SBB, Rhomberg and Vigier turning to smart railway tracks

The new LVT supports in the Oelberg tunnel on the Gotthard axis contain RFID chips. These are the future link between the physical infrastructure and the cloud.

The project partners are turning to digitisation when refurbishing the superstructure in the Oelberg tunnel on the lakeside Axen track. With more than 6,000 LVT supports, each has an RFID chip in the concrete, laying the foundations for precisely identifying and locating every single rail support. Combined with a database, it then becomes possible to assign a multitude of data throughout the entire lifecycle. Further potential is offered in the form of identification of the chips by measurement and maintenance vehicles and improved positioning accuracy. The chip is thus the link between the physical infrastructure and production, measurement and operator data. In the event of discrepancies, the response can be fast and sleeper-specific – with no laborious re-measuring on site.

Digitisation is arguably the most pioneering development of our times. Even when it comes to the rail system, whose infrastructure has basically not changed since its "pioneering age" in the 19th century, digitisation offers opportunities which are being actively pursued. The rail industry expects that up to 30% more trains will operate on the existing infrastructure thanks to the SmartRail 4.0 programme.[i] SBB also wants to use digitisation for maintenance – for example, in the form of the swissTAMP software tool that calculates the condition of the track based on various factors, such as stress, thus making fact-based planning of infrastructure maintenance possible.[ii] An article on the practicality of such applications was published in the February edition of the journal EI.[iii]

However, there is still a gap between "big data" and the physical railway infrastructure. The maintenance work recommendations, such as tamping, grinding or component replacement, made by the best software can only ever be as good as the quality of the data allows. This data quality largely depends on the condition detection level – and thus determines how accurate performance forecasts for a route section can be. How much historical data, such as service life in the track or maintenance of components, is stored? And how precisely can these components be permanently and automatically located in situ?

Digitisation on the Axen route that dates back to the era of the railway pioneers

This last question in particular has been a key focus for SBB and its project partners, Rhomberg Sersa and Vigier Rail, in relation to the renewal of the track in the Oelberg tunnel. At 1,987 metres, this is the longest tunnel on the lakeside track of the Axen route. Originally put into operation in 1882, emergency upgrading work was carried out in 2003/2004. This was designed to last for the next 25 years – on the assumption that the new route with the Axen tunnel would be ready by then. This tunnel was to link Felderboden in the canton of Schwyz to Altdorf in the canton of Uri.[iv]

However, the federal government has since changed the priorities for Swiss railway upgrades under the strategic development programme. There are currently no upgrades planned for the Gotthard axis, as there is sufficient capacity for both passenger and freight services.

Consequently, SBB is refurbishing the lakeside track of the Axen route once again between 2016 and 2020 – this time for a service life of 50 years. The structure gauge is also being increased to a corner height of four metres.

16 bridges, 24 culverts, 94 retaining structures and 9 tunnels are being refurbished on the 12-kilmometre stretch between Brunnen and Flüelen. SBB is renewing the superstructure along the entire route – with some use of the slab track system in tunnels. In the tunnels, overhead contact lines are also being replaced by overhead conductor rails, arches and walls are being reinforced and replaced, new cable systems are being constructed and self-rescue facilities such as alcoves are being installed.

But let's return to digitisation. As planned, SBB is installing a slab track system instead of traditional ballasted track in four longer tunnels and on 200 metres of open line. Slab track systems need less maintenance and offer a higher consistency of track geometry. Rhomberg Sersa is installing LVT supports produced by Vigier Rail in these tunnels. These supports now contain a radio frequency identification chip as standard.[v] RFID chips are already part of our everyday lives – they are found in contactless bank cards, biometric ID and the SwissPass.

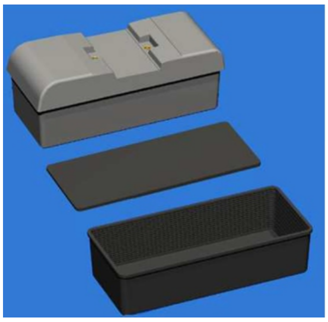
Sleeper blocks with chips benefit the whole of Switzerland

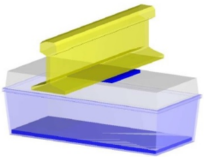
As with these everyday applications, every RFID chip in the Oelberg tunnel pilot project has a unique reference number, which allows for unambiguous identification within the infrastructure. The absolute position is precisely stored. What's more, data from Vigier's production and quality control is assigned, including for all sub-components installed (e.g. rail fastenings).

