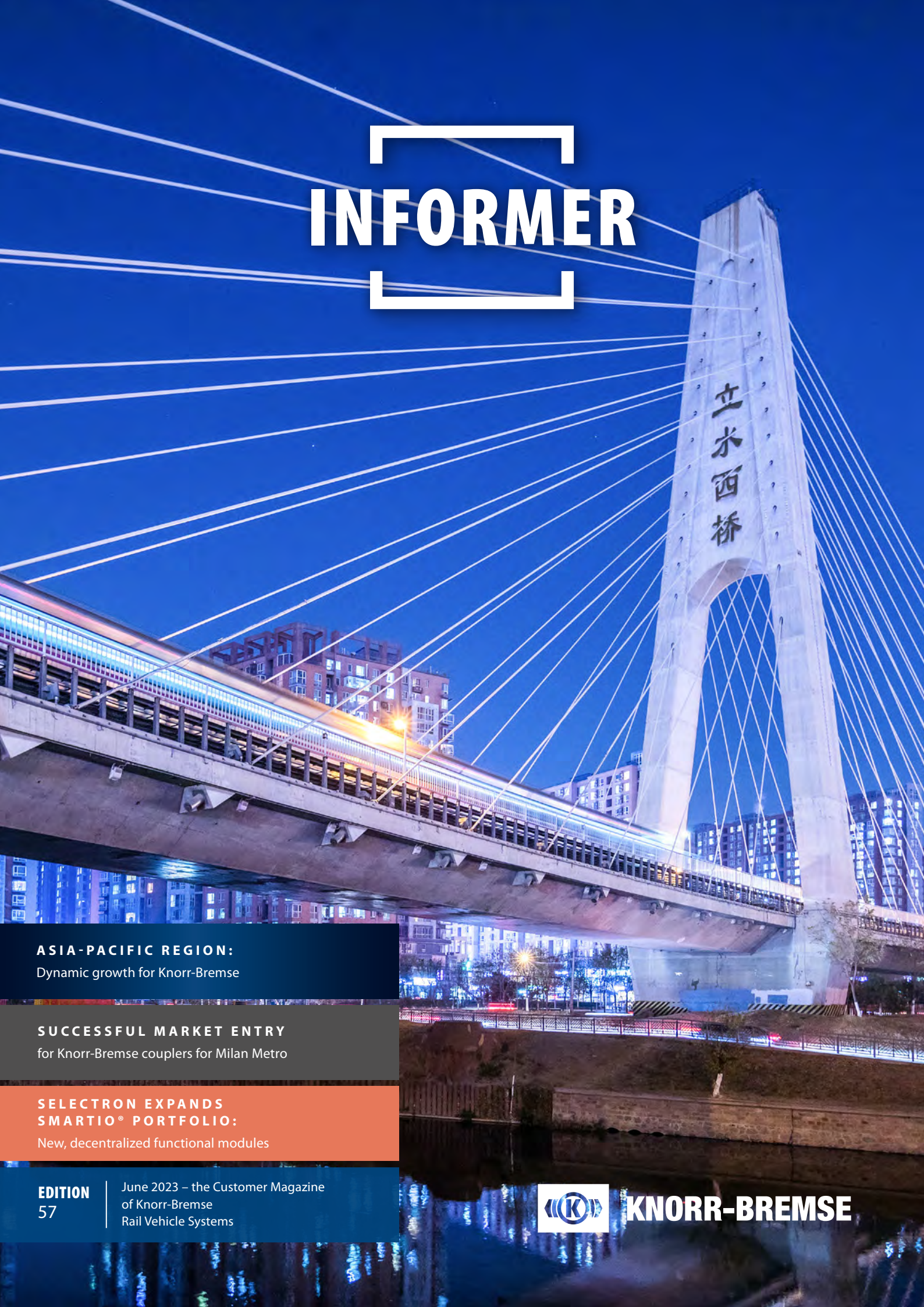
INFORMER



ASIA-PACIFIC REGION:
Dynamic growth for Knorr-Bremse

SUCCESSFUL MARKET ENTRY
for Knorr-Bremse couplers for Milan Metro

SELECTRON EXPANDS SMARTIO® PORTFOLIO:
New, decentralized functional modules

EDITION 57

June 2023 – the Customer Magazine of Knorr-Bremse Rail Vehicle Systems

KNORR-BREMSE

Contents

The first time I visited Asia was when I backpacked across the continent as a student in the late 1980s. I came home with a deep fascination for the different Asian cultures. Over the course of my professional life, Asia, and especially Japan, has become a kind of third home for me after the UK and Germany. I continue to be intrigued by the way cultures shape and influence technical problem-solving processes.

This brings me to the spotlight of our latest issue of informer, since it is equally fascinating to witness the passion for technology and innovation that characterizes our efforts to meet passenger and freight transport needs in the Asia-Pacific region. Knorr-Bremse has been an ever-present partner there for many years. Our company's history in this region exemplifies how technological excellence and an unfailingly positive attitude towards innovation mutually reinforce each other to deliver outstanding results. In this issue, we turn the spotlight on these synergies and the impressive outcomes they enable.

This issue also takes a look at various other flagship projects. In Milan, a collaboration with a prestigious manufacturer and a highly specialized technical coupling layout have allowed our coupler business to enter the metro market. TÜV SÜD has given us the green light to start testing our Digital Automatic Coupler (DAC) on the normal railway lines rather than just on test tracks. Field testing in Sweden is due to commence soon as part of Europe's Rail Joint Undertaking (ERJU).

Not all our products and systems are as visible as that. The new decentralized function modules of Knorr-Bremse's Selectron brand offer a range of benefits for vehicle manufacturers. The company's development teams have added wheel slide protection and pilot pressure controls and the counter input module to the Smartio® portfolio. This makes vehicle configuration very much easier. The wheel slide protection functionality constitutes a unique market feature that also significantly reduces operating costs. Hence, even systems that are not immediately visible can add considerable value!

I hope you find plenty to interest you in this issue of informer.

Dr. Jonathan Paddison

DR. JONATHAN PADDISON,
member of the Executive Board of Knorr-Bremse Asia Pacific

Information for Knorr-Bremse's customers and business partners

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Knorr-Bremse's global trade fair and conference schedule

Knorr-Bremse's local presence is not confined to its facilities and service centers in rail markets around the world. You can also visit us at one of our upcoming trade fairs or conferences and discover firsthand how our products and systems can add value. We look forward to speaking with you in person. You can also find a fully updated schedule at rail.knorr-bremse.com.

Trade fairs and events in 2023

Swissrail Mobility Day	Baden, Switzerland	May 23	May 23
Rise of IoT & Big Data in Rail Conference	Cologne, Germany	May 31	June 1
RailLog	Busan, Korea	June 14	June 17
Eurasia Rail	Istanbul, Turkey	June 21	June 23
Africa Rail	Johannesburg, South Africa	June 27	June 28
APTAtech Transportation Technology Conference	Anaheim, CA, USA	July 30	August 2
Railway Forum (IFE)	Berlin, Germany	September 6	September 7
EuroBrake	Barcelona, Spain	September 12	September 15
Modern Rolling Stock Conference	Graz, Austria	September 17	September 19
TRAKO	Gdansk, Poland	September 19	September 22
RSI Technical Conference at Railway Interchange (NYAB)	Indiana, USA	October 1	October 4
Expo Ferroviaria	Milan, Italy	October 3	October 5
APTA EXPO	Orlando, FL, USA	October 9	October 11
IREE – 15th International Railway Equipment Exhibition	Pragati Maidan, New Delhi, India	October 12	October 14
Alpine Rail Optimisation	Vienna, Austria	October 19	October 19
MassTrans Innovation Japan	Tokyo, Japan	November 8	November 10
AusRAIL PLUS	Sydney, Australia	November 13	November 16

Another DAC milestone

TÜV SÜD gives the green light to start field testing of Knorr-Bremse's Digital Automatic Coupler (DAC). Field testing is set to commence on rail lines in Sweden.

