NFP 41 Verkehr und Umwelt

Zukunftsgüterbahn

Schlussbericht der Vorstudie

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Summary

1. The Problem

Railways are not just losing market share due to the intensifying international competition. The road freight sector is also at the same time constantly reducing its specific pollution (particularly air pollutant emissions and noise) and thus has been able to reduce its environmental disadvantage compared to railways. This is undermining the transport policy justification for giving preferential treatment to railways on environmental grounds.

In order to counteract this trend effectively, the freight train of the future must therefore increase both its economic and also its environmental productivity[1] by certain factors. With the introduction of railway reforms, the political framework conditions are created which break down certain barriers.

The increase in productivity in the road freight sector should continue in the future: economically, the increased weight limits (in Switzerland, the removal of the 28 tonne limits), the freedom of cabotage as well as improved navigation systems have led to an increase in productivity, while in the environmental area further improvements can be expected, particularly in air pollutant emissions. The current ideas on pollution limits (EURO IV) would, for instance, mean a further reduction in nitrous oxides of around 75% as compared with the current average.

At the same time, the circumstances of demand and therefore the requirements of customers have undergone a structural change: the increasing value of freight and the decreasing specific weight, changed stockholding strategies as well as the increased flexibility of production methods today require transport tailored to a high degree to meet the needs of the customer. Here, railways are at a disadvantage compared to road freight for the moment, due to the slow nature of large systems.

This project deals first and foremost with the **productivity potential of railways on the supply side.** The central question is how and with what products and under what

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1 Economic productivitity: Tkm per franc invested or per employee
Environmental productivity: Tkm per unit of environmental damage

framework conditions railways are in a position to be able to double economic and environmental productivity so as to transport double the amount of freight and make double the amount of profit with the same costs and same amount of environmental damage[2]. All in all, we describe this improvement as „Factor 4" following v. Weizsäcker (1995). At the same time a strategic bridge is built between supply and demand.

An international expert workshop which was held in mid October 1997 in Olten formed a key element of this project.

2. Innovation paths

On the supply side, we identify five different innovation paths:

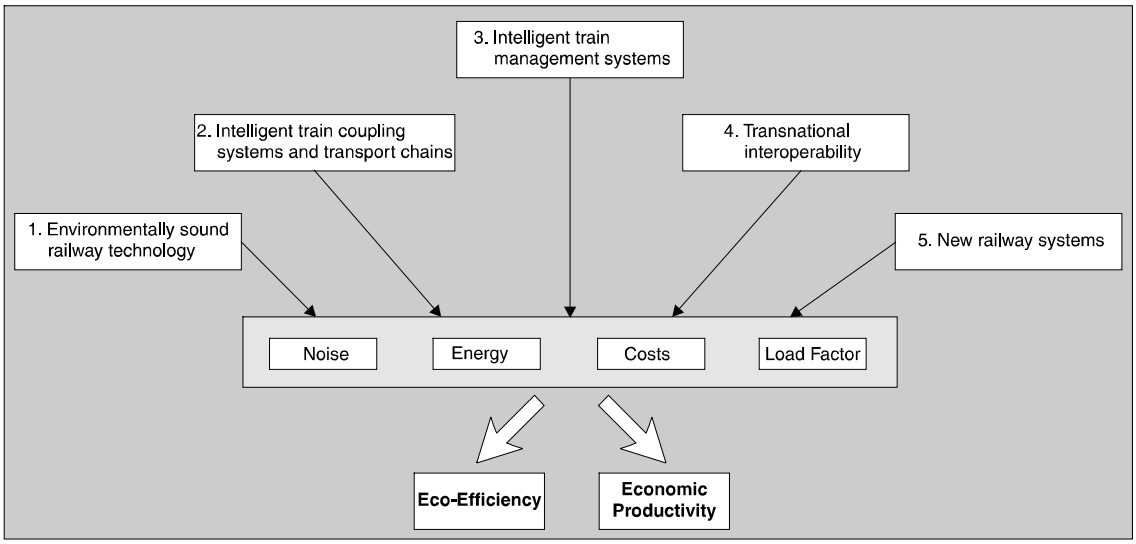

Figure S-1: Overview of the different innovation paths for a „Factor 4" train

a) Environmentally sound railway technology

This innovation path investigates potentials in rolling stock and infrastructure so as to reduce specific damage to the environment, but without direct consequences on the load factor. An improvement in economic productivity (reduction in costs) is only possible to a very limited extent since additional investment is necessary for the im-

2 From an environmental point of view, noise pollution and energy consumption (indirectly by way of CO_2 emissions from electricity production) are to the fore.

provements required. However, on the other hand, from a demand point of view the attractiveness of railways can be increased (image for customers and politics).
Various measures are available for the rolling stock to reduce noise pollution (new brake technology, wheel sound absorbers, wheel covers). These show good potential and thus a relatively good cost-benefit ratio, especially if one compares these measures with local measures (e.g. noise prevention walls).
As regards energy consumption, the potential is much more modest. Since it is a question of a cost factor, reductions in energy consumption are constantly being achieved. Central to this are improved recovery systems. Longer term, there is potential in the optimisation of efficiency and the use of new power technologies (e.g. fuel cells).

b) Intelligent train coupling systems and transport chains

Here, reference to demand is very important. The greater the success in focussing on demand and creating symmetrical transport circuits, the greater the potential for using high productivity systems (e.g. integral trains, shuttles). While in single waggon loading systems the use of intelligent decentralized handling and shunting systems can be made more productive with automation, the greatest potential lies in coupling part trains (so-called train coupling/sharing). An important precondition is the use of automatic coupling as well as automatic waggon identification. The greatest potential is achieved if integrated systems can be set up. The German Federal Railway's „Cargo Sprinter" is a good example of this. In principle, both the development of high productivity central train coupling systems and also the specific promotion of smaller decentralized structures is needed.

c) Intelligent train management systems

Intelligent train management systems make integral train control and automated management systems possible. They also help make use of the existing infrastructure more safely and productively (e.g. with longer and heavier trains on the one hand and more flexible forms of management on the other hand). Systems which are compatible throughout the whole network are of paramount importance. With the introduction of ETCS (European Train Control System), Europe-wide requirements have now been set. The system can be expanded modularly. However, a large investment is needed for the implementation of these international standards throughout the whole network. At the moment, the investment is being concentrated on the high-speed stretches.

