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Innovations as an Option to Increase the Market Share of Rail Freight Transport in Europe

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Abstract

Successful market adoption of rail freight transport innovations that might offer opportunities for market share increase is the focus of this paper. Firstly, seen from a theoretical point of view, it is not incremental innovations but radical organizational and transformation innovations that are likely to increase the market share of rail freight transport. Secondly, the particular inovations that offer some success potential for market adoption are: dedicated infrastructure, the fixed timetable, locomotive upgrades, and INTERFACE. Thirdly, unfortunately, the opportunities to increase the market share of rail freight transport appear to be limited.

keywords : *Rail freight transport, Innovations, Market share, Modal shift*

1. Introduction

In Europe, the road transport sector is important measured in terms of the volume of transported goods. Whereas road transport in the period 1985~1995 grew by 163 percent (tonkm), rail freight transport only increased by 20 percent (European Commission, 2001). A number of reasons are cited for the diminishing attractiveness of rail: incompatible forms of train electrification, differing track gauges, 'closed' national systems, low quality, decreasing networks, and lengthy border checks, to name but a few. In a recent report, the European Commission found that the average speed of international freight services has fallen to 18 kilometers per hour: 'slower than an ice-breaker opening up a shipping route through the Baltic Sea' (European Commission, 2001). This lack of integration reduces the rail operators' chances of offering fast, reliable and efficient international services. However, increasing freight volumes in major seaports in Europe can generate scale economies to operate (intermodal) rail transport cost effectively to numerous destinations with high frequency (van Klink and van den Berg, 1998). Woodburn (2006) has identified the non-bulk rail freight market as having considerable growth potential. Especially intermodal services and less-than-train-load services (LTL) are important in achieving an expanded role for rail freight transport. Furthermore, theory indicates that innovative bundling models and new-generation terminals might attract small flows into the intermodal transport system (Trip and Bontekoning, 2002). This suggests that completely new markets might have to be developed in order to increase the market share of rail freight transport. Therefore, in this paper, the focus is on rail freight transport innovations that might offer opportunities for market share increase. But, innovations that focus on more traditional markets are also included, because winning more business from existing customers is also important. Whereby an innovation is defined as 'a historic and irreversible change in the way of doing things' and 'creative destruction' (Schumpeter, 1947). The research question addressed in this paper is as follows: *Which innovations might be implemented successfully and offer opportunities to increase the market share of rail freight transport?* To answer this question, innovation management theory that evolves into a theoretical framework and rail freight transport innovations are analyzed in section two. In section three, the potential success of innovations will be evaluated and the potential for increasing the market share of rail transport will be analyzed. Section four ends with the conclusions and their geographical implications.

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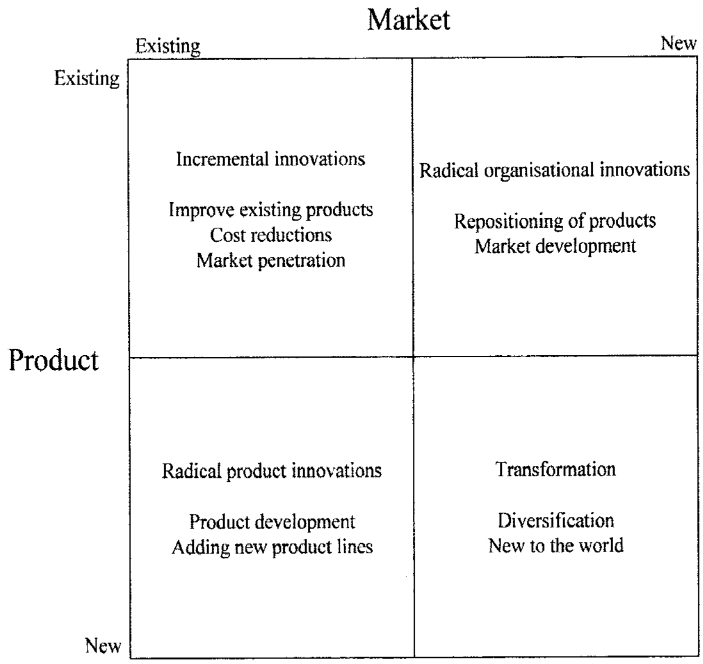


Sources: based on Ansoff and McDonnell, 1990, and Tidd et al., 2001.

