Concept of modeling the influence of telematic based services on the transport and the socio economic system by combination of an activity-based micro-level-model and an aggregated macro-level-model

Christoph Gringmuth

Universität Karlsruhe (TH)
Institute for economics policy and economics research IWW
Section for traffic and communication (Prof. Dr. Werner Rothengatter)

P.O.B. 6980
D-76128 Karlsruhe

+ 49 / (0) 721/608-3073
gringmuth@iww.uni-karlsruhe.de

Designated presenter: Christoph Gringmuth

In the research project OVID "Strengthening the self organization of transport by new information services" (http://www.ovid.uni-karlsruhe.de/) the work package A6 "System based assessment of information services" has got the aim to assess the specific influence of new information services on the transport system and the socio economic system in a long term sense.

In existing models, the effects of new information services can be considered as factors in macro-variables like e.g. technological progress, but these factors are not based on causal models on the micro-level. On the other hand actors on micro-level are influenced by developments on macro-level. These interrelations shall be modeled by generating a behavior model, which models the impact of information services on micro-level. The output represents the input for a macro-model, which calculates long term effects of information services which backlash on actions on the micro-level.

Thus a micro-funding of long-term effects of information services is possible.

Introduction

In the Research Program "Getting a better Understanding of Mobility" The Federal Ministry of Education and Research (BMBF) of Germany has sponsored the Research Project *OVID,* which aims to deliver a better understanding of the influence of new Information Technologies on transport. Therefore a Simulation Platform shall be built up to model and

assess measures of transport infrastructure, telematics and logistics, which have an influence on the transport system and on the socio economic system.

This article represents the research concept of the work package A6 “system based assessment of telematic services”. Goal of the work package A6 is to assess the specific influence of new telematic services on the transport system and the socio economic system in a long term sense.

The Research Project *OVID (http://www.ovid.uni-karlsruhe.de/)* started in 11/2002 and ends in 04/2005.

Problem definition

Presently the result of the self-organization in transport systems is - from the point of view of a social assessment - not satisfactory. The multiplicity of individual decisions results in congestion, a high amount of health problems and strong environmental impacts. There are three existing problems which have to be distinguished:

- Road users decide in non optimal manners because they miss important information to obtain a complete overview of the traffic situation.
- Road users decide in non optimal manners because they miss important information about the impact of their actions on other road users.
- Authorities decide in non optimal manners because they are unable to forecast the impact of the institutional constraints they have to constitute.

All these problems mentioned above are caused at least in part by missing or wrong information. In order to improve this situation information on a high quality level has to be delivered on all levels of decision making in transport.

The information can not be reduced to on-trip-information, where the alternatives of action are quite limited, but has to be extended even on pre-trip as on post-trip information. In the field of freight transport the meaning of pre-trip information in a strategic sense is obvious, because the decision for a logistic concept determines the patterns of transport activities.

While the permanent and all-embracing availability of information for the road user of tomorrow is a concrete perspective, it is not clear how this information will be prepared in a user specific way.

On the other hand it is obvious that the impact of new telematic services is not only reduced to the transport system but also exists on the socio economic system. At an existing infrastructure one positive effect of telematic services would be a smoother characteristic of the load peak. This means that

a) less people are on the road; some decided to cancel the trip because of traffic information

b) the same amount of people is on the road, some of the people chose another starting time of the trip.

In a) and b) the change of trip time or amount of trips has got an influence on the remaining activities of people, which has to be considered when the benefits of new information

technologies shall be assessed.

Aim of the project

A main goal of today's transport research is the improvement of telematic services in a way that existing infrastructures can be used in a more efficient way. It is necessary to focus on

- generating new telematic based information services,
- road user reactions on information,
- the resulting traffic conditions,
- the mid-term and long-term impacts and feedbacks on the whole socio-economic system.

This shows that improved information has got an influence on all time horizons and on all decision relevant levels. One problem is to build up a usable bridge between activity based models, which work on short term time horizons and macroeconomic models, which work on mid and long term time horizons. The aim of this project has got 2 main directions:

- Principle identification of the influence of information and services on the activities of road users and the consequences for their daily routines an life styles.
- Assessment of the long term effects of information and services on socio economic systems with a detailed analysis of the effects of information on freight and passenger traffic.

Approach

Telematic services have different effects on different levels.

Direct effects on the behavior of road users

The kind of effects of information on road users is based on the following assumptions referring to general behavior rules postulated by [Lüdemann, C. 1997]. Road users plan their actions under existing restrictions. Telematic services reduce the restrictions.

