Planning Sustainable Mobility with the Stakeholders - A System Dynamics Approach

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Abstract

MODUM stands for Environment - Mobility Model. MODUM is a research project (founded by the Swiss Science Foundation, 1997-1999) intended to provide a strategy model for Switzerland that is developed in close cooperation with the stakeholders in the mobility system on the basis of system dynamics. The project stems from a reaction to the increasing limitations encountered in the mobility system with regard to environment, infrastructural capacities, financing and, most important, lacking capacities to solve these problems on the political level. Three aspects are focused on:

- *Participation of the stakeholders*
- *Mental modeling and model moderation*
- *Integrating the perspectives of different disciplines*

The objective of the project is to find starting points where (state) action can actually (acceptance of measures by different interest groups) and effectively (leverage points) influence the future development of the transportation system respectively its impacts.

Project Scope

MODUM stands for Environment - Mobility Model. MODUM is a research project (founded by the Swiss Science Foundation, 1997-1999) intended to provide a strategy model for Switzerland that is to be developed in close cooperation with the stakeholders in the mobility system on the basis of system dynamics.

Today's mobility system in Switzerland increasingly encounters limits: limits of the environment (keywords air pollution, noise pollution), limits of capacity (keyword traffic jam), limits of financing (keywords large-scale railway projects, external effects), but also limits of political problem solving capability (keywords suburban traffic, NEAT).

Efforts to solve these problems often and increasingly fail because of objective conflicts: „solutions" for a problem in one field regularly threaten to lead to problems in other fields (e.g. construction of a freeway causes new noise pollution for residents). Blockades in planning work are the result of sectorial oriented strategies that insufficiently consider effects on other fields.

It was an objective of MODUM to make a suitable instrument for the planning available, that considers (also middle- and long-term) interactions between different fields. With it not at last a transparent dealing with traffic- and environment-political measures and theirs different consequences should be promoted and enabled. Within the scope of a so-called „stakeholder platform“ (see below), on one side the model developing process, but on the other side also a communication process between different interest representatives took place. The strong inclusion of stakeholder groups guaranteed from the beginning that the implementation aspect was a part of the project.

Research Methods

To achieve these objectives two procedures were combined:

a) A „stakeholder-platform“ was built up. Mental models of the stakeholders were created by model moderation.

In MODUM, it was worked with the mental models of the stakeholders in the system „mobility-environment“. The procedure was based on the methods described by Akkermans H. (1995), Pretty J. (1996), Senge P. M. et al. (1996) and Vennix J. A. M. (1996). To begin with, stakeholders representing very diverse interest groups and perspectives within the mobility system (e.g. conventional automobile associations as well as „green” traffic organizations) were selected as members of the stakeholder-platform. They accompanied and supported the working out of the model. New perspectives on contexts of mobility behavior within a changing society are being enabled, whereas, interestingly enough, those transportation modes that are (more) sustainable gain in weight. With five members of this stakeholder-platform so-called model moderation (see fig. 1) was carried out. This gives the stakeholders the opportunity to formulate their views (mental models) in everyday language and to have them translated into a "model standard language". This enables us to bring "traditional" and "new" (e.g. slow traffic modes or women-related aspects of mobility) perspectives into a relationship of equality. A dialogue process can ensue. The method of model moderation also integrates different disciplines: "Soft" or qualitative information is linked to "hard" data information. Relevant information does not have to be disregarded simply due to lack of “hard” data. Findings from various disciplines can therefore be linked. The result should be a model that corresponds much more to "everyday transportation functioning" than classical, techno-economical models did in the past.

In a first step of model moderation, the mental models of these members were established: at first, the most important terms of the system “mobility-environment” for the stakeholder were noticed on separate slips of paper. Secondly, the stakeholder sorted these terms according their structural context. Thirdly, the stakeholder told his or her “story”. At last, the model moderator established the abstracted mental model in cooperation with the stakeholder. In a second step, these mental models were presented to the whole stakeholder-platform. The different mental models were compared and discussed. Important common grounds and differences were recorded. This working step formed the basis for a common functional understanding of the system “mobility-environment” and for the working out of a corresponding system dynamic model (see below).