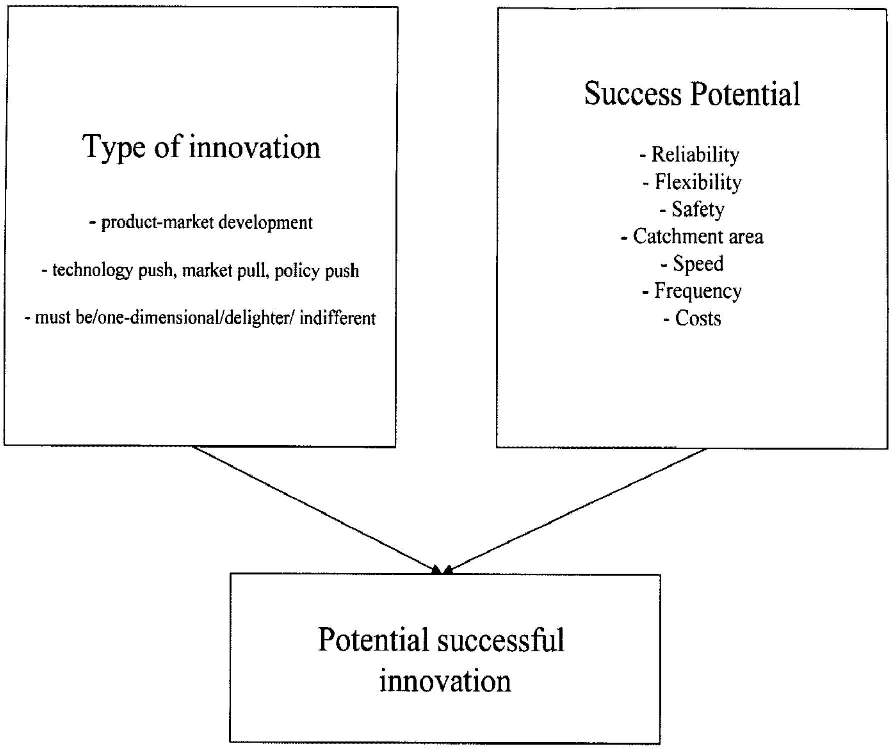
Fig. 1 Product-market Combinations and Corresponding Innovations

2. Innovation Management Theory

2.1 Innovations, Management and Theory

In recent years, the main drivers for innovations in rail freight transport have been cost-effectiveness and efficiency. Porter (1980) distinguishes four ways to build market leadership: i) cost leadership (low costs, broad focus); ii) cost focus (low costs, narrow focus); iii) differentiation focus (high costs, narrow focus); iv) differentiation (high costs, broad focus). According to Ansoff (1958) there are two innovative ways to generate more sales: product differentiation, and market differentiation. For any sector, it is important to have a portfolio of innovations in order to be able to build on strengths, realize opportunities, and counter weaknesses and threats (Wiegmans, 2005). This portfolio should ideally contain elements of product and market development, market penetration and diversification. These product-market combinations can be connected to innovation classes. *Incremental innovations* aim to gain more purchases from existing customers, to capture customers from competitors, and to win non-users. The company tries to maintain or increase its share of the current market with current products. Product modifications and increased quality levels can characterize radical product innovations. *Radical organizational innovations* can be characterized by new distribution channels, new geographical areas, different package sizes, differential-pricing policies, and new market segments. *Transformation innovations* result in completely new products for entirely new markets (see Fig. 1).

In order to build and maintain market leadership and/or to generate more sales, innovations are required. Schumpeter (1947) described innovation as 'a historic and irreversible change in the way of doing things' and 'creative destruction'. In general, innovations require technological, organizational, social, cultural and/or institutional changes to enable them to be successful in a certain market. The innovation is successful if it achieves what it was intended to achieve (adoption in a certain market). Another way to classify innovations is to make a distinction between product and process innovation. *Product innovation* refers to a change in the product (or service) that an organization offers. *Process innovation* refers to a change in the way the product (or service) is delivered. Abernathy and Clarke (1985) group innovations into four categories (radical, architectural, incremental, and modular), depending on the impact of the innovation on the innovating firm's capabilities and knowledge of its technology or market. In this paper, the focus is on potential successful innovations on the rail freight transport market and not on the firm. Henderson and Clarke (1990) classified innovations according to whether the innovation overturned existing knowledge of core concepts and the linkages between them (e.g. the introduction of ERTMS/ECTS). However, to date, the information on innovations in the rail freight transport industry has been too limited to make this classification. Tushman and Anderson (1986) make a distinction between 'competence destroying' or 'competence enhancing', de-



Sources: based on Ansoff and McDonell; Berger et al., 1993; 1990; Konings, 1996; Konings and Kreutzberger, 2001; Tidd et al., 2001; Tsamboulas and Dimitropoulos, 1999; van Wee, 2003, and Wiegmans, 2003.

Fig. 2 The Theoretical Framework

pending on what the innovation did to the knowledge base of the innovation entity. For this article that point of view could be interesting, but the information on the innovations is too limited to be able to make this distinction. Van Wee (2003) distinguishes – among other things – between technology push (driven by companies), market pull (driven by market requirements), and policy push (driven by governments). One or more of these powers determine the market potential of innovations. Another distinction in innovations concerns the degree of novelty involved (Tidd et al., 2001). The degree of novelty runs from minor changes (incremental) through to radical changes that transform the way we think about and use the innovation. However, this classification has much in common with the classification of new product-market combinations and is therefore not further explored. Afuah and Bahram (1995) combined the type of innovation with the impact of innovations on different actors. According to Berger et al., (1993), there are four types of customer demands, concerning the properties of a (new) product/service. The first group concerns those properties which a product must have before a potential customer will consider it. These are called 'must be's'. Customer expectations about the quality of these demands are high. The satisfaction of customers with these 'must be's' will diminish if expectations are not met. The second type of demands are the 'one dimensionals'. These are product properties that enable comparison between products (Tidd et al., 2001). User satisfaction increases with the functionality of the product (Berger et al., 1993). The third category is the 'delighters'. Those are properties that are not specifically asked for, but can persuade the customer to use the product (Tidd et al., 2001). These characteristics do not negatively influence the quality of the product. If these characteristics occur, then, the product is assessed positively. The fourth category is the 'indifferents'. The quality judgment of customers concerning a product is not influenced by the (absence of) 'indifferents'. See the left part of Fig. 2 for an overview of the innovation classifications that are included in the theoretical model.

