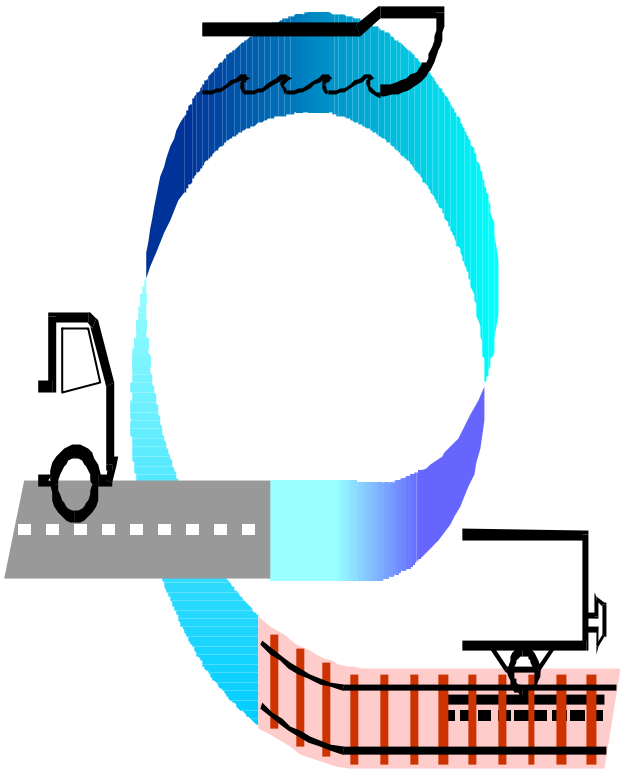

Potentials for Modal Shift in Freight Transport

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Abstract

The contribution addresses transport research issues in freight transport / logistics and transport modelling. It focuses on analysis methods for identifying the potentials for modal shift between road and intermodal transport and the role of new technologies and framework conditions considering the supply and demand side. Experiences using the micro and macro approach from Switzerland the Netherlands are outlined.

To get a realistic view about the potential for modal shift from road to intermodal transport and to realise the modal shift it is very important to estimate and scan the potential for modal shift on strategic and company level.

The outlined examples show that there are two main approaches – the macro and micro approach – to identify the potential for modal shift. Whereas the macro approach focus on the supply side the micro approach take into account the decision behaviour on company level. Both kind of approaches are needed to improve intermodal transport chains and increase the share of intermodal transport. There is a need to improve and optimise the procedures, methods and tools used for macro and micro approaches in order to provide the necessery information for decisions concerning infrastructure planning, freight transport concepts/services and mode choice.

To increase the share of intermodal transport it is especially important to promote a shift from the shippers choice of road transport to intermodal or rail transport by means of providing support and advice in a objective and modality independent way. On European level activities and projects are planned in this field. Switzerland (national and cantonal authorities, transport actors., etc.) should take part in these activities and should apply scanning tools on company level to support and stimulate intermodal transport.

Keywords

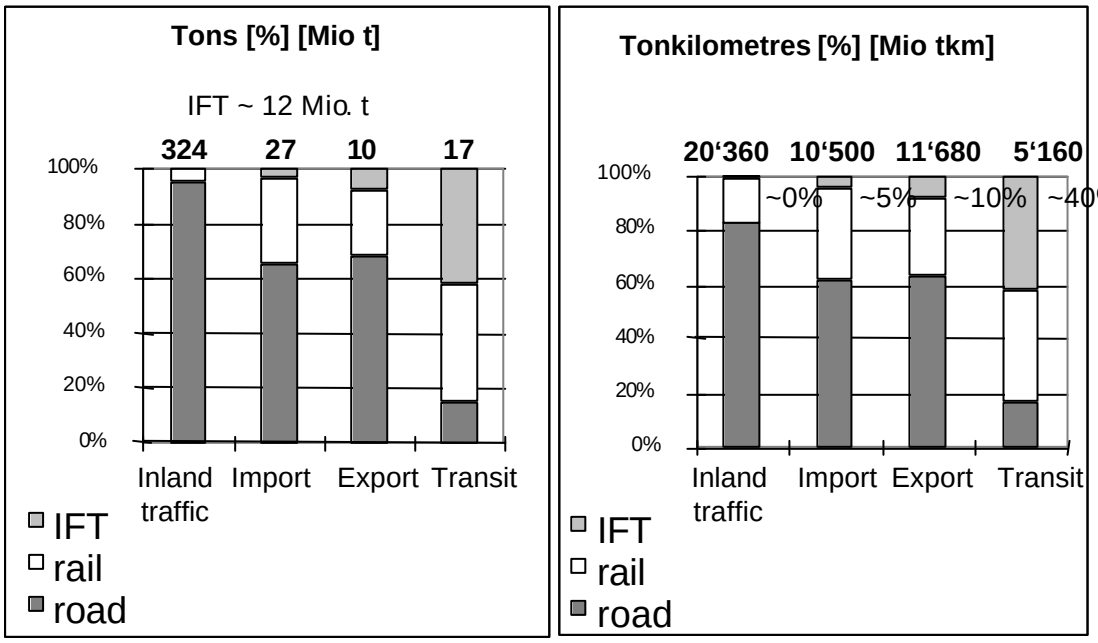
Freight Transport – Intermodal Transport – Modal Shift – Swiss Transport Research Conference – STRC 2001 – Monte Verità

1. Introduction and need for identification of the potential for modal shift

As in other European countries, in Switzerland the goods transport increases strongly with a dominance in road transport. It is expected that goods transport will more than double over the next 20 to 30 years. This causes problems according to environment, capacity of the road network and in qualitiy of life in general. Therefore the Swiss Freight transport policy aims for sustainable freight transport with a strong support of intermodal transport rail/road (Maillefer 2001).

