

INFORMER



INTO THE FUTURE

Knorr-Bremse at InnoTrans 2022

DOING THINGS DIFFERENTLY

Technological advances with the Innovation Cell™

HIGH SPEED

High-speed train platforms rely on Knorr-Bremse

EDITION
55

August 2022 – the Customer Magazine
of Knorr-Bremse
Rail Vehicle Systems



KNORR-BREMSE

Contents

EDITORIAL

- 03** Mario Beinert
Member of the Management Board,
Knorr-Bremse Systeme für
Schienefahrzeuge GmbH

NEWS

- 04** Urban mobility in North America – major orders
from the US passenger sector
- 06** Commissioning support with rig testing
- 07** New rapid E-bus system for Italy
- 07** Braking equipment for DB 20 locomotives
- 08** Digitalizing field service
- 09** Knorr-Bremse at the European Mobility
Expo in Paris

SPOTLIGHT

- 10** Knorr-Bremse at InnoTrans 2022
- 12** Conversation with Dr. Jürgen Wilder –
Future mobility issues and expectations
of InnoTrans
- 14** Knorr-Bremse’s InnoTrans presence
- 18** Encouraging a pioneer spirit – the Knorr-Bremse
Innovation Cell™

CUSTOMERS + PARTNERS

- 22** Flying along the track – Knorr-Bremse
as an enabler for high-speed projects
- 26** Shorter headway times, greater punctu-
ality – practical testing of Reproducible
Braking Distance (RBD)

PLEASE ALSO TAKE NOTE OF OUR ENCLOSED SPECIAL SUPPLEMENT ON INNOTRANS

Information for
Knorr-Bremse’s customers
and business partners

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PUBLISHER
Knorr-Bremse
Systeme für
Schienefahrzeuge GmbH
Marketing
Katharina Bachem,
Birgit Kuhn
Moosacher Straße 80
80809 Munich
Germany
Tel. +49 89 3547-0
rail.knorr-bremse.com

REALIZATION
Knorr-Bremse Services GmbH
Corporate Marketing
Nathalie Goldhacker
LAYOUT, GRAPHICS
Knorr-Bremse Services GmbH
Corporate Marketing
Anna Lilakewitsch
TEXT
Thorsten Rienth
PRINTED BY
Weber Offset GmbH

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informer.muc@knorr-
bremse.com

Dear Reader,

Development projects in the rail sector are currently facing something of a dilemma: On the one hand, they need to be designed to accommodate digital features and functions – including some that are still just bright ideas in the heads of the development engineers. Compared with previous generations, products, systems and trains are now expected to offer significantly improved performance. But at the same time, customers want them to be less complex and to emerge from production facilities in significantly shorter cycles.

In the past, our industry did well with the conventional approach to product and systems development – indeed, the European Union declared rail transportation to be a central pillar of its European Green Deal. But yesterday’s approach doesn’t fit the bill when faced with tomorrow’s requirements. That is why at Knorr-Bremse we have been trying out a new, unusual approach to behavior-oriented innovation management. The key concept here is the Innovation Cell™. You can read all about it – and what the future holds – on pages 18 to 21.

Focusing on the future is also a feature of many other articles in this edition. One example is the Knorr-Bremse Reproducible Braking Distance (RBD) development program, the purpose of which is to significantly reduce braking distance variation – thereby establishing the basis for a significant increase in rail infrastructure utilization. On pages 26/27 you can read about the results of the first real-life study of the impact of this approach on a specific urban transport network.

Braking systems for the “Velaro” trains ordered by Egyptian Railways are also future-proof: Knorr-Bremse is currently developing an ingenious new design that protects them from large quantities of swirling desert sand (pages 22 to 25).

You will also be able to learn more about the future of the rail industry at the InnoTrans trade fair in Berlin from 20 to 23 September – so it is logical for us to focus on this highlight of the year in our current edition (pages 10 to 17) and with an extra supplement. It suffices to say that Knorr-Bremse is coming to Berlin with a new booth concept that is bristling with innovations for tomorrow’s mobility!

As usual, this edition of the informer also contains an entry ticket to InnoTrans in the form of a voucher code.

We look forward to welcoming you to our booth!

Best wishes,

M. Beinert

Mario Beinert



MARIO BEINERT,
Member of the Management Board, Knorr-Bremse
Systeme für Schienenfahrzeuge GmbH

Mario Beinert joined the management team at Knorr-Bremse Rail Vehicle Systems at the start of April 2022. He succeeded Mark Cleobury, who will in future take on an advisory role for management. Having worked for the Rail Vehicle Systems division since 2012, Beinert previously served as Vice President of RailServices for four years, during which time he successfully developed it as a service partner for the global rail sector.

Innovative technologies and systems competence from a single source

Knorr-Bremse Rail Vehicle Systems offers an impressive variety of customized solutions for braking and onboard systems.



Braking Systems



Entrance Systems



Climate Control
Systems



Power Electrics



Control Systems
/ TCMS



Digital
Solutions



Lifecycle
Management



Electrical
Systems



Wiper / Wash
Systems



Driver
Assistance



Sanitary
Systems



Coupling
Systems



Signaling
Systems

Urban mobility in North America

Knorr-Bremse wins major passenger transit contracts in the United States. Knorr Brake Corporation is to equip Amtrak Intercity passenger trains, Washington D.C. metros and MARTA metros.

