

BOLTED

A MAGAZINE ABOUT BOLTING TECHNOLOGIES

ISSUE 1 - 2019



get smart

The future of industrial
automation is here

NEW SUPERBOLT TOOL

The holy grail of jackbolt tensioning

INSTRUMENTED BOLTS

Cutting-edge research using
sensors and artificial intelligence

HYUNDAI ROBOTICS

A simple solution for an
advanced machine

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**NORD-LOCK
GROUP**

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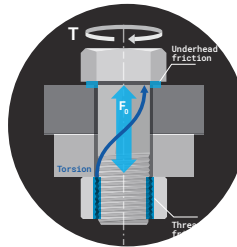
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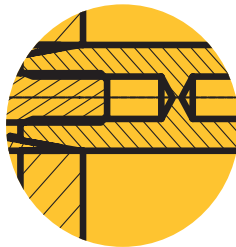
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Fredrik Meuller
CEO Nord-Lock Group

Welcome to the new Bolted! I hope you recognized us despite the updated cover. Don't worry, the inside of the magazine is still the same – almost.

For 10 years, Bolted Magazine has been spreading bolting knowledge across the globe — and it's time to celebrate! What better way to do that than with a completely new design and more inspiring and interesting content than ever before?

Instead of looking back at how the bolting sector has evolved over the past decade, we will look into the future with a theme story about how technology changes everything we do. How can the manufacturing industry benefit from connected machines and intelligent networks to help make life easier for customers? It's time to get smart!

Speaking of smart technology, we also met Professor Raid Karoumi, who has developed numerous methods, including sensors, for structural health monitoring and vibration analysis of bridges.

And on the topic of bridges, read about how Nord-Lock Group helped secure the bolted connections on a busy bridge in Germany, with trains running underneath.

Beyond solving big bolting challenges, we are always focused on making life easier for our customers. That's why we developed a new Superbolt Tool that helps operators tighten all jackbolts on a Superbolt Multi-Jackbolt Tensioner (MJT) in one go. The inventor, Andy McPhee, talks to us about the challenges and breakthroughs he encountered when developing the tool.

We are also continuing our geographic growth and have opened new offices in Chile and India as well as acquiring our long-term distribution partner, IDQ, in Spain.

I hope you enjoy reading our 10 year anniversary edition!



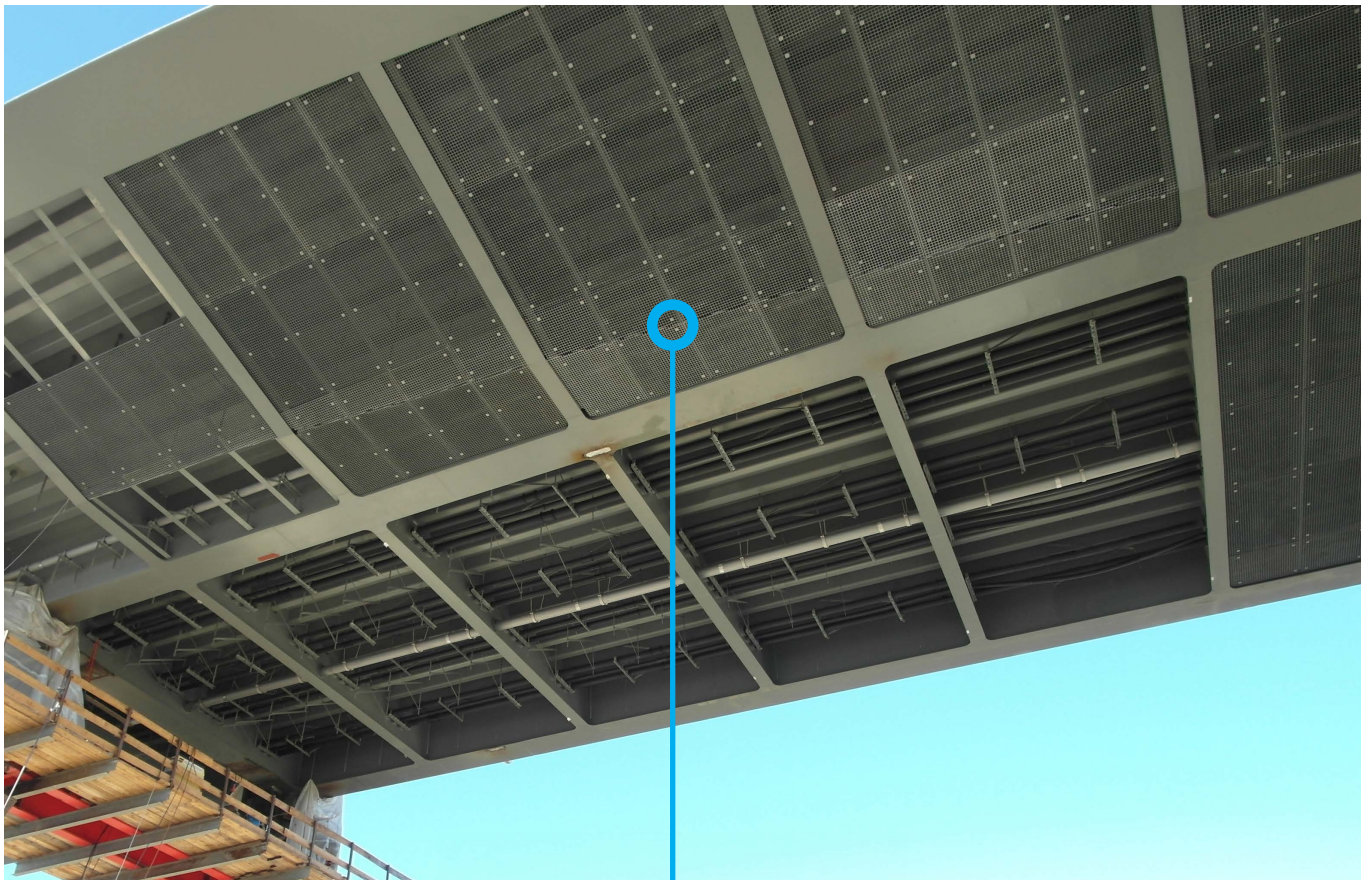
GETTING THE BEST OF BOTH WORLDS

On the face of it, building the Kienlesberg bridge was a real-life mission impossible. After all, how can you successfully bring together two completely opposing concepts?

Located in Ulm, between the southern German cities of Stuttgart and Munich, the Kienlesberg bridge was to become a beautiful example of filigree architecture. Stretching 270 metres in a smooth curve, this work of art would feature specially-fitted vantage points. Here, pedestrians and cyclists could pause to behold the historic city below them, and especially the glorious Gothic style Minster church, which boasts the world's tallest steeple.

At the same time, however, everything had to be about rules and reliability, safety and sturdiness. Requiring over 2,500 tonnes of steel, this construction needed to be robust enough to support two train tracks.

Moreover, with a bustling Deutsche Bahn intersection below, the bridge meant complying with strict and uncompromising safety regulations. The endless rules governed everything from electrical cables to train tracks. Despite the seemingly impossible nature of the challenge, the solution came in the form of a dream-team combination of two products. This included glass-



CUSTOMER

CTS COMPOSITE TECHNOLOGIE SYSTEME GMBH

PROJECT

KIENLESBERG BRIDGE, ULM, SOUTHERN GERMANY

CHALLENGE

BOLT-LOOSENING DUE TO VIBRATION

SOLUTION

NORD-LOCK X-SERIES WASHERS

STEEL USED

OVER 2,500 TONNES

fibre reinforced plastics (GRP) from CTS (Composite Technologie Systeme GmbH), and special washers from the Nord-Lock X-series bolt securing system.

