

Hybrid Locomotives Improve the Last-Mile

Bentheimer Eisenbahn Presents Results of Performed Cost-Benefit Analysis

Single wagonload (SWL) operation has to be comprehensively improved to strengthen its competitiveness, thereby focussing on crucial factors such as cost efficiency, reliability and transport time. Especially the “last-mile” offers potentials for cost reductions. Besides improvements of operation processes, an optimised rolling stock in the last-mile service can benefit the overall SWL efficiency. As a consequence, ViWaS activities also focus on new SWL traction schemes using multi-functional hybrid locomotives.

In order to meet future emission limits, hybrid powertrains, already successfully established in the automotive industry, enter the rail sector, too. Both locomotive manufacturers as well as rail operators see manifold improvement opportunities for rail freight through the usage of hybrid powertrains in locomotives: hybrid engines can operate on both electrified and non-electrified track sections. They are therefore able to replace diesel locomotives currently running on electrified lines. By doing this, the share of electrified operations would increase, whereas operation costs, greenhouse gas (GHG) emissions, and noise would decrease at the same time. If rail transport routes consist of both electric and diesel parts – typical for SWL service –, a hybrid locomotive could be used serving the entire transport chain. The elimination of locomoti-



Bombardier's TRAXX F140AC with last-mile functionality delivers the best efficiency on the network of Bentheimer Eisenbahnen. Source: Bombardier

ve changes between electrified and non-electrified route sections leads to significant benefits for reliability and transport time. Older engines currently used in short-haul traffic or shunting operations could be also replaced. Additionally, the diversity of operated locomotive models would decrease and, consequently, ease up maintenance procedures and costs.

ANALYSIS

Especially in regard to the profile of serviced routes, ViWaS partner Bentheimer Eisenbahn might benefit from the operation of hybrid locomotives in their SWL transports. To determine possible advantages, Bentheimer Eisenbahn recently performed a cost-bene-

fit analysis. Company-specific factors like the length of sections not equipped with catenary lines, maximum weight and speed of trains as well as the current costs for electricity and diesel have been considered.

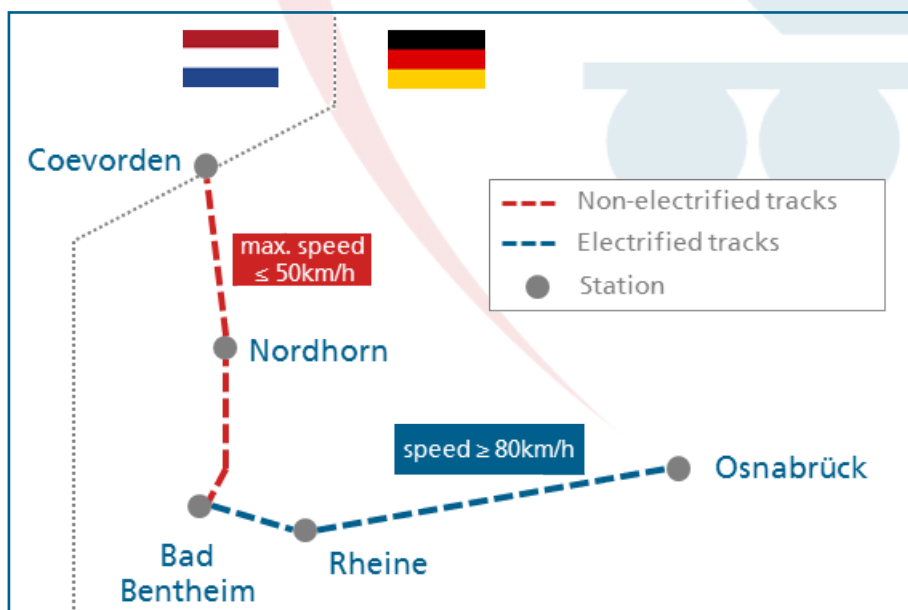
The starting point of the analysis is a comparison of different locomotive types. For this purpose, the main characteristics of four models have been listed. On the one hand, the existing rolling stock with the company's D20 (DB Class V200) and D24 (DB Class V100), on the other hand two models from Bombardier's TRAXX locomotive family: the F140 DE with diesel engine and the F140 AC hybrid engine with last-mile functionality.