AFTER THE TESTS, TÜV SÜD and the European DAC Delivery Programme approved "FreightLink" (pictured with the prototype electric contact coupler) and gave Knorr-Bremse the go-ahead to test its DAC in a real-world setting.

With around 500,000 freight cars and 17,000 locomotives today that still have to be coupled manually, the automation and digitalization of the European rail freight sector represents a vast future market. However, taking advantage of this opportunity will require a Digital Automatic Coupler that couples the cars mechanically and pneumatically and also provides an interoperable power and data line. Knorr-Bremse already has a solution. Its "FreightLink" Digital Automatic Coupler (DAC) is at an advanced stage of development.

After three days of test runs at the Görlitz testing facility, during which a wide range of predefined criteria were assessed, an important milestone has now been reached. TÜV SÜD and the European DAC Delivery Programme have approved "FreightLink" and given Knorr-Bremse the go-ahead to test it on European rail lines outside of closed testing facilities.

This next test phase has now begun. As part of the EU research and technology program Europe's Rail Joint Undertaking (ERJU), "FreightLink" has now been installed on an intermodal train in Sweden. Between now and 2025, it will gather several hundred thousand kilometers of operational experience. The harsh winter conditions in northern Europe will provide an ideal test of just how tough this complex yet highly robust coupling system really is.

The system initially installed is the "Type 2" DAC. This couples the trains mechanically and pneumatically. The train will subsequently be upgraded to "Type 5", which enables remote uncoupling and numerous intelligent, telematic process automation functions in conjunction with the "FreightControl" system.

Rail Vision receives first commercial order

The high-tech company is to equip Israel Railways passenger and freight trains with high-performance electro-optical sensor and artificial intelligence systems – "Argus eyes" that are essential for automated train operation. Meanwhile, a proof-of-concept pilot program is underway in the USA.

ISRAELI RAILWAY TECH COMPANY RAIL VISION has won an order from Israel Railways to equip passenger and freight trains with high-performance electro-optical sensor systems that alert the locomotive driver in hazardous situations.

By the end of 2023, Rail Vision, in which Knorr-Bremse holds a 33 percent stake as part of a strategic partnership, is to supply ten of these high-tech systems to operator Israel Railways. Offering smart detection of potential obstacles such as people, vehicles and rolling stock from a distance of up to two kilometers, the systems not only help to significantly increase safety, efficiency and punctuality in rail operations but also form an important building block for the development of automated operation (ATO) of passenger and freight trains.

This is the first commercial order for Rail Vision and marks a milestone in the successful market launch of the systems, with their smart interplay of sensor technology, artificial intelligence and deep learning. Based in Ra'anana near Tel Aviv, Rail Vision has been gradually preparing its sensor systems for market launch in the course of numerous tests in Israel, Australia, the USA and German-speaking countries, amongst others. Intelligent networking of the sensor systems with the train braking system is another important development over which Knorr-Bremse and Rail Vision are collaborating.

Efficient switching operations

In the USA, Rail Vision is launching a proof-of-concept pilot program involving a leading US rail and leasing services provider. The customer has purchased Rail Vision's Switch Yard System with a view to carrying out a six-month field trial at their facility.

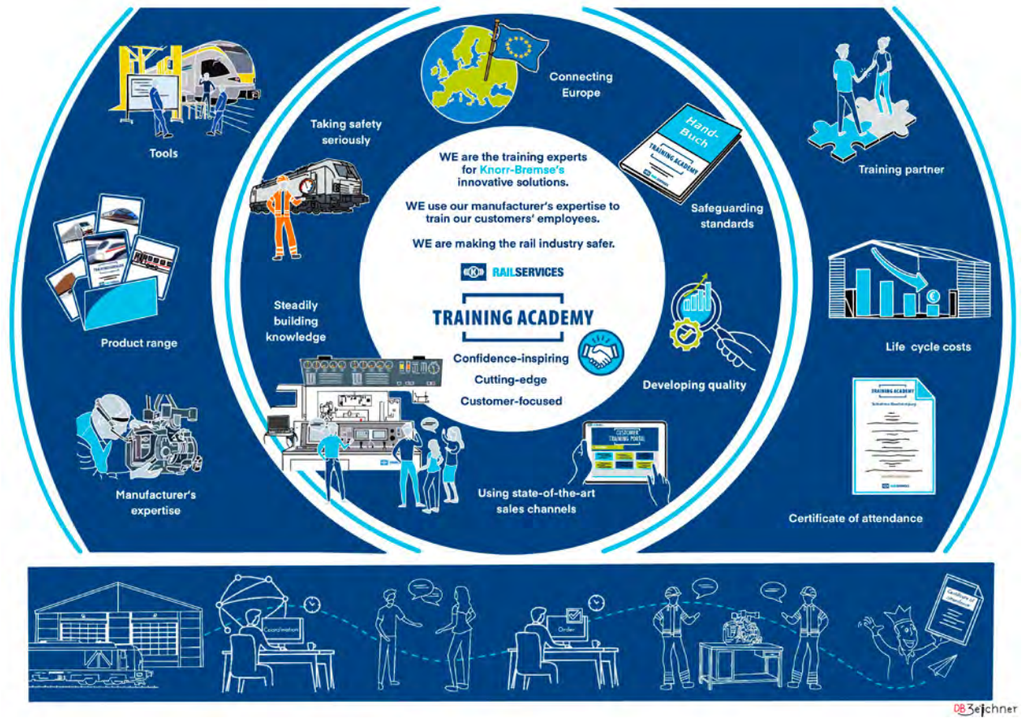
The system classifies objects at a distance of up to 200 meters – in diverse weather and lighting conditions – and its Pathfinder technology can even detect switch positions. In addition to safety aspects, both make an important contribution to greater efficiency of switching operations.

Knorr-Bremse rolls out Training Academy in Europe

If rail vehicle and fleet availability are a priority, you need technical personnel trained to the highest standards. The partner of choice for delivering this training, Knorr-Bremse's RailServices Training Academy is now available throughout Europe.

The Europe-wide rollout means that customers at all European sites will be able to access the effective, high-quality training courses offered by the Academy. It's easy to search for the right training course and book places via our Customer Training Portal (https://training-railservices.knorr-bremse.com/).

Close cooperation between trainers at the Training Academy locations ensures that the training courses always reflect the latest technological advances. Knorr-Bremse's continuous learning process keeps the know-how of our trainers throughout Europe up to date. And the virtual classroom in Berlin means you can access all the training courses, wherever you are worldwide. This allows you to save traveling time and travel expenses, while also doing your bit for the climate.