Over the last year, Knorr-Bremse's US subsidiary Knorr Brake Company (KBC) has been busy signing contracts and securing new business. Early last year, KBC and Stadler US Inc. received a contract for 224 metro cars for the Metropolitan Atlanta Rapid Transit Authority (MARTA), including an option for an additional 100 cars.

The contract includes bogie-mounted brake equipment, the Piston-Supply Eco (VV80-T™) oil-free compressor air supply system and converters developed specifically for US metro trains. The brake control and wheel slide protection systems will be linked to the Train Control and Management System (TCMS) via a platform developed by Knorr-Bremse subsidiary Selectron.

CubeControl orders span coast to coast

In 2018 KBC secured the first CubeControl order for the North American market in Los Angeles with LA Metro (HR4000). This year, on the East Coast, the second order has been secured for the WMATA 8000 series. The contract with Hitachi Rail includes 256 base cars and options for a further 328 vehicles for the Washington D.C.-based Washington Metropolitan Area Transit Authority (WMATA). WMATA trains have been equipped with Knorr-Bremse braking systems for many years – including the 2000, 3000, 5000, 6000 and 7000 series vehicles.



SEPARATELY DRIVEN
DOOR LEAVES
save valuable seconds
at station platforms.

This latest order also includes Knorr-Bremse HVAC and door systems. The new door technology, Linear Drive entrance systems, provides independently-driven door leaves, which on busy platforms can save valuable time by speeding up the flow of passengers. Extensive testing for the Linear Drive entrance system was conducted under the challenging conditions of the New York Metro.

Braking, HVAC and Sanitary systems for new Amtrak intercity trains

KBC has made a major breakthrough in the North American passenger car market. KBC will supply braking, air-conditioning and sanitary systems for a base order of 576 cars for Siemens Mobility's new Amtrak

Intercity trains. At least another 700 cars will follow as option orders. These cars will all be pulled by 215 new Amtrak ICT locomotives, also being equipped by KBC. Amtrak intends to use the diesel-electric trains on the North East Corridor as well as on the Pacific Northwest Coast in Washington State.

Test-rig testing supports licensing

Knorr-Bremse is using its in-house capacity in Munich to support Siemens with the certification of the new Deutsche Bahn ICE 3neo trains.

Deutsche Bahn is expanding its high-speed fleet with the ICE 3neo, the latest (Class 408) train from Siemens' Velaro family. DB has ordered 73 units. Although the new trains are based on a tried-and-tested platform, in recent years stricter licensing requirements (known as the 4th Railway Package) have been introduced for high-speed trains and especially for their braking systems. Fortunately, Knorr-Bremse has access to extensive testing capacity at its Munich headquarters. This will ensure that the verification required by the latest regulations for friction pairings and temperature calculations can be provided as quickly as possible. Time is of the essence, since the first ICE 3neos are due to enter service on the busy routes between North Rhine-Westphalia and Munich towards the end of the year.

"We are carrying out all the required friction pairing tests for the wheel- and axle-mounted brake discs", explains Knorr-Bremse systems engineer Stefan Aurich. "We are also performing the test runs for the more demanding new procedures for verifying temperature calculations." As a rule, what Aurich describes as the Company's "excellent test rig infrastructure" is available to help customers execute their projects. This includes meeting new verification requirements as in the case of the ICE 3neo.

The systems Knorr-Bremse has selected for the trains are based to a large extent on the tried-and-tested "Velaro D", which simplifies the approval process and ensures a short time to market. However, the air supply units and braking software have been improved – with the latter having some new features to facilitate its use.



TESTING INFRASTRUCTURE enables Knorr-Bremse to rapidly provide practical evidence, for example, of friction pairings.

© Deutsche Bahn AG, Steve Wiktor

New e-bus rapid transit system for Rimini and Riccione

Many Italian cities are investing in new e-bus systems with a view to offering visitors and residents rapid, comfortable and sustainable transportation. In this context, the popular tourist region on the Adriatic coast between Rimini and Riccione has now launched a new e-bus rapid transit system (eBRT) with in-motion charging (IMC®). Operator START Romagna SpA has bought nine 18-meter buses from a consortium formed by Kiepe Electric and Belgian bus and commercial vehicle manufacturer Van Hool. IMC® technology means the vehicles have an unlimited operating range and their HVAC systems can ensure pleasant interior temperatures at all times.

The city of Milan is also making rapid progress with the introduction of an emission-free mass transit system: Operator ATM Milano has ordered a further fifty 18-meter buses with IMC® technology from manufacturer Solaris. Once the last of the "Trollino" trolley-buses are delivered during the first half of 2024, there will be a

total of 125 e-buses equipped with Kiepe Electric traction systems in the ATM fleet. They will operate on a circular line around downtown Milan, with the IMC® system drawing 200 kW of energy from the overhead line during operation to charge the modular traction battery – enabling the buses to continue beyond the limits of the catenary system, and avoiding the need for lengthy charging times at the terminus.



NEW E-BUS WITH IN-MOTION CHARGING in the Rimini holiday region has unlimited range.

Brake equipment for DM 20 locomotives

Despite the rail sector already operating with engines that conform to European Stage V standards for fuel consumption and reduced emissions, there is now an increasing interest in hybrid drive systems for rail vehicles. In this context Vossloh Locomotives has developed a new DM 20 hybrid locomotive for marshalling and freight operations. Whatever form of energy storage or generation – diesel, battery or hydrogen fuel cell – becomes established in the future, the modular D 20 platform is capable of integrating present and future technologies. Energy supply via the catenary system is also possible.

