# The ViWaS Project: Future-proof Solutions For Wagonload Transport

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**Abstract**

Rail transports of single wagons or wagon groups are an indispensable part of the transport chain, such as for the forestry and the chemical industry. However, high production costs and low quality standards have led to a continuous decline in market shares in recent years. In order to counteract this tendency, ten European companies and research institutions, covering the areas of rail transport and logistics, have combined their forces in the scope of the research and development project ViWaS (Viable Wagonload Production Schemes). The goal: Innovative and simultaneously practical solutions for a sustainable wagonload transport. The applicability of these solutions and their effects have been proven with the aid of business cases in terms of field tests and pilot operations. The following main innovations have been achieved within the ViWaS project:

(1) Improved “last-mile“ operating concepts incorporating hybrid locomotives and bi-modal shunting engines (by Bentheimer Eisenbahn, Fret SNCF and SBB Cargo supported by HaCon and NEWOPERA): The new production method for last-mile delivery is based on the idea of separating train movements and sidings shunting processes by deploying bimodal road-rail tractors. Processes within the sidings have been simplified; as a result costs for equipment and staff could be reduced considerably.

(2) Modular wagon technologies for a flexible and efficient use of resources (by Wascosa and SBB Cargo): In detail, three components have been developed up to prototype status: Wascosa’s Flex Freight Car is a light container wagon with an accessible floor and thereby applicable for various transport purposes. The Timber Cassette 2.0 is a new superstructure for log wood transport that features foldable stanchions and can be used in combination with a container wagon. Additionally, SBB Cargo has developed the so-called Container Loading Adapter, another add-on to a container wagon. It facilitates container loading and unloading in sidings.

(3) Smart wagon telematics allowing improved tracking at reduced costs (by Eureka): A separate abstract “Smart Telematics Enabling Efficient Rail Transport“ (Code 711) has been submitted for WCRR 2016).

(4) A new simulation tool for planning and optimising single wagonload networks (by ETH Zürich): WagonSIM is an agent-based simulation tool for rail freight networks to facilitate the optimisation of SWL production schemes. It is based on the OpenSource software MatSIM. The tool models the routing of freight wagons according to the routes within the real SWL network. Therefore, the modelling of two network levels is required, the production network and the physical infrastructure.

The ViWaS project is co-financed by the European Commission in the scope of the Seventh Framework Programme.

## 1. Introduction

Between 2005 and 2010 the share of single wagonload (SWL) in Europe's rail freight transport performance dropped from 39 % to just 30 %, mainly due to low quality and unfavourable cost (related cuts in infrastructure). While there is a lack of internal competition, SWL faces strong competitors from outside (block trains, intermodal and road transport). In detail, the decrease of SWL market shares is supported by the following key factors:

- high fixed costs linked to infrastructure and operation of marshalling yards;
- insufficient SWL service profitability due to slow and expensive "last mile" operations, wagon handling and poor utilisation rates of resources, e.g. trains and wagons;
- insufficient SWL service quality and transport time compared to other transport modes, especially in competition with road
- negligible competition in the SWL segment because of heavy fixed costs, complex operations and the need for a minimum critical mass of traffic;
- loss of profitable markets/transports to intramodal competitors and production systems (wagonload block trains/intermodal services) and
- increasingly limited possibilities to cross-subsidise SWL from the profitable full trainload (FTL) business.

Nevertheless, SWL is important for several industries. In a bid to halt its deterioration, the Viable Wagonload Production Schemes (ViWaS) project has undertaken to breathe new life into the SWL market through improvements in cost efficiency, transport quality and sustainability. Ten European companies and research institutions from the areas of rail transport and logistics have joined forces in the frame of the Seventh Framework Programme (FP7) of the European Commission. The aim is to further develop SWL technologies and concepts, tested and proofed on the basis of real business cases, in order to

- streamline last-mile operations,
- improve flexibility and efficiency of equipment usage,
- raise transport quality and reliability,
- capture new markets.

In a final step, all developed solutions have been evaluated with regard to impact, applicability in regular operations and their potential application in a wider European scale.

## 2. Description – ViWaS Innovations

This article describes the ViWaS developments that are related to one of the following four innovation areas:

(1) "Last-mile" improvements;
(2) Modular wagon technologies;
(3) Smart wagon telematics;
(4) SWL simulation.