2.2 Market Adoption and Success Characteristics

In this research, the success characteristics are based on literature study. Rail freight transport quality criteria are used to assess the potential success (market adoption and potential to increase the market share of rail freight) of the innovations. Several quality criteria have been found in

Table 1. Importance and Score of Intermodal Rail Freight Quality Aspects

Quality aspect	Importance	Score
Reliability	18.9	2.6
Flexibility	8.5	2.1
Safety	6.5	3.7
Catchment area	4.9	3.1
Speed	8.9	1.9
Frequency	9.4	2.2
Costs	17.3	2.2
Total quality	8.4	2.7

Importance: the respondents were asked to divide 90 points between the quality aspects.
Score: 1=bad; 2=moderate; 3=neutral; 4=reasonable; 5=good.
Source: Langstraat, 2005.

rail freight and terminal research (Konings, 1996; Konings and Kreutzberger 2001; and, Wiegmans, 2001): reliability, flexibility, safety, speed, frequency and costs. The nodal center's size, catchment area, and the level of political support for the investment have been identified as the main decisive factors for choosing the appraisal method and decision criteria for investments in rail terminals (Tsamboulas and Dimitropoulos, 1999). In a recent study, important success characteristics have been found for intermodal rail freight transport (see Table 1).

From the research it follows that the most important drivers for choosing intermodal rail freight transport are costs and quality (Wiegmans, 2007). Other aspects that determine this choice are flexibility, speed and frequency. Relatively less important are safety and capacity. The least important aspect is catchment area. Table 1 shows that the two most important quality aspects of intermodal rail freight transport score between moderate and neutral, whereas the best scores are given to aspects that are relatively less important (safety and catchment area). Overall, the study underlines the importance of characteristics found for rail freight transport in general.

For this present research, the criteria (reliability, flexibility, safety, catchment area, speed, frequency, and costs) that follow from rail freight and terminal research have been selected to analyze potential successful innovations. *Reliability* is the degree to which the rail freight transport service meets the agreed service time. *Flexibility* is the degree to which a rail freight transport (or shipping/intermediary) company is capable of solving problems for customers when they arise. *Safety* refers to the possibility that transport units might be damaged (or lost) during transport. The *catchment area* refers to the average distance to and from

Annex 1. Overview of Characteristics of Rail Freight Innovations

Innovation	Initiator	Rail freight operator	Goal(s)	Short description
1. Infrastructure				
Betuweroute	Dutch government	n.a.	use infrastructure exclusively for rail freight	Dedicated freight infrastructure is currently being built in the Netherlands (the Betuweline). This is one of the few initiatives to develop infrastructure exclusively for rail freight. The Betuweline is 160 kilometers long, is electrified by 25 kv, uses ERTMS/ETCS, and allows a maximum speed of 120 kilometers/hour. The Betuweline has cost 4.7 billion euros and has a maximum capacity of 10 trains/hour both ways. In 2007 it is expected that 1 dieseltrain/2 hours will use the Betuweline. But within two years it is expected that operations on the Betuweline approach 150 trains/day.
Voltage system	EU	n.a.	use locomotives efficiently, reduce costs, and improve quality	In Europe, harmonization of the voltage systems is under way. At present, several voltage systems (e.g. 1.5, 15 and 25 kv) are used in Europe, and this limits the efficient use of locomotives, because these must be changed at borders. Research efforts concentrate on harmonizing voltage systems in the EU
Marshalling yards investments	EU	EU	increase capacity and efficiency	If rail freight transport is planned to grow, investments in transhipment are needed. The optimization of wagonload traffic sometimes requires investments in marshalling yards. The expanded facilities will be more efficient and have a larger capacity (SBB, 2003). Several new concepts have been developed but seem difficult to be successfully implemented (Wiegmans et al., 2007).