Vossloh Locomotives has already ordered a range of brake equipment from Knorr-Bremse for the first 100 of these hybrid locomotives, including brake calipers and discs, brake panels with the new generation of KEF



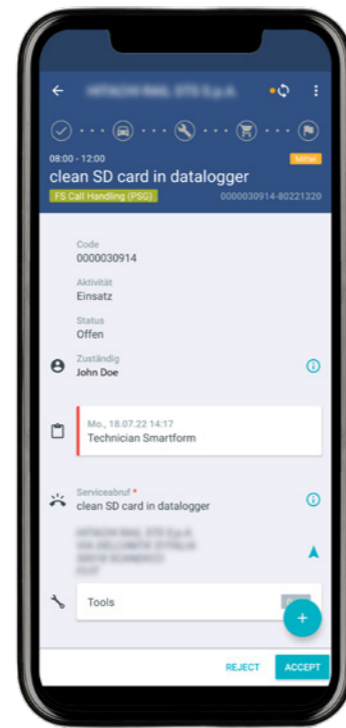
LOCOMOTIVE IN KIEL SEAPORT

control valve, oil-free compressors, air dryers and cab equipment. The order placed by Vossloh is a first in two respects: A 26-inch version of the RZT brake caliper is being supplied for the first time; and the brake panel developed for the DM 20 has a directly integrated, ethernet-capable control system.

Digitalizing field service – new management tool in Suzhou

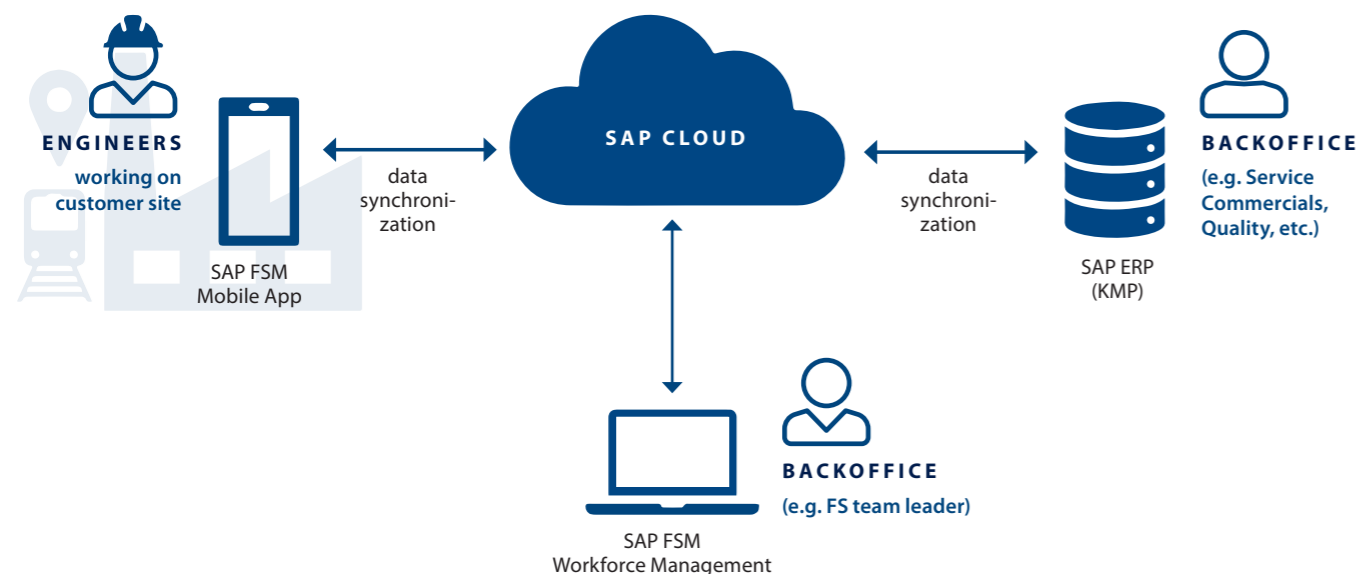
In line with the principle of “always close to the customer”, Knorr-Bremse currently has more than 760 field service technicians operating all over the globe. This number has grown steadily over recent years, prompting the Company to standardize and digitalize the associated field service management process. The result is that all information and data collected during field service activities is now available in a standardized and centralized form. This new SAP tool is currently being rolled out worldwide, following successful testing at Knorr-Bremse’s Suzhou, China, site.

The cloud- and browser-based tool is based on the SAP field service management application and, starting with the initial customer contact, bundles all field service activities into a single, end-to-end process. The goal is to achieve uniform processes worldwide, and a faster internal information flow that speeds up customer order processing, as well as globally standardized and comparable quality data that enables ongoing monitoring of product quality. In particular, an entirely new method of collecting data will significantly increase the quality of feedback on product performance in use. As well as offering suggestions for country-specific product improvements, this information can help optimize overhaul intervals (condition-based maintenance). Functions already in operation are Planning & Dispatching, Smartforms & Feedback, Analytics & Reporting, and Mobile Field Service Management. Going forward, the tool offers potential for expansion to include a “Customer Self Service” function.



MORE RAPID processing of customer orders thanks to new SAP Field Service Management tool.

SAP FIELD SERVICE MANAGEMENT COMPONENTS



Knorr-Bremse at the European Mobility Expo

In early June, colleagues from Knorr-Bremse Rail Vehicle Systems’ two French facilities in Tineux and Lisieux, together with representatives of the three business units Braking, Entrance and HVAC Systems, and of Kiepe Electric, Selectron and Rail Vision – in other words virtually the whole of Knorr-Bremse’s rail business – came to Paris to present the Group’s latest innovations at the European Mobility Expo. In particular the RailServices roadshow truck drew the attention of visitors in the French capital.