Greater potential is also expected by the increased operational disengagement of passenger and freight transport. The potential for this is, however, rather small in Switzerland.

d) Transnational interoperability

One of the greatest hindrances to an efficient international freight service is that the systems in the different countries are incompatible. Particular examples of this are different electrical and safety systems, the lack of international investment in personnel and different requirements on engines, which still require a change of locomotive at a border.[3] Another problem is different tariff systems. There is particular potential here in the administrative and organisational area. These areas are also important for the improved international diffusion of the technical innovations outlined above.

e) New railway systems

New different systems to the conventional wheel and track technology such as magnetic levitation or vacuum tubes (following the Swissmetro project) are possible as alternatives or as extras. However, they are not a high priority at the moment given the expected very high investment needed and the possible problems of interoperability with the existing systems. Moreover, the environmental balance of new systems is rather worse (particularly the manufacture as well as the operational energy consumption).

3. The „Factor 4“ Scenario and preconditions for implementation

While environmentally sound railway technology has a direct effect on environmental damage, the other innovation paths would result first and foremost in increased economic productivity. The expected increase in the load factor would also indirectly improve environmental productivity.

The evaluation of the individual innovation potentials shows that the synergy potentials are relatively high, particularly the preconditions for increased compatibility of

3 These factors are primarily attributable to the national railway thinking which evolved historically.

the systems. A rough estimate shows that an improvement by a „Factor 4" is possible in principle with the potentials foreseeable at the moment. However the relatively high investment costs in some cases and the long replacement cycles should also be taken into consideration. The greater the need for extra investment, the higher the depreciation costs too. This leads to the conclusion that only a longer term organic introduction of innovations would be able to bring about an improvement even on the costs side. In the shorter term, on the supply side the realisation of operational and organisational potential is central (intelligent train coupling and improved transnational operability). Also, the least investment risks are associated with a thrust of this kind. The more dynamic the railway market, the larger the demand of the railways for innovative products in the rail industry. The railways as a customer are in a good position to demand customer- and environmentally-friendly products from the system suppliers and rolling stock industry. Experience with the reform of the railways has shown clearly that this line-up of protagonists is very important.

Table S-1 shows the most important key elements for a „Factor 4":

Innovation paths	Necessary key elements for a „Factor 4" Scenario
Environmental technology	New braking technology (e.g. synthetic brake blocks) Latest generation of locomotives Intelligent recovery technology
Train coupling and train management system	Organisational: train coupling/sharing systems, optimized processing in CT (combined transport), intelligent shunting forms Technical: Automatic train coupling, electr. brake interrogation and control, intelligent freight waggons, new handling systems
Management systems	ETCS, Stage 3
Interoperability	Standardized regulations, standardized signal technology Improved operational sequences at border crossings

Table S-1: Key elements for a „Factor 4" train scenario

Various elements are necessary for the **transmission** of the innovations shown:

Competition, improved coordination of the international systems, making integrated systems possible and investment incentives and financing mechanisms are the most important framework conditions for the successful implementation of innovations. The rolling stock industry and the system suppliers have an important role to play here.

The political standards for it are fundamentally in place. However, stringent implementation is needed.

Reference to demand takes on a great significance (actual marketing). The greater the success in taking the customer's wishes into consideration in the market, the better the prospects of a good return and thus the incentives for investment.

On the political level, the most important lines of action are the consistent implementation of the railways reform with open access, an investment-friendly environment and improved international coordination. A central instrument for an environment ripe for investment is the improvement of the competitive road-rail conditions by pricing policy measures (internalising the external environmental and accident costs).

4. Research questions

The following questions for further consolidation crystallized out from the discussions at the expert workshop:

- **Consolidation of the innovation paths and analysis of the cost-benefit ratio:** central to this is the consolidation of paths 2 (innovative train coupling) and 3 (innovative train management systems). It is still not clear how interchangeable the various possible systems and technologies are with regard to **system-compatible development** (e.g. implementation of automatic freight trains, compatibility of different road freight systems with each other and with waggon loading transport; reference to demand).[4]

- Reference of the innovation paths to **demand**: how can the supply-oriented innovation paths formulated be matched to the future needs of demand? What are the cost-benefit paths for optimum allocation of investment? What concrete innovation paths or investment priorities can be derived for the future?

- **Implementation** and role sharing between private business and government. Assuming the analysed success factors for the implementation of innovations and the future needs of demand, what is the role or main focus for government? Central to

4 These subjects have also been taken up in the context of the EU Task Force Future Train under the title „The Modular Train" and „European Rail Transport Management System (ERTMS)" as subjects for research (cf. EU 1997).

this is the interface or investment priorities between infrastructure (financing by government) and rolling stock (financing by the private sector), particularly as regards the development of internationally compatible and centrally controlled systems.