(1)"Last-mile" improvements

*"Last-Mile" operation method*

Generally, "last-mile" rail operations for the delivery and collection of rail wagons require a team of two people and a diesel locomotive. These operations include (1) the train run on the main tracks of the National Railway Network, (2) the train run on the secondary line to reach the entrance(s) of the private siding(s) and (3) the delivery of wagons to the private siding by a backing movement, if necessary. The wagon movements inside the siding as well as cargo transshipment are organised by

the private siding operator himself. All related “last-mile” processes together generally account for some 40-50% of the overall SWL transport costs.

To reduce this share in costs, Fret SNCF with the support of NEWOPERA have assessed possible improvements through separating train movements and shunting actions. For this purpose, bi-modal road/rail tractors were deployed to enable wagon delivery/collection and shunting operations independently from the line locomotive.

Within the project two process chains have been looked at in more detail: one with direct entrance in the private siding, the other with a reverse entrance. In each case the operation scheme is that the Railway Undertaking (RU) distribution train stops in front of each siding but does not shunt wagons, whereas the shipper’s road-rail shunting vehicle detaches the loaded wagons from the train that is stopped on the line, and attaches the empty ones (or vice versa). The driver of the RU train helps the bimodal vehicle driver to shunt (coupling, decoupling, switch...). When the shipper’s delivery is complete, the RU train moves towards the next siding by rail and the bimodal moves by road.

The theoretical economic analysis considered various elements impacting the efficiency. A methodology of analysis has been proposed to see where the solution could be effective. It appears that the global economies (for the distribution train service and the private siding operation) could be at the level of 10% for a single delivery, to 22% for a double delivery, suitable framework provided. In the French application case, overall economies of 35% were reached. After the positive cost-benefit evaluation, a trial in real-life conditions proofed the capabilities and advantages of the new method and the bi-modal shunting engines.

*Regional network of rail logistics centres*

Whereas the number of small rail sidings is continuously decreasing it becomes more and more important to develop capable rail freight bundling points that also serve rail freight customers without own rail siding. ViWaS partner and German regional railway operator Bentheimer Eisenbahn supported by HaCon has taken up this challenge with the further development of the “Railport” concept. The envisaged network of multifunctional rail logistics centres (RLC) facilitates the transshipment of a wide range of products. Additionally, the centres provide for further logistics services such as warehousing, pre- and end-haulage by truck or commissioning of goods.

The main improvement idea within ViWaS is to develop several rail logistics centres in close neighbourhood to each other so to enlarge the number of potential rail freight customers that can be reached in a distance of max 20-30 km (from a rail logistics centre and to bundle rail volumes from the different locations. Complementary improvement components are mainly related to three areas:

Efficient rail production schemes for long haul and “last mile” transport. In order to optimise the “last mile” by rail, the use of hybrid locomotives has been evaluated. The calculations show that the TRAXX F140 AC with last-mile functionality has a great cost advantage on mainly or fully electrified railway relations. In view of the specific framework conditions at Bentheimer Eisenbahn like route profile and speed limits, the last-mile locomotive shows the best efficiency in comparison with other traction configurations, analysed.

Extended logistics service profiles of rail logistics centres widen the range of potential customers. A very important issue is the introduction of SWL services into just-in-time or just-in-sequence supply chains. Bentheimer Eisenbahn developed corresponding logistics concepts for (1) steel panels, (2) intermediate bulk containers (IBC) and (3) big bags with salt products.

The previously listed logistics chains have been also used to improve transshipment processes and technologies within the rail logistics centre. Optimisation options include a better organisation of road-rail transshipment sequences (e.g. increasing share of direct transshipment between road and rail) or introduction of improved transshipment technologies (like fork lift trucks with high load capacity allowing “twin lifts”). Bentheimer Eisenbahn also developed a methodology to analyse and optimise related transshipment processes and technologies and derive decisions for necessary improvement

actions (e.g. exploitation of productivity by the help of a new forklift and reorganisation/extension of storage areas). Additionally, a concept that allows the flexible and multifunctional deployment of staff has been introduced. With a special training a dedicated team achieved the permission to perform shunting operations and thereby put another development idea into practice to make operations more flexible, free waiting times and increase productivity, which finally led to the possibility of increasing the frequency of services.

Altogether, the developments can serve as a blueprint for bundling points of conventional rail freight transport that need to be developed in a wide range to enable the viability of less-than trainload services in the long-term.