Four important certifications for Danish service hub

Since acquiring DSB Component Workshops last year, RailServices has been able to strengthen its focus on the priority areas of environmental enhancements, availability solutions, process optimization and lifetime expansion in Scandinavian countries, too. Within only a few months of the acquisition, the four sites now belonging to Knorr-Bremse Denmark have already met an important customer requirement by obtaining certification for key quality, environmental, and health and safety standards.

The specific standards in question are the ISO 9001 quality management system standard, the ISO 14001 environmental management system standard, the ISO 45001 occupational health and safety system standard, and the European Union's ECM (Entity in Charge of Maintenance) standards for service workshops. Certification has been obtained for ECM F2 (maintenance development function) and ECM F4 (maintenance delivery function).

RailServices is currently developing the renowned component and spare parts specialist's four sites into a regional service hub for components, comprehensive aftermarket solutions, ultra-reliable maintenance and innovative services.

UK service business expanded

With the acquisition of service provider Westcode, Knorr-Bremse has strengthened its train system service business in the UK rail market. "As a reliable partner, we're constantly seeking to expand the range of services we offer our customers – in key areas such as maintenance and repair, for example – so we can cover the entire train life cycle" says Mario Beinert, Member of the Management Board of Knorr-Bremse Rail Vehicle Systems with responsibility for the RailServices business.

The acquisition will allow Knorr-Bremse to service and maintain more train sub-systems, such as air supply, brake control, HVAC and entrance systems. It will also enable RailServices to service an even greater number of third-party components from other manufacturers. In addition, Westcode's highlyskilled workforce will be an asset for Knorr-Bremse's RailServices business.

WHEN THE ORIENT EXPRESS "LA DOLCE VITA"
welcomes its guests in Italy from mid-2024, Knorr-Bremse technologies will contribute to a safe and sustainable travel experience.

Knorr-Bremse chosen for luxury passenger train

Agreement signed to supply multiple system technologies for modernization of Italy's "La Dolce Vita" luxury trains.

The Orient Express "La Dolce Vita" trains are currently being modernized by ARSENALE Express S.p.A. and are due to return to service from mid-2024. The two eleven-car trains will cross Italy from north to south, offering luxury "slow travel" journeys to some of the country's most iconic locations and regions. Knorr-Bremse's braking technology and state-of-the-art entrance, HVAC, and sanitary systems will contribute to a safe, sustainable, efficient and comfortable travel experience.

The HVAC systems' intelligent technology ensures optimal cooling distribution in the passenger areas. It also allows manual or automatic temperature and ventilation control in every car. Sustainable CO_2 is used as a refrigerant. With closed water circuits and early fault detection, the compact sanitary systems are environmentally friendly and have low maintenance requirements. Meanwhile, the customized entrance systems in the opulent lounge car and other parts of the train help to maximize space and ensure comfortable boarding and alighting.

Building bridges by rail

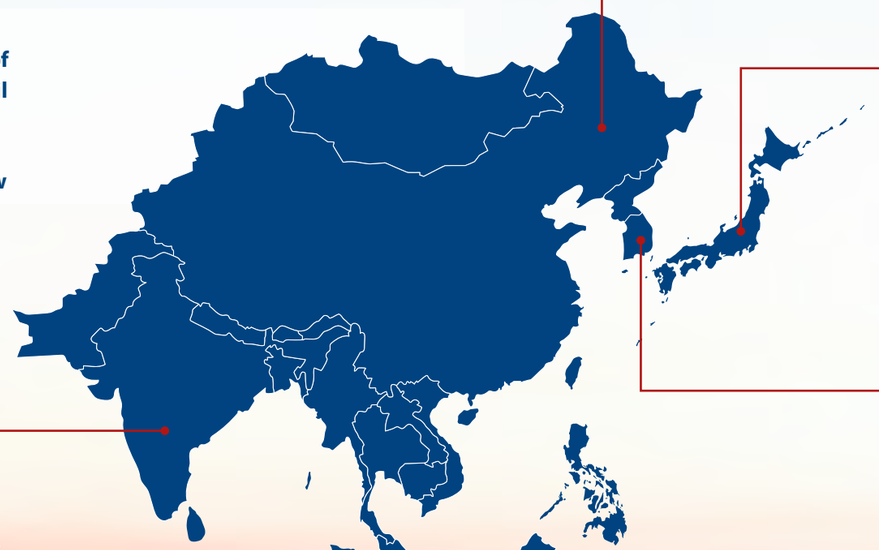
For decades, the Asia-Pacific region has been one of the world's most dynamic growth areas – and Knorr-Bremse has made a central contribution to its success in the field of rail transportation. Why this is the case – and what the future holds.

Back in the 1970s, Knorr-Bremse was one of the first western rail vehicle companies to establish strong links with the Asia-Pacific region – a part of the world that few European companies had on their radar at the time. But things were to change rapidly. Knorr-Bremse's first project, in 1990, involved equipping Metro Line 1 in Shanghai with complete braking systems.

Over the course of the following years, the Knorr-Bremse East-West link was increasingly strengthened. There is now a two-way exchange of technological trends between Knorr-Bremse and the Asia-Pacific region, as well as the rest of the world. With 21 facilities in six markets, a workforce of more than 4,500, market-specific systems and products, and its own service centers and field service technicians, Knorr-Bremse now has a presence in virtually every place that rail networks can be found.

The Asia-Pacific region and its major markets

The unique diversity of the Asia-Pacific region is reflected in its variety of rail systems. They summarize the full range of possibilities offered by rail transportation systems: the first ever dedicated high-speed train line (Japan), by far the largest high-speed network and metro systems (China), and the world's longest freight train (Australia). A brief overview of the region's major rail transportation markets:



China

China's metro systems in Beijing and Shanghai are by far the most extensive in the world. Shanghai Metro was a premiere for Knorr-Bremse: The Company delivered its first braking system for a Chinese metro in 1990. Since then – including further sub-systems – Knorr-Bremse has equipped 46,000 Chinese metro cars with its technologies.

Japan

Japan is virtually synonymous with the Shinkansen high-speed train – and the link between the latter and Knorr-Bremse braking systems is equally strong. The Shinkansen network is regarded as a classic example of how successfully trains can replace short-haul air journeys. But Japan is also a center of innovation in the field of metro systems. So it is no coincidence that Knorr-Bremse's intellegent Air Supply Unit (iASU) is to be first installed in a Japanese metro. Last year the Company celebrated its 30th anniversary in Japan.

South Korea

The South Korean railway network fans out towards the coastal areas in the east, south-east and south of the country from the capital, Seoul in the northwest, often traversing mountainous terrain on the way. In Hyundai Rothem this small country has a major rolling stock manufacturer with an international reputation. And even though it only has a small service and production plant in Korea, Knorr-Bremse has a highly effective team representing it in the market.

India

India is currently investing heavily in rail transportation. In the passenger sector, Knorr-Bremse is involved, amongst other things, in retrofitting automatic door systems. A recent highlight has been the introduction of the domestically developed Vande Bharat regional commuter train for which Knorr-Bremse supplies doors, sanitary systems, power electrics and brakes. India also recently opened two dedicated freight corridors (DFCs) each more than 1,500 kilometers long and has ordered 800 Prima double locomotives, for which Knorr-Bremse is supplying braking systems.