In Switzerland intermodal freight transport rail/road (IFT) reached with about 40% only in transit traffic a remarkable market share (see Figure 1). In Import/Export traffic the share of Intermodal transport is with 5 to 10% rather low. In Inland traffic intermodal transport is nearly not existing with a share of less than 1%. Over all kind of transport (transit, import/export, inland) the intermodal transport has in Switzerland a share of approx. 12 Mio. t or about 3 to 4%. Excluding the transit traffic the share of IFT is a little less than 1%.

Figure 1 Modal Split in Swiss Freight Transport (1996)



Source: RAPP AG (2000) p. 21

The missing breakthrough is caused by obstacles in legal, political and organisational framework conditions, prices/costs (especially pre- and endhaulage, rail main haul), leading times and also in the information/communication processes applicable to the overall transport chains (RAPP 2000).

A shift from road transport to other modes of transport (in Switzerland especially to rail and intermodal transport) is to be considered to be one of the main policy instruments for the EU and national governments. Considering the share oft IFT the Swiss Freight Transport Policy should strongly aim for

- Keeping the high share of IFT (and Rail) in transit traffic
- Increasing the share of IFT in Import/Export and Inland traffic.

A bundle of measures to increase the share of intermodal transport was carried out by the Swiss Federal Office of Transport taking into account the rail, road and intermodal transport (Maillefer 2001).

To get a realistic view about the potential for modal shift from road to intermodal transport and to realise the modal shift it is very important to estimate and scan the potential for modal shift on strategic and company level. However such information is also needed for infrastructure planning as intermodal terminals and rail connections, the planning of new intermodal transport services and for mode choice of the transport actors.

2. Approaches and methodologies identifying the potential for modal shift

Approaches and tools with the objective of identifying potential flows for modal shift were already developed in earlier EU and national research projects (e.g. LOGIQ, TRILOG). Most research in the past focused on the supply side, but the need and development of approaches goes in the direction of the demand side. There are two main approaches dealing with identification of the potential for modal shift (see Table 1).

Table 1 Main Approaches for Identifying the potential for Modal Shift

Approach		**Key factors (examples)**	**Methodologies / Tools used**	**Experiences**
Macro Approach	Identification of potential for modal shift based on analysis of aggregated freight flows on regional, national or international level (focus on **supply** and demand side)	Characteristics and quality of transport network (cost, time, reliability, ...) and freight flow matrices, Characteristics of commodities	e. g. Matrices analysis (incl. affinity factors) Freight transport models (incl. Modal Split approaches)	Several projects and experiences available (e.g. Switzerland, Germany, the Netherlands)
Micro Approach	Identification of potential for modal shift based on analysis of freight flows and logistics/transport chains on company level (focus on **demand** and supply side)	Real Life Logistics/Transport chains, Behaviour of individual company (decision making process), ...	e. g. Transport chain analysis Scanning tools, Decision Supporting Systems	Limited number of projects experiences available (e.g. the Netherlands, Switzerland)

Source: RAPP AG / M. Ruesch

Both approaches are taking into account the supply and demand side but the macro approach focus more on the supply side whereas the micro approach focus more on the demand side. The **macro approach** is a more strategic approach which identifies the potential for modal shift for regional, national and international freight flows. As input data the freight flows (origin, destination) for the various commodities, informations about the transport networks and transport offers and also affinity factors are needed. The results provide an estimation on the potential for modal shift for a region or a an origin-destination connection. Statements on company level and recommendations for individual mode choice are not possible. The **micro approach** is a more supply chain specific or individual tailormade approach which identifies the potential for modal shift on company level taking into account the decision making process of the shippers. As input data the transport logistics chains and freight flows for the transported commodities on company level are needed and also the key factors for the decision making process (cost, reliability, leading times, etc.) have to be known.

3. Methods and experiences using the Macro Approach

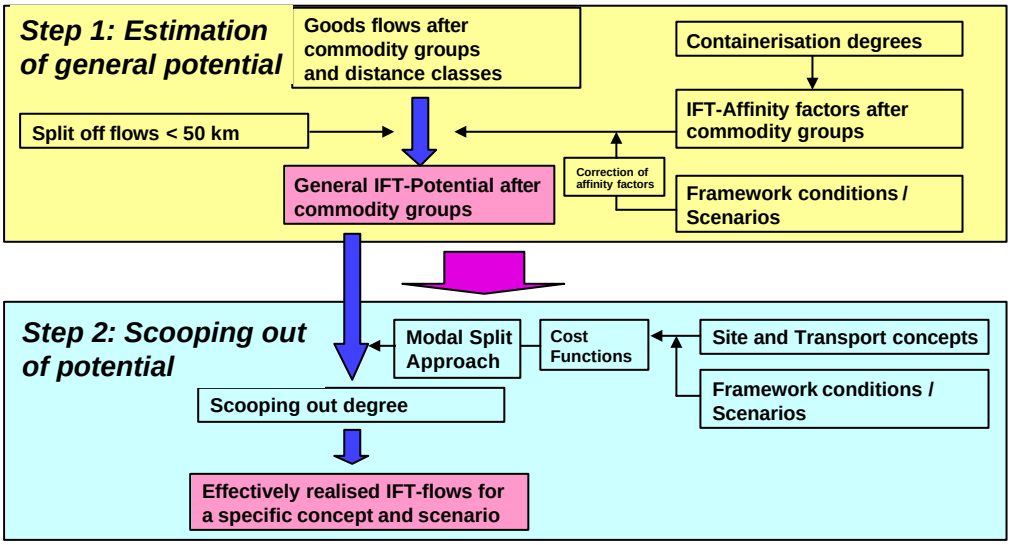
The following chapters give a short overview about the approaches used and the experiences made within the project 'Standort- und Transportkonzepte für den Kombinierten Ladungsverkehr: Verlagerungspotentiale und Umsetzungsstrategie für den Import-/Export und Binnenverkehr" (RAPP AG 2000) and within the IDIOMA Project (RAPP AG / ETH/IVT 2001).