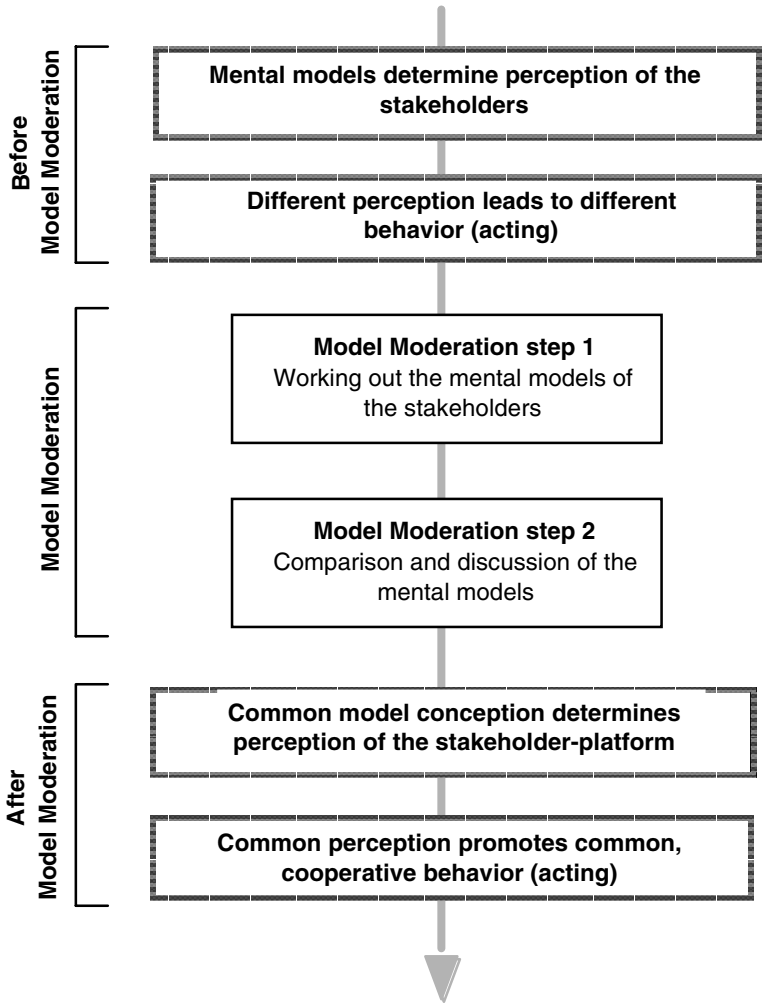

Fig. 1: Basic concept for model moderation

b) A practice oriented, system dynamic model of the system „mobility-environment" was worked out.

Founded on this common functional understanding of the system "mobility-environment", a practice oriented, system dynamic model was worked out. The chosen system dynamic modeling approach considers (in contrary to the usually used models in the field of traffic) additionally so-called feedback mechanisms. That means self-increasing (positive feedback) and self-regulating (negative feedback) processes could be included. This kind of modeling is especially suitable for the examination of middle- and long-term developments and of interactions between different fields. Recent foreign experiences and modeling approaches (group-modeling, soft-modeling) have been integrated.

MODUM

Based on the mental models worked out by the stakeholders and based on the know-how of the project group the "Environment - Mobility Model" (based on STELLA Software) was worked out. An overview of this model is shown in fig. 2:

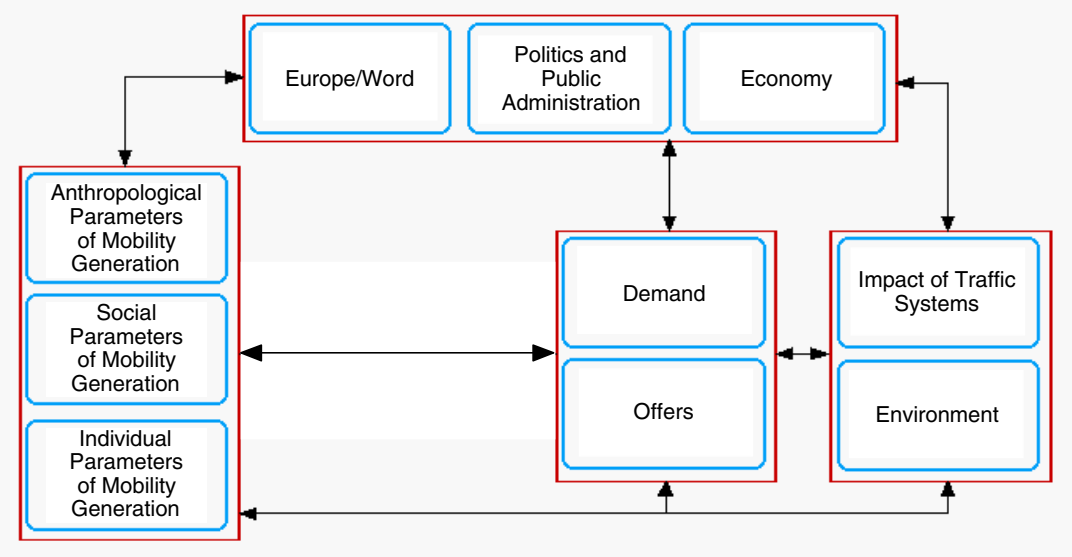

Fig 2: Macro Structure of MODUM

Mobility is generated by anthropological parameters (need for social interaction, need for freedom to move, etc.), social parameters (lifestyle, legitimation of lifestyles, etc.), individual parameters (environmental consciousness, educational level, etc.) and the economical needs. Important frame conditions are the political and economical development on the European and global level. The generated demand is covered by different traffic means (individual traffic means, public transit, etc). Attitudes on the individual and social level play an important role in the selection of the different traffic means available. The structure of traffic system is determined by decision-makers in politics and administration. The traffic system has a clear impact on the environment as well as on the economy. These impacts lead furthermore to feedback reaction on the individual and political level (including the public administrational).

The model is rather focussing on the aspects of mobility generation than on traffic flow systems. Since there are not a lot of data available in this sector (specifically about anthropological, social and individual parameters) the calibration and validation of the model will be a big challenge. The know-how and experiences of the members of the stakeholder platform will play an important role in solving this problem.

One of the main feedback systems (or "stories") is shown in the fig. 3.

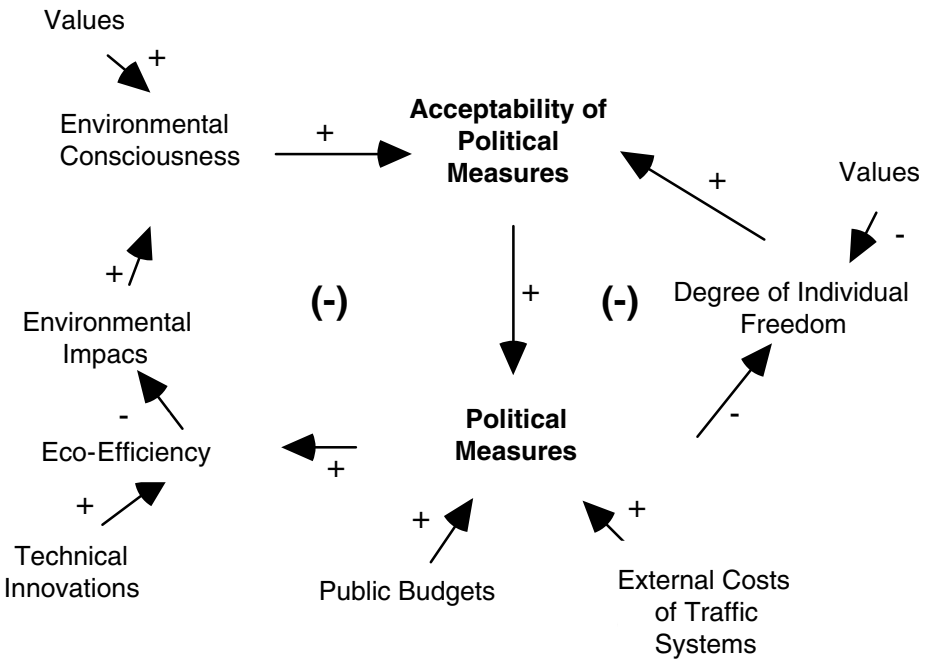

Fig. 3: Feedback systems determining the acceptability of political measures in the field of mobility management