There are two main reasons why Nord-Lock products were a perfect fit for this project. Severe vibration from rattling carriages on a high-speed train can lead to bolt loosening, but not when used with Nord-Lock X-series washers. The wedge-effect underneath the bolt head and nut means the washers cannot loosen unintentionally.

CTS found Nord-Lock washers to be highly reliable as they also passed Deutsche Bahn's strict safety tests. CTS could now guarantee that their product – fitted using Nord-Lock washers – could withstand the vibration.

Text Rob Hyde **Photos** Christian Frumolt

REDUCING LUG WEAR ONCE AND FOR ALL

CUSTOMER
BLACKWELL, PART OF HARGREAVES SERVICES PLC

SOLUTION
EXPANDER SYSTEM

BUSINESS
EARTHWORKS CONTRACTORS

PROJECT
HOUSE OF WATER COAL MINE, SCOTLAND

CHALLENGE
REDUCING DOWNTIME DURING MAINTENANCE

APPLICATION
TRUCK SUSPENSION LEG MOUNTINGS AND HOIST MOUNTINGS

TIME SAVED
DOWNTIME REDUCED FROM DAYS TO A FEW HOURS



Earthworks contractor, Blackwell, supplies all the mining equipment at House of Water, one of the last remaining surface coal mines in the UK. The company wanted to use a Caterpillar 777G off-highway truck because of its efficient hauling capability and travel speed.

After many hours of operation in the abrasive conditions of a granite quarry, the truck had suffered significant wear in its suspension lug mountings and hoist mountings, and required maintenance work.

Because of the design of the Caterpillar 777G, line boring would have required removal and storage of the rear wheels. As each wheel weighs 4 tonnes, it is a manually intensive and risky job. Furthermore, line boring is a costly, disruptive and time-consuming process that had been an integral part of Blackwell's business for decades due to the use of regular straight pins. At a modern mine, every minute of lost production costs money, so to keep production going, replacement machines were brought in, which increases complications and expenses. When Expander System approached the company with an alternative, they were happy to try it.

During the installation of the new pins, the heavy rear wheels of Blackwell's 777G could stay in place, which alone saved several hours.

"With the Expander System, downtime was reduced from days to just a few hours," says Blackwell Plant Manager, David Lancashire. "While it's too early to judge the long-term savings, the system has already given us impressive savings in both time and money."

The Expander System also increases the lifecycle of the joint up to 50,000 hours. After a positive start with the system, Blackwell recently used it on a wheeled loader and are looking to increase its use as a repair option on their extensive fleet.

Text David Nikel

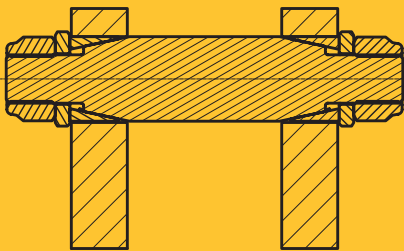


What is the difference between a straight pivot pin and the Expander System?

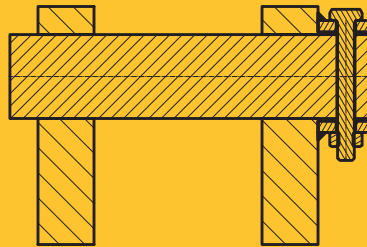


Jonny Wiberg
ENGINEER, NORD-LOCK GROUP

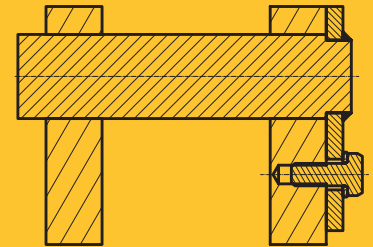
Email your questions about bolting technologies to experts@nord-lock.com



Expander System



Traditional straight pin with locking ring



Traditional straight pin with flag washer

Pivot pins are located on cylinder rod ends and between moving mechanical parts. They provide applications with the flexibility they need to operate efficiently.

Damage-prone straight pins

A straight pin cannot fit into the lugs of a machine unless the lug holes are slightly bigger than the pin itself. This means that there is always a gap between a straight pin and the lugs. Although this gap is necessary to mount the pin in the lugs, it is also problematic as it affects the precision of the machine. Moreover, it allows the axle to hit the lugs with full speed and force when the direction of the machine changes. It is common to forget that flag washers, locking rings and other fasteners do not actually fix the pin in the lugs – they only prevent it from rotating and falling out.

When a machine is exposed to heavy loads and vibration, the pin slowly wears down the lug holes. This leads to the loss of precision and control of the machine and makes it necessary for the lugs to undergo repairs. These usually take place every 3,000 to 5,000 hours, depending on the load intensity on the machine.

The play between the lugs and the pin is not the only reason why straight pins make lugs more prone to damage. When a pin is loaded, all the pressure is forced onto a small area, deforming it permanently. Lugs are also typically made from softer material than the pin, and easily lose their shape after repeatedly coming into contact with a hard pin.

A simple method to prevent lug wear

An Expander System consists of a pivot pin tapered at both ends, two expansion sleeves, two tension washers and two fasteners. The pin is installed directly into the existing mounting. Upon tightening the fasteners, the washer presses the slotted expansion sleeve up the tapered ends of the pin. The sleeves then expand, conform to the pattern in the lugs and lock the system in place. Once retorqued, the system locks from both sides.

The pressure from an Expander System pivot pin is well distributed over the whole contact area in the direction of the force, so the lugs do not become damaged from the pressure. This system permanently prevents lug wear and eliminates the need for repairs.

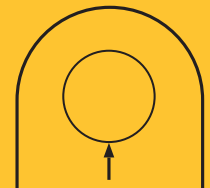
Days of downtime vs short repairs

Traditional straight pins and Expander System also have different repair procedures. Welding and line boring are used to repair worn lugs when using straight pins. This not only takes time but also necessitates an experienced mechanic with specialized equipment. Since complex repairs like these are difficult to make in the field, the machine is usually moved to a workshop causing costly and time consuming downtime.

Since the Expander System can be mounted directly into the worn lugs, there is no need for welding and line boring. In many applications it can actually be installed on site and operations can resume after a few of hours.



EXPANDER SYSTEM
Distribution of external force on lug



TRADITIONAL STRAIGHT PIN
Distribution of external force on lug

Since the launch of the Superbolt Multi-Jackbolt Tensioner (MJT) in 1984, efforts have been made to constantly improve efficiency. One suggestion came up regularly - to tighten multiple jackbolts simultaneously.

The consensus was that this idea was technically and cost effectively extremely difficult to develop, until an inventor from Australia inadvertently built the technology that would change the course of jackbolt tightening forever.

In 2014, Andy McPhee visited his friend and fellow inventor, Peter Armstrong. He found Armstrong hunched over the kitchen table working on a design for a continual motion tool that could replace a traditional hydraulic torque wrench. McPhee looked over his friend's shoulder and, always full of ideas, made a few suggestions. Since Armstrong did not have the CAD capabilities to implement them, McPhee offered to help.

"I used to have my own company, which supported crazy mad inventions," explains McPhee. "We helped people with wonderful ideas bring them to the market. I've also invented many things, I get real pleasure out of creating things and seeing them come to life."

The idea was exactly what the industrial sector needed and it was not long before outside interest started to grow. In January 2015, as the pair were finalizing the drive technology for a potential investor, they got a call from an old contact who worked for Nord-Lock Group and invited him to take a look.