3.1 Example 1: Macro Approach used for Swiss Import-/Export and Inland Traffic

3.1.1 Approach

In the framework of the project B2 ("Standort- und Transportkonzepte für den Kombinierten Ladungsverkehr: Verlagerungspotentiale und Umsetzungsstrategie für den Import-/Export und Binnenverkehr", RAPP AG 2000) a macro approach was developped which identifies the potential for modal shift in two steps (see Figure 2).

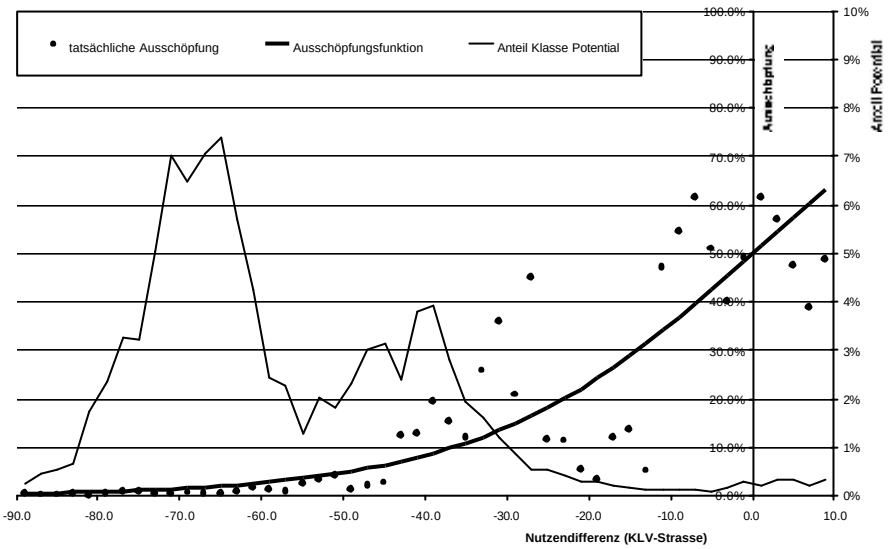
Figure 2 "Two step" macro approach



Source: RAPP AG (2000) Annex F4, p. F4-2

In the **first step** affinity factors have been applied on road freight matrices taking into account 7 commodity groups to estimate the maximum potential. These affinity factors are based on experiences made in several studies about combined transport terminals and intermodal transport. In the **second step** modal split functions based on transport mode related cost functions have been developped which describe the scooping out of the maximum potential. For these functions a logit approach was used (Figure 3). The cost functions were based on generalised costs considering the transport cost and also the transport time.

Figure 3 Scooping out functions Road → Intermodal transport



Source: RAPP AG (2000) Annex F4, p. F4-8

The criteria for the potential for modal shift included the supply and demand side (transport network/services, terminal locations, transport costs, transport time, value of time, etc.).