Conclusions

Mental modeling with stakeholders is proved to be successful to build models of complex systems integrating social, environmental and economical aspects. The contribution of the stakeholders to building the model led from defining key elements and structures of the system to defining model functions. The process made it possible to make a more efficient use of the "soft knowledge" of the stakeholders, which are considered to be experts of their activity system. The process made it also possible to combine technical (hard-system) and often excluded social (soft-system) aspects of mobility generation and mobility management.

Furthermore the stakeholders learned to use system dynamics (specifically the "language of STELLA") to communicate in a new way. This generated a more structured discussion and avoided at the same time confusions caused by hidden or not properly communicated mental models and agendas.

The challenge is now to calibrate and validate the model. It is planned only to quantify key sectors of the model where data or reliable stakeholder know-how is available. This concept tries to combine the advantages of wide range (and not quantified) structure models as a communication tool and more focussed, calibrated and validated models for policy development support. First key sectors are already ready for scenario analyses (see fig. 4).

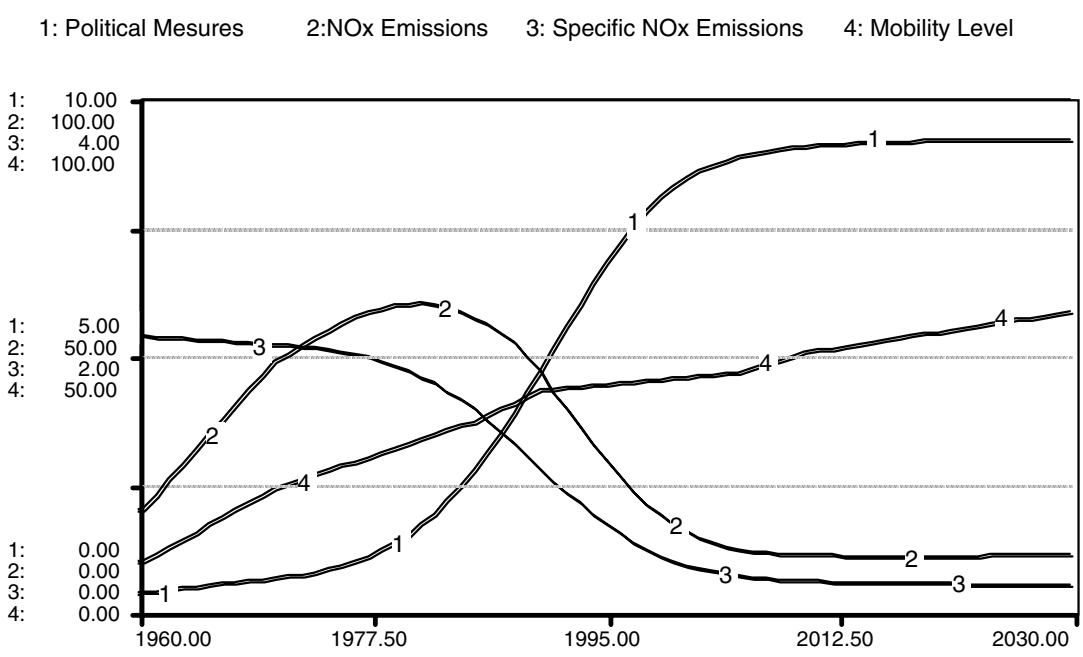

Fig. 4: Influence of political measures on environment (NOx) and mobility development.

Literature

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