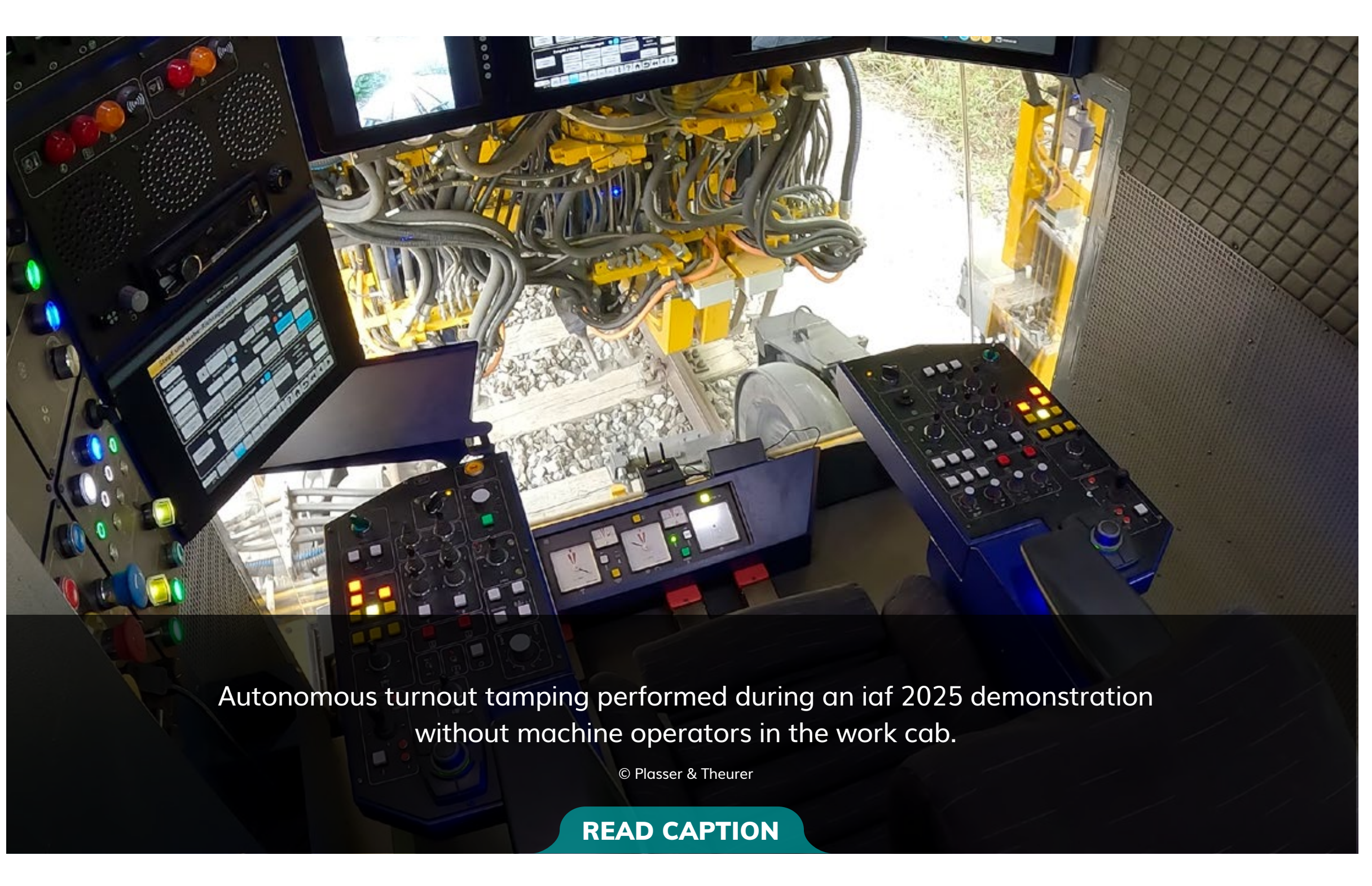
Increasing network capacity through innovation: why track maintenance must do more with less

Rail networks are carrying more traffic than ever, but maintenance windows are shrinking. Fabian Hansmann, Head of Marketing, and Bernhard Antony, Director of Strategic Product Development at Plasser & Theurer, explain how digitalisation and automation are being used to increase network capacity – and why organisational change is now as important as technology in determining whether that capability reaches the track.