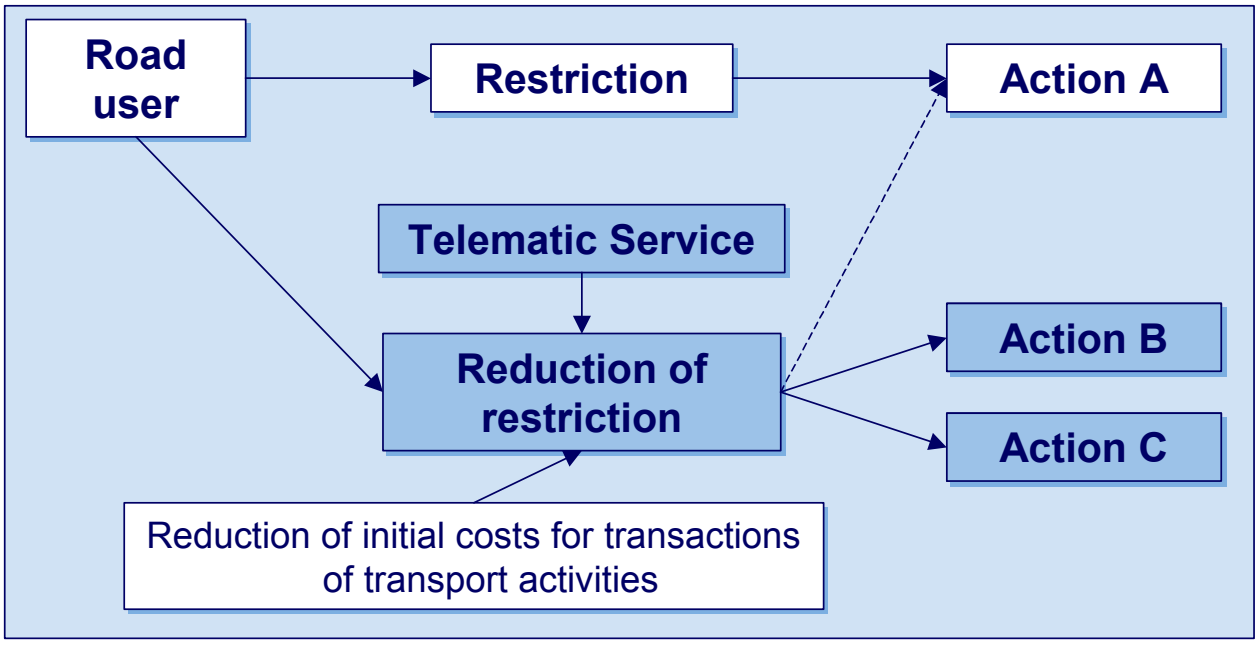

Figure 1: Principle effects of telematic services in Transport systems

Figure 1 shows that the alternatives of actions in principle are growing because the restrictions which determine actions are reduced. So the road user has new possibilities (Action B, C) of actions which could not be considererd without telematic services.

Indirect effects by exploring new road pricing possibilities

The technical Progress in terms of better information services could allow new kinds of controlling. It is imaginable that with new information technologies dynamic road pricing could be realized and new steering mechanisms for the use of infrastructure can be implemented. So the boundary conditions can be changed by new telematic services.

Influence on the four step approach

When we look at the four step approach of transport modeling, there are different levels on which road users have to take decisions under information. These are:

Trip generation: The trip generation can be different because of increased action alternatives. The share of trip purposes could be changed.

Trip distribution: The Trip distribution can be influenced because of new destination alternatives.

Modal Split: The modal split could be changed by new information services because the attributes of the elements, which constitute the modal split, can be changed. The attributes of the traveler are not so much influenced, but the attributes of the trip like trip purpose, date of the trip can change with more or better information. Even the attributes of the means of travel costs, comfort or reliability can be influenced by better information through telematic services.

First the principle influence of information and telematic services on road transport shall be described. A model shall be built up which simulates the short term effect of information for

road users on micro-level. It shall be a qualitative model with synthetic data which shows the basic connections between consumption, recreation, work an transport. It should be a so called behavior-module. The results will be interpreted and used as an input for a long term system dynamics model, which simulates long term effects of telematic services in the field of transport and their impact on the socioeconomic system. On the basis of the behavior-module the macro-model is based on causal correlations of the behavior-model, which represent the impact of information.

So this approach is an extension of existing integrated system dynamic models, which are based on an aggregated view. They are able to handle dynamic relations between transport and transport influenced areas like Regional economics, Environment, Macroeconomics [IWW et al. 2000, Kuchenbecker and Rothengatter, 1998, Schade, B.,Rothengatter and Schade W., 2000].

Until now the effects of information can be integrated as factors in macro-variables, but these factor only can be estimated and are not based on causal models. The other way around the development on macro-level have got an influence on the actors on micro-level.

So an extension of the existing assessment models is planned to be made in the following way:

Generating of

a) a behavior model, which
    - calculates the impact of information on causal correlations micro-level and
b) a macro-model, which
    - calculates long term effects of information and
    - this calculation of long term effects is based on interactions between the micro-level and the macro-level.

The combination of these two models builds the new model structure, which allows to consider individual information-based activities in a long term macro-economic structure.

The existing combination of system dynamic macroeconomic models like ASTRA [IWW et al. 2000] with 4-step Transport–models could be extended on information based activities of individuals. On this way simulations could be compared, which interpret the impact of information in an aggregated and a disaggregated way. New cognition can be made referring to the meaning of activity based modeling for long term macroeconomic models. Effects of self-organisation, where individuals and system conditions stand in interaction with each other can be assessed. A first version of the behavior-model is planned for June 03.

Literature

[IWW et al. 2000] IWW, TRT, ME&P, CEBR (2000): *"ASTRA - Assessment of Transport Strategies - Final Report"*. Report on Behalf of the European Commission DG VII, Karlsruhe.

[Kuchenbecker and Rothengatter, 1998] Kuchenbecker, C. und W. Rothengatter, 1998*: A System Dynamics Approach to Transport Infrastructure Planning*. WCTR - Paper.

Karlsruhe

[Schade, B.,Rothengatter and Schade W., 2000:] Schade, B.; W. Rothengatter and W. Schade, 2000: *Assessment der Verkehrsszenarien des OECD Projekts EST (Environmentally Sustainable Transport) mit Hilfe von ESCOT (Economic assessment of Sustainability poliCies Of Transport). Bewertung*. Endbericht. IWW, Universität Karlsruhe.

[Lüdemann, C. 1997]. Lüdemann, C. 1997: *Rationalität und Umweltverhalten*. Deutscher Universitätsverlag GmbH. Wiesbaden

Back to the Top