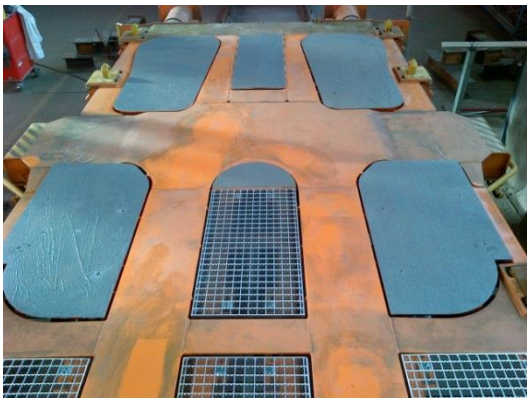
(2) Modular wagon technologies

*Flex Freight Car*

For container transports to customers' sidings SBB Cargo has been looking for a new cargo wagon. Today, SBB Cargo also uses the wagons to deliver sea containers from gateway terminals in Switzerland to customers' sidings. Although the wagons' dimensions suit the sidings platforms perfectly, there are some disadvantages. Due to the fact that the Ks wagons are not equipped with receptive points for containers, these have to be secured manually with increasing maintenance costs (use of wooden blocks).

Together with Wascosa and ETH Zurich, a solution for a new type of wagon that meets the requirements for loading and unloading containers in sidings was developed. The "Flex Freight Car" is based on a classic container wagon (code Sgnss). Compared to standard KS wagons the wagons' floor is filled in with modular iron grids so that it is possible to remove the different parts of the grid as they are not permanently connected to the chassis. The wagon can be used as a classic container wagon for terminal-terminal transports where no floor is needed or - after a few modifications - it can be used to distribute sea containers into sidings. To test the wagon under realistic conditions SBB Cargo deployed the wagon in defined sidings.

Figure 1: Wascosa Flex Freight Car (Source: Wascosa/ViWaS)

Timber Cassette 2.0

Conventional rail transports are generally operated with special wagons for specific types of cargo. Consequently, frequent empty runs reduce cost efficiency. Wascosa has therefore developed the flex freight system® to enable a multi-functional usage of container wagons. The system is based on two elements: a light 60ft container wagon and removable swap bodies for a wide variety of cargo. Subsequent to the first flex freight unit, a new timber cassette was designed to improve capacity utilisation. This advanced cassette - so-called "Timber Cassette 2.0" (Figure 2) - is stackable for empty runs in order to provide more loading capacity for container transport on the standard rail container wagon. Moreover, it has a reduced height of 2.5 m in order to comply with the limits of maximum allowed overall height for road transport in Europe.

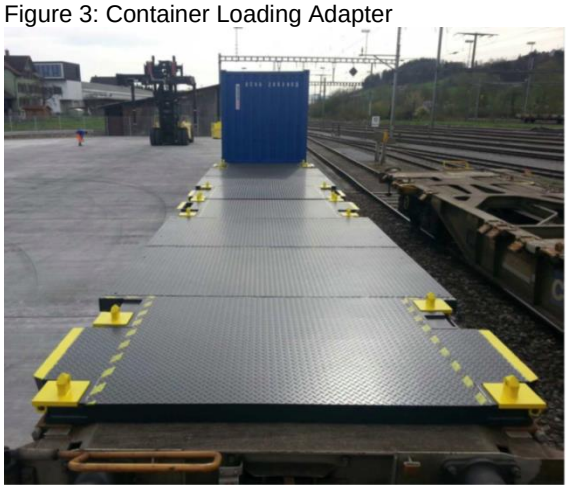
Figure 2: Timber Cassette 2.0 (Source: Wascosa/ViWaS)

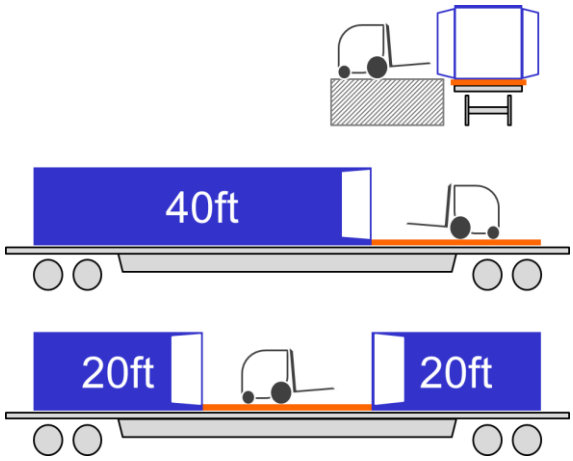
Container Loading Adapter

SBB Cargo developed a 60ft platform: The “Container Loading Adapter” consists of three separate 20ft modules, which together can be put on every standard Sgns or Sgnss container wagon. This platform guarantees also a stable surface to load and unload the containers with forklifts, as shown in Figure 3.