Autonomous turnout tamping performed during an iaf 2025 demonstration without machine operators in the work cab.

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Rail networks are carrying more traffic than at any point in their history, which means less time available to work on the track – and less time on the track means a higher probability of geometry degradation that causes the very disruptions operators are trying to prevent.

According to Fabian Hansmann, rising traffic volumes are pushing railway networks worldwide to their capacity limits. While the growing demand for rail transport is a positive development, it also creates increasing pressure on infrastructure maintenance. As maintenance windows become more limited, the industry is placing greater emphasis on efficient maintenance strategies, automation and digital solutions to ensure infrastructure availability and long-term network reliability. The result is a system under pressure from both ends: operators need more capacity, but achieving it requires maintenance investment that competes for the same infrastructure.

Track geometry, Bernhard Antony explains, is a fundamental determinant of network availability. Poor geometry directly impacts operational performance and can ultimately result in line restrictions or even closures. Digitalisation changes what is possible here not because it eliminates the need for maintenance, but because it makes that maintenance more predictable. Condition monitoring generates data that can be converted into information; information enables forecasting; forecasting enables planning. "With all this data, we can convert it into information and use it to improve the maintenance process," Antony says. "And also to increase the quality during the maintenance process – because with automation, we can react to the condition of the track and improve it as needed."

The most significant shift is not necessarily in execution, but in how maintenance is structured. Hansmann also sees significant potential in better coordination of maintenance activities. Increasingly, interventions that were previously carried out separately can now be combined within a single track possession. By aligning maintenance activities across different teams, railway operators can reduce track closures, improve efficiency and make better use of limited maintenance windows.

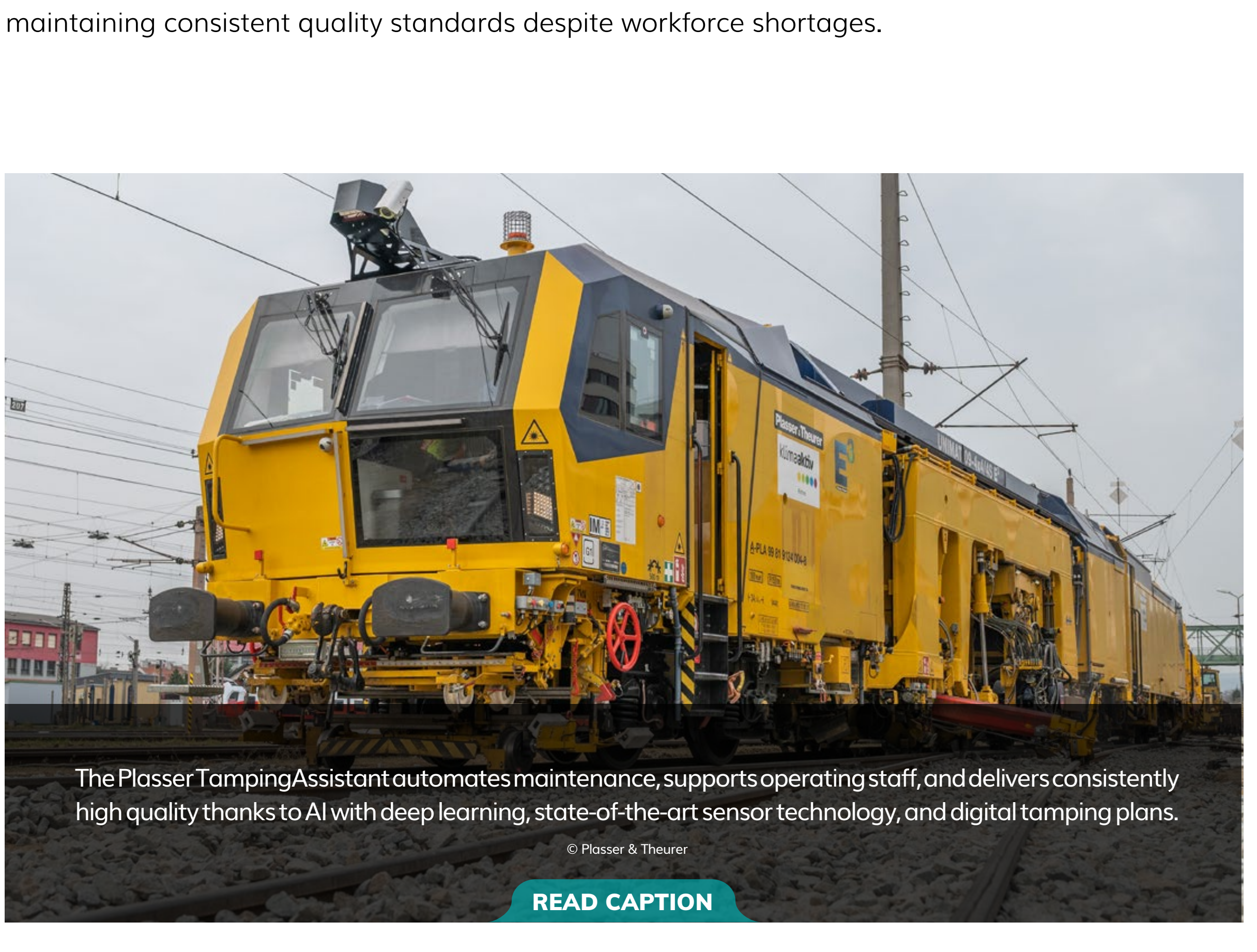
Digitalisation, Hansmann argues, makes maintenance more predictable in a way that enables that kind of coordination – and predictability has value beyond the possession itself. "If we can predict track failures, we can share this information with all the customers – the people that run the trains, the freight operators – so they can actually plan."