Little did they know that this was exactly what Nord-Lock Group had been waiting for – a compact drive mechanism that could generate enough torque required to tighten multiple jackbolts simultaneously. At this time, a very conceptual model was unveiled to show how the drive, powered by what they were calling 'scroll drive technology,' could be utilized. Soon, McPhee and Armstrong were officially developing the new Superbolt Tool for Nord-Lock Group.

Overcoming technical challenges

Although McPhee and Armstrong were on the right track, there were still challenges on the horizon. Indeed, how do you develop something that is potentially impossible to create? "It's sort of been a holy grail to see if someone could figure out how to tighten multiple jackbolts simultaneously," explains Steve Greenwell, Director of Tensioning Division at Nord-Lock Group. "Not only is it technically challenging, the forces and torque requirements involved are also very high."

One of the biggest challenges they encountered when developing the Superbolt Tool was optimizing the 'scroll



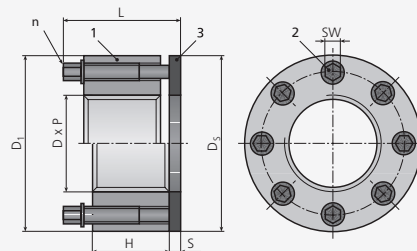
THE HOLY GRAIL OF JACKBOLT TENSIONING

drive technology' – now known as UniForce – which needed efficient torque delivery to drive the Superbolt jackbolts. The technology was derived from a worm drive, which incorporates standard balls and a scroll. Rather than having one point of contact, the inventors decided to distribute it over several teeth in order to increase efficiency.

"It took me many hours to calculate the helical path of the scroll because it's forever changing its diameter as it constantly engages the balls in the ball gear when it rotates around," says McPhee.

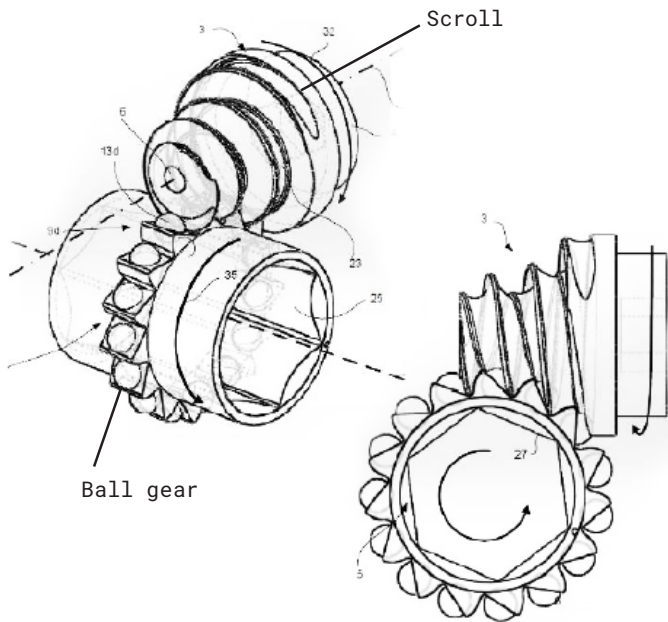
Superbolt Multi-Jackbolt Tensioner (MJT)

Tightens joints with high accuracy without requiring specialized skills or heavy tooling.



Components

- 1 Nut body
- 2 Jackbolts
- 3 Hardened washer



McPhee and Armstrong also had to decide on the best way to align all the jackbolts and get them to the same starting position. Indeed, the jackbolts on Superbolt MJTs do not have a consistent starting point, which makes tightening them simultaneously complicated. If the jackbolts are not in the same starting position, once one has been tightened, they all stop moving.

This was solved with the use of a highly ingenious ratcheting drive cassette, which only needs a simple battery drill for operation. Now the main tightening can be performed using the Superbolt Tool with a power cassette attachment. “There’s still challenges out there,” explains McPhee. “But it’s all about servicing the customer and doing the best possible job for them.”

Putting customers first

Indeed, customers have been at the heart of the development process, something that is part of McPhee’s philosophy. “I studied industrial design and whilst there was heavy emphasis on engineering, it was also critical to think about the human side of things as well,” he explains. “That’s very important in terms of how I look at functionality.” McPhee wanted the Superbolt Tool to be quick, simple and easy to handle – and he succeeded.

“The Superbolt Tool is unique,” says Steve Greenwell. “Customers with many MJTs or those that have to undertake frequent maintenance will achieve impressive gains in efficiency and timing”.

Although the Superbolt Tool has just been released, McPhee’s mind is already racing with potential developments. “The sky’s the limit with the Superbolt Tool,” he says. “There’s a lot of scope out there for future development and I’m really excited. One of these days it could end up on a space station – who knows where we go with this.”

Text Ariane Osman **Photos** Jörgen Lindström

HOW DOES THE SUPERBOLT TOOL WORK?

The key principle behind the Superbolt Tool is powered by UniForce Technology – invented by Nord-Lock Group. The patented technology consists of a unique scroll and ball drive mechanism for uniform and high transfer of torque. In operation, effective torque amplification is achieved in a very compact design – with input torque kept to a minimum. Tailored cassettes, which attach to the main drive unit, are used to transfer the necessary torque equally to each of the Superbolt tensioner jackbolts.



Name
Andy McPhee

Title
Research & Development Engineer at Nord-Lock Group

Age
49

Education
Postgraduate degree in Applied Science
– Industrial Design from Queensland University of Technology

Professional background
Automotive design, hovercraft manufacturing, irrigation, software design

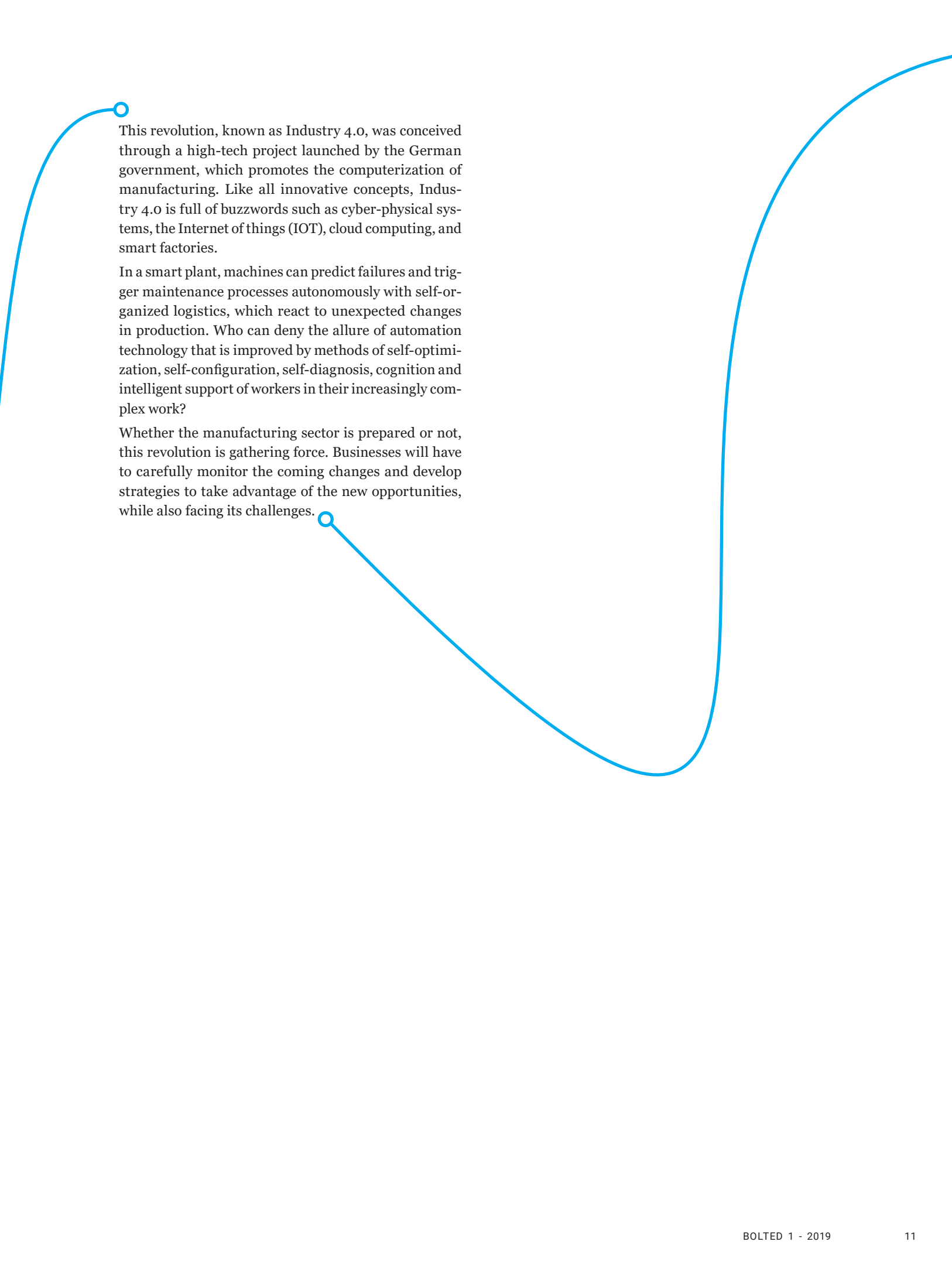
Passion
Solving problems that enhance people’s lives