This provides 100% traceability of the installed elements both upstream and downstream along the entire value chain. For the field recording of the chips, Rhomberg Sersa has planned the Mephisto manual measuring system, which can be moved along the track and has a carrier platform for RFID scanners. As the position of the individual chips in the track is initially unknown after the installation of the LVT supports, their correct sequence in the route section must first be determined. During the reading process, both distance and speed play a role in the unambiguous assigning of the signals. The aim for the next phase is for it to be possible to read and further process the recorded ID numbers and the track geometry measurements in tandem via the Mephisto interface.

A database means that information such as measurements by SBB diagnostic vehicles and other operator data can also be assigned to each individual support.

We're therefore already talking about the benefits of RFID chips in LVT blocks for railway infrastructure operators, who will be able to reference their measurement data to a precise sleeper in future. Over time, this will enable better comparisons of forecasts and the actual condition recorded, leading to constant improvements in forecasts. The LVT supports with chips in the Oelberg tunnel will therefore benefit all tracks in Switzerland. When defects occur, it will be possible to find the affected support much faster in future. The days of having to count sleepers or measure out metres of track from a reference point such as the tunnel portal are over. It is even feasible that further installations in the tunnels could be identified via the supports in future too. And all this is possible without any complicated equipment – all that is needed is a smartphone with an RFID reader link.





While Vigier Rail is installing the RFID chips in all newly produced LVT supports for Switzerland, these data carriers in the infrastructure are still very much uncharted territory for SBB as the installation owners. Although the industry programme SmartRail 4.0 hails RFID chips as the "jigsaw piece for digitisation, automation and logistics"[vi], SBB wants to test out which railway sleeper applications are possible and worthwhile, before taking the decision to use the chips throughout the network. SBB is therefore working in partnership with the Domain of Permanent Way and Track Technology at TU Dresden's Institute of Railway Systems and Public Transport. The aim of supervised Master's theses is to identify potential and verify it through network measurements. This particularly involves pursuing a new approach to describing and assessing track defects through pattern detection in frequency range analysis from kinematic condition variables.

At the end of such a development, there would then be a more or less permanently networked, smart railway superstructure. Just as its literal foundations – the slab track system – was new and innovative more than 50 years ago, the use of RFID chips in LVT supports gives rise to new possibilities for the inspection and maintenance of railway infrastructure, and these need to be analysed further over the coming years.

Sources:

[i] Cf. the statement by SBB CEO Andreas Meyer in connection with SBB's 2016 annual reporting: M. Stutz and A. Stuber: "'Wir wollen einen Quantensprung mit der Bahn machen'", *Unterwegs*, 21 March 2017, https://dima.sbb.ch/unterwegs/artikel/48157/wir-wollen-einen-quantensprung-mit-der-bahn-machen, accessed on 21 May 2018 at 17:15.

[ii] SBB AG, "SBB 2020 strategy: Creating added value for customers – increasing efficiency", press release, 13 February 2017, https://company.sbb.ch/en/media/media-relations/press-releases/detail.html/2017/2/1302-1, accessed on 21 May 2018 at 17:30.

[iii] Sassan Schirazi, "Können Algorithmen die Zukunft errechnen?", *EI*, February 2018, p. 6–8.

[iv] SBB AG, "Korridorrahmenplan Zentralschweiz: Schlussbericht", p. 52, 30 March 2018, https://durchgangsbahnhof.lu.ch/-/media/Durchgangsbahnhof_Luzern/Dokumente/20180425_SBB_Korridorrahmenplan_Zentralschweiz.pdf?la=de-CH, accessed on 23 May 2018 at 15:15.

[v] Cf. Vigier Rail, "Einsatz der RFID-Technologie nun serienmässig möglich", press release, 11 July 2017, http://www.vigier-rail.ch/de/news/detail/einsatz-der-rfid-technologie-nun-serienmaessig-moeglich, accessed on 23 May 2018 at 16:45.

[vi] Michel Kunz, "SmartRail – Die Bahn der Zukunft", presentation, undated, https://company.sbb.ch/content/dam/sbb/de/pdf/sbb-konzern/die-sbb-bewegt-die-schweiz/partnerschaften/01-SmartRail_Die_Bahn_der_Zukunft-SBB-Michel_Kunz.pdf, accessed on 23 May 2018 at 16:30.

Authors:

Thomas Rubi: owner of Rubi-Bahntechnik GmbH; Labor@rubi-bahntechnik.ch

Olaf Schulz: Diploma in Engineering (University of Applied Sciences), MBA; SBB AG; olaf.schulz@sbb.ch

Patricia Marty Tribelhorn: Diploma in Rural Engineering, ETH, Risk and Safety post-diploma course, ETH; EPFL and Uni St. Gallen Head of Diagnostic Department; Sersa Maschineller Gleisbau AG; patricia.marty@sersa-group.com

José Manuel Barrios Fragoso: Technology and Innovation Project Manager; Vigier Rail AG; jose.barrios@vigier.ch