> *It's not about reducing people — it's about reducing the jobs we can no longer fill*
>
> *Fabian Hansmann, Head of Marketing, Plasser & Theurer*

Reframing automation under workforce pressure

The pressure driving this shift is increasingly human. Track maintenance has always required experienced people willing to work nights, weekends and public holidays, but the demographic trends now make workforce availability a structural problem rather than a recruitment inconvenience. Antony notes that future railway workforces are likely to include more employees entering from outside the rail sector, requiring faster and more structured training approaches. Hansmann argues that the industry's challenge is therefore not eliminating jobs, but ensuring that enough qualified people are available to perform them.

Therefore, the focus is shifting toward simplifying operations, supporting less experienced staff and maintaining consistent quality standards despite workforce shortages.



The Plasser TampingAssistant automates maintenance, supports operating staff, and delivers consistently high quality thanks to AI with deep learning, state-of-the-art sensor technology, and digital tamping plans.

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Building capability into the machine

At machine level, this is embodied in Plasser SmartTamping technology, including the Plasser TampingAssistant system, which operates as a structured human–machine workflow rather than a fully autonomous process. Antony describes a development path that began approximately 10 years ago. Initial automation focused on positioning working units, while later developments concentrated on setting the correct work parameters. Machines are now increasingly capable of detecting ballast conditions and adapting treatment methods accordingly to optimise track geometry results.

The Plasser TampingAssistant scans and records track sections during working travel, detects and classifies obstacles and turnout components in real time, and calculates configurations for each tamping position based on the tamping plan and live conditions. Operators remain within the decision loop, confirming or adjusting recommended actions before execution. The integrated obstacle detection removes the need for a separate pre-measuring run, reducing possession overhead before physical intervention begins, and each completed action is automatically recorded – compiling a traceable operational history across the maintenance cycle.

The objective, Antony explains, is not to replace operators, but to redefine their role. Increasing automation is intended to take over repetitive and highly specialised tasks, allowing operators to focus more on supervision and decision-making. "Our idea is that the machine will take over more and more tasks from the operator," he says, "so that the machine supports operators in achieving consistently high-quality results." Less experienced personnel can achieve consistent, standards-compliant results across complex turnout conditions without the years of accumulated expertise that the current model demands. The ambition extends to the experience of the work itself. Railway maintenance must remain an attractive profession if operators hope to recruit and retain skilled employees in the future.