Australia

More than any other part of the country, Western Australia, with its rich sources of raw materials, is famous for its massive, kilometer-long trains that transport ore from mines in the interior to the Indian Ocean harbors of Port Hedland or Dampier. Back in 2014, mining giant Rio Tinto started to operate its first completely driverless train – with Knorr-Bremse technology on board: The platform for the AutoHaul® concept is provided by the LEADER® driver advisory system.

Think global, act local

In conversation with Dr. Jonathan Paddison

The Asia-Pacific region is considered to be particularly open to innovative rail solutions. Cultural differences mean doing business is not always easy from a European perspective, but they represent an exciting challenge which Knorr-Bremse has been ready and willing to take up over the last decades.

DR. JONATHAN PADDISON is a member of the Executive Board of Knorr-Bremse Asia Pacific, based in Hong Kong in China – by no means his first professional post on the continent. He says: "Asia, especially Japan, has become a kind of third home for me after the UK and Germany."

"Think global, act local" is one of Knorr-Bremse's central maxims. What is the underlying idea?
I often like to use this catch-phrase, especially with our customers. It neatly sums up a complex aspect of Knorr-Bremse's corporate culture: In all our markets, we maintain strong local organizations that are familiar with the particular conditions on the ground – cultural, technological and legal. At the same time they have access to the combined expertise of the global Knorr-Bremse Group.

What does the phrase mean in practical terms from the customer's perspective?
With only a few exceptions, local management for example is in the hands of local colleagues. On the one hand, they bring with them soft skills in local operations that are very important, especially in Asia. They know best how challenges should be assessed and what is the most appropriate way to tackle them. On the other hand, they are also bridge-builders – they have developed excellent networks within Knorr-Bremse that enable them to move things forward quickly at the internal level. Where appropriate we have augmented the local staff with experienced experts from our major locations in Europe and North America. The result is that customers all round the globe receive a tailor-made package of products, systems and services that offer maximum added value.

Is another reason for this maxim the fact that the Asia-Pacific region 'ticks' differently from Europe?
Of course the same principle applies all round the globe – but the cultural differences between the Asian market and our core European market mean it is particularly relevant. There are also differences between the various cultures within the region – to a much greater extent than we are used to in Europe or North America.

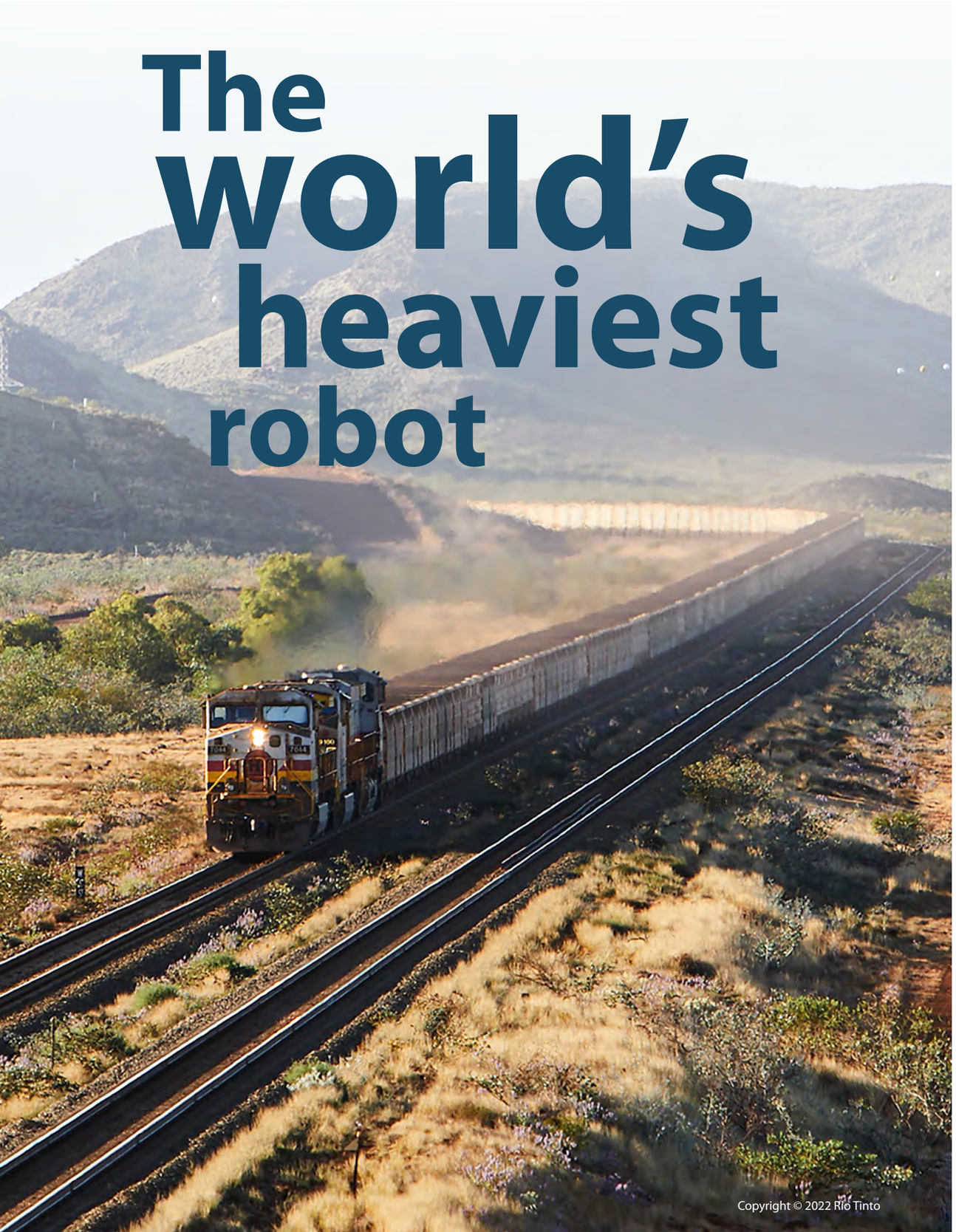
Can you give us an example from everyday operations?
In Anglo-Saxon countries, there is usually a project manager in charge of each project. In many Asian cultures that would cause confusion. Over there, the task of managing a project is spread across several people, and the team as a whole has a stronger profile and more focus is placed on strong team communication. Furthermore the expectations placed on us as a systems supplier are also enormous in many parts of Asia: Every request is important – and ideally needs to be dealt with immediately…

… which is not that easy in reality.
Precisely. But there are good reasons for this: Manufacturing a product that is adapted to local market requirements takes time. As you know, our portfolio usually contains products that are extremely safety-critical. This means it is in the interests of the customer for us to come up with the most attractive concept, including in terms of the timeline. Our customers appreciate that we do all we can to find solutions that meet their wishes. That's the name of the game! But at the same time the entire Asian region is very open to innovative solutions. And that is a huge opportunity for us.

Knorr-Bremse operates six sites and numerous service centers in the region. There is also a whole range of field service teams. What is the Company's objective with this network?
Well, on the one hand we are not just concerned to sell excellent products and systems. We are also determined to offer reliable support throughout the decades-long operating life of a train. The local service centers are essential if we are to offer short delivery times, for example for spare parts, thus maintaining a high level of vehicle availability. In the event of service, our customers expect fast response times and sustainable solutions. To be able to offer these, we need to have experts on the ground in the form of our field service quality and engineering teams.