Bristling with exhibits and digital displays of Knorr-Bremse’s expertise, it was visited by scores of top industry decision-makers, especially from the French mobility sector. Prominent visitors included Louis Nègre, President of the French rail body Fédération des industries ferroviaires (Fif), accompanied by Jean Castex, who until mid-May had been France’s Prime Minister. In particular the LEADER driver advisory system, with its functions designed to encourage energy-efficient train operation, generated huge interest amongst the visitors.



JEAN CASTEX, ERIC TASSILLY AND LOUIS NÈGRE at the RailServices truck roadshow in Paris

INNOTRANS 2022

 **KNORR-BREMSE**
 **MICROELETTRICA**
COMETFANS
Hall 5.2, Booth 700

 **ZELISKO**

Hall 25, Booth 120

Europe's Rail Joint Undertaking:
Europe's Rail

Hall 27, Booth 511

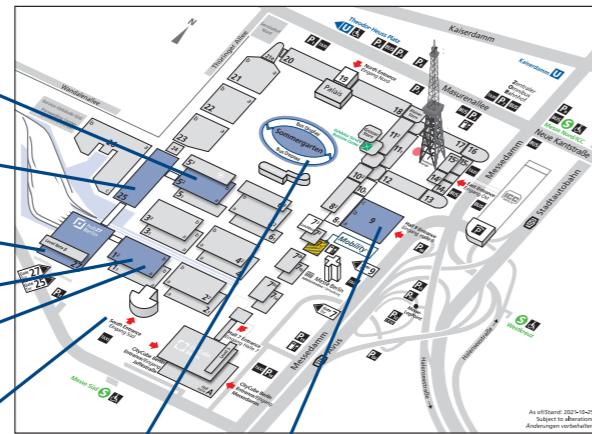
 **KNORR-BREMSE**

Hall 1.2, Booth 250

 **nexxiot**

Hall 1.2, Booth 560

 **MERAK**
DB Ideas Train: Outdoor Display O/1,
South Entrance

 **EVAC**

 **KIEPE ELECTRIC**
Bus Display B/340, Sommergarten

 **Rail Vision**
Hall 9, Booth 455

Knorr-Bremse at InnoTrans 2022

After a gap of two years caused by the pandemic, InnoTrans is once again making Berlin the top meeting place for the global rail industry – from 20 to 23 September, 2022.

The main presence of the Knorr-Bremse Group will be in **Hall 1.2, Booth 250**, but the Company will also be found elsewhere:

Energy, Signaling Systems and Traffic Management Systems specialist Zelisko will be presenting its products in **Hall 25, Booth 120**.

Microelettrica and Cometfans are exhibiting in **Hall 5.2, Booth 700**.

Group companies Evac and Merak have a joint presence in the **Deutsche Bahn "Ideas Train" in front of the South Entrance**.

Kiepe Electric can be found in the **bus display B/340 in the "Sommergarten"**.

Knorr-Bremse is making a guest appearance at Europe's Rail Joint Undertaking (ERJU) in **Hall 27, Booth 511**.

And Rail Vision, Knorr-Bremse's partner for rail vehicle obstacle detection systems, will be in **Hall 9, at Booth 455**.



“The mobility sector is undergoing a systemic transformation”

DR. JÜRGEN WILDER has been a member of the Executive Board of Knorr-Bremse AG since September 2018, and is responsible for the Rail Vehicle Systems division. With a doctorate in Physics, he was previously CEO of DB Cargo, where he oversaw global rail freight operations.

In conversation with Dr. Jürgen Wilder

Knorr-Bremse's answers to the most pressing mobility issues of the future – and the Company's expectations as it attends the world's biggest rail industry trade fair, InnoTrans.

Dr. Wilder, it's been four years since the last InnoTrans trade fair. Now the rail industry is coming together again in the German capital. What are you most looking forward to?

I often find myself thinking of our industry as one big family. When you haven't seen each other in a while, you really enjoy meeting up again. Especially this year! While we've all made personal progress over the past couple of years, many of us have only been able to meet virtually after the pandemic forced the cancelation of the last trade fair. At the same time, the industry has made huge strides forward, many of them in the form of pioneering innovations. I'm very much looking forward to discussing these developments with our colleagues and partners – not least because we'll finally be talking to each other in person again.

This year's trade fair is happening at a time of profound change for the entire rail sector ...

... that's quite right. On the one hand, the whole world needs to drastically cut carbon emissions. On the other, there's a steadily growing demand for passenger and freight transportation. That's why the rail sector in particular is so relevant to so many global systems – and why it's coming under so much pressure to change. We need highly innovative solutions to make rail travel and transportation more reliable, more connected, safer and cleaner – as well as more comfortable and efficient. On our stand at the trade fair, we've created a whole experience to showcase the many ways Knorr-Bremse is tackling these challenges and helping to overcome them.

The Knorr-Bremse trade fair stand is focused on four solution spaces. What's the idea behind this approach?

