Position Paper

Technical Innovation Circle for Rail Freight Transport (TIS)

Berlin, 23 September 2014

About TIS

During the Innotrans 2012 trade fair in Berlin, the Technical Innovation Circle for Rail Freight Transport (TIS) presented its White Paper "Innovative Rail Freight Wagon 2030 – The '5L' Future Initiative as a Basis for Growth in Rail Freight Transportation".

The following companies are currently participating in a Practice Group within the Technical Innovation Circle for Rail Freight Transport:

- AAE Ahaus Altstätter Eisenbahn AG
- BASF SE
- DB Schenker Rail AG
- GATX Rail Germany GmbH
- Knorr-Bremse Systeme für Schienenfahrzeuge GmbH
- SBB Cargo AG
- VTG AG
- Waggonbau Graaf GmbH
- Waggonbau Niesky GmbH

TIS has the support of a scientific advisory panel, a technical advisory panel and a project management team. Professor Hecht (TU Berlin) and Professor König (TU Dresden) are scientific advisors, while Mr Vaerst (Railmind GmbH) and Mr Redeker are technical advisors. Project management is provided by Professor Wittenbrink and Mr Hagenlocher (both with hwh Gesellschaft für Transport- und Unternehmensberatung mbH).

Background

In recent decades, the rail freight industry in Europe has not been effective enough in developing technical innovations for freight cars or maturing them for the market. Reasons for this lack of innovative power in the sector include the following:

- The market for new rail freight cars in Europe is small. As a result, the development costs for innovations are relatively high compared with the quantities likely to be sold. Moreover, in number terms there is only moderate market demand for freight cars. This is compounded by the fact that wagon manufacturers are insufficiently resourced financially for developing basic innovations.
- Innovations should not jeopardise the compatibility of the freight cars deployed in Europe.
- The basic innovations required by wagon keepers have not been adequately defined, nor have these demands been collated.
- The implementation of basic innovations is slow because assets have a long service life.

- Innovations must generate commercial benefits for wagon keepers (who are the ones who decide on investments and introduce any technical innovations). For this to happen, the total life cycle costs must be lower than in the past or there must be scope to pass the incremental costs on to the transport market, in part or in full, in the form of rents or offsets.
- It is not necessarily the wagon keepers who reap the (economic) benefit of a freight car innovation.

Consequently, TIS has identified the need for a new sector-wide approach to freight car innovation.

Working together in TIS serves to strengthen the innovative power of the rail freight transport sector, and especially the potential for innovative freight wagons, in order to tap into growth opportunities for rail freight transportation as a whole. Devising migration strategies for basic innovations is an essential part of the TIS project. It is clear to all TIS participants that the only key to success is a joint sectoral approach that brings together shippers, wagon keepers, railway undertakings and the wagon manufacturing industry. It is also very important to involve trade associations and political decision-makers. The wagon keepers in the Technical Innovation Circle for Rail Freight Transport are especially conscious of their responsibility to play a significant role in initiating and managing this process.

TIS objectives

The Technical Innovation Circle for Rail Freight Transport pursues the following objectives:

- To identify relevant basic innovations to meet or support the following functionalities:
  - **Low-noise:**
    Lower noise emissions from freight cars
  - **Lightweight:**
    Bigger payloads and less net wagon weight
  - **Long-running:**
    Fewer outages and less downtime for freight cars, increase in average annual wagon mileage
  - **Logistics-enabled:**
    Options to integrate the innovative freight car into supply chains, service quality better than/equal to road and air transport
  - **Life cycle cost-oriented:**
    Incorporation of LCC-oriented components at acquisition costs that achieve rapid payback over their service life and are more than offset by savings on operating and maintenance costs – consequently reducing total life cycle costs.

TIS task forces

During 2013/2014, TIS concentrated its work on the following three areas of innovation:

- Innovative bogies
- Telematics and sensor technology for freight cars
- Earnings-adjusted/Basic LCC model

TIS recently set up another task force to focus on “Innovative Coupling Systems”.

These task forces determine the technical, operational and economic requirements that basic innovations must meet and document these in a report. Because the task forces are composed of experts from the various market segments – wagon keepers, railway undertakings, shippers and the manufacturing industry (wagon builders and component suppliers), the listed requirements can be explored from different angles.