And local production is mainly a result of the localization requirements for the country concerned?
That may seem an obvious point, but there is more to it than that. If, for example, China decides to plan new metro lines, we have to be quick with our systems for the new vehicles. Then ability to deliver is of the essence. But that is only possible if there are production plants and established delivery processes at local level – and in the case of Knorr-Bremse these often take the form of joint ventures. I think this approach is also the result of our company's philosophy: Others come and go. We stay for the long term.

The world's heaviest robot



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In Western Australia, heavy-haul freight trains several kilometers in length carry thousands of tons of iron ore through the outback – without a driver on board. The technology that makes this possible comes from Knorr-Bremse company New York Air Brake (NYAB).

The trains are 2.4 kilometers in length from nose to tail and consist of three heavy-duty locomotives together with 240 freight cars, transporting an amazing 30,000 tons of iron ore from mines in the Pilbara region of Western Australia to ports on the Indian Ocean. Rio Tinto's automated trains are the world's heaviest robots – a record confirmed by Guinness World Records Ltd. In place of drivers, the cabins of the trains contain some of the world's most advanced automation technology.

Rio Tinto's AutoHaul® system is the world's first Automatic Train Operation (ATO) application for heavy-haul freight trains. Rio Tinto and system integrator Hitachi Rail began the multi-year collaboration that developed this system in 2006. The AutoHaul® system incorporates numerous sub-systems developed by a large group of companies, including Knorr-Bremse Group company New York Air Brake (NYAB).

NYAB provides the sub-system responsible for driving the train. Its name? LEADER® Auto Pilot (Locomotive Engineer Assist Display & Event Recorder). LEADER® Auto Pilot utilizes information about the train's configuration, as well as its route, current speed and position to calculate the most efficient way of driving it at any given moment.

"LEADER® carries out tasks usually performed by the locomotive crew," explains Matthew McDonald, one of the engineers at Knorr-Bremse Australia. "Accelerating, braking, adhering to speed limits, reacting to signals – all of these functions are performed by LEADER®."

On secondment from NYAB to Knorr-Bremse Australia and attached to a technical team within system integrator and signaling manufacturer Hitachi Rail, McDonald is one of those responsible for ensuring the smooth running of the self-driving freight trains. "The trains are controlled and monitored from a control center in Perth." The city is some 1,500 kilometers south of Rio Tinto's rail network. Although the trains are controlled from Perth, NYAB team members travel north when necessary to support on-track testing and deployment of enhancements to the system.

The driverless heavy-haul freight trains now operate on a total of almost 1,900 kilometers of track. The self-driving trains are well established and have an excellent record of reliability. They first went into service in July 2018, and by the end of the year the autonomous trains had clocked up more than a million kilometers. "Rio Tinto's autonomous heavy haul trains have now traveled tens of millions of kilometers, and almost all journeys on the network are autonomous", says McDonald.

There are sound economic reasons to use this technology. Automation of more than 200 locomotives has significantly improved operational efficiency. A typical round-trip journey is around 800 kilometers and requires approximately 40 hours – including loading and unloading. Prior to automation, Rio Tinto had to transfer its locomotive crews a total of 1.5 million kilometers per year by road to their workplace. That is now a thing of the past – as are stops for crew changes.

Rio Tinto's recently opened Gudai-Darri Mine is the company's most technologically advanced mine, and the first that was designed to be driven using automated trains from beginning to end. Gudai-Darri is connected to Rio Tinto's rail network by a new 166-kilometer rail line – bringing the total extent of automated track operations to almost 1,900 kilometers.

Tablet-based multi-system support

In China, Knorr-Bremse operates a dense RailServices network aimed at ensuring constant operational readiness for its systems across 150,000 kilometers of track. An important role is played by a specially developed app.

The dimensions are staggering. The westernmost station for passenger trains in the People's Republic of China is in Kashgar. A good 4,500 kilometers to the northeast as the crow flies, the tracks run almost as far as the Amur River. And the southernmost city served by trains is almost 4,000 kilometers away – Sanya on the island of Hainan. Within the triangle formed by these points, more than 150,000 kilometers of track interweave to form the largest rail network in the world. And between the urban centers in the east and southeast of the country it is also one of the densest.

"A large number of trains travel on this network every day," says Eric Bi, member of Knorr Bremse Rail China Board. Customer expectations in terms of service and train availability are both high.

Rapid problem-solving wherever possible

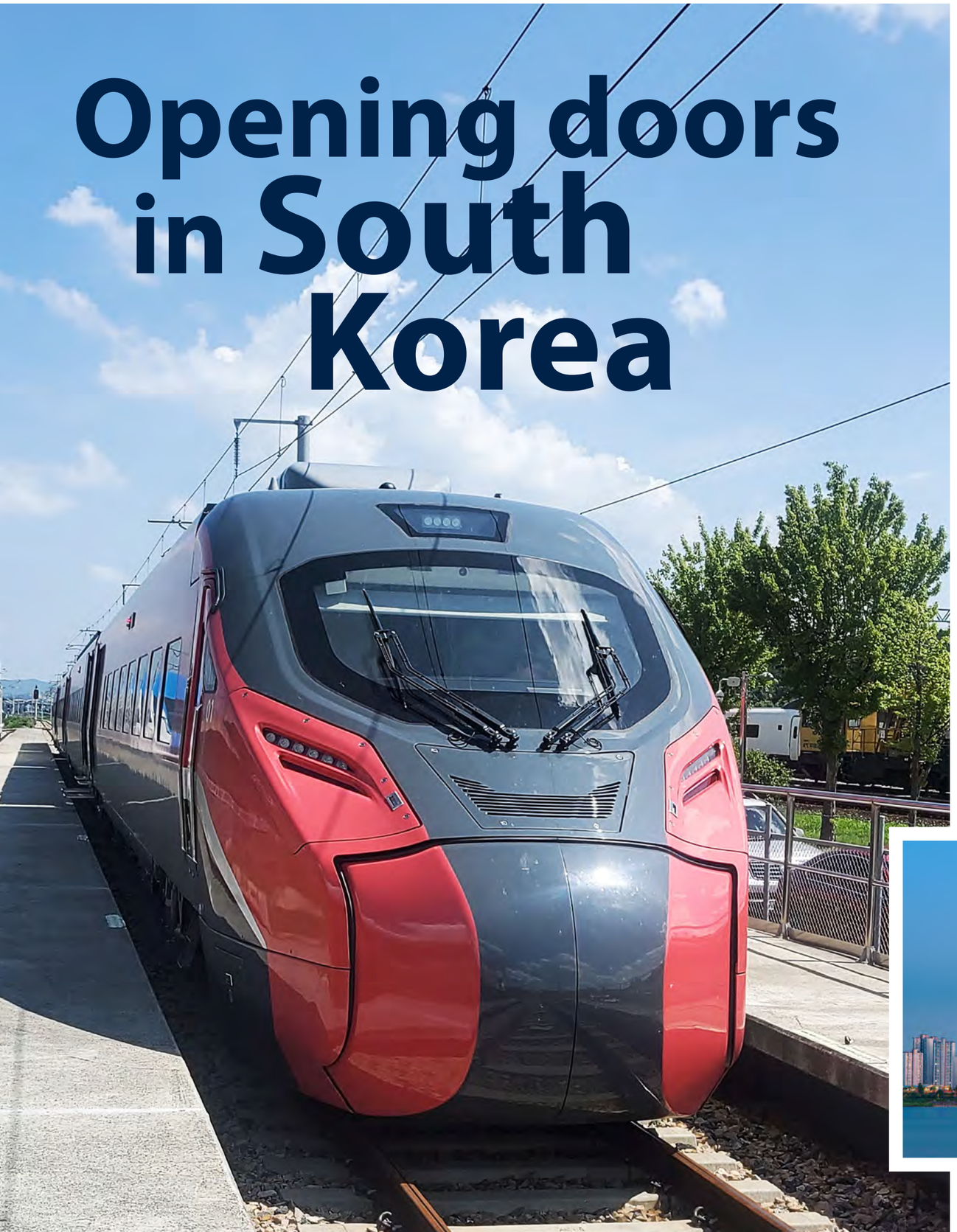
The Knorr-Bremse RailServices app is effectively shortening the great geographical distances involved. "It brings together everything we need to ensure a rapid service response and on-the-spot decision-making," explains Bi. "Equipped with an interface to Knorr-Bremse's SAP in China, and the function to upload photos and videos directly from a tablet camera, our engineers can make appropriate problem-solving decisions as quickly as possible – without having to immediately get on an airplane." The impact on vehicle and fleet availability is similarly positive.