There is a safety dimension to this that the efficiency argument does not displace. Track maintenance takes place in live environments, with people operating where trains are still running on adjacent lines. Automated obstacle detection reduces the need for staff to work in dangerous positions around machines and helps mitigate risks associated with trackside inspections.

Hansmann sees this as part of a broader industry challenge. "In the future we won't have the people who can walk the track and have the knowledge to identify what they are looking at," he says. "We have to think about how we replace that capability."

As experienced specialists retire, railway operators are increasingly looking to automation and digital support systems to preserve critical engineering expertise and ensure consistent inspection and maintenance quality.

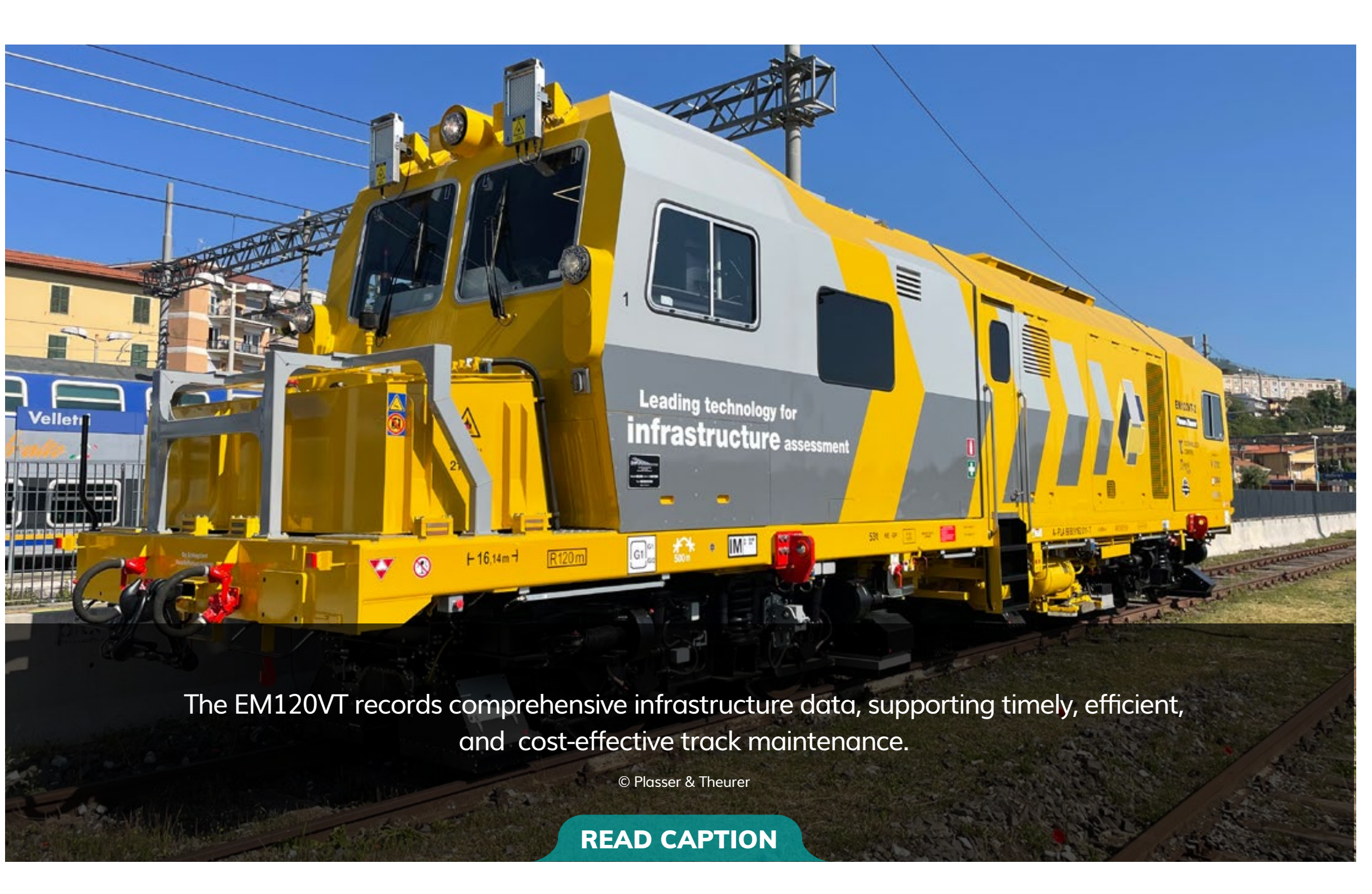
> *The question is not whether we need automation. The question is when we need automation – and the answer is: now*
>
> *Bernhard Antony, Director of Strategic Product Development, Plasser & Theurer*