We believe it's vital to focus on the big picture. That's why we've arranged our responses according to the four major challenges currently facing rail mobility – challenges that are inextricably linked to the needs of rail vehicle manufacturers and operators. First, how can they cut energy consumption and emissions and so reduce their environmental footprint? By choosing our new climate control solutions, for example, or our on-demand (hence much more energy-efficient) air supplies for braking systems. Second, how can they boost their traffic flow and streamline passenger flows? By opting for our continually evolving braking technologies or cutting-edge entrance systems. Third, how can they raise the efficiency of their train operations and maintenance to a whole new level? By using our process optimization and remote diagnostics tools. And finally, because digitalization and new

technologies are more interdependent than ever before, we're offering Smart Solutions for all these core areas of activity, in the form of smart applications, functions and services.

What does all this mean for customers?

It means we're well aware that there's no such thing as a standard, one-size-fits-all solution. That's why we're offering our customers an ecosystem of assets – to enable them to put together their own tailored, optimized package of solutions by selecting products, systems and services from all four of our solution landscapes. The defining issues here are automation, connectivity and big data. We've ensured that our entire ecosystem is tightly integrated, based on end-to-end compatibility. Anyone who buys from us is effectively taking the risk out of their portfolio.

What developments is Knorr-Bremse backing to ensure that rail remains competitive in certain areas, and becomes competitive in others?

Digitalization and automation are opening the floodgates to major surges of innovation, which we'll see over the next few years. Very soon, there won't be any train functions left that aren't based on fully integrated digital sub-systems. With our in-depth knowledge, our domain-specific skills in mechanical engineering and mechatronics, and our digital expertise, we're ready to take the next big steps forward. Trains fitted with our Reproducible Braking Distance (RBD) system will brake more precisely than ever, even in adverse conditions. This means that the frequency of train services can be increased, so more people can travel on existing lines. And with our digital freight train, we're driving forward the – urgently needed – transformation of the rail freight sector. Our automated solutions and processes, such as the Digital Automatic Coupler (DAC), are making rail freight more predictable, faster and more flexible – and those are the key attributes of the end-to-end mobility chains that will be so important in the future.

Final question: Where do you see the rail industry in ten years' time?

The mobility sector is undergoing a systemic transformation. Large parts of our rail infrastructure were built in the middle of the last century – and then underfunded for decades. But now governments have started reinvesting in a strong, efficient rail sector. And so they should, because our existing rail networks have enormous potential. Politicians, businesspeople, the general public – so many people have already seen the signs and realized that sustainable mobility should rely on a rail-based backbone. Soon, it will be axiomatic. So when I think about the future of the rail industry, I feel no anxiety at all – quite the opposite, as it happens!



VISUALIZATION OF THE KNORR-BREMSE TRADE FAIR BOOTH

Knorr-Bremse at the trade fair

Natural landscapes don't change abruptly – they merge seamlessly into one another. And the same applies to innovations for tomorrow's mobility market: Solutions don't develop in isolation – they complement, intensify and reinforce each other.

Knorr-Bremse nurtures its own solutions landscape with highly innovative products, systems and services. The underlying vision is one of a smooth, seamless flow of vehicles and fleets, people and goods, ideas and inspiration.

The leitmotif of the Company's exhibition booth is the future of mobility. The goal is to optimize rail's **ecological footprint**, improve **traffic flows**, and increase the efficiency of **train operations and maintenance processes**. All this can be achieved through **smart solutions** based on networkable sub-systems, functionalities, services and applications that can be tailored to individual requirements.

Get into the flow at the Knorr-Bremse booth 250 in Hall 1.2!



IN THE INNOTRANS SUPPLEMENT YOU WILL FIND SHORT, INFORMATIVE EXPLANATIONS OF THE

Ecological Footprint Smart Solutions

Ecological Footprint is about making green train operations even greener: for example with clean, efficient HVAC systems or a paradigm change in compressed air supply.

Smart solutions mean across-the-board digitalization of vehicles and fleets: digitalized functions and smart services are the key to future-proof rail operations. From autonomous functionality to fully-integrated systems – the operator can choose the degree required.

MAIN PRODUCTS, SYSTEMS AND SERVICES ON DISPLAY AT THE KNORR-BREMSE BOOTH.

Train Operations & Maintenance Traffic Flow

Train Operations & Maintenance covers the totality of innovations introduced by Knorr-Bremse RailServices to boost the efficiency of vehicle operations: optimized processes and extended life cycles, for example using remote diagnostics and predictive maintenance.

Traffic Flow refers to improving the dynamics of rail passenger and freight transportation: for example by reducing periods between successive trains using Reproducible Braking Distance, installing entrance systems that speed up boarding/deboarding processes, or creating the Digital Freight Train for greater efficiency and availability.