Annex 1. Continued

Silent track	Southampton University, Volker Stevin, SNCF, Hyperlast, Edilon	n.a.	reduce noise	Silent Track was developed in partnership with the University of Southampton, SNCF, Hyperlast, Volker Stevin and Edilon. This innovative product has been developed to deliver perfor-mance benefits to railway operators and to meet European noise legislation. Silent Track is a noise reduction system utilizing sound absorbers applied on the web and upper part of the foot of rails. Its use avoids the need for costly construction of noise abatement walls (http://www.muchmorethanrail.com/en/design_and_innovation/innovation/rail_products/).
Cargo Domino	SBB	SBB	achieve higher average speed and network density	Cargo Domino is a concept whereby the rail freight transport company collects the swap-body from the customer and delivers it to the final customer. Advantages are higher average speed and network density. The core part of the system is an innovative transshipment device, which radically simplifies transshipment from truck to rail wagon. It can do without expensive terminals taking up so much space (SBB, 2003).
2. Rolling stock				
Locomotive upgrade	Railion, SBB	Railion, SBB	achieve efficient cross-border working	Several rail freight transport companies have implemented locomotive upgrades for cross-border working. The electric locomotives are internationally compatible and able to operate in different countries. Together with extensive staff training it is longer needed to change locomotives at national borders (SBB, 2003).
Trailers-on-train	Alpine countries	Alpine countries	enable standard trailers to be include	Trailers-on-train concepts (Rollende Landstrasse) are relatively important in the Alpine-countries. The combined rail transport might grow by enabling standard trailers to be included in the trailers-on- train concept. This requires changes to wagons and terminals. Cost indications range for wagons between €60.000 to €170.000 and the terminal investment varies between 30,000 up to 3,750,000 per terminal track (depending on the concept).
Automated freight transport	n.a.	n.a.	reduce labor costs, enables small trains	Automated rail freight transport is capable of running without an engine driver. This enables container wagons to run in small trains and the network to be used more flexibly.
Double stacked containers	EU	n.a.	increase efficiency	The introduction of trains able to transport double-stacked containers might give an important boost to the attractiveness of intermodal rail transport. This has been the case for instance in the United States. Since the mid-eighties when the number of double stack train services rapidly increased, the market share of intermodal rail transport has grown significantly. The double stack train appears to be more environmental friendly than the conventional train. Due to their lighter construction and doubled capacity a fuel cost saving of 40% per transported container, and consequently emission reductions, can be achieved in comparison with ordinary trains. The double stack train is typically meant for long distance transport (in the US above 800 km). Presently, only at long distances can the cost advantages resulting from double train capacity compensate the higher terminal costs. However, the existing infrastructure in Europe may be an important bottleneck for developing a double-stack train network (http://www.tbm.tudelft.nl/webstaf/jann/git5.htm).
Cargo Sprinter			transport limited number of containers	The Cargo Sprinter is a short train for the transport of a limited number of containers. It is also called a 'truck on rails'. Every train can carry up to 10 containers, and has own traction. This new freight train system is based on small trains, which can be easy coupled and split up. It leads to more but shorter trains and this may require additional energy use compared to traditional train systems. The concept enables the offering of a dense network. (http://www.tbm.tudelft.nl/webstaf/jann/git5.htm)

Annex 1. Continued

Renewing wagons	SNCF, Green Cargo, etc	SNCF, Green Cargo, etc	offer customers more quality	Several rail freight transport companies are renewing their fleet of freight wagons (e.g. the Modalohr wagon for the Trans-Alpine iron highway and the Shimms wagon). Prototypes of a new wagon designed for combined road-rail transport with a 25-tonne axle load were completed during the year. Twenty of these wagons were placed into service. The new wagons, which are lower and longer, can carry modular articulated vehicles with a length of up to 25.25 meters (SBB, 2003; SNCF 2001-2004).
Low noise break paths	n.a.	n.a.	reduce noise	Many new rail wagons are equipped with low-noise synthetic brake paths. This allows for noise reductions of around 10 decibels, which the human ear perceives as a reduction by half. (SBB, 2003).
Derailment detectors	n.a.	n.a.	reduce risks associated with dangerous goods	Derailment detectors are being fitted on freight wagons. In the service plants of the Swiss Federal Railways (SBB), the retro-fitting of 623 special wagons for mineral oil products with derailment detectors started. The aim is to reduce the risks associated with the transport of dangerous goods (SBB, 2001-2004; Ferrovie dello Stato, 2002-2004).
Common locomotive pool	SBB and Railion	SBB and Railion	increase efficiency	SBB and Railion have introduced a common locomotive pool for the axis Köln-Basel. The goal is to increase efficiency (SBB, 2003).
Bimodal railroad systems	n.a.	n.a.	save costs	In order to avoid vertical transshipment and thereby saving costs, different kinds of bimodal systems have been and are being developed for intermodal rail transport. In these systems trailers can relatively easy be coupled into trains using special rail cars. Since these rail cars are notas heavily constructed than conventional rail wagons for trailer transport, these bimodal trains can offer fuel consumption savings and therefore emission reductions. A disadvantage however is that often only adapted trailers are suited in these concepts. Probably for this reason these systems have been used on a moderate scale until now in mainly a few large countries (United States, Canada, Germany, France, Italy and Australia). Research efforts and experiments that are being undertaken regarding the optimization of these bimodal systems and roll-on/roll-off systems for intermodal rail transport (TERMINET, 1997) will probably give an impetus for the market expansion of these systems in future (http://www.tbm.tudelft.nl/webstaf/jann/git5.htm).
3. control and ICT-systems				
European Train Control System (ETCS)	EU	EU	improve safety and capacity	The European Train Control System (ETCS) is a European-wide train safety system. Relevant information is provided to the engine driver in the cabin instead of along the track. All signals along the track can be removed. The European Railway Traffic management system (ERTMS) is an extension of ETCS. ERTMS is a movement management system. It enables the optimization of the movement process, the infrastructure exploitation and the usage of locomotives and wagons.
Tracking and tracing	EU	EU	improve pre- and end-haulage	Tracking and tracing comes in several alternatives. One is the identification system for wagons and load units. The system ensures that the data relating to the cargo are already at the terminal before the train is actually there. The European Octopus project goes one step further; it gives shippers the opportunity to follow their cargo themselves (online).
radio control systems	n.a.	n.a.	optimize operations in the marshalling yards	Shunting locomotives will be utilizing remote radio control systems in order to optimize operations in the marshalling yards (SBB, 2003).