Key findings of the task force on "Innovative Bogies"

What TIS primarily requires of an innovative bogie are improved or at least equal profitability (less wear on wheelsets, lower maintenance costs) and a reduction in noise emissions (-2dB(A) for existing rolling stock and -4dB(A) for newbuilds).

TIS set up two "dialogue platforms" with European bogie manufacturers. As most of the manufacturers involved had already developed innovative bogies under their own initiative, it was agreed that the first step would be to evaluate their existing innovative bogies.

Currently none of the bogies analysed meets all TIS requirements. Although some of the bogies examined could probably help to reduce the wear on wheels and rails due to their radially adjustable wheelsets, a full assessment of the actual impacts is not feasible.

In fact, in some cases ongoing maintenance costs for these bogies are likely to be higher because they include parts that are subject to wear, such as rubber suspension. The acquisition costs of most of the bogies examined are sometimes higher than for a Y25 bogie. It is doubtful whether the positive effects of the innovative features, some of them isolated components, would compensate for these increased acquisition costs.

Given this state of affairs, TIS does not believe it would be helpful or economically reasonable to conduct the proposed in-service testing for the bogie newbuilds that were identified. Some manufacturers intend to conduct their own in-service testing. However, it is essential to draw up standard evaluation criteria.

This discussion between wagon keepers and bogie manufacturers under the TIS umbrella resulted in the following fundamental demands, where the "5L" factors have been applied to reflect an integrated approach to innovative bogies, be they enhanced versions of current products or new developments:

Low-noise

- Technical modifications or replacement of components to reduce noise emissions for the complete car by -2 dbB(A) for existing freight wagons and -4dB(A) for newbuilds.
- Use of straight-web discs in axle-mounted disc brakes.

Lightweight

- Not in itself an absolute goal for an innovative bogie. Lightweight design should suit the specific circumstances, as this criterion is a decisive market factor for certain types of wagon.
- The long-term goal is to develop a lightweight construction with the same properties as a Y25 bogie.

Logistics-enabled

- Not relevant to the innovative bogie

Long-running

- Use of axle-mounted disc brakes while ensuring that the braking system is operationally acceptable to the railway undertaking.
- Use of radially adjustable wheelsets.
- Less wear on wheelsets as a result of using innovative wheelsets that can cover a distance of at least 2 million km.

LCC-oriented

- Greater or at least equal profitability (compared with the Y25 bogie), not least by increasing mileage and cutting maintenance.
- Substantial reduction in acquisition costs for axle-mounted disc brakes so that they can also be used profitably in freight cars covering less mileage.
- Willingness of wagon keepers in principle to use axle-mounted disc brakes in freight cars.

Key findings of the task force on an "Earnings-adjusted/Basic LCC Model"

TIS distinguishes between an earnings-adjusted model and a basic LCC model. The earnings-adjusted model serves to capture life cycle costs (LCC) **and** earnings and is applied in order to assess the profitability of a complete **freight car** over its economic lifetime. The LCC model only captures life cycle costs (LCC) and is used to describe the service life cost situation of **systems** (e.g. bogie) and **modules** (e.g. wheelset) and to compare them with innovative systems / modules.

As a first step, TIS has developed an LCC model for bogies with the following objectives:

1. Development of an earnings-adjusted / basic LCC model, agreed across the sector, founded on real or plausibly derived rates
   ➔ **Target: Rail freight sector**
2. Decision-making tool for wagon keepers seeking to invest in innovative freight cars / systems / modules
   ➔ **Target: Profitability for wagon keepers**
3. Indication to manufacturers of target costs for the development of innovative freight cars / systems / modules
   ➔ **Target: Wagon manufacturers**
4. Definition and visualisation of benefits to various rail freight stakeholders of innovative freight cars / systems / modules
   ➔ **Target: Profitable rail freight transportation**
5. Findings from the earnings-adjusted / basic LCC model serve as a basis for developing transfer of benefit models (incentive system) if the benefit is not reaped by wagon keepers
   ➔ **Target: Profitability for wagon keepers**
6. Formulation of migration scenarios for innovative freight cars / systems / modules based on findings from the earnings-adjusted / basic LCC model and the transfer model
   ➔ **Target: Implementation of innovations to strengthen the rail freight business**
7. Identification of funding agenda or need for seed funding for innovative freight cars / systems / modules
   ➔ **Target: Political community**

The LCC model for bogies devised by TIS demonstrates that bogies using shoe brakes with composite brake blocks incur substantially higher life cycle costs than bogies with cast iron blocks. Over a 20-year period at an annual mileage of 50,000 km, the life cycle costs for a bogie with cast iron blocks are already approx. 2 % lower than for a bogie that has a shoe brake with composite blocks and bilateral action. When annual mileage increases to 100,000 km the difference in LCC is 9 %, and for an annual mileage of 150,000 km the difference is even 12 %.