Inventions
Inflatable tent, carbon fiber bicycle, mobile solar powered lights, bicycle rear-view mirror



get smart

Connected machines, components, and systems are creating intelligent networks that can control each other autonomously. Industry 4.0 is happening now but how will it affect the manufacturing industry when data is the new oil?



This revolution, known as Industry 4.0, was conceived through a high-tech project launched by the German government, which promotes the computerization of manufacturing. Like all innovative concepts, Industry 4.0 is full of buzzwords such as cyber-physical systems, the Internet of things (IOT), cloud computing, and smart factories.

In a smart plant, machines can predict failures and trigger maintenance processes autonomously with self-organized logistics, which react to unexpected changes in production. Who can deny the allure of automation technology that is improved by methods of self-optimization, self-configuration, self-diagnosis, cognition and intelligent support of workers in their increasingly complex work?

Whether the manufacturing sector is prepared or not, this revolution is gathering force. Businesses will have to carefully monitor the coming changes and develop strategies to take advantage of the new opportunities, while also facing its challenges.

LINKING GLOBAL PRODUCTION

Management consulting firm McKinsey reports that it is highly likely the world of production will become increasingly networked until everything is interlinked. This is the driving force behind the Internet of Things and also means the complexity of production and supplier networks will grow enormously.

So far, networks and processes have been limited to one factory. But the new industrial step will lift the boundaries of individual factories, and even individual countries, in order to connect multiple factories all over the globe.

In addition to condition monitoring and fault diagnosis, components and systems in these factories are able to gain self-awareness and self-predictivity, which will provide management with more insight into the status of the factory.

REAL-TIME TRACKING

H&D Wireless is a company that has positioned itself on the fast-growing market for industrial IoT solutions and wireless real-time tracking (RTLS). The company's solutions support multiple wireless technologies, which are combined with security protocols, data analysis and artificial intelligence (AI).

World-renowned truck manufacturer Scania has chosen H&D Wireless as a supplier for the indoor positioning system GEPS for Industry (Griffin Enterprise Positioning Services).

According to Pär Bergsten, CEO of H&D Wireless, by using GEPS, Scania can constantly monitor and manage its fleet of robot tugs and material handling carts across their factories in real time. Scania can use this data to optimize the utilization of expensive assets and improve efficiency, while ensuring the safety and security of its employees.

"The system digitizes and visualizes physical processes and identifies — among other handling of material — production bottlenecks, uneven production flow, and unexpected machine interruptions," says Bergsten. "Less time is wasted in the factory and throughput increases. It is easy to quickly locate the necessary tools for proper assembly using the GEPS equipment dashboard."

Tracked items are visualized on easy-to-use software on PCs, tablets and smart phones. Besides position, Scania can monitor the condition of the tracked asset in order to know if it has been damaged or exposed to temperature extremes.

SECURITY CHALLENGES

However, this new revolution does not only signal bright opportunities on the horizon. According to a survey by McKinsey, executives estimate that 40 to 50 percent of today's machines will need upgrading or replacing to meet the new demands.

Security is also an issue as online integration will allow room for data leaks and security breaches. This will cost manufacturers money and might even hurt their reputation. Consequently, research into security is crucial.

Establishing who owns the data accumulated from networks of connected machines and components may also prove difficult — especially with the value of data constantly increasing.

DATA IS THE NEW OIL

The Internet of Things is viewed as a major component in this transition, and for good reason. It involves the use of big data, connected sensors, autonomous machines and artificial intelligence. By fitting sensors onto industrial components, launching connectivity to systems, collecting data and using advanced computer processing, companies hope to boost productivity and efficiency.

Pierre Kellner, Business Developer, Smart Products & Services at Nord-Lock Group, says that in the past, data was gathered from surveys, research, and other external sources. Now, sources of data are being supplemented by the product itself, and its value increases exponentially when it is integrated with other data. "It is crucial to start collecting and owning big data, although we do not know the value of the data today. Data is the new oil," says Kellner.

MONITORING BOLTS

When it comes to bolted joints, there are several fields that will benefit from connected sensors and AI, such as aircrafts and airports, trains and railways, mining equipment, bridges, oil platforms, nuclear power plants and wind parks.

In the case of wind parks, the offshore variety are preferred since they can be built on a large scale, enjoy better efficiency due to higher wind speeds and have less noise considerations than their onshore counterparts.

However, these turbines have hundreds of bolts each — a number that will likely increase into the thousands as they get bigger and which could cause many problems.

"Since access is hard and in some cases dangerous this makes services difficult and thereby expensive," says Kellner.

Several sources estimate that the operation and maintenance cost will contribute to between 20 and 25 percent of the cost of offshore energy, compared to 10 to 15 percent onshore.

The remote analysis, monitoring and reporting capabilities offered by Industry 4.0 would make this more efficient and affordable — advantages that are set to revolutionize not only the bolting sector but the manufacturing industry as a whole.

Text Martin Neander



Pierre Kellner
BUSINESS DEVELOPER,
SMART PRODUCTS
& SERVICES AT
NORD-LOCK GROUP

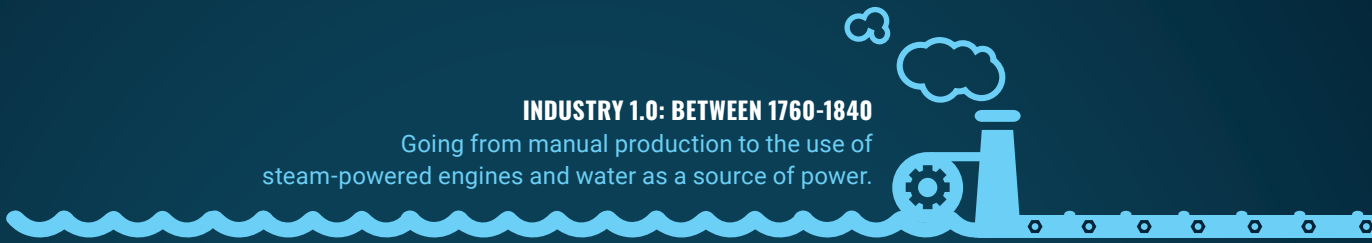


Pär Bergsten
CEO OF H&D WIRELESS

FOUR INDUSTRIAL STEPS

INDUSTRY 1.0: BETWEEN 1760-1840

Going from manual production to the use of steam-powered engines and water as a source of power.