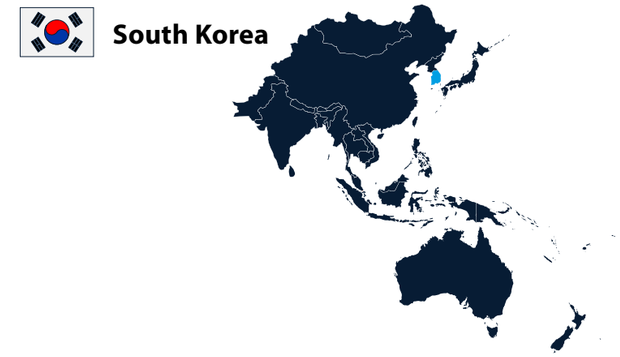
The RailServices app is already launched and running, including the field service operated by CRRC, the world's largest rail vehicle manufacturer. "Right now, we are in the process of rolling it out to other parts of the country, closing the remaining 'white spots' on the map." Collaboration with CRRC, which also uses its own service app because of the scale of the enterprise, has been particularly fruitful when it comes to developing digital solutions, according to Bi. "We share our successes, and sometimes run joint workshops."

Dedicated engineering team for modernization projects

China's huge investment in its rail network during the first decade of the millennium means that its fleets are still, on average, relatively young. Inevitably, operators will face an important decision in the foreseeable future, according to Bi: "What should they do with vehicles close to the end of their life cycle?" There are two options: incorporating them into the spare parts management system and modernizing them. "Both can be attractive in their own way, but only depending on the strategy the fleet operator is pursuing." The important thing, though, is that Knorr-Bremse should be ready: "At the moment we are setting up a dedicated multi-system engineering team with access to the expertise of the entire Group that can organize and carry out modernization projects on a customer-specific basis."

Opening doors in South Korea





New Korail EMU-150 Intercity trains built by Dawonsys are the first South Korean rail R&C (regional & commuter) vehicle project for which Knorr-Bremse is supplying complete braking systems.

South Korean state railroad operator Korail has a tradition of ongoing fleet modernization, gradually taking older vehicles out of service and replacing them with new ones. As a result, the average age of rolling stock is kept low, and capacity planning remains easy.

The operator's Intercity fleet is currently undergoing such a transformation. In summer 2014, "ITX Saemaeul" multiple units started to replace the locomotive-hauled "Saemaeul-ho" Intercity trains which operate, for example, between Seoul and Busan or on the Jeolla Line, connecting the country's west and south coasts. And completely new EMU-150 series trains ordered from manufacturer Dawonsys under the project name of "Korail EMU-150" are to be launched as of the second quarter ot 2023.

The order marks a milestone for Knorr-Bremse – the first time the company has supplied complete braking systems for a South Korean R&C rail vehicle project.

Fulfilment of special customer requirements

The order from manufacturer Dawonsys is split into 27 four-unit and 7 six-unit trains. But since last October, it has also been clear that braking equipment will be required for more than these 150 cars, as Korail has redeemed options for a further 208. This time round there will be 28 four-unit and 16 six-unit trainsets. They are designed for a maximum speed of 165 km/h, and Korail calculates they will operate on a daily basis at 150 km/h.

"We were able to meet the customer's highly specific requirements and also supply a similarly customized maintenance and support plan," says Sungmin Kim, responsible for OE sales & PM at Knorr-Bremse Korea. Knorr-Bremse has therefore also expanded its field service in the country – including extensive investment in local testing equipment.

The trains' braking systems are based on the decentralized brake control system "FlexControl Lite" (type EPC-L) with ESRA Classic electronics, a newly developed "blending" unit, and redundant wheel slide protection. The bogies are fitted with "WheelAct Compact" wheel brake discs and brake calipers (type RZTS), and the system uses "PistonSupply Eco" oil-free compressors (type VV120-T and VV10-T). At the customer's request, Knorr-Bremse has also fitted a separate control panel in the driver's cab for the parking brake and pressure regulator.

Crossing India in the new Intercity

The Vande Bharat Express is bringing modern intercity travel to the subcontinent. Knorr-Bremse is one of the key players, supplying several sub-systems for this major project that is also receiving interest from abroad.

On December 30, Indian Prime Minister Narendra Modi connected by video link to the rail station in Howrah, a city of over a million inhabitants in West Bengal. He started by speaking of the forthcoming investments in the nation's rail network. At the end of his address, he picked up the green flag and waved it to the camera. As he did so, the doors of the train standing at the platform in Howrah closed – in India, the green flag signals that the train is authorized to depart. Moments later, the white-and-blue train pulled away.

There is huge political and public interest in these trains, even though it has now been four years since they entered service – including a planned gap of two years following the rollout of the first two trainsets at the end of 2018. The Vande Bharat Express will take seven-and-three-quarter hours to complete the newest of its seven routes, stopping at Barsoi, Malda and Bolpur on its journey of just under 600 kilometers to New Jalpaiguri. "The new Intercity EMUs will complete the journey almost exactly three hours faster than other trains on this route," says Dipankar Ghosh, Managing Director of Knorr-Bremse India, which is headquartered in Palwal, near New Delhi.

0 to 100 km/h in 54.6 seconds

In the past few years, Ghosh has dealt with matters relating to the Vande Bharat Express on an almost daily basis. Knorr-Bremse supplies the braking and entrance systems for these multiple units, while Microelettrica provides much of the power electronics. In addition, EVAC is supplying the sanitary systems for the newer trains.

"We obtained the product approvals for the systems, geared up our supply chains, and trained our staff and augmented the local supplier ecosystem in record time," explains Ghosh. Designed for an operating speed of up to 160 km/h, the Intercity trains are required to have 80 percent domestic content. There are two other noteworthy aspects: The underside of the chassis is designed to allow the trains to run in up to 40 centimeters of water, providing greater flexibility during the rainy season. And if they set off from a station at maximum acceleration, the Electrical Multiple Units (EMUs) can reach a speed of 100 km/h in just 54.6 seconds.