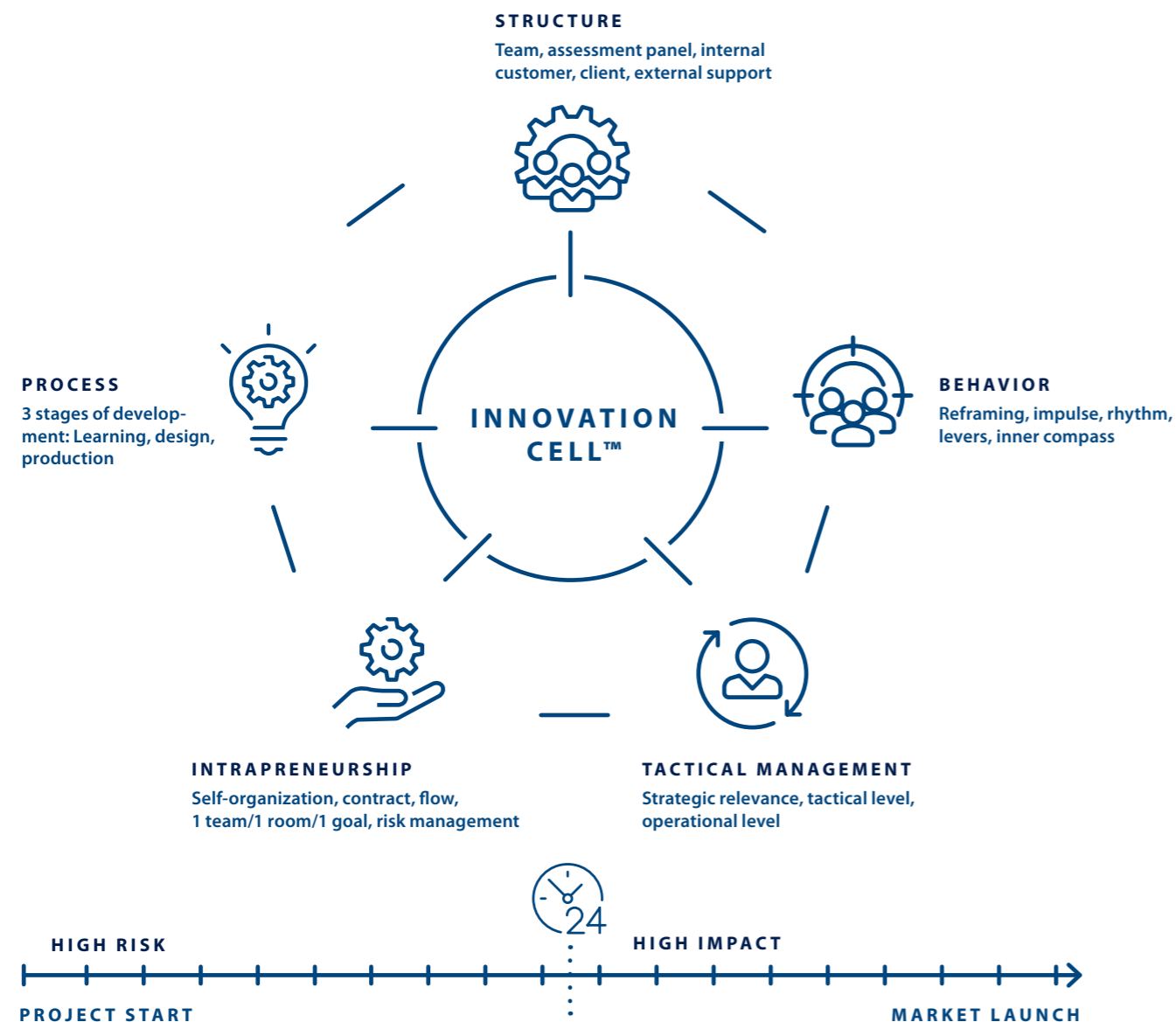
A cellular approach to innovation

Knorr-Bremse is piloting a new method of tackling challenging innovation problems: the Innovation Cell™. The aim is to significantly reduce idea-to-market time for our products and systems.

Incremental product development is no longer enough in today's world. We need to meet the requirements of a digitalized future, deliver significant efficiency and performance gains and bring innovations to market much faster. The new products and systems we develop must also be less complex, more flexible, more reliable and cheaper than the previous generation.

The Innovation Cell™ is a radical methodology that can help meet these challenges. It employs behavioral innovation management to achieve a paradigm shift: A temporary, cross-functional, high-performance team develops new ideas, concepts and solutions – and is given everything it needs to develop genuine breakthroughs.

A TRIED-AND-TESTED APPROACH TO DEVELOPING GROUNDBREAKING SOLUTIONS



The process has an innovative structure guided by fixed parameters. On Knorr-Bremse's side, an agreement setting out the targets for the new generation of braking products provides the starting point for an eight-day workshop. This binding agreement is signed by the external customer who places the order and by the internal customer. An Innovation Cell™ now engages in a form of development process comprising a learning phase followed by a design phase and a production phase. In order to ensure a customer-focused perspective, the team includes customer representatives and external experts. Regular feedback from an assessment panel provides guidance and new ideas.

At the end of the process, the solutions developed by the Innovation Cell™ are submitted for approval by the internal and external customers, who then decide on the next steps.

“More agile, bolder and more focused”

We put three questions to Mark Gilbert of the Rail Vehicle Systems division's innovation management team, who was responsible for organizing Knorr-Bremse's first Innovation Cell™.

Let's begin with a provocative question:

Why do we need yet another new architecture and product development methodology?

The Innovation Cell™ approach isn't an end in itself, but is actually quite a radical approach for Knorr-Bremse. Genuine quantum leaps in technology are now often needed in order to meet the extremely demanding requirements of new products and systems. But you can't leap a little bit at a time, which is why we have adopted this disruptive methodology.

Let's stick with the same metaphor: What prompted Knorr-Bremse to take the leap and introduce the Innovation Cell™?

Several things. Firstly, we needed to make a leap like this for our “Evolution of Braking”. Secondly, we needed to significantly reduce our idea-to-market time. And thirdly, we needed to ensure that our systems remain manageable and don't become over-complex, despite our constantly adding new functionality to them.

There is no doubt that our old methods worked well, but our established processes are now reaching their limits. We need to become more agile, bolder and more focused. That's why the Innovation Cell™ team goes offsite for eight days so it can fully focus on the task at hand. If everyone worked onsite as usual, the same process would take weeks or even months, and the outcome would be uncertain.

So it's about striking a balance between focusing on outcomes and having the freedom to think out of the box before actually implementing anything?