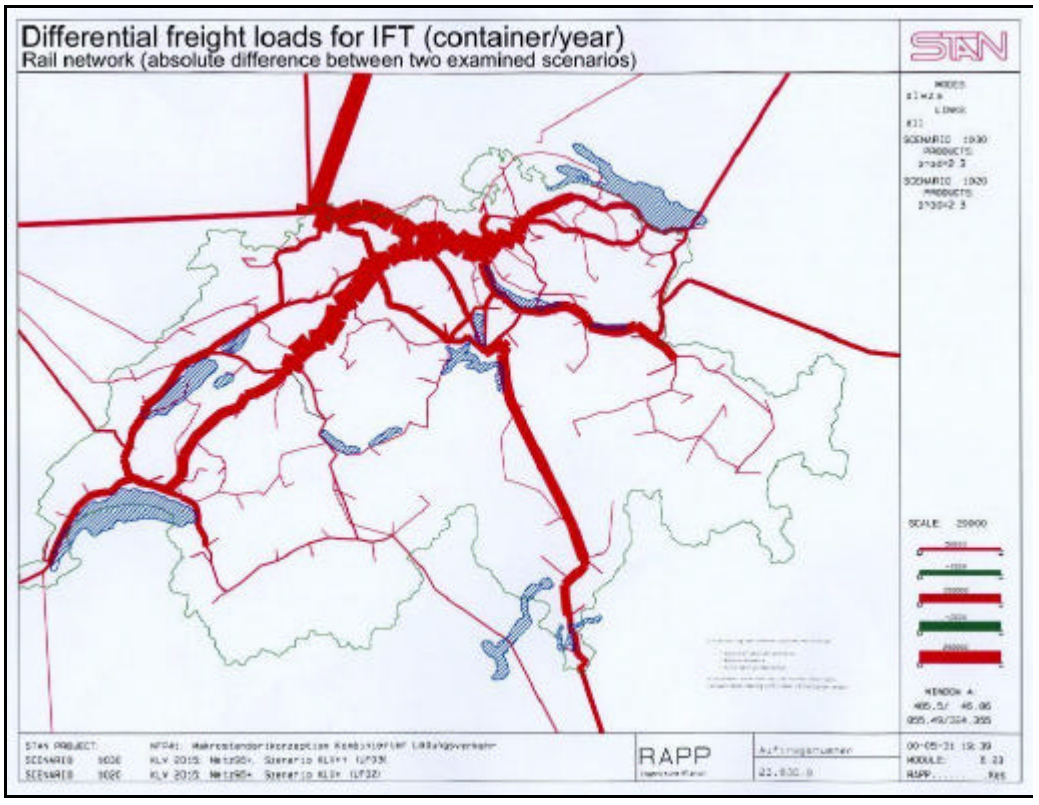
3.1.2 Results

The macro approach described was used to estimate the potential for modal shift from road to intermodal transport for import/export and inland traffic of Switzerland for three intermodal terminal site and transport concepts and three scenarios. For the effects analysis a multimodal freight transport model has been used (Freight Transport Software STAN[1]) including a modal

[1] **S**trategic **T**ransportation **AN**alysis, developed by INRO, Montreal

split and assignment model. The **potential shift from the roads to IFT** for the planning horizon 2015 is between approximately 1 mil. t/year (IFT+/-) and 40 mil. t/year (IFT++) depending on the framework conditions as well as the location and transport concept. This transfer potential is affected much more strongly by the framework conditions than by the elaboration of the various location and transport concepts. Without any significant additional promotion of IFT, its volumes will increase only to an insignificant extent despite the introduction of the Heavy vehicles fee (HVF).. The additional expense of using the roads due to the HVF will be compensated by the productivity benefits deriving from the 40-tonnes weight limit. The **transfer potentials** are found **principally in import/export traffic**, with a share of between 85% or 10 million tonnes (IFT+ scenario) and 65% or 26 million tonnes (IFT++ scenario). **Significant shifts to IFT in inland traffic** of 16 million tonnes will result only if a significant improvement is made in the framework conditions for IFT (scenario IFT++). Nevertheless, an increase of 1.8 million tonnes/year in IFT inland traffic can already be expected for the IFT+ scenario. The following map shows the increase in inter-modal freight traffic between the IFT+ and IFT++ scenarios for the reference alternative.

Figure 4 Difference in IFT traffic (rail part, containers/year) between the IFT++ and IFT+ scenarios (reference alternative 2015)



Source: RAPP AG (2000) p. 98

The **transfer potentials from pure rail to IFT** are negligible on the assumption that normal rail freight trains are retained. The competitiveness ratio between IFT and road traffic is significantly greater than that between IFT and rail traffic. The **market share of IFT in inland as well as in import/export traffic** referred to all traffic carriers can increase from today's level of below 0.5% to 3% with a minor improvement in the framework conditions (IFT+/-) and to approximately 7% with major improvement (IFT++) in these conditions. Because of the high share of road freight traffic in the short-distance sector (approx. 80% of the tonnage is transported over distances of less than 75 km), the **reduction of road tonnage** remains modest at between 1 (IFT+/-) and 7% (IFT++). Modified framework conditions and the location and transport concepts mean that long road trips in particular will be shifted to IFT. Nevertheless, a considerable reduction in road use can be achieved, from 140 million vehicle-kilometres per year or 2% (IFT+/-, liner train) up to 2,590 million vehicle-km[2] or 40% (IFT++, liner train). Larger-scale shifts from the road to IFT presuppose an improvement in the terminal infrastructure, investment in rolling stock and containers as well as sufficient staff. Irrespective of the IFT service and operating concepts for inland traffic, an **improved link-up of Swiss terminals to seaports and European economic areas** can shift import/export road traffic to IFT. Transfer effects would already result under the existing framework conditions or with minor improvements of them.

The **multi-modal freight transport model** (road, rail, IFT) set up within the scope of this project on the basis of the STAN model software has proved its worth as an aid for developing alternatives (goods flow analyses) and estimating the effects of various location and transport concepts. It can also be used as a network optimisation tool. Further applications in goods traffic are also conceivable, although various supplements and adaptations will be required depending on the type of questions posed (e.g. integration of transit traffic, sub-model of traffic generation etc.). The model approaches used (modal split, cost functions of modes, etc.) should be optimised in further applications. The increased use of improved strategic planning tools for goods traffic should be recommended in order to allow the impact of these measures to be analysed. However, the basic data acquisition which is increasingly used to perform freight surveys applicable to all traffic carriers must be improved at the same time.