INDUSTRY 2.0: BETWEEN 1870-1914

The defining characteristic was the introduction of mass production as a primary means of production in general.

INDUSTRY 3.0: BETWEEN 1950-1970

Often referred to as the digital revolution, it involved the change from analog and mechanical systems to digital ones.



INDUSTRY 4.0: FROM 2010-PRESENT

The machine is becoming an independent entity that is able to collect data, analyze it, advise upon it, and constantly work on maintaining itself.



ALSTOM AND NORD-LOCK GROUP: A SECURE COUPLING

French multinational Alstom is a global player in the rail transport industry. The company has a raft of international customers seeking the most comprehensive range of products and services on the rail market — from trains and integrated systems to signalling and services. To ensure that Alstom maintains its position as the preferred partner for clients like SNCF and Eurostar, the group looks to a broad range of suppliers to provide the solutions and services it needs.

Nord-Lock Group has worked with Alstom since 2014, providing solutions for their tough engineering challenges.

Alstom first started using Superbolt technology from Nord-Lock Group almost by chance. “I’m in a rail transportation working group along with representatives from some of the big rail customers like French railway operator SNCF, and manufacturers like Bombardier Transport. Three years ago, we were invited to a two-day workshop at the Nord-Lock Group premises in Lyon, France,” says Luc Moyart, Fasteners Expert and Right First Time Manager at Alstom. “Among the products they showed us was their Superbolt tensioner range, and I thought they might be per-

fect for a certain type of coupler assembly that we were using on trains for the Los Téquès project for the Caracas subway,” he says.

These couplers require very large diameter bolts, which present certain issues when it comes to tightening. Although Alstom hadn’t actually been looking for a solution, the new Nord-Lock Group Superbolt technology they’d seen offered some clear advantages. “I thought they might be suited to train bars and couplers because these require big 30mm bolts that were proving tricky to tighten,” says Moyart.



Luc Moyart
FASTENERS EXPERT, ALSTOM, FRANCE

THE PERFECT SOLUTION TO SECURE TRAIN COUPLERS

Moyart was right, and since then, Alstom has used Superbolt tensioners for two more projects. After their adoption in 2014, they were used at Alstom's Lapa site in Brazil and on trains for a South African network. The third project involved trains produced in Katowice, Poland, for the Riyadh subway system in Saudi Arabia.

"Superbolt tensioners limit the torsion in the screws used for fixing the couplers because they use pure tension. The fusible screws are machined and calibrated so that in the event of an impact – a crash for example – they will snap at a certain pressure, leaving the coupler to slip beneath the train, thus avoiding derailment," Moyart explains. "Superbolt tensioners can also be used in places that are tricky to access, and they aren't sensitive to the different temperatures we might experience in different locations over the year, unlike with hydraulic tightening solutions," he adds.

Using Superbolt technology has allowed Alstom to reduce manufacturing time thanks to coupler installation as well as simplify assembly. "The tensioners are easier to access, which has saved us money in terms of industrial capacity and handling. We need less storage for the tools because we can now tighten these M30 screws with a simple torque wrench, and they don't require the same hydraulic benches to manage the tightening process like before," says Moyart.

Furthermore, Alstom has found that Superbolt tensioners are not just integrated into an assembly more easily, but they can be assembled and dismantled with greater ease too. "One major advantage is that Superbolt tensioners can be reused, unlike our previous bolts, which had to be discarded once they were removed from an assembly. Superbolt tensioners have a lifetime guarantee, which represents significant savings," says Moyart.



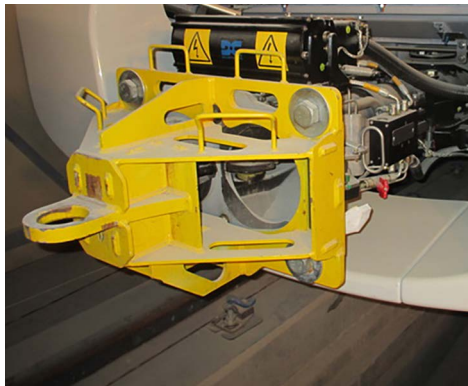
Another key benefit is that fewer Alstom employees are suffering from repetitive strain injury and other problems related to bolt tightening since the group started using Superbolt tensioners. "People handling the heavy equipment used for hydraulic tightening are prone to health issues, and our employees have literally felt the benefits of this technology, and they're very happy about that," explains Moyart.

INNOVATING A TRADITIONAL INDUSTRY

"The railway industry is a fairly traditional world and employees can sometimes be a little sensitive to change, making it tricky to introduce new ways of doing things, but we've had excellent feedback," says Moyart. "They can see the benefits, not just in terms of their health, but also in terms of the working environment and how these tensioners have made their lives easier. They have been trained by Nord-Lock Group teams to use Superbolt tensioners, and it's been a very smooth transition," he adds.

Naturally, it is important for a group like Alstom to cultivate positive relationships with its suppliers, something that has been very easy to do with Nord-Lock Group. "Our relationship with Nord-Lock Group has always been excellent – we have worked closely with them throughout the experience. When we wanted to carry out initial tests, looking at how Superbolt technology might work, they came to our premises several times to consult with us and offered a lot of support," explains Moyart. "They also came to train our operators, which was very successful, and since we validated the solution and started using the bolts, we haven't had a single issue with them," he says.

Alstom has recently signed a number of new contracts for similar solutions and Moyart is certain they will be working with Nord-Lock Group again. "I wouldn't be surprised if I visited Nord-Lock Group again to see an innovative new product and subsequently find an application for it in our technology. Indeed, improvement is part of our group culture – that's what we do!" he concludes. →



ALSTOM AND NORD-LOCK GROUP COLLABORATION TECHNICAL INSIGHTS

“Alstom switched to Superbolt tensioners on their railway coupler applications to ensure that any potential crash would be ‘smoother’, and the coupler would move back underneath the carriage,” explains Olivier Gaillard, Sales Manager France at Nord-Lock Group. “They wanted to use double-slotted nuts but the existing fuse bolts risked breakage during tightening. Regular hydraulic tools brought too much torsion, which is why they looked to Nord-Lock Group Superbolt tensioners that tighten using pure tension,” he says.

“The French railway market tends to be rather conservative and introducing new technology can be challenging, so we worked with the engineering methods and industrialization departments at Alstom, along with individual operators, to set up a first design win of 1,100 nuts,” says Gaillard. The second step was to undertake a design-to-cost action on a large scale, resulting in a new project encompassing 57,600 nuts. “Since 2014, 1,700 M30 nuts have been delivered. We are looking forward to new opportunities both with Alstom and other rolling stock manufacturers,” he concludes.