Absolutely. But the fixed workflow serves as a guide. The three phases steer the team through a learning and gestation process, ensuring that the solutions they ultimately come up with are well thought-out, robust and viable. But they also leave room for open discussion, which is absolutely essential. We start by looking at the task we have been given from every possible angle, so we are sure we fully understand it. The agreed targets provide a stable framework. This helps management to “let go” and give the team genuine responsibility. The team is fully empowered to take all the relevant decisions itself.

I'm not going to pretend that working like this for eight days on the spin isn't pretty full-on – it's a real adventure. But, by its very nature, it means the team goes through all the team-building phases and becomes a genuinely high-performance unit. This setup reduces the risks in the innovation process, such as a lack of resources, time or commitment to finding a solution. For me, the striking thing about our first “cell” is the wider impact of this nucleus of change. We are starting to see tangible changes in the rest of the organization around it.

We are also directly involved in implementation: The methodology, its results and ambition have ultimately persuaded management to invest in concrete implementation and devote key resources to it. The relevant activities have already begun.

Flying by rail

Europe, North Africa and North America are all investing in high-speed rail. Knorr-Bremse is extensively involved in Siemens Mobility's Velaro and Alstom's Avelia vehicle platforms, which are major enablers for putting these plans into practice.



© Siemens Mobility GmbH

The three-billion-kilometer train

The new Velaros for Deutsche Bahn will be equipped with Knorr-Bremse eddy-current brakes and a higher quantity of IFE entrance systems than other ICE trains. Meanwhile, Knorr-Bremse engineers are working on a new desert terrain solution for use in Egypt.

Siemens Mobility can now draw on three billion kilometers of experience. That is the total distance covered to date by the vehicle manufacturer's Velaro high-speed platform, the equivalent of almost 80,000 journeys around the equator.

The platform is in use all around the globe, from Spain and the Eurotunnel between France and England to Turkey, Russia and China.

The latest major order from Egypt extends the Velaro fleet's global footprint even further, while an order from Germany will boost capacity on the German network.

220,000 seats in 421 trains

The first Velaros ordered by Deutsche Bahn are due to enter service under the brand "ICE 3neo" name by the end of 2022. In total, 73 of these vehicles will progressively be introduced to strengthen Germany's long-distance intercity services. Capacity will also be increased on several international routes. According to the operator's website, "By the end of 2026, our long-distance fleet will provide a total of 220,000 seats on 421 trains."

Capable of speeds up to 320 km/h, the trains will be equipped with Knorr-Bremse braking systems. "One of their highlights are the silent and wear-free eddy-current brakes based on induction technology", says Senior Project Manager Michail Gecht of Knorr-Bremse's high-speed business. It hasn't been easy to integrate them into the vehicle's energy design. "But, in conjunction with intelligent brake manage-

ment, the technology significantly reduces brake pad wear." The ICE 3neo is equipped with a higher quantity of IFE entrance systems than other ICE trains, with 12 entrances on either side, including one wheelchair-friendly one. The fast-closing, pressure-tight systems supplied by Knorr-Bremse Group subsidiary IFE have already proved to be some of the most reliable doors in the existing "white fleet" of ICE trains. In addition, they are key to the intelligent management of passenger flows on platforms, and also help to enhance on-board passenger comfort.

A new Suez Canal – on rails

For the braking systems of at least 15 Velaros ordered by the Egyptian National Authority for Tunnels (NAT)

Knorr-Bremse is developing special braking systems adapted to the harsh environment of North Africa. As Gecht explains, "Large stretches of the planned route between the Mediterranean and the Red Sea pass through desert terrain". This means that the systems must be able to cope with large amounts of swirling sand.

Knorr-Bremse is using a new approach to tackle this challenge. "In the past, the focus was on sealing the systems as effectively as possible", says Gecht. "But the design we are currently working on is actually open to the environment at certain carefully chosen key points. This means that any sand that enters can find its own way out again." The Velaro order from Egypt is an important landmark: "With this order, the platform will soon be in use in all climatic conditions, making it a truly global train."



© ALSTOM SA_SPEEDINNOV SAS 2020 . D&S / AVELIA Horizon™

Heading for the horizon

Alstom's new Avelia Horizon from the Avelia platform will soon be entering service in France branded TGV M, while the Avelia Liberty trains derived from the same platform are also in demand in North America. Knorr-Bremse is supplying multiple systems.

When the French state-owned rail company SNCF ordered the TGV M from Alstom, it was still known under its former project name "TGV 2020" or "TGV du futur". The specifications for the new vehicle were both ambitious and groundbreaking. SNCF wanted to increase seating capacity by 20% without compromising on comfort or increasing the overall length of the train. They also wanted to reduce its carbon footprint by 37%, its acquisition cost by 20% and its maintenance costs by 30%. And all this was to be accompanied by greater flexibility, interoperability and modularity.

In fact, the "M" in the train's name stands for "modularity". The trains can be configured as seven-, eight- or nine-car

sets. 1st-class seats can be converted into 2nd-class ones, and the train's interior can be reconfigured by removing or adding seats, bicycle spaces or luggage stowage. The first 100 SNCF units are already on order.

Knorr-Bremse has, with its experience, played a key role in making it possible to meet requirements such as greater flexibility, reduced energy consumption and lower maintenance costs despite the increased passenger capacity. Knorr-Bremse's Brake, HVAC systems and Power Electrics equipment are designed to ensure safe operation at all times, to support comfortable travel. They are seen as the benchmark in terms of reliability, maintenance costs and digital added-value, thereby helping to keep lifecycle costs as low as possible. Smart energy recovery during braking and an ultra-efficient HVAC system play a key role in reducing energy consumption.