In comparison to the Flex Freight Car, the design of the platform offers some advantages in terms of width and height. To increase usability, the platform was designed with the standard floor dimensions of a 20-foot container. It is mounted on the wagon in the import/export terminal together with the SWL container. In addition to securing the SWL container to the wagon, the platform helps overcome the difference in height between ramp and wagon as well as ramp and container at the end of the customer’s siding. The platform guarantees a totally flat, passable surface on the wagon and is mountable on standard Sgns-container wagons.

Figure 3: Container Loading Adapter






The Container Loading Adapter as well as the Flex Freight Car are used by SBB Cargo within the “Swiss Split 2” business case aiming at the broadening of the traditional scope of SWL transports by integrating intermodal solutions. “Swiss Split 2” focusses on the delivery of maritime containers to sidings. The critical mass for a viable SWL system and its efficiency were improved. The new equipment helps considerably to realise cost efficient transports and meet the customers’ needs.

(3) Smart wagon telematics

In the scope of ViWaS, the general need for single wagon monitoring and specific requirements for data visualisation to the stakeholders of railway transports has been specified. As a result of the project work, the aJourOnline telematics IT platform concept has been developed by project partner Eureka Navigation Solutions AG. It is an interface service that ensures a direct data supply to railway lead contractors, railway sub-contractors, service departments and shippers. Eureka used the

experiences gathered during the ViWaS project to adapt the aJourOnline platform for the needs of DB Schenker Rail and its customers.

The data quality and availability was also significantly enhanced. Improved sensors and optimised design led to a cost cut of more than 50% in the capital and operations expenses, while at the same time the variety of information types and the frequency of data transmission was increased. Precise information on the location of a wagon can be given in more than 97% of all cases, even without GPS (use of GSM data). With the aid of the new developed loading sensor with weighing function, a full exploitation of payload is possible, while at the same time the risk of overloading is eliminated. Together with the mileage counter a decisive contribution to rail safety is made. A separate WCRR article regarding "Smart Telematics Enabling Efficient Rail Transport" (Code 711) has been submitted.

(4) A new simulation tool for planning and optimising SWL networks

SWL traffic in Switzerland has to deal with a rapidly growing passenger traffic which is prioritised in the access to the rail network. Thus, the number of available train paths for SWL is limited.

Within ViWaS, the Institut für Verkehrsplanung und Transportsysteme (IVT) at ETH Zurich has developed WagonSIM, an agent-based simulation tool for SWL transport. It is based on the OpenSource software MatSIM and models the routing of freight wagons in the network. Therefore, the modelling of two network levels is required. The first level is the production network. This stage comprises the assignment of the access points (sidings) to regional shunting points and shunting yards, including the specific timetables for the trains between these points. The second level is the physical infrastructure with its capacity limitations. The simulation tool enables the development of improved SWL networks and production schemes which are based on eight performance parameters (total number of wagons, stuck wagons, wagon hours, train kilometres, transported wagons, wagon kilometres, train hours, tonne kilometres).

## 3. Conclusion

A wide range of improvements of SWL was created in the scope of ViWaS. These improvements emerge from the system itself and thus really pave the way for a sustainable recovery and stabilisation of the generated transport volumes. Although these applications were related to specific situations, strong emphasis was given to the question of European-wide applicability. Main components, especially with regard to operational schemes, such as the use of hybrid locomotives or the "Railport" concept are gaining importance, not only in SWL "home countries" like Germany, Austria and Switzerland. Technical developments that enable a better modularity of wagons and the comprehensive use of telematics do not only favour SWL services. Higher flexibility as well as continuous monitoring of transports are topics that also apply to state of the art intermodal and block train services. The market maturity and the positive consequences of almost all project developments were proofed within ViWaS. The operative partners were able to resist the omnipresent negative trend of SWL or even gain increased market shares in dedicated fields.

Nevertheless, the analyses have also shown that the general framework conditions do not sufficiently support the development of rail freight services in the less than trainload segment. Current policies are more in favour of intermodal transport or even road services (e.g. higher weight limit of "last mile" services on road in intermodal transport). Furthermore, the harmonisation and streamlining of support strategies and funding schemes is recommendable. State support for private siding in one country cannot be effective when sidings or railports are closed in another country at the same time.

Within the 39 months of project lifetime, the ViWaS consortium partners addressed several challenges of European Single Wagonload traffic. The achieved developments have been applied and proofed their applicability in several dedicated case studies. The ViWaS developments may serve as blueprints and as a starting point for the revitalisation of European wagonload transport systems.