Text Anna McQueen Photos Getty Images



Olivier Gaillard

SALES MANAGER, NORD-LOCK GROUP, FRANCE

The client

Alstom Transport

End customers

Compañía Anónima Metro de Caracas, Venezuela for the Los Teques project

Metrorail, South Africa for the Prasa project

Riyadh Metro, Saudi Arabia for The Riyadh project

Application

Bars and couplers for mass transportation trains

Nord-Lock Group solution:

Superbolt tensioners

Benefits gained

Reduced costs and improved operator experience

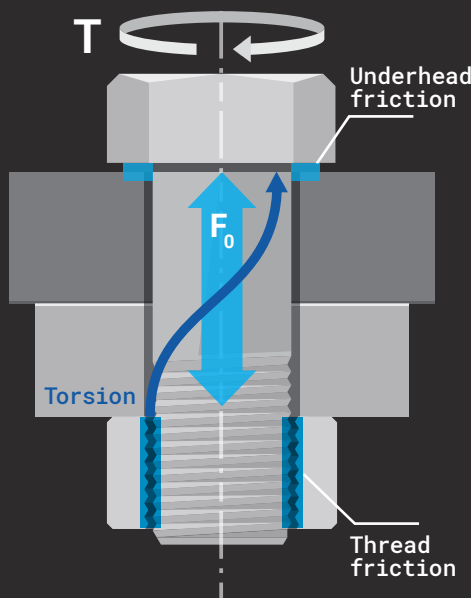
What is the relationship between torque, preload and friction?

Email your questions about bolting technologies to experts@nord-lock.com



Damien Thomas
EUROPEAN TECHNICAL MANAGER,
NORD-LOCK GROUP

One of the main methods to preload a bolt is to apply a torque on its head. This is a very common process in the industry, however it is not easy to control accurately.



When the fastener is turned down on the thread helix, the rotatory motion transforms into a linear motion. This causes the bolt to stretch, while parts are compressed. However, only a small amount of the input torque serves to pre-tension the bolt. Most of it is used to overcome the resistive effect of friction, which opposes the rotation of the fastener.

How friction affects torque and preload

Friction originates at two contact interfaces; between the turned part and the clamped part (often under the bolt head or under the nut) and in the threads.

This means that the portion of torque that transforms into preload is very small. Torque/Tensile tests help to characterize the coefficients of friction taking place at both contact interfaces. The breakdown of torque usually shows that only 10% of the input torque is useful. The rest is used up by friction.

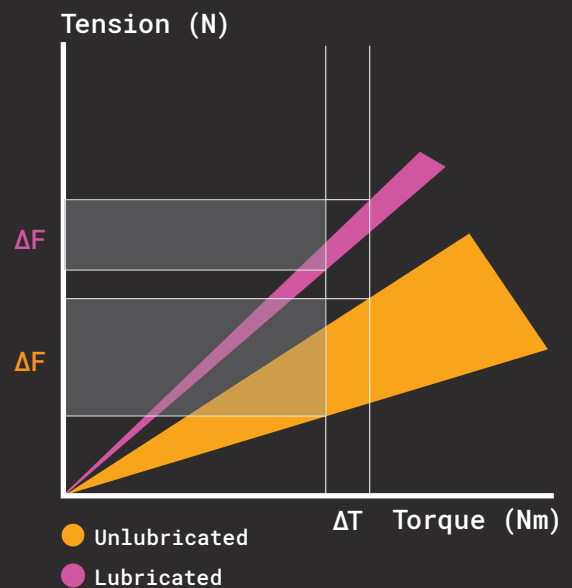
For example, underhead torque represents 50% of the input torque and thread torque is 40%. Hence, the torque tightening process is not very efficient. This portion can be increased by applying a low friction lubricant. Using lubricant reduces friction and decreases the necessary torque to reach the same preload.

Scatter and its effects

Friction coefficients are also highly variable (+/-20% usually), which introduces scatter in the process. Also, even though tightening tools can be very accurate (+/-1% for calibrated hand torque wrenches for example), the deviation on applied torque varies from +/-10 to +/-50%. Many operators get confused when they realize how much influence the position of their body and how they handle the tool has on the applied torque.

It is commonly known that the scatter in achieved preload is +/- 30%. This means that the maximum possible preload can be twice as much as the minimum possible preload. Scatter can be even higher for rusty bolts or for stainless steel fasteners, which are prone to seizing.

Luckily, scatter can be decreased by applying lubricant or using bolts with a specified coefficient of friction, for example with a top coat or wax.



RAID KAROUMI

If you have a bridge in need of a check-up, Professor Raid Karoumi is the doctor to call. A renowned expert in the field, Karoumi has developed numerous methods for structural health monitoring and vibration analysis of bridges. He is now conducting cutting-edge research using sensors and artificial intelligence to prepare bridges for the challenges of the future.

Title

PhD, Professor of Bridge Engineering and Head of Department, Structural Engineering and Bridges, KTH Royal Institute of Technology, Stockholm

Age

54

Education

MSc in Engineering from KTH Royal Institute of Technology in Stockholm

PhD in Structural Engineering and Bridges from KTH Royal Institute of Technology in Stockholm

Professional Background

Design consultant for buildings and bridges

Passion

Cars, especially sports cars



“Instrumented bolts would be really interesting for the industry”

How do bolted joints affect bridge durability, safety and maintenance?

In my opinion, bolted joints are preferred over welded joints. When you weld, you always end up with defects and stress concentrations, which make these connections very critical for fatigue. Bolted joints also allow some movement, which gives a lot more energy dissipation and thus higher damping. Installing and connecting prefabricated parts is much easier with bolted joints too, especially in Nordic winters when it is often too cold to weld.

What are the main bolted joint challenges, and how are these solved today?

Loosening due to vibration, fatigue and corrosion are the primary challenges, which are of course solved by tightening, maintenance, and treating. Something that could be really interesting for the industry to solve these issues in the future would be instrumented bolts. Smart sensors could tell us what is happening to the bolt in real time and let us know when it has reached its lifetime or if it needs tightening.

What does vibration mean for bridges and what challenges does it present?

Vibration can be bad, not only for passenger and pedestrian comfort, but also for safety. High vibration levels on a railway bridge, for example, reduces track stability and could cause a train to derail. Bridges suffering from a high level of vibration also require more maintenance, repair and retrofitting.

Any interesting projects underway?

We've developed a wireless smart monitoring system to train an artificial neural network to recognize healthy bridge conditions. In the future, the network will compare new measurements with this old data, allowing us to detect changes and deterioration much earlier than just by looking at the signals or the structure.