The challenge beyond technology

Where machine capability is advancing, system integration remains uneven. Hansmann walks through the end-to-end maintenance cycle – condition monitoring, pre-measurement and work preparation, execution, post-measurement – and describes it as a process that digitalisation is beginning to connect, but that remains fragmented in practice. "We have to look at track maintenance as an overall process," he says. "And that means we have to open up our systems so that data from one step can actually flow to the next." The barriers are less often technical than organisational: overhead line maintenance and track maintenance may sit in different departments within the same infrastructure manager, with separate data streams that rarely converge.

According to Antony, the railway sector's structures and long-established procedures often slow the adoption of new technologies and working methods. Introducing automation therefore requires not only technical innovation, but also organisational change and a willingness to rethink established operational processes. He sees cost pressure as the factor most likely to shift that. "We are facing increasing costs. And by using the end-to-end process and the knowledge we can gain from it, we could reduce costs significantly – because we could combine different maintenance actions in one time window. But this is only possible if we have done one measurement across the whole track and looked at all the conditions: where we need to do something on the rail, where there is a soft spot, where work is needed on the overhead line. That will only be possible if we work and think end-to-end."

Regulatory complexity adds another layer of difficulty. Vehicle homologation and approval processes are becoming increasingly demanding, potentially slowing the introduction of innovative maintenance technologies. While European standards frameworks are designed to create interoperability and consensus, Hansmann argues that they can also limit flexibility and slow the implementation of tailored solutions. "By definition, it cannot be the best solution for every individual case," he explains. As a result, balancing standardisation with innovation remains a key challenge for the future development of railway technologies. Antony adds that safety considerations naturally reinforce institutional caution. Because railways operate within highly safety-critical environments, organisations are often reluctant to modify established rules and procedures, particularly when accountability for change remains unclear.



The EM120VT records comprehensive infrastructure data, supporting timely, efficient, and cost-effective track maintenance.

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Research, adaptation and the global footprint

Despite these constraints, Plasser & Theurer's development model is explicitly international. Antony highlights research partnerships in countries including Austria, Germany, Japan and the United States, allowing the company to better understand differing operational environments and infrastructure conditions.

"We have understood that in principle the work is the same everywhere – we have ballast, sleepers, rails," he says. "But if you look at the details, you find a lot of differences."

