

changes

Russia With confidence into the future
Mixed reality A new dimension in services

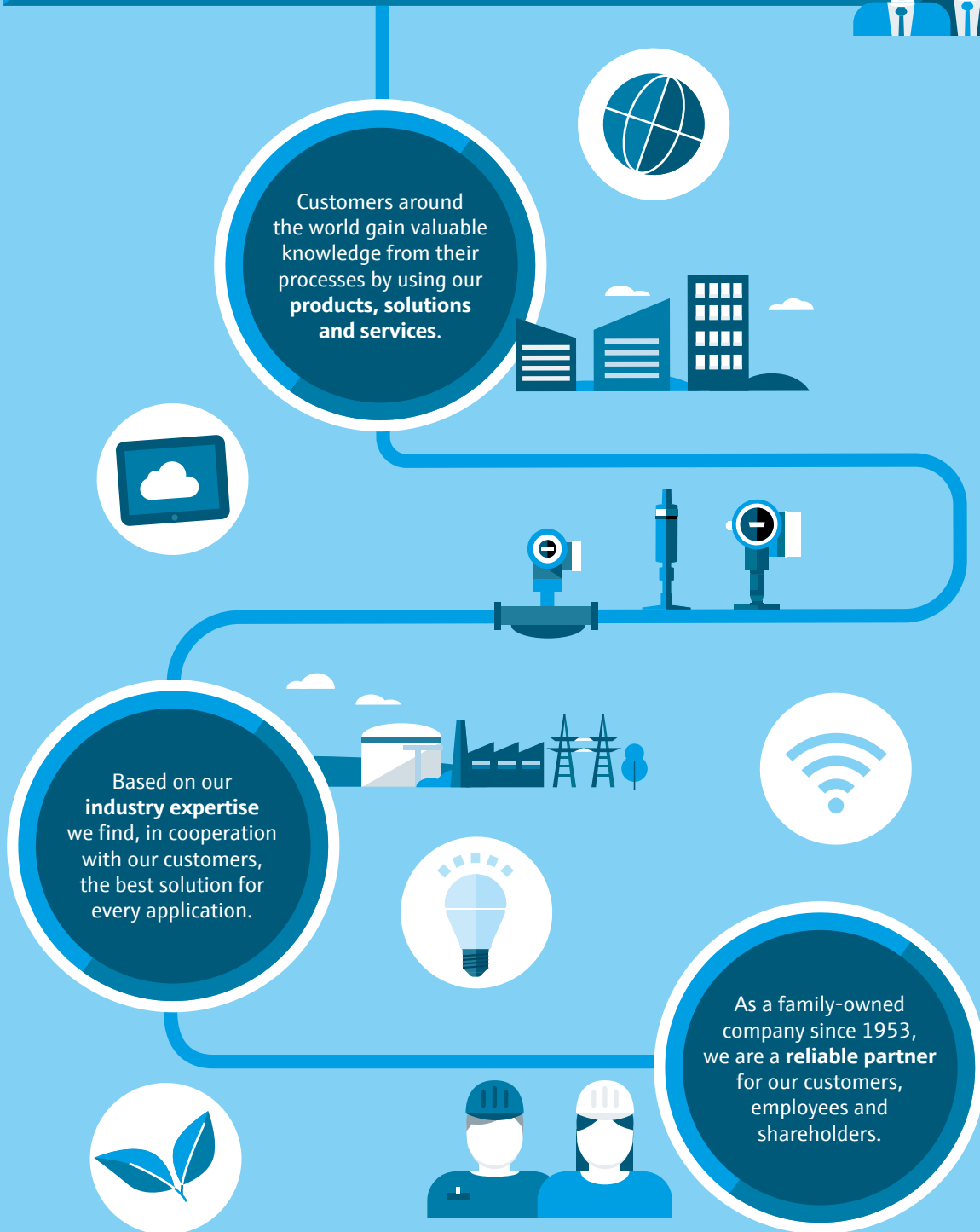
Primaries & metals industry

Modern treasures



A strong partner worldwide

We are a successful family company. In **laboratory and process automation**, customers around the world trust our products, solutions and services to improve their processes, and thus their products, sustainably.



Watch our corporate video to learn more about the People for Process Automation.