Annex 1. Continued

Online services	All	EU	improve service quality	Several rail transport companies are striving to enhance their online services by building Internet-based extranet networks. These operate alongside the EDI (electronic data interchange) systems. The target is that all consignment notes will be in electronic format (SBB, 2003).
4. Service				
Fast freight trains	Railion, TGV, EU	Railion, TGV	increase average speed	Fast freight trains have been introduced in order to increase the average speed of freight trains. Concepts that have been introduced are Parcel IC, TGV Postal, Overnight Express and the Fast Freight Train. The focus is on parcels and mail.
INTERFACE	EU	EU	reduce the waiting time at the border terminal	*INTERFACE* is a program targeted to reduce the waiting time at the border terminal. Waiting times can be reduced, but, at the same time, safety increases, regulations are harmonized, and opportunities exist for added services.
Long freight trains	ECS, SNCF, TU Delft	ECS, SNCF, TU Delft	partly accommodate the expected growth of rail freight transport	LIIIFT is a research project aimed at increasing the length of freight trains in Europe.
Fixed timetable	SBB	SBB	raise productivity, reduces waiting time	The SBB has introduced a fixed timetable for cargo transport on the north-south axes in Switzerland. This means that cargo no longer waits for a specific train number, but is transported in the first available train. The advantage of this system is that waiting for delayed cargo or trains is eliminated from the system. This raises the productivity of carriages, locomotives and wagons, and staff (SBB, 2003).
Rail feeding	Railfeeding (RSC Rotterdam)	Railfeeding (RSC Rotterdam)	increase terminal efficiency	Rail feeding is defined as outsourcing the pre- and end-haulage by rail (at the terminals) to another specialized company. This enables a more efficient usage of the locomotives and the staff of the rail freight transport companies.
Improving rail shuttles	n.a.	n.a.	increase speed and reliability	Train paths are optimized (e.g. Rotterdam to Switzerland) in order to eliminate bottlenecks and improve the rail freight product
Setram project	SNCF Fret	SNCF Fret	improve customer service	The Setram project consists of selecting and proposing solutions for organizing freight transport and logistic support (Ferrovie dello Stato, 2002-2004).
Agrologis	Trenitalia	Trenitalia	customer service	Agrologis is a project that focuses on improving intermodal rail freight for the agro-industry in Southern Italy (Ferrovie dello Stato, 2002-2004).
Wagonload	SBB	SBB	improve efficiency, reduce costs	The Wagonload services project was launched by SBB (in Switzerland) in connection with the changeover to a new timetable. By restructuring regional operations, it has been possible to achieve a significant reduction in costs (SBB, 2003).
Different services	SBB	SBB	improve sales	A rail freight transport company has introduced several different services. A division is made between 'cargo train flexi' (service with additional items and flexible) and 'cargo train fix' (service is fixed at a better price), (SBB, 2001-2004).
TERFF	EU	EU	promote competitive international rail and counter its long-term loss of market share	Freeways combine unitary route planning and management with the development of faster train paths offered by a single sales point and a range of complex commercial and legal issues are involved ((http://www.arup.com/rail/project.cfm?pageid=2166).).

Annex 1. Continued

5. Other				
Sister companies	SBB	SBB	improve international sales	Several European rail freight transport companies are building sister companies in neighboring countries (e.g. Swiss Rail Cargo Köln, Swiss Rail Cargo Italy). Besides building sister companies, also relatively small rail freight companies are acquired and cooperative agreements are agreed upon (SBB, 2003).
Team station	SBB	SBB	improve efficiency	SBB in Switzerland has also optimized the Team station concept. The number of stations has been reduced (from 120 to 43). The teams have been enlarged and now handle a greater catchment area (SBB, 2003).
Focus on core business	n.a.	n.a.	improve sales and results	Several rail freight transport companies focus more on their core businesses. One rail freight transport company has sold its cargo service centers (SBB, 2003).
Dedicated rail road locomotives	SNCF Fret	SNCF Fret	increase reliability and efficiency	In a restructuring plan, another rail freight transport company has allocated 120 locomotives to road-rail traffic only. The allocation of these locomotives to road-rail combined traffic provided a 90 to 95% punctuality rate for all domestic combined transport trains (SNCF, 2001-2004).
Trunk route management systems	SNCF Fret	SNCF Fret	increase efficiency	In a restructuring plan, five trunk route management systems have been implemented. The five principal trunk route managements - for Basle-Bettembourg, EPOC (Île-de-France hub for combined transport), North- East/Savoie, East/South-East and North/Atlantic - handle long-distance traffic. A quality gain of 6% was observed already in 2003 on the Basle-Bettembourg trunk (SNCF, 2001-2004).

the rail terminal. *Speed* refers to the average speed of a transport service from origin to destination. *Frequency* is the number of transport services to a certain destination that is offered per day (or week). By *costs* are meant the costs to purchase the rail freight transport service. See the right-hand box of fig. 2.