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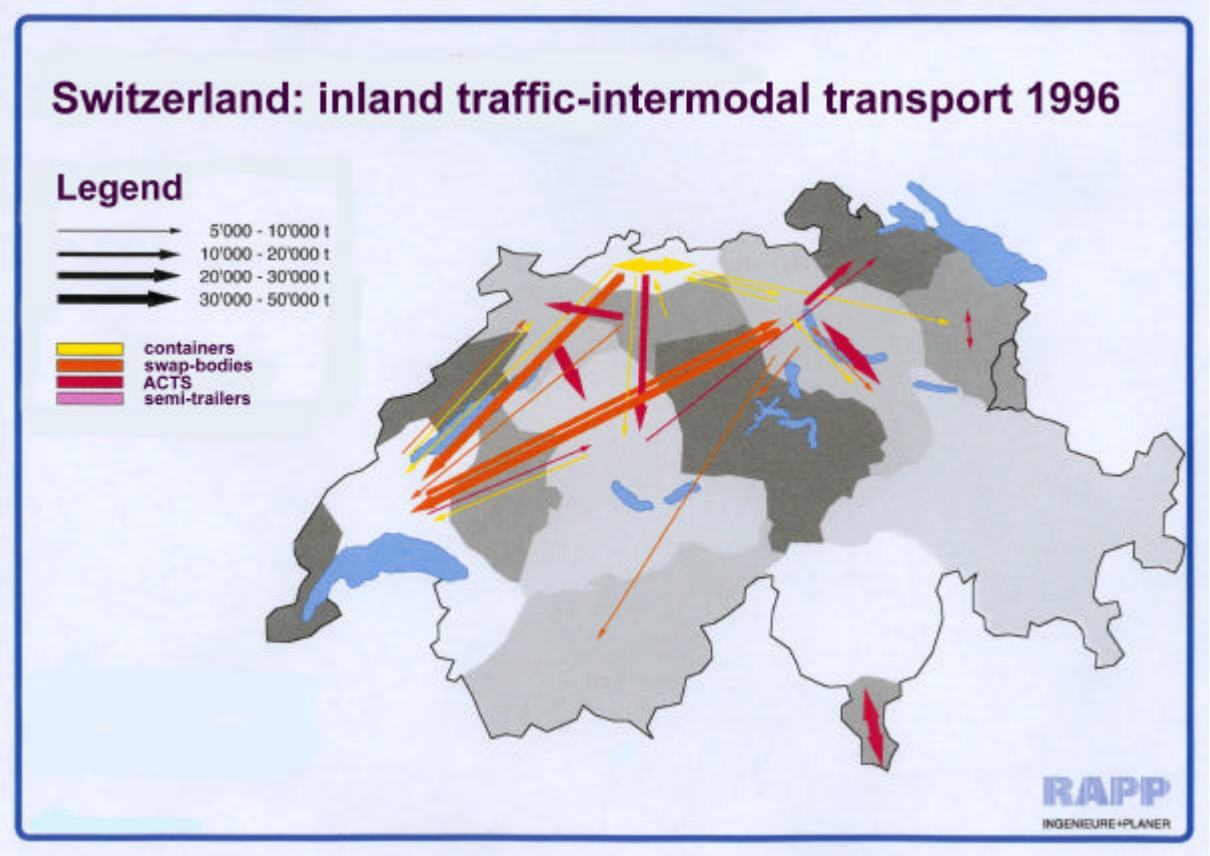
[2] Savings in transport distances in Switzerland and abroad (CH share: 950 million vehicle kilometres): In comparison: transport distances of heavy commercial vehicles in CH (1993): 2136 million vehicle kilometres.

3.2 Example 2: Macro Approach used for the estimation of the potential of ACTS

Today (year 1999) the ACTS (Abroll-Container-Transport-System) has with about 600'000t a year a market share in inland intermodal traffic between 50 to 60%. Today ACTS is used especially in bulk transport chains (waste, building materials, agricultural products, etc.) and in company-inhouse transport chains. ACTS is used also over short and medium transport distances (see Figure 5). But more and more the ACTS is used also in consumer goods transport chains (e. g. running transports for Coca Cola, pilot project of Migros).

Figure 5 Intermodal inland traffic (1996)