For the comparison, two different line sections have been analysed.

First of all, the company-owned line between Bad Bentheim and Coevorden in the Netherlands. On its complete length of about 57 kilometres the track is not electrified at all and the speed is limited to 50 km/h. Secondly, Bentheimer Eisenbahn uses a DB Netz railway line connecting Bad Bentheim and Osnabrück. The length of this fully electrified route amounts to 74 kilometres with a minimum speed of 80 km/h. To reach this speed when pulling a train with a total weight of 2,500 tonnes, the trains are currently operated in double traction (D20 and D24). In contrast, both Bombardier locomotives would reach a speed of 100 km/h when pulling a train with the same parameters, individually.

For the cost calculation, the following parameters (status: October 2014) have been considered:

- Electricity costs (according to DB Energy terms),
- Fuel costs,
- Train driver's salary,
- Depreciation period of 25 years without residual value,
- Full capacity utilisation of 2,500 tonnes per train,
- Locomotive operation of 16 hours per day.



Bentheimer Eisenbahn's rail service network.

LOCOMOTIVE	COEVORDEN – BENTHEIM	BENTHEIM – OSNABRÜCK	TOTAL ROUTE
TRAXX F140AC with Last Mile	0,19 € / t	0,14 € / t	0,33 € / t
TRAXX F140DE	0,16 € / t	0,19 € / t	0,35 € / t
D20	0,21 € / t	0,33 € / t	0,54 € / t
D24	0,20 € / t		0,53 € / t

Comparison of the resulting transport costs.

Source: Bentheimer Eisenbahn

RESULTS

Based on the specific conditions of Bentheimer Eisenbahn, the analysis shows that both Bombardier locomotives are more cost efficient on the examined routes. The advantages are especially obvious on the relation Bad Bentheim – Osnabrück. Due to the necessary double traction with the D20 and D24, personnel, fuel and fixed costs are significantly higher compared to the TRAXX locomotives, with the F140 AC achieving the highest efficiency. On this route, the hybrid locomotive takes full advantage of its electric powertrain.

However, in view of the section connecting Bad Bentheim and Coevorden, the TRAXX diesel version is the most efficient. The hybrid locomotive is limited to a maximum speed of 25 km/h in last-mile mode, which leads

to an extended transport time, and thus higher personnel and fixed costs (see table above).

CONCLUSIONS

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.

Currently, Bentheimer Eisenbahn operates its trains with a utilisation rate of 35 to 50 percent. Due to this level, the purchase of a new engine has not yet been considered. Nevertheless, the company has to expand in order to increase the overall efficiency. A sustainable exploitation of new routes is only feasible with a more efficient rolling stock. The use of a hybrid locomotive would increase the competitiveness, but further analysis and comparisons of different hybrid solutions are necessary.

A successive field test with a hybrid locomotive is planned for April 2015. However, for the specific requirements of Bentheimer Eisenbahn, modifications regarding the maximum speed in last-mile mode as well as the operation radius have to be made to maximise the potential advantages of hybrid locomotives on the company's transport relations.

Source: HaCon

New Load Unit Prototype Increases Flexibility of Timber Transports

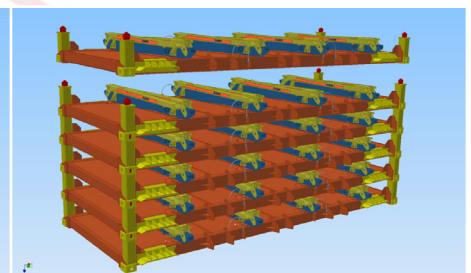
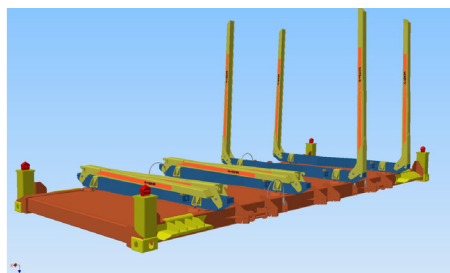
Timber Cassette with Foldable Stanchions Completes Wascosa flex freight system®

Conventional rail transports are generally operated with special wagons for specific types of cargo. Transport flows are often done in one direction. Consequently, the share of empty wagon transports is comparably high and reduces its 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.