Several innovations in rail freight transport have been identified. These innovations were selected through Internet search, annual reports of the main rail freight transport companies, and literature study. For a complete overview see Annex 1. In the next section, the innovations will be evaluated.

3. Evaluation Of Potential Successful Innovations

In section two, theory concerning classifying innovations and success criteria has been used to build the theoretical model and the rail freight transport sector and its innovations have been described. In this section, the innovations that have been identified are evaluated to analyze to what extent these innovations may or may not be successful. Furthermore, possible contributions to an increase in the market share of rail freight transport in Europe are analyzed. For the analysis to be done, criteria are needed to compare the different innovations in rail transport and to divide between potentially successful and less successful innovations.

The methodology that has been used to distinguish between potentially successful and less successful innovations is Multi-Criteria Analysis (MCA). This approach enables a structured judgment of the effects of a certain scenario (or in this case an innovation) through a set of criteria. MCA enables (Panou and Sofianos, 2002):

- Evaluation/prioritization of the best alternative scenarios (by public or private project promoters) and justification of the final choice to supervising/financing authorities;
- Identification and structuring of project objectives and characteristics (by project designers) with the aim to define alternative scenarios which best fit the particularities of the project.

MCA can be regarded as a decision-making tool that helps to analyze and evaluate different innovations. Firstly, the standard approach for MCA is to depict all the effects of a certain innovation in a table. In the MCA approach, criteria can be both qualitative and quantitative. In this research, all criteria are qualitative, given the quite general characteristics of the innovations.

A second important aspect of MCA can be the weighing of the criteria. In general, the weighing can be based

Table 2. Product-Market Combinations and Rail Freight Innovations

Incremental innovation	**Radical organizational innovation**
ETCS (sy), locomotive upgrade (rs), dedicated infra (i), trailers-on-train (rs), automated transport (rs), INTERFACE (s), Cargo Domino (i), long trains (s), double-stack (rs), fixed time-table (s), tracking/ tracing (sy), voltage systems (i), rail feeding (s), rail-shuttles (s), Cargo sprinter (rs), Setram project (s), Agrologis project (s), wagonload (s), Team station (o), remote radio control (sy), terminal investment (i), new wagons (rs), noise reduction (rs), derailment (rs), core business (o), common locomotives (rs), road-rail only (o), trunk routes (o), TERFF (s), silent track (i).	sister companies (o), different service offerings (s), online services (sy).
Radical product innovations	**Transformation innovations**
fast freight trains (s).	bimodal rail-road systems (rs).

i=infrastructure; rs=rolling stock; sy=system; s=service; and o=other.
Source: based on Ansoff and McDonnell, 1990; CP, 2004; DB Cargo AG, 2002-2003; Deutsche Bahn, 2001; Green Cargo, 2001-2004, Nationale Maatschappij der Belgische Spoorwegen, 2001-2004, ÖBB, 2001-2004; Railion Deutschland AG, 2004; Renfe, 2003; SBB CFF FFS, 2001-2004; SJ Group, 2001; SNCF Fret 2001-2004; Tidd et al., 2001; VR Group, 2001-2004; www.alcatel.com.; www.arup.com; www.ertms.com; www.muchmorethanrail.com; www.prorail.nl; www.railcargo.nl; www.railfeeding.nl; www.ovnet.nl; and www.tbm.tudelft.nl.

Table 3. Push/pull and Rail Freight Innovations

Technology push	Market pull	Policy push
automated transport (rs), cargo sprinter (rs), bimodal rail-road systems (rs).	fast freight trains (s), locomotive upgrade (rs), Cargo Domino (i), fixed time-table (s), tracking/tracing (sy), voltage systems (i), rail feeding (s), rail-shuttles (s), Setram project (s), Agrologis project (s), sister companies (o), Wagonload (s), Team station (o), remote radio control (sy), terminal investment (i), new wagons (rs), different service offerings (s), core business (o), common locomotives (rs), road-rail only (o), trunk routes (o), TERFF (s), online services (sy).	ETCS (sy), dedicated infra (i), trailers-on-train (rs), INTERFACE (s), long trains (s), double-stack (rs), noise reduction (rs), derailment (rs), TERFF (s), silent track (i).

i=infrastructure; rs=rolling stock; sy=system; s=service; and o=other.
Sources: based on CP, 2004; DB Cargo AG, 2002-2003; Deutsche Bahn, 2001; Green Cargo, 2001-2004, Nationale Maatschappij der Belgische Spoorwegen, 2001-2004, ÖBB, 2001-2004; Railion Deutschland AG, 2004; Renfe, 2003; SBB CFF FFS, 2001-2004; SJ Group, 2001; SNCF Fret 2001-2004; Tidd et al., 2001; VR Group, 2001-2004; van Wee, 2003; www.alcatel.com.; www.arup.com; www.ertms.com; www.muchmorethanrail.com; www.ovnet.nl; www.prorail.nl; www.railcargo.nl; www.railfeeding.nl; www.tbm.tudelft.nl. and van Zuylen, 2000.

on the judgment of policy-makers, historical decisions or historical evaluations. In this article, the weighing of the criteria has not been performed, due to the fact that the information is too limited to do so.