So far, firm orders for 102 16-car trains have been received in several individual call-offs from the state-owned manufacturer Integral Coach Factory (ICF) in Chennai besides another 200 and 100 though Global Tender for the private sector. There are also options for a further 120 trains. "At the moment, one train rolls off the production line every 15 days," says Managing Director Ghosh.

And it's likely that they will soon start producing even faster. "Despite their relatively low cost, when it comes to passenger comfort – entertainment, vacuum toilets and soon-to-feature sleeper car configuration – these reliable trains are every bit the equal of the big, established manufacturers," says Ghosh. "Some Asian and South American operators are showing a lot of interest in these vehicles." It looks as if the first Vande Bharat Express export projects are just a matter of time.

Successful market entry

For the first time, Knorr-Bremse is equipping a metro with coupling systems – in collaboration with a well-known vehicle manufacturer. Hitachi Rail is installing them in 46 of the new generation of metro trains it has developed for Milan's public transport operator.

Guaranteeing safe, smooth train operation

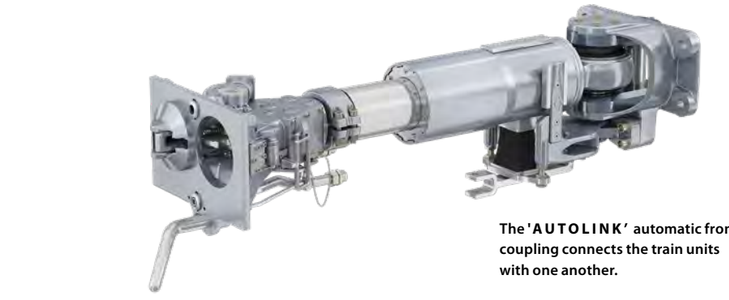
Milan Metro started with the north-south Red Line (M1), which opened in 1964 measuring 11.8 kilometers but was gradually extended as time went on. Within two years, a branch line had been built off to the west, and from then on, Milan's transit authority, Azienda Trasporti Milanesi (ATM), continued to expand the network in all three directions. The latest extension to be built connects the new exhibition center to the northwest branch near Rho Fiera. And the network map now shows a dotted line at the end of the northern section, indicating that two further stations – Sesto Restellone and Cinisello/Bettola – will soon follow.

When a network expands, additional trains are also required, and ATM has ordered 46 of a new generation of metro trains from vehicle manufacturer Hitachi Rail. The order marks a significant milestone for Knorr-Bremse, as it is the first time the Company is equipping a metro with state-of-the-art couplers. And for such a prestigious manufacturer!

The reaction from Knorr-Bremse's top management is understandably upbeat: "Being awarded the contract for coupling systems is a fantastic initial step for us as we enter this technically challenging and growing market segment," says Dr. Jürgen Wilder, member of the Executive Board of Knorr-Bremse AG responsible for the Rail Vehicle Systems division.

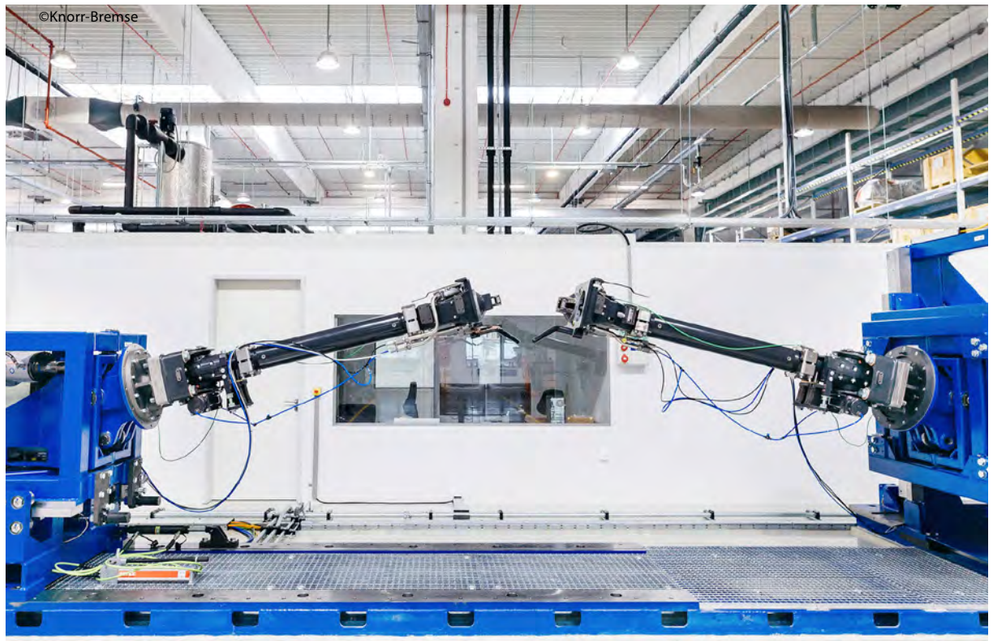
Knorr-Bremse first got into the passenger and freight train coupler business in 2019, and since then, the brake specialist has combined the manufacture of couplers with its claim to be the market-leading producer of innovative systems for the rail sector.

Couplers play an important role in ensuring safe, smooth train operation: The complex, multi-functional units establish mechanical, pneumatic and electrical connections between trains and individual vehicles. Their job is to monitor, manage and control the tractive and compressive forces between train sections and also compensate for the relative movements between vehicles. Together with other safety-critical systems, they are essential elements in crash-proof train design.



The '**AUTOLINK**' automatic front coupling connects the train units with one another.

The '**SHORTLINK**' connect semi-permanent couplers the cars within the trainset.



AUTOMATIC COUPLING AND UNCOUPLING is part of the extensive testing procedures for the coupling systems at the Budapest site, where they are produced.

Coupling at up to 15 km/h

Hitachi Rail is installing three types of couplers in its trains. Firstly, the 'AutoLink' automatic front coupler, which connects the individual train units with each other. Then there are two types of semi-permanent 'ShortLink' couplers for connecting the cars within a set. The coupling system has a high-spec design in terms of robustness. "It enables the operator to couple the vehicles at speeds of up to 15 kilometers per hour," explains Maximilian Menzemer from Knorr-Bremse SfS Sales.

But it is not just their robustness that makes the front couplers for the Milan metro special. For historical reasons, Milan uses a variant of the standard coupler head that is known as "Type 10". For the Knorr-Bremse engineers, their own "Type 10" design formed the basis for the development. "Effectively we are continuing the traditions of Milan's public transport operator with state-of-the-art coupler design," explains Menzemer.