In 2010, Wascosa has presented the first flex freight unit for timber transports that is a major market for SWL. Within Vi-WaS, the so-called timber cassette has been further developed. Accord-

ing to the following design goals it should be compatible for intermodal handling equipment, foldable and stackable on standardised twist lock positions. The prototype has been delivered in August 2014.



The unloaded timber cassettes can be fold down, removed and stacked to increase transport efficiency and reduce empty runs.

Source: Wascosa

Combining SWL and Intermodal Transport

TU Berlin Analyses Rail Hub Requirements for Joint Intermodal/SWL Transports

Transports in classic SWL production systems are often costly and time consuming. Decreasing train utilisation jeopardises an economic viability of this type of service. Consequently, the ViWaS partners aim for actions to raise utilisation rates and thereby decrease transport costs per unit. One approach is the linking of conventional wagons or wagon groups with intermodal trains. The researchers at TU Berlin analysed the necessary requisites for the operation and management of joint intermodal/SWL transports with special attention to the operations in rail hubs.

Currently, the infrastructural situation, the technical equipment

and the operational processes of rail hubs are designed for the specific needs of the respective rail production system. The operational analysis focuses particularly on the evaluation of additional efforts in the relevant hubs to enable joint intermodal/SWL services. Through the examination of different scenarios, technical and operational requirements for the terminal layout are derived.

With the support of operational simulations, different infrastructure options and corresponding procedural efforts (with respect to train and wagon handling, transshipment processes as well as storage organisation) have been analysed. Only scenarios

that guarantee robust rail operations and terminal processes have been considered for further evaluation.

The results show that it is possible to integrate SWL with intermodal trains under the following main conditions: (1) There has to be sufficient infrastructure available in the direct surroundings of the hub to allow train coupling and sharing, (2) reliable train arrival times have to be secured to maximise the benefits from joint production schemes, and (3) IT systems have to be adapted, enabling a seamless integration of different production schemes as well as real-time transport monitoring and management.

SWL Simulation Supports Network Optimisation

ETH Zurich IVT Develops New Simulation Tool WagonSIM

Single wagonload (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. Especially during the peak hour of passenger transport, a lack of train paths for SWL is observed. Even under these boundary conditions, SWL has to cover all national relations in Switzerland with an overnight service to remain competitive with road transport. Consequently, the production schemes have to be continuously improved to meet these requirements.

Within the ViWaS project, 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 Open-Source 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 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 restraints. The simulation tool enables the development of improved SWL networks and production schemes, based on eight performance parameters (see figure below).

WagonSIM analyses and optimises eight parameters.

WagonSIM analysis parameters

Total number of wagons	Stuck wagons	Wagon hours	Train kilometres
Transported wagons	Wagon kilometres	Train hours	Tonne kilometres

PROJECT KEY FACTS

- Budget: 4.2 million €
- EU contribution: 2.9 million €
- Duration: 9/2012 – 8/2015
- Coordination: HaCon Ingenieurgesellschaft mbH
- Consortium: Ten European companies and research institutions from the areas of rail transportation and logistics
- Project goals:
 - capturing new markets for SWL
 - optimising "last/mile" operations
 - improving flexibility and efficiency of equipment usage
 - increasing transport quality and reliability

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VIWAS APPEARENCE AT TRANSPORT LOGISTIC 2015

From 5-8 May 2015, ViWaS participates in the transport logistic exhibition in Munich. Project status and outcomes are presented at the ViWaS stand (B6.122) and in the open-air exhibition ground as part of the <<SwissMovers>> presentation (FGL.Track 1/4).

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