A third important aspect of the MCA is the sensitivity analysis. This helps to determine the effects of different weights for different criteria and their impact on the order of the innovations. In the next section, MCA is used to evaluate the innovations.

In this section, the innovations are classified according to type of innovation. The theoretical model distinguishes between three different classes. Table 2 shows the distinction between product-market combinations. It shows that most innovations are incremental. This means winning more business from existing customers. In general, the market position of rail operators towards existing customers is quite good. It will be difficult to generate extra transport (sales) from existing customers and to increase the market share of rail freight transport. In contrast, radical organizational innovations and transformation innovations aim to increase the market share of rail freight transport. These type of innovations try to develop new market segments, to increase growth, and to win new customers for rail (like e.g. containers in the past).

In Table 3, the distinction between push (driven by developments from innovative companies or government regulation) and pull (driven by market requirements) innovations is less clear concerning the opportunities to increase the market for rail freight transport. All three categories contain innovations that offer opportunities to increase the market share of rail freight transport. For the sector this signals a nice balance between 'pushed' and

Table 4. Product-market Combinations and Rail Freight Innovations

Must be's A product/service must have	**One-dimensionals** Enable comparison between products	**Delighters** Not asked for, but can persuade	**Indifferents** Not requested, not needed
fast freight trains (s), locomotive upgrade (rs), voltage systems (i), railshuttles (s), Setram project (s), sister companies (o), new wagons (rs), TERFF (s), dedicated infra (i), INTERFACE (s).	different service offerings (s).	tracking/tracing (sy), Cargo Domino (i), fixed time-table (s), rail feeding (s), Agrologis project (s), Wagonload (s), Team station (o), remote radio control (sy), terminal investment (i), common locomotives (rs), core business (o), road-rail only (o), trunk routes (o), online services (sy), automated transport (rs), Cargo sprinter (rs), bimodal rail-road systems (rs), trailers-on-train (rs), long trains (s), doublestack (rs).	ETCS (sy), noise reduction (rs), derailment (rs), silent track (i).

i=infrastructure; rs=rolling stock; sy=system; s=service; and o=other.
Source: based on Berger et al., 1993; CP, 2004; DB Cargo AG, 2002-2003; Deutsche Bahn, 2001; Green Cargo, 2001-2004, Nationale Maatschappij der Belgische Spoorwegen, 2001-2004, ÖBB, 2001-2004; Railion Deutschland AG, 2004; Renfe, 2003; SBB CFF FFS, 2001-2004; SJ Group, 2001; SNCF Fret 2001-2004; VR Group, 2001-2004; www.alcatel.com.; www.arup.com; www.ertms.com; www.muchmorethanrail.com; www.prorail.nl; www.railcargo.nl; www.railfeeding.nl; www.ovnet.nl; and www.tbm.tudelft.nl.

'pulled' innovations. The Table further signals that many innovations try to meet market requirements ('pulled by the market'). Table 4 shows that it is particularly those innovations that improve the must be's (e.g costs, quality) that offer opportunities to increase the market share of rail freight transport. Furthermore, it can be observed that many innovations can be characterized as delighters that are not asked for but can persuade.

Seen from a theoretical point of view, radical organizational innovations and transformation innovations aim to increase the market share of rail freight transport, and therefore offer opportunities to increase the market share of rail freight transport. These types of innovations try to build new products in new markets, or try to sell existing products in new markets. These innovations might result in a market increase for rail freight transport. Innovations that focus on the 'must be' characteristics of the rail product seem to be connected most to current customers and current markets. Seen from a customer point of view, it is those innovations that focus on the delighter characteristics of the product/service that offer opportunities to increase the market share of rail freight transport. However, in practice, it proves difficult to implement and adopt such innovations successfully. And, moreover, notwithstanding these innovations, rail freight transport is still struggling to maintain its market share. Therefore, it is important to treat the innovations with great care. The innovations are not likely to change the market for rail freight transport dramatically, but might add some limited improvement to rail freight transport services offered and to customer satisfaction.

In this section, the author evaluates the innovations on the basis of Internet research, the scientific literature and information on the innovations. This evaluation has been performed with the central idea of 'potential successful innovations' in mind. This means that in the case of dedicated infrastructure, better reliability results in improved (+) potential success for that innovation (see Table 5 for an overview). The idea is that if the innovation improves the rail transport for its customers, the successful implementation and adoption of the innovation will be easier.