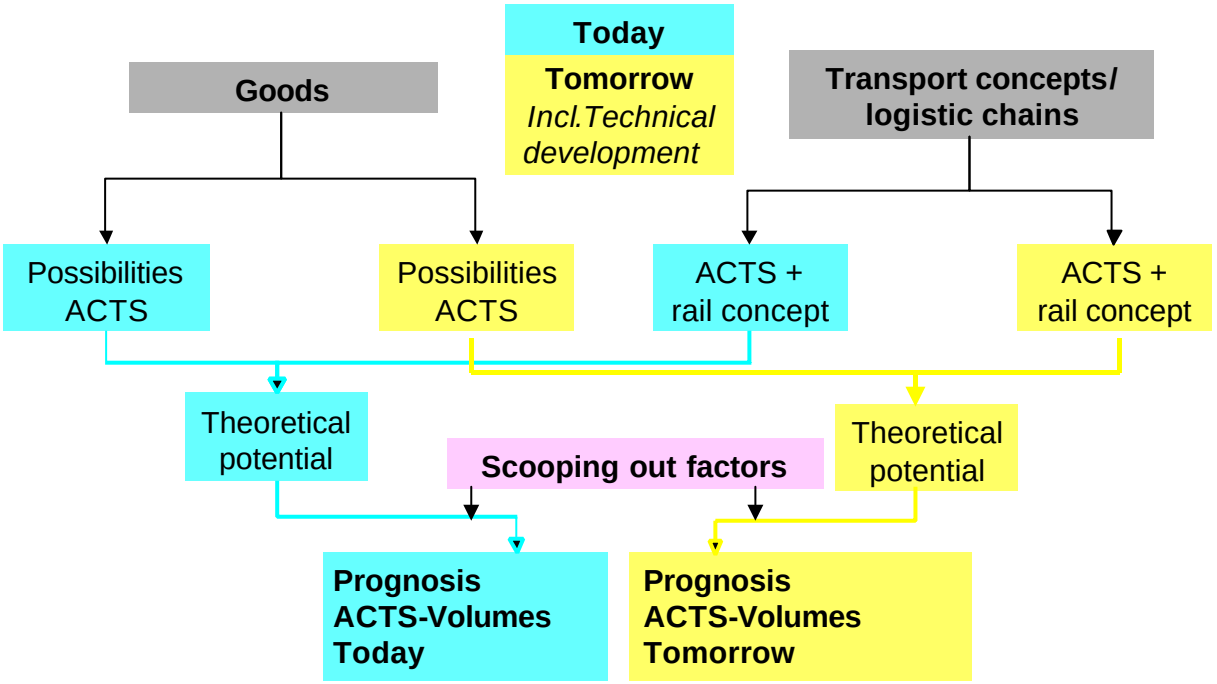


Source: RAPP / ETH/IVT (2001)

3.2.1 Approach

In the frame of the IDIOMA project (RAPP / ETH/IVT 2001) one subproject dealt with the ACTS (Abroll-Container-Transport-System[3]) used in intermodal transport chains. Within this project a potential analysis has been carried out taking into account the requirement of the commodities and the transport chains (see Figure 6). The potential analysis is based on road transport freight flows in 2015 (inland traffic) divided in 7 main commodity groups. Referring to the goods and logistics chains criteria as shock sensibility, temperature sensibility, consignment size (full load, part load, cargo), requirements for the transport speed, distance class etc. have been considered.

Figure 6 Approach used for Potential Analysis of ACTS



Source: RAPP / ETH/IVT (2001)

[3] Roll-on Roll-off Container System

3.2.2 Results

The available data and the necessary simplifications allowed only a rough estimation of the potential. The **ACTS-Potential in inland traffic** has been estimated for about **5 million tons in 1996 and 14 million tons in the year 2015** (RAPP / IVT/ETH 2001). Compared to the todays volumes (approx. 600'000 t /a) this correspond to an increase of a factor 8 respectively 23. It can be expected that the ACTS System will be used more and more also for consumer goods.

4. Methods and experiences using the Micro Approach

Within the micro approach the decision making process for modal choice plays an important role. This decision making process on company level has been analysed in European (e.g. LOGIQ, LOGICAT) and national projects (e.g. Bolis/Maggi 1999). Main criteria for mode choice have been identified as cost, reliability, frequency of services and leading times (LOGIQ Summary report, RAPP 2000 p. 37). It appears that the division of the decision power of actors varies between different supply chains, and each actor has its own priorities and criteria in mode choice. Micro approaches to scan the potential for modal shift between road and intermodal transport have been applied in the Netherlands (e. g. EVO 2000, Quispel 1999) and also in Switzerland (e.g. Bolis/Maggi 1999). Compared to the macro approaches only a limited number of experiences are available. The tools and instruments used for these company scans are so called decision supporting systems (DSS). In the following chapters some examples and experiences using the micro approach are outlined.

4.1 Example 3: Micro Approach used for Waste transport chains

In the past years several waste logistics studies have been carried out in the context with the ban to deposit waste in Switzerland (since 2000) and Germany (from 2005) and the realisation of waste burning plants (e.g. RAPP/Regioplan 1997, 1998 etc.). Within these studies comparisons between intermodal transport road/rail and road transport have been made taking into account roll-on/roll-off systems. Within these studies the practicability, suitability and the economical and ecological effects have been analysed.

4.1.1 Approach

The investigation based on a micro approach including the following steps (e.g. RAPP/Regioplan 1997, 1998 etc.):

a) Analysis of infrastructure (road, rail), waste transport technologies and waste goods flows

b) Development of transpoort concepts/logistics chains (intermodal/road)

c) Prove of organisational, operational and infrastructural feasibility

d) Effects analysis (Costs over the whole transport chain, mileage, use of area space, emissions)

e) Sensitivity analysis (costs, waste flows, influence of heavy vehicles fee and change in weight limits etc.)

