handle it and to act according to the information in some logical manner. Intelligent transport is currently without any precise or scientific definition. It is described rather via the applications and their nature. In order to clarify the role intelligence plays in transport, and thereby to provide a framework for further use a Transport Intelligence Framework (TIF) was developed by Himanen et al. (2004b).

The phenomenon of intelligent transport is approached from the human perspective, because intelligence is a human ability. TIF incorporates the intelligence and knowledge transformation at the system level. It takes into account the inter-relationships between stakeholders´ intelligence and needs, and transport intelligence. Information exchange between users, producers, policy makers, and transport system and the formation of knowledge are also included.

Major stakeholders to be discussed are the producers and (end-) users. The producers use their intelligence for providing transport services and the users use their intelligence for using these services. In production the human tendency of making actefacts, which is a characteristic of human intelligence (Bergson in Tuomi, 1999, 114) expresses itself. The

other characteristic of human intelligence being the generator of selective behaviour (Bergson in Tuomi, 1999, 121) appears in the use of the transport system. The users are using their intelligence for benefiting from (intelligent) features of the transport system.

Therefore also the intelligent activities of these two groups are different. Producers base their actions mainly on technical and economical expert knowledge about the transport system and on the needs of the users. The TIF can also be understood as a description of two different approaches to transport: technology push and market pull. This kind of concept is common to many technological systems, however in transport we also have to consider the impacts of policy making.

There is also the opportunity for the users to lend their intelligence to the transport system by giving feedback to the planners and other producers, or participating in the planning and implementation.

The user interface includes the means of connecting the user to the transport system. The final driving force of the user behaviour is formed by human needs.