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Synthesebericht

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INFRAS **Zertifiziert nach ISO 9001/14001**
Gerechtigkeitsgasse 20, Postfach, CH-8039 Zürich, Tel. +41 1 205 95 95, Fax +41 1 205 95 99, E-Mail zuerich@infras.ch
Mühlemattstrasse 45, CH-3007 Bern, Tel. +41 31 370 19 19, Fax +41 31 370 19 10, E-Mail bern@infras.ch

Summary

1. What is it all about?

The freight train has reached a turning point. It has to re-position itself in a changed environment (new logistic structure and liberalisation). At the same time, the road freight sector has significantly increased its productivity (through the increase in weight limits and the use of telematics) and has also improved its eco-efficiency (mainly air pollutant emissions). If the railway wants to consolidate its position on the freight market, it will also have to achieve a massive increase in productivity. The target variable is known as "Factor 4" (doubling of productivity and halving of environmental pollution).

This study investigates the medium-term innovation potential and illustrates how this can be implemented on the future freight market. The diffusion possibilities are illustrated using the SBB's individual waggon load freight system as an example.

2. Possibilities on the supply side

Innovative, technical concepts can improve both the ecological and the economic efficiency of the rail freight system. The following illustration shows a total of five different concepts.

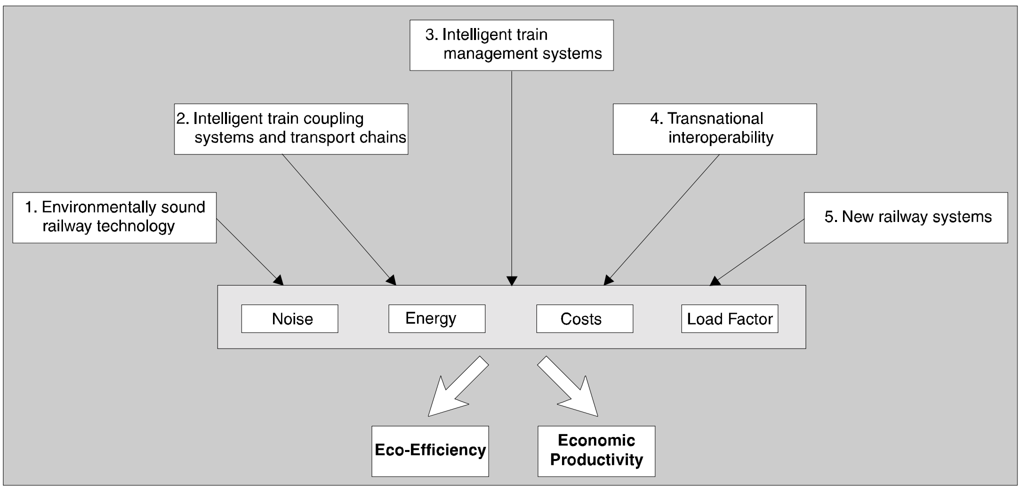

Figure S-1: The most important technical innovation paths for the rail freight system and their lines of influence at a glance

Information and communications systems are an integral component and, apart from improved networking of the carriers, also allow the efficient use of the existing infrastructure and improve the traffic flow through integrated information, control and monitoring systems. They also improve traffic safety and can help to replace physical traffic by data flows and thereby reduce environmental pollution at the same time. The focal points are the transnational standardisation of train management and safety systems, improved data exchange between customer and logistics supplier and also the automation of rail freight.

In principle, it can be said that the technical expertise available today and also the concepts that have been developed do not constitute a bottleneck in themselves. Instead, the problem lies in implementing these innovations to suit the market and also the system. Individual innovations, on the other hand, which can be implemented as isolated solutions, independently of integral system aspects, have it easier, but then the cost-cutting potential cannot really be utilised because of the small production series involved.