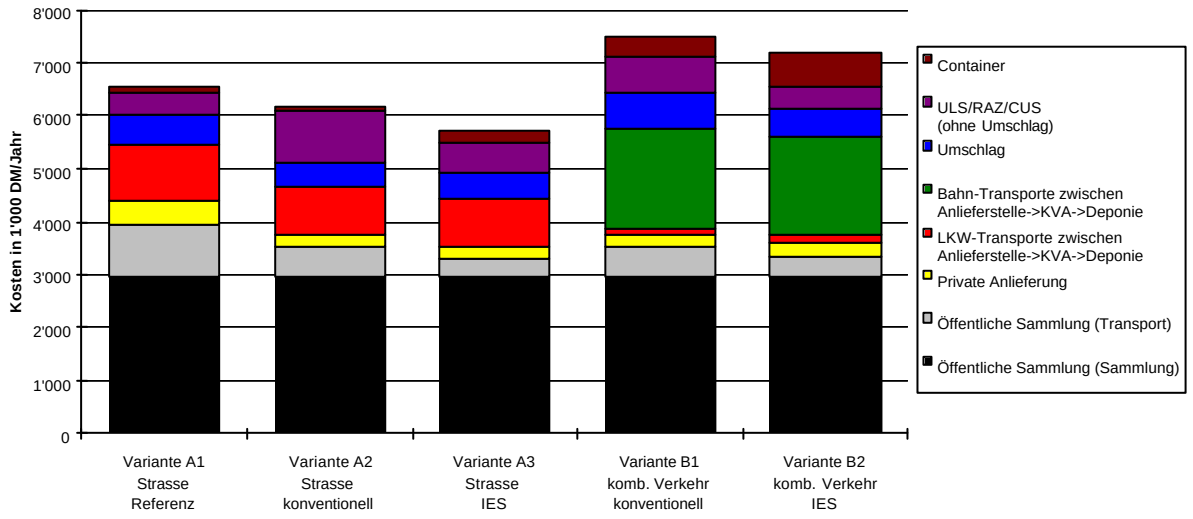
f) Assessment and comparison between intermodal and road transport.

4.1.2 Results

In the figures 7 and 8 some results of the effects analysis of the waste transport between Landkreis Waldshut (Germany) and waste burning plants in Switzerland are shown. Within this example the roll-on/roll-off system used in pure road transport chains has the lowest overall costs. The intermodal concept is not competitive compared to the pure road transport because of the split of transport in three burning plants (high rail main haul costs) and the higher equipment costs (longer turn around intervals). The concepts using roll-on/roll off systems (also called IES-systems) are within a transport mode (intermodal, road) more economical than conventional technologies.

Figure 7 Effects on logistics costs

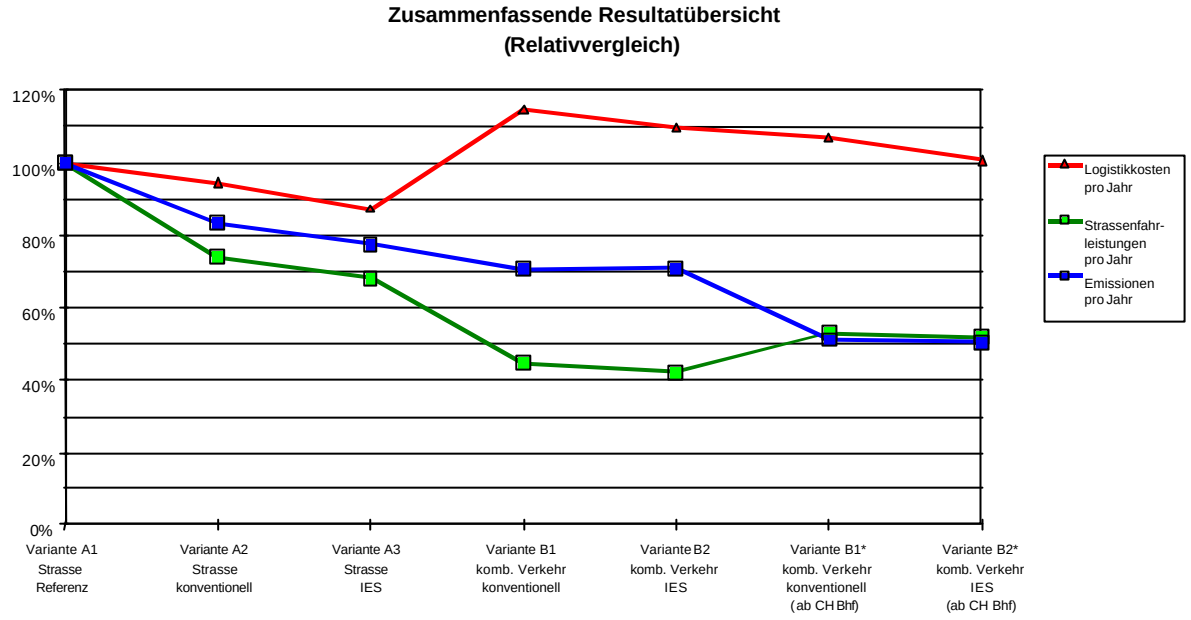
Abb. 7.7 Logistikkosten pro Jahr (Abfall und Schlacke)



Source: RAPP AG / REGIOPLAN (1998) p. 63

According to the mileage and the emissions the intermodal solutions are better than pure road transport solutions. Because of the diesel drive partly used for rail main haul the reduction of the emissions by the intermodal are not so big unless the rail transport starts from Swiss rail freight goods stations.

Figure 8 Effects compared to present state



Source: RAPP AG / REGIOPLAN (1998) p. 74

The following experiences have been made with the used micro level approach:

- It is very important to investigate the whole transport chain from origin (collection area of the waste) to destination (slag to dump) including all processes (e.g. transport, transhipment, handling).
- To prove the feasibility (e.g. infrastructure, rail operation) is a crucial point and has to be shown within the project.
- To get market prices it can be useful to make a call for offers for rail and intermodal transport.
- The local framework conditions (legal, infrastructural, waste collection system, etc.) and the density of transhipment points have a big influence on the design of the logistics concept, the feasibility and the economical and ecologial effects.
- Roll-on/Roll-off technologies have usually economical and environmental benefits compared to conventional waste collection technologies. This technology allows it to

use the expensive waste collection vehicles very efficient and has low infrastructure and operation costs at the transhipment points.