In-house testing infrastructure secures development and production

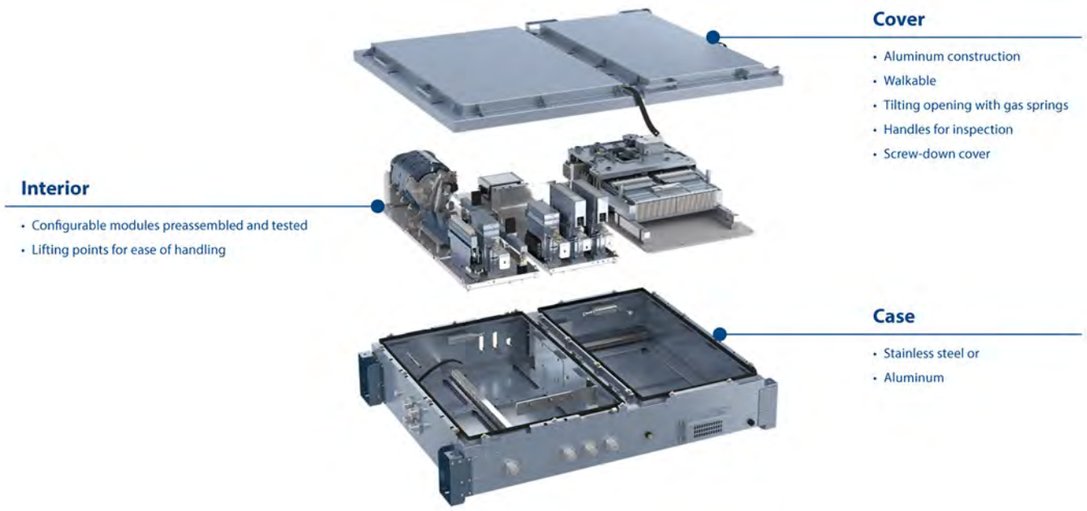
In this context, an important role is played by the in-house testing facilities at the Budapest site, where Knorr-Bremse is capable of manufacturing over 1,000 couplers a year. "Not only does it give us complete control over many of the testing procedures prior to delivery," explains Menzemer. "We also save the time that would otherwise be spent transporting the systems to and from external testing facilities." This is one of the reasons Knorr-Bremse will be able to supply the first Milan couplers within a year of receiving the order, i.e. in the fourth quarter of 2023. ATM plans to put the first trains into service on the M1 line the following year, and the trains for the M2 and M3 lines will then follow.

But the couplers are not the only contribution from Knorr-Bremse: As well as pneumatic braking systems with FlexControl modular controls, the project also includes door systems from IFE. Plug sliding doors (eight per car) play a vital role in ensuring that passengers can quickly and safely board and alight from trains. As such they make an important contribution towards streamlining passenger flows on platforms and ensuring that trains operate punctually.

Smart switching

The corporate brand Microelettrica – global market leader in control components for traction and power distribution systems – is part of the Knorr-Bremse Group. An overview of the main focus of its product portfolio – and its new systems-based approach.

Designing the control electronics for a rail vehicle can involve spending huge amounts of time working out how to combine the countless individual components. The problem is that no one usually has much time to design how to link switches, isolators, contactors and protective motor switches and position them in the various different parts of the vehicle. "In the past, this sort of time-consuming planning process was unavoidable," explains Camillo Vacca, Product Manager at Microelettrica Scientifica S.p.a. in Milan.



The company has 70 years of experience in developing and producing electronic control components for rail vehicles and industrial applications. "We have used this experience to take a significant step towards simplifying the process and adopting a systems-based approach."

Integrated power technology with remote-capable digitalization interfaces

System Integrated Functional Unit (SIFU) is the name of the product that offers a solution, and at the same time represents a systems approach. It achieves smart integration of most of the electrical vehicle control and diagnostic components into a single, compact unit – from simple resistors to high-speed disconnectors. "The modular design means it is highly adaptable and can even be tailored to special requirements."

Rapid configuration using carefully matched modular components above all brings advantages in terms of the timeline. Cabling in the vehicle is reduced by more than 70 percent. In addition, the SIFU is equipped with remote-capable digitalization interfaces, for example for comprehensive condition-based maintenance (CBM). "But of course all our components are still available individually," confirms Vacca.

ECOMeter: Precision measurement technology between pantograph and traction unit

Large flows of energy also have to be measured – after all, economical operation of the rail vehicles is what it is all about. This why the Microelettrica portfolio includes the ECOMeter. Its sensor technology connects high-precision measurement technology with the pantograph as well as the traction unit and measures, among other things, voltages, currents and reactive energy in accordance with the latest standards for energy measurement (EN 50463). "Again, the systems approach is crucial," explains Vacca. "The product – which incidentally can be used for 15 years without recalibration – combines current and voltage measurement of direct and alternating current for both consumed and regenerated energy in one device."

It goes without saying that inclusion in the Knorr-Bremse Group portfolio was taken into account from the very outset: The ECOComNG onboard data handling system makes the ECOMeter data easily analyzable for infrastructure and vehicle operators via the ECOLogic data collection system.

COMET FANS PORTFOLIO EXPANDS WITH SYSTEMS

The Microelettrica subsidiary Comet Fans is a leading supplier of fan units for vehicle traction systems and other high-end industrial applications.

Following the same system-based approach, the product range has recently been expanded to include complete cooling units and ventilation systems for critical on-board applications such as traction converters, transformers and engines. With more than 30 projects ongoing and demand from customers continuously increasing, this is already becoming a successful new business for the Microelettrica brand.

New, decentralized functional modules

By incorporating the wheel slide protection and pilot pressure controller as well as the counter input module into its Smartio® portfolio, Selectron Systems AG has massively simplified vehicle layout design.

When a new vehicle is built, dozens of functionalities have to be ingeniously integrated: for example, wheel slide protection, pilot pressure control and counter input module. But needless to say, the space available for such hardware in a vehicle is severely limited. That is why Selectron Systems AG, the Knorr-Bremse Group's specialist for control, network and communications technology, has now integrated these three functionalities into its Smartio® concept.

Powerful, decentralized

Developed as smart remote I/O systems and SIL 2-certified throughout, the function modules can now be flexibly installed at numerous locations in the vehicle. The decentralized architecture means they can even be installed under seats, door jambs or roof coves – offering a crucial advantage over the previous central stand-alone architecture.

The Smartio® concept is an innovative I/O system that combines terminal block and signal conditioning in a single device. "All vehicle manufacturers now have to do is mount the precisely fitting hardware modules for the individual functions on the DIN rail," explains Selectron Product Manager Matthias Ingold. "This optimized design, although based on proven technology, reduces the number of components as well as the amount of wiring required, especially in critical vehicle areas such as cable whips, cable transitions and EMC-sensitive areas (electromagnetic compatibility). This saves valuable time for the vehicle manufacturer and the modular, flexible design reduces maintenance effort for the operator."

In addition to improving performance, the solution also offers an impressive degree of further flexibility: As well as the module itself, Selectron also supplies a customized software package consisting of a wheel slide protection algorithm and a central wheel slide application.

Even during towing operations, the wheel slide protection system reliably prevents flat spots

Without much additional outlay the compact, efficient system now also provides this function during towing and when the TCMS (Train Control & Management System) is switched off. This means that in future it will also be able to prevent wheel flats caused by locking wheels in this state. The advantage in terms of operating costs should not be underestimated: Depending on the type of wheel, repairs can easily cost tens of thousands of euros – not to mention the vehicle downtimes involved.

The new modules offer smart performance exactly where it is needed in the vehicle. And they also have one major advantage: Their slim Smartio® design means they can be easily integrated into the overall system without the need for additional software.

Selectron's function modules have already been successfully used in customer projects.

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