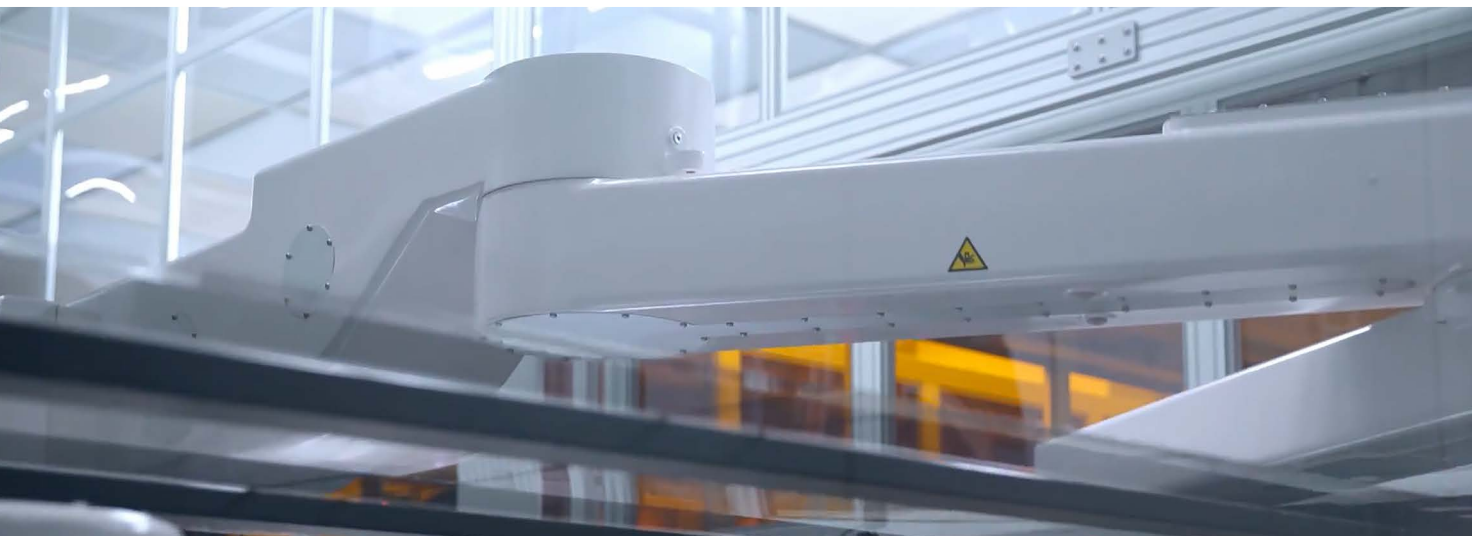
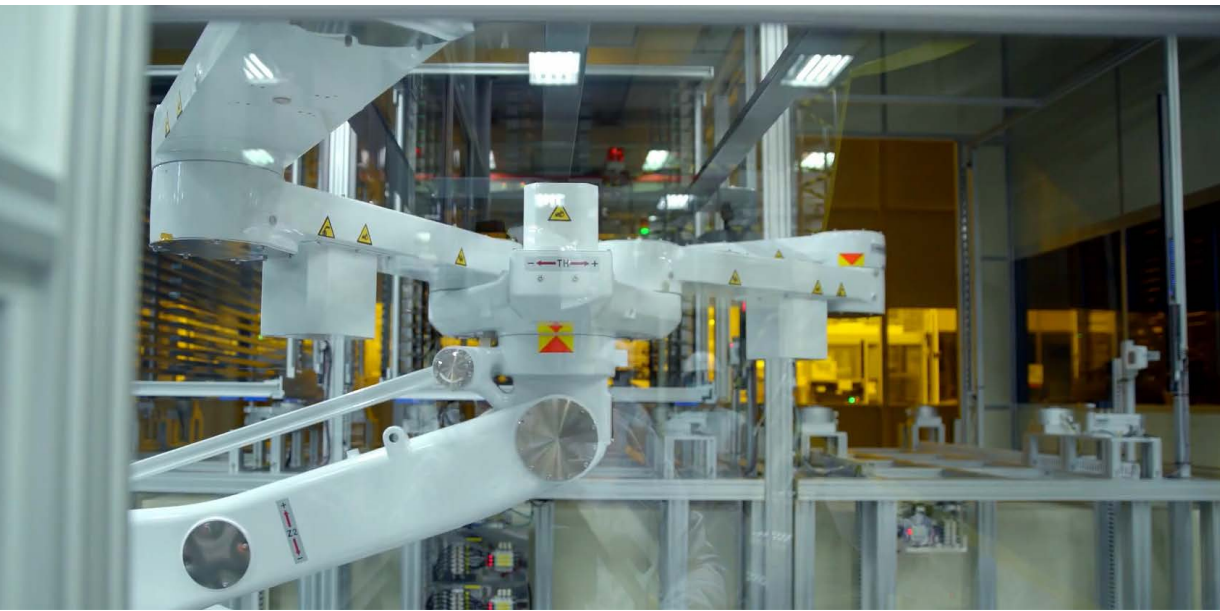
Any other exciting innovations in the pipeline?

For a railway bridge project we're working on right now, we've installed a device that harvests vibration from the track and converts it into energy, which is then used to recharge the batteries of the monitoring system. Because the system takes energy from the vibration, it also works as a damper to reduce it on the bridge. We hope to be able to use this harvested energy for other exciting future innovations as well — for example to heat the pavement of a road bridge to reduce skidding accidents.

Text Chris Kleinman Photos Oskar Omne



Raid Karoumi demonstrates one of the smart sensors.



Client

Hyundai Robotics

End customer

Prominent Korean LCD display manufacturer

Location

Daegu, Korea

Application

Key bolting areas on the 6G/8G/11G LCD Transfer robots

Solution

Nord-Lock washers

AUGMENTED REALITY

Have you ever wished you could try out a tool without the hassle of carrying it around on site? Now you can experience working with a tensioner directly from your mobile device thanks to a new augmented reality (AR) experience from Boltight.

The first trial experience shows a Typhoon tensioner in 3D with an exploded view of the tool. The user can then place the tensioner onto a bolt on a virtual flange to check compatibility. With links to a datasheet, YouTube and the Nord-Lock Group website, the experience also gives the user all the information they need to understand how the tool is used.

Benefits of augmented reality

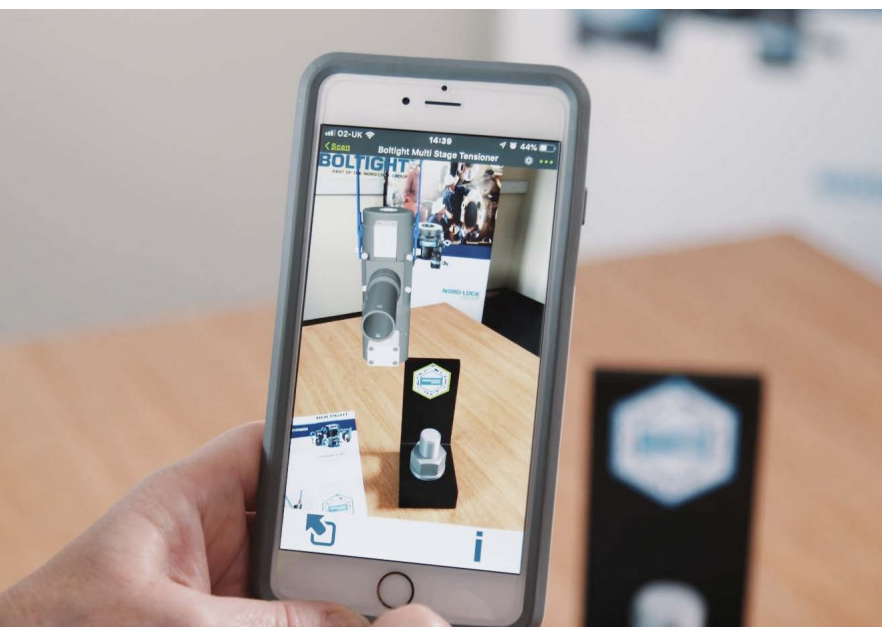
The new AR experience will provide a valuable aid for the Boltight sales and marketing teams. Sales teams can show customers how the tools would work on site when it is not possible to bring actual tools. The detailed level of interactivity can offer customers a much better idea of product design and functionality, as well as providing access to a wealth of information at the touch of a screen.

“We are very excited to be offering our customers this level of AR interaction,” says Graham Souter, Sales Director at Boltight. “This is just the start of our digitalization journey and the technology has the potential to be applied right across the business. AR and VR will play a pivotal role in the future of manufacturing as digital service comes to the fore. Digitalization sits at the heart of the UK’s industrial strategy and this new offer will help us take the lead.”

Future developments

As the AR experiences are developed further, they will include installation instructions, manuals and e-learning modules for online training. Boltight will be producing a similar experience for all the other tools in their standard range. Eventually the technology could be offered to customers when special tools are being designed and the customer is keen to see how the tool will fit onto their application.

