Freight trains are getting smarter

While the complex migration to operation using digital automatic couplers lies ahead, Europe's freight trains are already being digitalised. Reinhard Christeller presents a snapshot of the benefits in safety, productivity and cost effectiveness.

Although freight train accidents are extremely rare, they often have disastrous consequences. Such was the case when a train in the Gotthard Base Tunnel derailed due to a broken wheel in August 2023 (RG 10.23 p54). Before being detected, the derailed wagons had destroyed 7 km of infrastructure.

The tunnel is now expected to be repaired by September at a cost of more than €100m, after almost a year of total or partial closure. Understandably, questions will be asked about how far digital or 'smart' monitoring technology could have anticipated or immediately detected the derailment and allowed the damaged train to be rapidly brought to a halt.

Equipment to energise existing and new wagons and equip them with sensors and data transmission is now mature and economically viable. In this context, much progress could be made to modernise rail-borne logistics ahead of the mass roll-out in Europe of digital automatic couplers, which is not likely until towards the end of the decade (RG 6.24 p00).

Photo: Reinhard Christeller

Above left: Swiss Federal Railways subsidiary SBB Cargo says it is the first operator to use the automatic brake test for freight trains. The approved process takes a few minutes and can be supervised by the driver of the train locomotive, reducing the need for shunting crews at terminals and marshalling yards.
Above right: An easy-to-retrofit axlebox generator can feed the smart wagon functions.

Safety first

Since 2022, the Italian operator Mercitalia Intermodal has equipped 200 of its combined transport wagons, mainly semi-trailer carriers, with the WaggonTracker tool supplied by Austrian manufacturer PJ Monitoring GmbH. WaggonTracker is a self-contained system that includes an axlebox power generator with buffer battery and a set of sensors to monitor safety issues. The sensors collect operational and wear data from the wagon, which is used to support condition-based maintenance. Data records are consolidated and displayed to the train driver via an in-train radio network and then transmitted to a central server.

WaggonTracker is able to supervise a wide variety of parameters related to operational safety. These include wheel-rail interaction, brake conditions, shock impacts and — in the case of vehicles carrying semi-trailers — a monitoring of the status of the king pin that secures the trailer to the wagon. After two years of operation, the operator reports that its investment of several thousand euros per wagon has already been paid back. Another 180 wagons are to be equipped this year, and Mercitalia has set a goal of fitting WaggonTracker to its entire intermodal fleet.

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Productivity gains

Another case study of progress being made pre-DAC is LoadMonitor, an automatic payload oversight tool fitted to around 600 wagons managed by Mercer Holz, one of Europe's largest timber logistics companies based in Germany. Austrian group Lenzing AG also uses the system on around 100 timber wagons.

The tool continuously supervises the load status and triggers an alarm when a load of tree trunks becomes dangerously unbalanced. Equally importantly, the monitor can inform loading staff about the optimal payload, ensuring as much wood is carried as possible. According to the supplier, this means up to five tonnes more is being moved per wagon than was the case without the technology. At the same time, LoadMonitor is also designed to mitigate the risk of overloading wagons, which occurs periodically in timber transport. When such a risk is identified mid-transit, the excess payload must be removed form the wagons affected, causing a delay of several hours and a cost of several thousand euros.

Speed, safety, working conditions

A key area of progress in the digitalisation of freight trains concerns the automation of the brake test. Brake tests have been conducted almost entirely manually for decades, and it has been clear for some time that this was a major drag on the effective throughput of rail freight in increasingly time-sensitive logistics chains.

Today, a number of rail operators, rolling stock owners and suppliers are actively deploying tools to automate the brake test. Among the frontrunners is a consortium set up by freight operators SBB Cargo and Rail Cargo Austria, also working with supplier PJM.

The collaboration began with initial trials in Switzerland in 2016, where the first wagons to be fitted with the automation equipment covered a total of around 1 million km and were subject to more than 500 brake test sequences. This meant around 10 000 brake applications were undertaken through automation.

In February 2022, the technology received a positive appreciation from the accredited inspection, testing and certification body TÜV Süd and in November 2023 it was granted type approval by BAV, the Swiss Federal Office of Transport. This means it is now available for widespread deployment. As the tool is also compatible with future DAC technology, immediate roll-out across the two operators' fleets is envisaged.

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Mercer Holz uses flat wagons from Transwaggon that are equipped with LoadMonitor. This facilitates optimal loading of the vehicle, while minimising the risk of overloading.

Today, almost 200 SBB Cargo wagons have already been equipped to allow automated brake testing. This is seen as an essential part of the 'one person operation' model, which is gradually being implemented by several operators including SBB Cargo, primarily as a measure to combat the shortage of skilled labour. The productivity gains are clear: a 500 m-long train can undergo a full brake test in around 5 min; this compares to the legacy practice where two shunting specialists would need to walk around the entire train, a task often taking 45 min or more for a long formation.

The safety gains are equally apparent: staff benefit from better safety and comfort as they have to spend less time on the track. Trains can depart from the shunting yard much earlier than before, while the operator reaps benefits in saved labour. The average cost of a conventional brake test is around €350; automation using the approved methodology can cut this by about 80%.

Furthermore, the PJM technology can identify locked handbrakes as well, which reduces the risk of wheel flats caused by dragging brakes — these have a typical repair cost of approximately €2 500.

Based on this success, VTG and Transwaggon Group, two major European freight wagon lessors, are now offering automatic brake testing and additional digital monitoring to their leasing customers. These come as a further option on top of the PJM WaggonTracker tool already available.