Innovations that appear to be the most potentially successful (resulting in the most improvements) are: dedicated infrastructure, the fixed time-table, locomotive upgrades, and INTERFACE. These innovations will bring the most change to product/services for rail freight customers. Other promising innovations appear to be Cargo Domino, the introduction of sister companies, online services, and TERFF.

4. Conclusions and Policy Implications

Potential successful innovations in rail freight transport have been the focus of this paper. The research question addressed in this paper was as follows: 'Which innovations might be implemented successfully and offer opportunities to increase the market share of rail freight transport?' Firstly, seen from a theoretical point of view, radical organizational innovations and transformation innovations aim to increase the market share of rail freight transport, and therefore might offer opportunities to

Table 5. Innovations and Score of Quality Aspects

Innovation	Reliability	Flexibility	Safety	Catchment area	Speed	Frequency	Costs	Total
Dedicated infra	+	+	=	+	+	+	=	5
Voltage systems	+	=	=	=	+	=	-	2
Terminal investment	=	=	=	=	=	=	=	0
Silent track	=	=	=	=	=	=	-	0
Cargo Domino	=	=	=	+	+	=	+	3
Locomotive upgrade	+	+	=	=	+	=	+	4
Trailers-on-train	=	-	=	=	=	=	-	0
Automated transport	+	=	=	=	+	=	=	2
Double-stack	=	=	=	=	=	-	+	1
Cargo sprinter	=	+	=	+	=	+	-	3
New wagons	=	=	+	=	=	=	+	2
Noise reduction	=	=	=	=	=	=	-	0
Derailment	=	=	+	=	=	=	-	1
Common locomotives	=	=	=	=	=	=	+	1
Bimodal	=	-	=	=	=	=	=	0
ETCS	=	=	+	=	=	=	-	1
Tracking/tracing	=	=	=	=	=	=	=	0
Remote radio control	=	=	=	=	=	=	=	0
Online services	+	+	=	=	=	=	+	3
Fast trains	+	=	=	=	+	=	-	2
INTERFACE	+	=	+	=	+	=	+	4
Long trains	=	=	=	=	=	-	+	1
Fixed time-table	+	+	=	+	+	=	+	5
Rail feeding	=	=	=	=	=	=	=	0
Rail-shuttles	+	=	=	=	+	=	=	1
Setram project	=	=	=	=	=	=	=	0
Agrologis project	=	=	=	=	=	=	=	0
Wagonload	=	=	=	=	=	=	+	1
Different services	=	=	=	=	=	=	=	0
TERFF	+	=	=	=	+	=	+	3
Sister companies	+	+	=	=	=	=	+	3
Team station	=	=	=	=	=	=	=	0
Core business	=	=	=	=	=	=	=	0
Road-rail only	=	=	=	=	=	=	+	1
Trunk routes	=	=	=	=	=	=	+	1

What improvement will the innovation make to products/services of current and potential rail freight transport customers?
+: improve; =: no effect; -: decrease.
i = infrastructure; rs = rolling stock; sy = system; s = service; and o = other.
Sources: based on Ansoff and McDonell, 1990; CP, 2004; DB Cargo AG, 2002-2003; Deutsche Bahn, 2001; Ferrovie dello Stato, 2002-2004; Green Cargo, 2001-2004; Konings,1996; Konings and Kreutzberger, 2001; Kreutzberger, 1997; Nationale Maatschappij der Belgische Spoorwegen, 2001-2004; ÖBB, 2001-2004; Railion Deutschland AG, 2004; Renfe, 2003; SBB CFF FFS, 2001-2004; SJ Group, 2001; SNCF, 2001-2004; VR Group, 2001-2004; Wiegmans, 2001; www.alcatel.com; www.arup.com; www.ertms.com; www.muchmorethanrail.com; www.ovnet.nl; www.prorail.nl; www.railcargo.nl; www.railfeeding.nl; and www.tbm.tudelft.nl.

increase the market share of rail freight transport. However, in practice, these innovations might require considerable changes that are difficult to realize. Especially in Switzerland, there are a considerable number of initiatives to improve rail freight transport. Seen from a customer-oriented point of view, innovations that improve the must be's characteristics of the rail product offer opportunities to increase the market share of rail freight transport. Many of these innovations have their origin on the EU-level.

Secondly, the most potential successful innovations might be: dedicated infrastructure, the fixed time-table, locomotive upgrades, and INTERFACE. These innovations bring the most change to the rail product. Other promising innovations appear to be Cargo Domino, the introduction of sister companies, online services, and TERFF. Dedicated infrastructure has been opened in the Netherlands and it is now to be seen how successful it will be. The fixed time-table has been implemented in Switzerland. It has improved the reliability and decreased the costs. Locomotive upgrades and INTERFACE both have to do with improvement of border crossings on the European level.

Thirdly, unfortunately, the opportunities to increase the market share of rail freight transport appear to be limited. The main part of the innovations – if introduced – will only result in small changes in the rail freight transport service. Therefore, it will be difficult to increase the market share of rail freight transport. The recent trend of diminishing market share for rail freight transport might have stopped, and even growth for rail freight transport might have been started again. But, the most promising innovations do not seem to be able to dramatically increase the market share of rail freight transport in the short-term future.

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