3. Market requirements

The future freight market will be moulded by three main factors:

- **Increasing work sharing in Europe and throughout the world:** attractive international transport options will become increasingly important.
- **Freight structure:** bulk goods are becoming less important. New, high value goods demand complex forms of transport ('Supply Chain Management', 'E-Commerce').
- **Logistics:** the logistic processes are becoming more complex. Individual logistic requirements demand tailor-made forms of transport.

These factors are changing the demands on the transport market. Apart from an attractive price, flexibility, reliability, speed and frequency, not to mention service quality, safety and last but not least, a good customer relationship, also play a central role. Compared with these, environmental compatibility is not really an issue for many carriers.

For the railways, it means that market segmenting plays a very critical role. At the same time, it needs to re-think its strategic role (vertical and horizontal integration in the transport market). The following illustration compares the strategic lines of impact with the corresponding market dimensions and the possible innovations on the supply side.

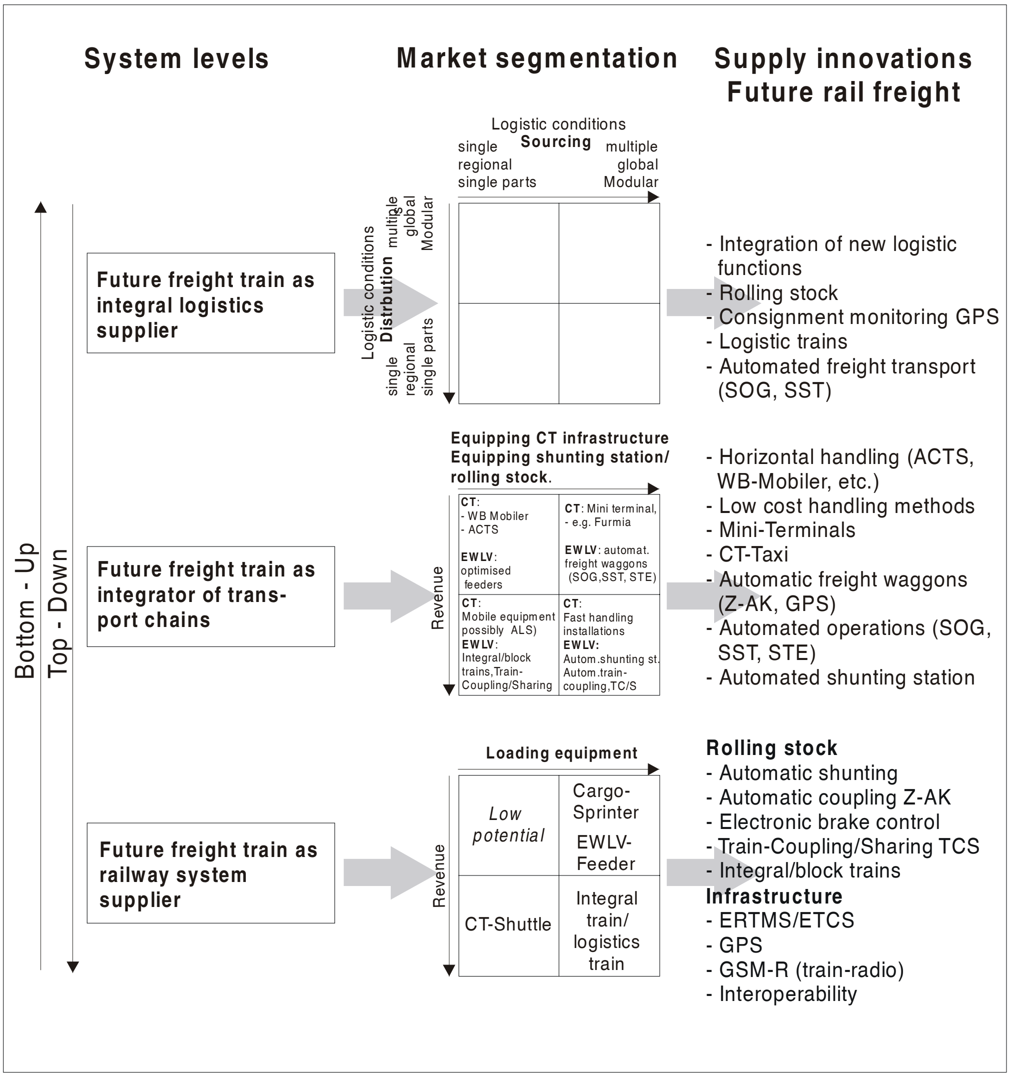

Figure S-2: System levels, market segmenting and corresponding supply innovations of future rail freight.

4. Investment strategies

If we look at the present strategies of the railways, we see that investments are principally directed at three areas:

- improving market presence through more intensive marketing, customer liaison, branch solutions, quality centres, etc.
- expanding the market area through strategic alliances combined with improvements in transborder traffic,
- vertical integration through building up additional services (in the forwarding area, loco pools, etc.).

Technical innovations, on the other hand, tend to be implemented in niche markets. These centre on improved technologies in combined transport. Therefore, these technical products are mainly successful if they are associated with small investments and are able consistently to reduce production costs while improving service quality at the same time. It can be concluded from this that today, purely ecologically motivated products are finding it hard to establish their position on the market. This statement also reflects the fact that the rail freight market in Switzerland, and in Europe too for that matter, is not a lucrative market - with the exception of a few 'cherries' - and its prospects are not likely to improve in the future, either.

Since the market (carriers and forwarding agents) determines which technology establishes itself, and with what degree of success, technical innovations at the interface between supply and demand are the fulcrum points of a promising investment strategy. Information and communications technologies are important here.