Knorr-Bremse fulfils all Buy America requirements in the US

In North America, Amtrak will soon be using the Alstom Avelia's platform's Avelia Liberty export version to serve the Northeast Corridor from Washington D.C. to Boston via New York. The first of 28 eleven-car sets equipped with new tilting technology are due to enter passenger service early next year.

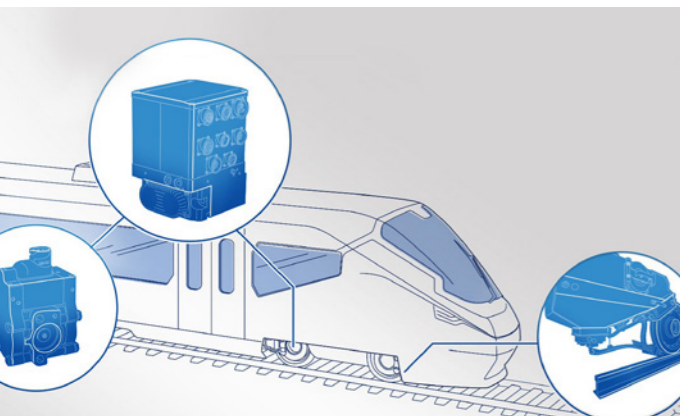
Knorr-Bremse is contributing braking systems and windscreen wiper and wash systems to this project, thanks in no small part to the Company's US Knorr Brake Company site in Westminster (Maryland). "KBC is the only high-speed braking system supplier that not

only meets the required US standards such as AAR and CFR, but also fulfils all the Federal Railroad Administration's Buy America requirements", explains Michael Gibbs, Director OE Sales at KBC. "This is the result of significant investment in our local production infrastructure, especially for air supply and brake control, but also an increase in our test rig capacity."

Following their production and final inspection in Westminster, the Knorr-Bremse systems are delivered direct to Alstom's production facility in Hornell (New York), some 300 kilometers away. The contract includes a service agreement for the braking systems with a minimum duration of 15 years, as well as the supply of spare parts and special tools.

More frequent, punctual train services

9 to 19% for metros, 1.5 to 4% for regional trains and up to 20% for high-speed trains in China. These were the theoretical headway reductions enabled by RBD on a dry track in generic simulations of typical operating conditions. The next step was to carry out a comprehensive study of the benefits in a specific mass transit network, focusing also on punctuality, especially under adverse track conditions.



INTEGRATED INTO RBD FOR THE FIRST TIME: newly-designed deceleration control, adaptive train-wide adhesion management and improved wheel-slide protection with optimal traction utilization.

Variations in rail vehicle braking distance are caused by differences in vehicle tolerances and characteristics, as well as by environmental factors. These include the brake pad/disc coefficient of friction, wheel diameter, load measuring tolerances and efficiency levels, as well as external factors like rain, dirt and autumn leaves. By compensating for these factors, trains can achieve statistically reproducible braking. Through the functions delivered by the Reproducible Braking Distance (RBD) development program, Knorr-Bremse aims to signifi-

cantly reduce braking distance variation, thereby helping to substantially improve rail infrastructure utilization and punctuality.

In 2019, Knorr-Bremse and the IFB Institut für Bahntechnik simulated the potential of RBD functions such as a new, integrated deceleration control (DCC) system, significantly enhanced wheel slide protection (WheelGrip Adapt) and an intelligently controlled sanding system. The simulations, which focused on generic transportation systems, showed that the RBD approach to improving statistical braking performance is particularly valuable in the context of ETCS and ATO. By optimizing both the ETCS and the ATO braking curves, it enables a direct reduction in the technical headway between trains.

Technical headway reduction range in a specific closed commuter train network averages 3% on dry tracks and 9% on wet tracks.

The logical next step, this time in cooperation with rail consultants NEXTRAIL and VIA-Con, was to demonstrate the potential for increasing capacity and improving operating quality by studying a specific case. A reference scenario and an RBD-optimized scenario based on the Hamburg commuter train network were simulated, and headways were calculated for both dry and adverse/wet track conditions.

The results of this study are of a similar order to the 2019 study. On a dry track, RBD can reduce technical headway by an average of 3% while also improving operating



WHEN TRAINS ARE RUN WITH SHORTER HEADWAY TIMES, more passengers can be transported using the same infrastructure.

quality. This gives an increase of 10% in average nominal capacity (1.5 trains per hour in each direction). The average technical headway reduction on a wet track was 9%. The simulation of the operating conditions on the Hamburg commuter train network found that these shorter headways could reduce uncompensated delays on a dry track by 18%. In adverse adhesion conditions – taking into account the higher headways required for defensive train driving – the simulation found that uncompensated delays could be reduced by more than half (57%).

When attempting to understand and contextualize these findings, it is important to note that the study simulated the behavior of the braking/adhesion management system as an input variable. The next logical step would be to demonstrate its technical feasibility.

Further research could also be carried out into other aspects. For instance, the Hamburg commuter train network model could be used to investigate the effect of lower RBD functionality penetration rates. This would make it possible to estimate how many vehicles would need to be equipped with RBD to deliver a given level of improvement. Following on from the simulations of a closed commuter train network, the benefits of RBD could also be analyzed for long-distance routes or routes with both commuter and long-distance services.

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