To view the experience, download the Vuforia View app from Google Play or Apple App Store and scan the code.



WHAT IS AUGMENTED REALITY?

Augmented reality (AR) allows users to interact with real-world environments that have been artificially enhanced. AR brings digital elements into the real world by integrating immersive sensory factors that can include sight, touch and hearing, which alters users perception of the everyday world.

IMPROVING SPEED AND EFFICIENCY FOR CUSTOMER CONVENIENCE

Fredrik Meuller became CEO of Nord-Lock Group in June 2018 and has not wasted any time establishing his vision for the company. The Nord-Lock Group commitment to high-quality, reliability and safety is what Meuller believes has created the perfect environment for accelerated growth and efficiency.

“The Group has been on an exciting journey, which will definitely continue,” says Meuller. “This includes expanding our geographic reach, delivering high-quality products, increasing efficiency and acquiring knowledge to continuously innovate in our product development. We aim to be close to our customers in order to provide them with the fast service and delivery they need.”

Keeping up with the pace of the industry

As part of the company’s focus on growth in major markets, Meuller has been working to increase support for customers and partners at a local level. This has entailed opening new sales offices around the world and building teams of knowledgeable sales engineers and product experts, such as the recent expansions in India and Chile. The Group has also

acquired a long-term distribution partner, IDQ, in Spain. The move has significantly boosted product availability and provided quicker delivery services for customers.

“The Spanish and Portuguese industries are developed in several sectors but across all of them remains the need for safe bolted joints,” says Paloma Bellido, General Manager of Nord-Lock Group Iberico, based in Spain. “This acquisition was a natural step in the growth strategy of the Group and a considerable improvement on the level of services and support to our customers, who will now have access to all our technologies and our engineering services.”

Improving efficiency through digitalization

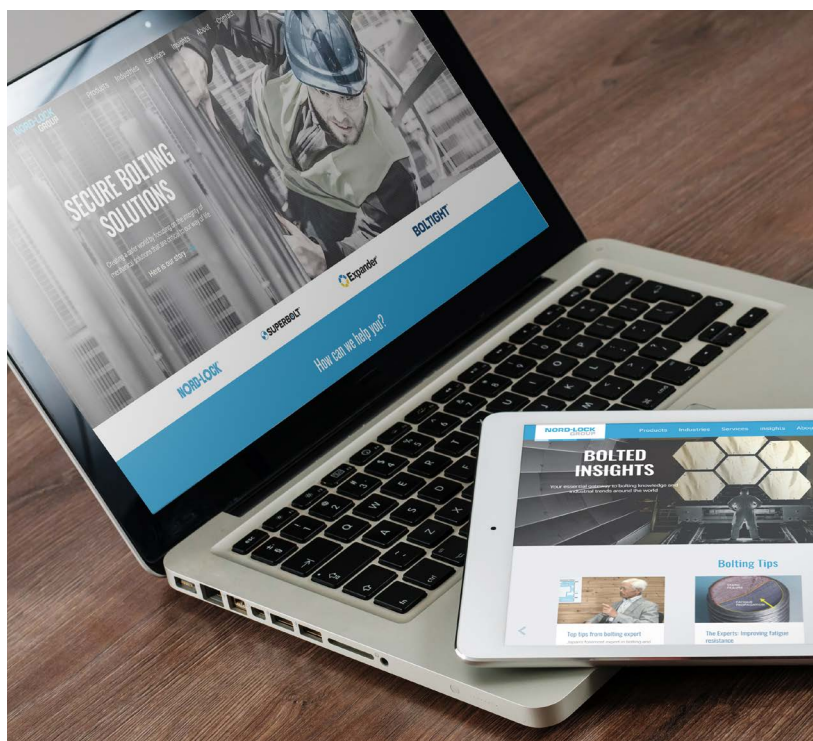
Nord-Lock Group also continues to improve efficiency through digitalization. This will increase service support for customized solutions through innovative design and application development. With customer needs a priority, the Group will further invest in smart digital tools that boost efficiency, such as ‘Torquelator by Nord-Lock’.

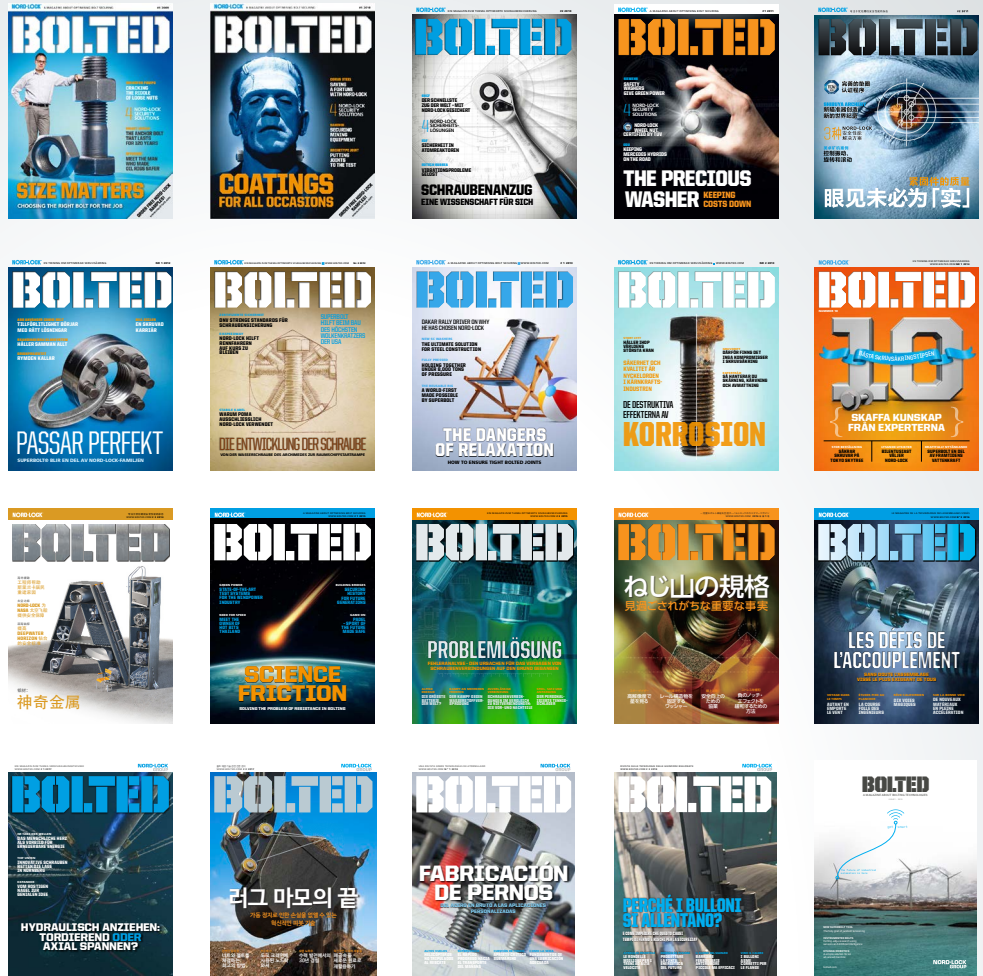
One thing that will remain the same is the need for safe bolted joints across all applications and industries. Despite the boundless possibilities, Meuller is adamant that the Group never becomes complacent and continues working hard to raise the bar within the bolting industry.

“We see the bolting industry and our customers’ needs and challenges constantly evolving,” he says. “We need to continuously improve our efficiency and productivity in order to provide the best service and delivery possible”.

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