However, the development of intelligent rolling stock is another focal factor of improved train management. The components of the **intelligent goods waggon** are, for example, automatic train coupling, automatic waggon recognition, electronic brake interrogation and brake control and also self-propulsion. Another concept is based on the **modular construction of the goods waggon** which, on the one hand, allows the **standardisation of the chassis** (including the afore-mentioned components of the intelligent goods waggon) to improve train coupling and, on the other, and depending on the transport requirement, **specific bodies** (e.g. combined transport containers, tankers, bodies for transporting bulk goods). When the freight waggon park is renewed in favour of intelligent freight waggons, or 'modular freight train', ecological synergies can also be utilised by using new, quiet brake systems, e.g. those with plastic/composite brake blocks (without additional cost compared with refurbishing the existing waggon park).

The biggest obstacle when improving international rail freight traffic is the lack of harmonisation at technical level (inter-operability). In particular, the very heterogenous situation of the train management and safety systems at the moment does not allow efficient and customised transborder train services. The development and implementation of **modern, standard train management systems with driver's cab signal**, like the ETCS project currently running at UIC level, are also important. However, the introduction of such systems involves major investment and long implementation times. However, since this means that the capacity of the existing network can be increased and passenger safety can be significantly improved at the same time, this investment is also offset by the benefits it brings.

The following investment strategies can be derived from this. The sequence is chronological:

1. **Market strategy with present IT and communications:** marketing is the priority investment with the present IT and communications facilities. Demand will be maximised with the existing production systems and resources by targeted customer liaison.

2. **Market strategy with modern IT and communications:** compared with strategy 1, specific investments will be made in modern IT and communications systems and the marketing efforts will be further strengthened as a result.

3. **Production strategy "software":** with intelligent management systems, productivity will be increased in particular and new train coupling forms will be offered that guarantee better transport quality (especially greater reliability).

4. **Production strategy "hardware":** in this case, major investments are made in the infrastructure, e.g. the introduction of ETCS (European Train Control System), highly productive handling installations, 'modular freight train'.

5. Case study EWLV-CH (full load traffic) in Switzerland

Today, full load traffic in Switzerland transports 16.3 million tons in inland traffic and 10. 4 millions in import/export traffic. Building materials and oil products are the most important and make up approximately two thirds of the tonnage. In inland traffic, 78% of the tonnage is transported over distances of less than 150 km; in import/export traffic, only 30% is transported for less than 150 km.