- Synergies with other disposal activities can reduce the transhipment costs and can support intermodal solutions.
- To reach user acceptance for innovative systems it is important to integrate the relevant actors in an early stage.

4.2 Example 4: Micro Approach used in the Netherlands

4.2.1 Approach

In the Netherlands Modal Shift Scans on micro have been carried out at about one hundred shipping companies (EVO 2000). Four types of modal shift scans have been carried out:

(a) Modal Shift by means of adaptation of the way the transport is organised

(b) Modal shift by means of a change of the shipment unit

(c) Modal shift combined with a change in the chain (for instance the relocation of stocks)

(d) Help with the request of subsidy.

Within these scans the individual situation of the companies (freight flows, commodities, consignment sizes, decision making criteria and priorities, etc.) have been taken into account.

4.2.2 Results

Some of the main results of the scans in the Netherlands can be summarised as follows (EVO 2000):

- The scanning practice showed that many companies do not, or partly not examine alternatives to road transport (53% of the companies). There is an insufficient knowledge of what rail and intermodal transport have to offer.
- For 80% of the participants a positive recommendation has been formulated to divert at least one flow of goods from the road to the inland waterway transport, rail and shortsea modalities. Also smaller companies (<100 employees) have a potential for modal shift.
- The scan types (a) and (c) led to the most promising possibilities for modal shift, the scan types (b) and (d) have been less promising.

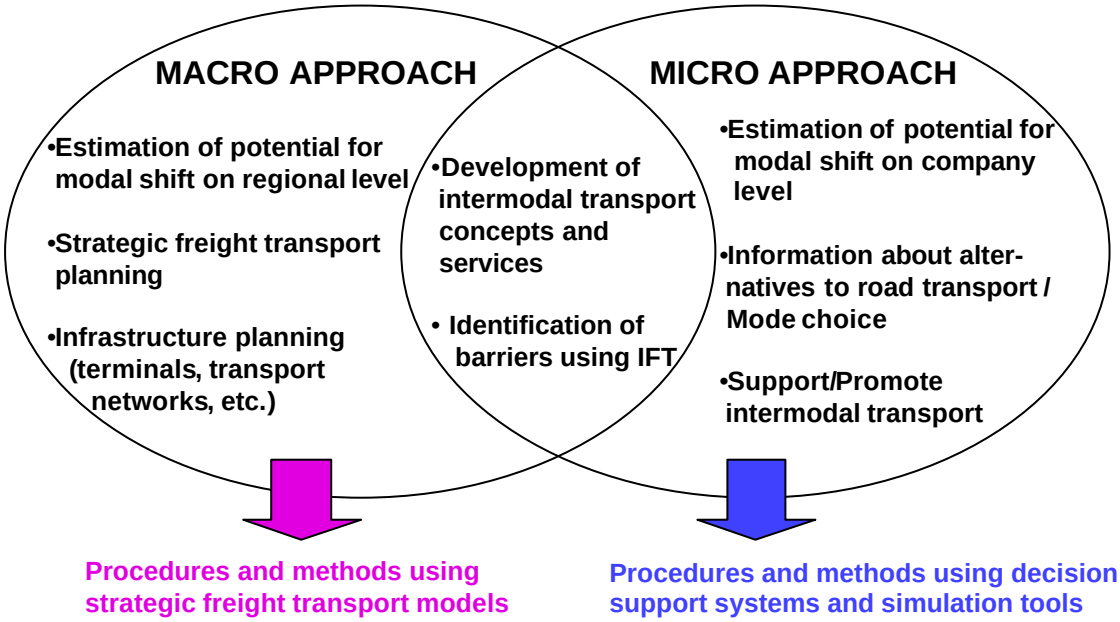
- The implementation of a modal shift can lead to a reduction of costs of about 7 to 12%.
- On the basis of the 100 scans the total modal shift potentials amounts to around 4 million tonnes, of which around 1.75 million tonnes have good prospects for a shift within three years, and 2.25 million tonnes within 3 to 5 years.

Overall the experinces carrying out these scans have been very postive. A stimulation of intermodal transport can be expected. It has to be considered that in the Netherlands short sea shipping and inland waterway play an important role in intermodal transport and that therefore the results are not directly transferable to the framework conditions in Switzerland. Nevertheless scanning the potentials for modal shift seems to be a succsessful approach promoting intermodal transport.

5. Conclusions and Outlook

The outlined examples show that there are two main approaches – the macro and micro approach – to identify the potential for modal shift. Whereas the macro approach focus on the supply side the micro approach take into account the decision behaviour on company level. Both kind of approaches are needed to improve intermodal transport chains and increase the share of intermodal transport (see Figure 9).

Figure 9 Application of Macro and Micro Approach



Source: RAPP AG/M. Ruesch

There is a need to improve and optimise the procedures, methods and tools used for macro and micro approaches in order to provide the necessery information for decisions concerning infrastructure planning, freight transport concepts/services and mode choice. To increase the share of intermodal transport it is especially important to promote a shift from the shippers choice of road transport to intermodal or rail transport by means of providing support and advice in a objective and modality independent way. On European level activities and projects are planned in this field. Switzerland (national and cantonal authorities, transport actors., etc.) should take part in these activities and should apply scanning tools on company level to support and stimulate intermodal transport.

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