In other words, the LCC calculations performed by TIS clearly illustrate the additional costs that wagon keepers confront if they equip their freight car fleet with composite brake blocks.

The LCC model also shows that bogies with axle-mounted disc brakes incur substantially lower maintenance costs over their entire life cycle. However, the acquisition costs for axle-mounted disc brakes are currently too high, and so an axle-mounted disc brake does not break even until its annual mileage reaches between 80,000 km and 90,000 km. This means that the deployment of axle-mounted disc brakes could make sense from a certain annual mileage upwards. If the acquisition costs for axle-mounted disc brakes were to fall, this could also ensure a rapid payback for fitting axle-mounted disc brakes in freight cars which cover less distance per year.

The choice of a brake system will not only be influenced by LCC analysis, but also by other factors such as noise and weight. As an axle-mounted disc brake is considerably heavier than, for example, a shoe brake with bilateral action (approx. 1 tonne incremental weight), fitting these brakes on freight cars which tend to have a heavy payload will not necessarily be an option. Another point to consider is that freight wagons with axle-mounted disc brakes are not necessarily quieter than wagons with shoe brakes.

Sensitivity analyses performed as part of the LCC exercise demonstrate that the higher purchase price of an innovative bogie compared with a standard bogie cannot always be offset by possible reductions in maintenance costs over the life cycle. Consequently, one of the pivotal TIS requirements for innovative bogies is that they should display a better or at least equal profitability when compared with the standard bogie.

Key findings of the task force on "Telematics and Sensor Technology"

TIS highlighted the following overriding applications for telematics and sensor technology in rail freight cars:

- monitoring and tracking of transportation routes incl. mileage
- monitoring of freight carried (e.g. weight, condition, …)
- optimisation of operating processes (e.g. automatic registration of wagon sequence, …)
- maintenance support (e.g. monitoring technical conditions,…)
- integration into logistical and transport chains (e.g. automated billing,…)

TIS identified altogether 24 practical application opportunities for telematics solutions. Seven of these were defined as basic applications that should be implemented in every freight car.

For the system architecture, requirements for a modular system were formulated, consisting of:

- sensor hub as a central freight car component
- sensor technology
- power supply unit

Telematics suppliers are currently working on the development of different applications, for which they all use different basic units without standardised interfaces. Compatibility between the applications of different suppliers is not ensured. TIS has set out its requirements in a report. The linchpin is an open basic unit with defined interfaces that can “dock onto” different sensor applications. What is essential now is for the industry to take up this standardisation and implement it in developments. This is the only way to ensure that applications from different manufacturers can function in harmony, and it presents an opportunity to deploy telematics and sensor applications throughout the rail freight sector in future.

TIS therefore wishes to initiate dialogue with the manufacturers, setting out the requirements of wagon keepers and exploring feasibility. The first dialogue platform was scheduled for October 2014.

Conclusions and Prospects

TIS has set out to manage and promote basic innovations towards an innovative rail wagon for 2030. In so doing, TIS pursues an integrated approach with a focus on the business case for basic innovations in rail freight cars. That is why the wagon keepers in TIS have been joined by railway undertakings, shippers and companies from the wagon manufacturing and component industry. Essentially, there is a willingness among the wagon keepers in TIS to make use of basic innovations in newbuilds and in existing fleets. TIS defines technical, operational and economic requirements for basic innovations and engages in dialogue with the industry. The current focal themes for task forces in TIS are innovative bogies, telematics and sensor technology, and earnings-adjusted /LCC models. More task forces are planned to address, for example, innovative coupling systems, lightweight design and other issues. TIS also coordinates its activities with development projects such as Shift²Rail.

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