Developments in rail freight in the last few years reveal declining income and stagnating tonnage. In the period 1993 - 1998, the income per ton or per thousand km dropped by 25%. This trend also reflects the competitive pressure generated by the road sector and also the general income and margin erosion suffered by the freight industry as a whole, not least the road freight industry itself. However, there was a definite increase in volume in 1999, which might indicate that things are about to change. Nevertheless, the income per ton transported stagnated at the level of previous years.

The shunting and feeding of trains together make up 50% of the total costs. In the case of feeding, this percentage may be even higher, depending on the area.

In order to be ale to evaluate future innovations in waggon load traffic, we investigated four optimisation paths.

Optimisation paths	Optimisation concept	System organisation	Technology standard	Market interface
1 **Optimisation of actual status of EWLV-CH with present state of the art**	top down	central, 1 system manager	Low Tech	supply-driven
2 **Superimposing CT train system on the present EWLV* system**	bottom up	central, 1 player	Low Tech - High Tech (for CT service)	partly demand-driven
3 **Centrally organised high-tech shunting system**	top down	central, 1 player	High Tech	supply-driven
4 **Decentral, market-driven system with several players**	bottom up	decentral, several players	Low Tech - High Tech	demand and supply-driven

* EWLV = full load traffic

Table S-1: Overview of the four optimisation paths of the EWLV-CH case study

The analysis of the effects and evaluation according to different criteria (investment risk, market potential, economics, ecology, safety) produces the following overall assessment:

Initial experience with the rail reform has shown that at the moment, there are no alternatives to the previous integrated and newly privatised railways for system transport. Today, competition only exists in comparatively simple production systems (integral trains, CT shuttles). Therefore, we cannot rely on quantum leaps in productivity in the individual waggon load sector brought about by the pressures of competition.

Therefore, the two optimisation paths, 'optimised actual status' and 'CT train system imposed on actual status' appear to be the only viable way forward in the short term. Various efforts of the SBB, and of other European railways, are already being aimed in this direction. Without an essential system change, or technological quantum leaps, the costs of the existing system will be optimised on the one hand, and adapted more consistently to customer demands on the other. This will minimise investment risks and make intelligent use of the system margins still available. In principle, both optimisation paths can be implemented in parallel and lead to profitable services in the short term.

In view of the present market situation, associated with high cost pressure, "future investments" in an automated rail system are not really realistic at the moment, for the following reasons:

1. In view of the national and international integrating of system transport, the benefits will only become effective in the long term. However, at the moment, the newly privatised railways are mainly concerned with achieving a short-term improvement in profitability.

2. The investment risk associated with automation cannot be borne by the existing, integrated railways alone.

An automation strategy will only be possible in the short term if suitable, independent systems can be formed in which the benefit of a technological quantum leap can lead directly to a definite improvement in productivity in the short term. At the same time, a scenario with different isolated solutions (e.g. for automatic train coupling systems or consignment monitoring systems) is not exactly desirable either, for then, the volume would not be adequate for the mass production of rolling stock and therefore there would be no low product costs for the new technologies. Consequently, the international standardisation authorities (principally UIC), which have to drive forward the specification and standardisation of new automation technologies, are required to allow the railways pilot measures in the form of isolated solutions. Otherwise, there is a risk that the "pioneers" will not be able progressively to develop their automated isolated systems into an integral system, because international compatibility does not exist through the lack of pan European standards.