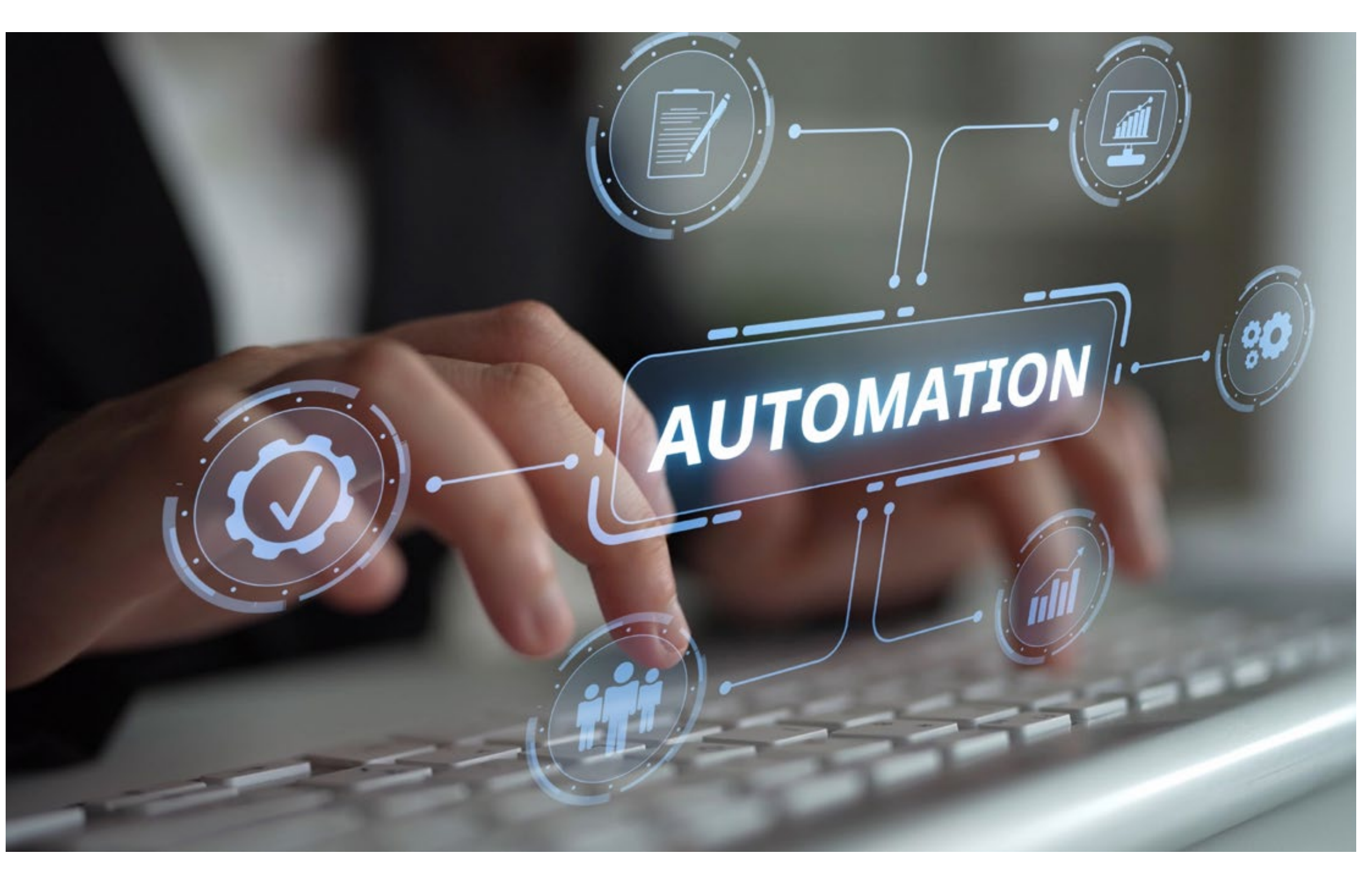
Although the core principles of railway maintenance are globally similar, regional differences in regulation, operating practices and infrastructure design require local adaptation. Understanding these differences is essential for improving maintenance technologies and optimising machine performance.

Hansmann describes this as a combination of global expertise and local presence. Railway operators generally expect suppliers to adapt technologies to local requirements rather than redesign operational practices around imported solutions.

"It's a combination of local footprint and global knowledge," he says. "You have to understand the local demands, because the railroads will not change their requirements for you. You have to adapt your technology to their market to their needs."

While core railway infrastructure elements may be similar worldwide, operational conditions differ significantly between regions. A tamping machine designed for European mixed-traffic corridors, for example, faces very different requirements from equipment used on North American freight railroads.

According to Hansmann, close collaboration with local railways and region-specific development are therefore essential to delivering effective and scalable railway solutions.



Automation as necessity rather than option

Looking ahead, both see automation less as an opportunity and more as an inevitability. "The question is not whether we need automation," Antony says. "The question is when we need automation – and the answer is: now."

As experienced engineers retire across the sector, the tacit understanding of how track systems behave risks being lost. "At least in Austria, a lot of people will retire in the next years," Antony says. "Somehow we have to ensure that with these retirements, we don't lose the knowledge that we need for the railway – because if you are a new person, how should you know that changing one thing in the system can create a problem somewhere else that seems completely unrelated? The old engineers have that in their fingertips. The new ones don't."

Hansmann closes on the fundamental point. "It's not about reducing jobs, it's about empowering people to get more out of the machines in less time. We want to run more trains, we want to run them safely. It's simply about using automation – in analysing data, in running maintenance operations, in doing track surveying. It's about how we can do more with the system we have."

Plasser & Theurer