A basic EWLV (full load traffic) system change, associated with the elimination of the present production structure and the re-organisation of a decentral system based on largely automated freight waggons with self-propulsion and control is equally difficult to implement, at least in the Swiss context. Apart from the safety aspects, the lack of a realistic implementation path in particular is a main obstacle. There is also the loss of the most important system advantages of rail freight, i.e. the combining of transport flows. A decentral system based on individual waggons could not really make optimum use of the sparse capacity in combined transport as it is and could therefore only be implemented on secondary sections that are not used as intensively. For transporting via the main lines and for the fine distribution within the conurbations, and with the existing conflicts between long distance passenger transport, regional and freight transport, this kind of production concept is hardly practical, or the existing production concept (short distance and long distance freight trains) would have to be continued in parallel.

6 Conclusions

Optimum investment is needed

The project is based on the theory that rail freight can be modernised so that productivity can be doubled and the effect on the environment halved. However, a differentiated response has to be made to this theory:

- A Factor 4 railway can only be achieved if a customer-driven strategy is given topmost priority. The key question that arises is, can the railways capitalise on their strengths if they combine their transports and operate over longer distances. Also, the bigger the system, the greater the economies of scale and economies of scope. But, the bigger the system, the greater also the risk of a cumbersome and inflexible approach to satisfying the new customer demands. A Factor 4 railway can only be achieved if this gordian knot can be cut.

- The Factor 4 railway is possible and can be achieved within a reasonable period if the railway players make the best possible use of their short-term optimisation latitude and progressively modernise the production system. Organisational and software investments play an important role here; at the moment at least, hardware investments come second. Nevertheless, in the longer term perspective, the transition is important. The short term view of the strategic investments of the railways observed at the moment and the long term modernisation of the infrastructure (Rail 2000, NEAT) lacks the central pillar (system and rolling stock investments). In a less attractive market and with an obsolete production system, the optimum investment times are quickly missed.
- The analyses have clearly shown that a top down strategy, a central re-engineering combined with the high-tech modernisation of the railways, does not make much sense at the moment. The investment risks are too great and the foreseeable benefit is too small. On the other hand, it is equally clear that a concentration on the central transport routes and the abandoning of the feeder traffic (withdrawal from this sector) is also associated with considerable risks, because there are hardly any other players in the short term who could play this important role in the overall system and could operate this important backbone of the freight transport system on an integral basis. The latter applies to Switzerland in particular, with its high sidings density and high level of cover.

Therefore, an optimum strategy has to take the middle path. The principal requirement is not simply to funnel investments into cost-saving production systems, but into marketable production systems. An important difference lies in the flexibility of the system, which can react to the changing demands.

The following table summarises the most important activities according to the player:

<table>
<tr><th>Player</th><th></th><th>Main investments</th></tr>
<tr><td rowspan="3">Rail-
ways</td><td>National railways</td><td>Most important measures: mergers, alliances for:
- Demand side improvement (improved service quality)
- Improved transnational interoperability
- Achieving scale effects
Software investments:
- Market strategy, customer service (service (call) centres)
- Branch solutions
- Forming segmented backbones
Hardware investments:
- modern train management and safety systems
- modern, internationally operable rolling stock (mainly multi-system locomotives)
- investments in new modular rolling stock</td></tr>
<tr><td>Small transport companies</td><td>Main investments:
Optimum market service through proximity to customer
Cost effective feeder systems (close to market)
Branch solutions
Targeting niche markets</td></tr>
<tr><td>Works railways</td><td>Main investments:
Branch solutions
Targeting niche markets
Cost-effective feeder systems</td></tr>
<tr><td colspan="2">CT operators</td><td>Most important measures
Mergers, alliances to improve transnational interoperability
Using the competitive situation on the railway market by outsourcing traction services
Keeping traction in-house</td></tr>
<tr><td colspan="2">Terminal operators</td><td>Main investments:
Modern handling methods to cover the various requirements of the customer. Particular attention to compatibility with the different types of container (see KLV-CH problems)
'Soft Measures': Create customer and supplier friendly conditions (opening hours, freight handling, information on delays and other transport problems)</td></tr>
</table>

Infrastructure operators	**Most important measures** • Reducing current costs • Guaranteeing non-discriminatory network access **Main investments** • Modernising the train management and safety systems (ETCS) to increase operating safety (passenger transport) and capacity (passenger and freight) **Questions still to be answered** • Degree of vertical integration of the infrastructure operator into the national railway business (interfaces between infrastructure and traffic)
Carriers	**The most important measures** • Work sharing with rail feeders **Main investments** • Possibly modern equipment ('Modular Freight Train')
Forwarding agents	**Most important measures**: • Supply of customer-specific branch solutions
Manufacturers/industry	**Main investments** • R+D in 'modern equipment' ('Modular Freight Train') with the aim of offering modern rolling stock in the largest possible numbers but nevertheless adapted to the diverse needs of the customer at competitive prices. Important preconditions in this respect are: - standardised interfaces (coupling, brakes, transfer of information - modular design of the individual components - Separation of body and chassis • Traction equipment: development of multi-system capable locomotives • IT and communications: standard components for the pan European economic introduction of ETCS
UIC	**The most important measures:** • fast standardisation of new technologies in order to: - Give pioneers security regarding the future capability of the new technologies ("no one invests in a technology where compatibility problems in the international rail system are probable in the long term"). - Give industry clear guidelines for the design and development of new technologies

Table S-2: Summary overview: measures and main investments needed for future proof rail freight system according to the different players.

Further development of the rail reform

At the heart of the matter is the need to create a positive climate for investments in the present and future competitive environment. Only those who can develop new business on the market and have commensurate profit expectations will also accept the relevant investment risk. This applies both to the major railways and potential newcomers. This has been the main problem so far. Now that the economic climate is improving and the transport policy is clearer - particularly in Switzerland - the investment climate has taken a turn for the better. We now need to build on this.

The following table summarises the most important measures:

EU	• Directive to implement the rail reform (network access, line price systems) • Implement cost truth in the road freight sector • Support R+D in future technologies and innovative services
Government	• In the transitional period (LSVA, abolition of the 28 ton limit) and the associated uncertainty on the road, create incentives for system change • Ensure non-discriminatory network access • Temporary line price subsidies to increase the price latitude of the railways and achieve profits. • Targeted refunding of combined transport services as a form of incentive.
Cantons	• no blanket subsidies, no siding subsidies, but: • Project subsidies: with provable transfer potential (road -> rail), e.g. reloading stations, but also sidings. In Switzerland, the implementation of inland combined transport takes priority.

Table S-3: Areas where the government bodies need to act to create a favourable investment climate.

Improving the environmental compatibility of the railways

As has been mentioned several times, the environmental compatibility of the railways is being improved through more productive services, by operating a certain tonnage with less use of resources. An economically sound railway system will also embrace the environment in the longer term. At the same, time, it has become clear that new waggons (as part of the investment cycle) will have to be increasingly less polluting, particularly with regard to noise. The necessary corner posts have already been driven in by the Swiss noise abatement programme for rail traffic. However, improving the environmental compatibility of the railway still has to take into account other conditions:

- Emissions regulations for diesel vehicles on the railway in order to reduce the harmful diesel particles as quickly as possible. This would also create potential for the feeder traffic.
- Condensing of the infrastructure towards the inside: it must be possible to develop the combined transport potential on the basis of the existing infrastructure as much as possible. This requires optimum use of terminal capacity, if necessary supplemented by mini terminals at sidings in bigger industrial areas.
- Eco current strategy of the railways: the track current mix plays a relatively important role for environmental compatibility in operation. A power purchase policy focused on renewable energies and also associated energy measures (energy taxes, labelling) are the main pillars of such a strategy.

Conclusion

In view of the climate, no revolution in rail freight is to be expected. Instead, we are looking at the gradual evolving of an optimum development. This study has shown that the potential is there. However, the main thing is that the present national state railways become conscious of their role as the principal players. The transformation process in the direction of a future rail freight system not only has an economic, technical and operational component but also a (time-consuming) cultural component, too.