Endress+Hauser **E+H**

Valuable collaboration

Dear reader,

This issue of 'changes' focuses on the **primaries & metals industry**. The growing demand for raw materials is driving the sector, but at the same time extraction is becoming increasingly difficult, whether through lower grade ore, rising energy costs or tighter environmental standards. Against this backdrop, how can the industry remain competitive? Industry expert Michelle Ash is convinced that the answer lies in the use of new technologies – and in increasing digitalization. In an interview, she explains why data is the new gold and how partners like Endress+Hauser support the industry in meeting these challenges.

The process industry is facing major challenges in **Russia** as well. Falling oil prices, international sanctions and structural problems have left their mark on the country. But Russia wants a fresh start and is determined to become one of the world's five largest economies within a mere five years. This will also require investments in measurement and automation technology. Our sales center in Russia is well positioned to meet this demand. In less than 20 years, we have created a tight network across the country. Our Market section illustrates what we can achieve for our customers with this unique proximity.

A precise understanding of the needs and requirements of our customers has always been crucial to Endress+Hauser. After all, our ability to develop tailored products, solutions and services for companies depends on our capability to identify these demands. In the **Know-how** section, you will learn about the innovations that we are working on together with our customers. Some of these not only make the difference in day-to-day plant operations, but have the potential to change the process industry across all sectors. Learn more about the possibilities of mixed reality in service applications and advanced analysis techniques that monitor product quality while the process is running.

And what's happening within the Endress+Hauser Group? How did the company develop? How do we go about meeting our social responsibilities? What new steps are we taking within the Group, and as a family-owned company, to prepare for the future? In the **Insights** section, we look closely at all of these issues, and Supervisory Board President Klaus Endress shares his own views and visions with you. I hope you will enjoy this year's selection of exciting and diverse articles!

Yours

Matthias Altendorf
Matthias Altendorf

PS: What do you think of this year's edition of 'changes'?
I look forward to receiving your feedback and suggestions!
changes@endress.com





Heavy gear: Efficiency, safety and environmental protection mark the primaries & metals industry.



Fast: Raman sensors for multi-parameter analysis.



Russia: Endress+Hauser strives for customer proximity.



Innovative: The collaborative campus in Freiburg, Germany.

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Thought leader: Interview with mining expert Michelle Ash.

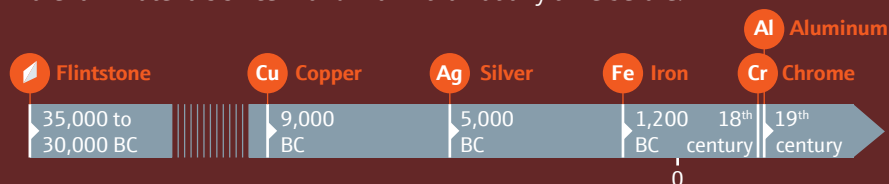


The foundation of the world

Primaries & metals have played a decisive role in advancing the development of mankind and continue to fuel its progress. But for how much longer? These natural resources are increasingly becoming a rare commodity.

Old acquaintances

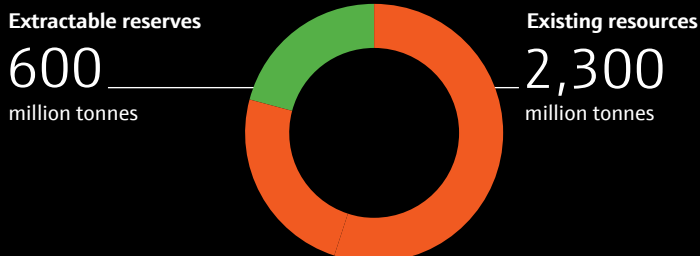
Humans have been harnessing primaries and metals ever since prehistoric times. But it wasn't until the Industrial Age that the demand skyrocketed, transforming these resources into a foundation of the global economy. Humankind has used up more raw materials since World War II than at any time before.



Dwindling reserves

Although most metal supplies are nearly inexhaustible, the amount of reserves that can be accessed at a reasonable cost are significantly less than the resources that can theoretically be extracted. Furthermore, large quantities of the reserves are distributed very unevenly. The situation with rare earths is especially critical.

Copper reserves



Countries with the highest raw material reserves (according to value in US dollars)

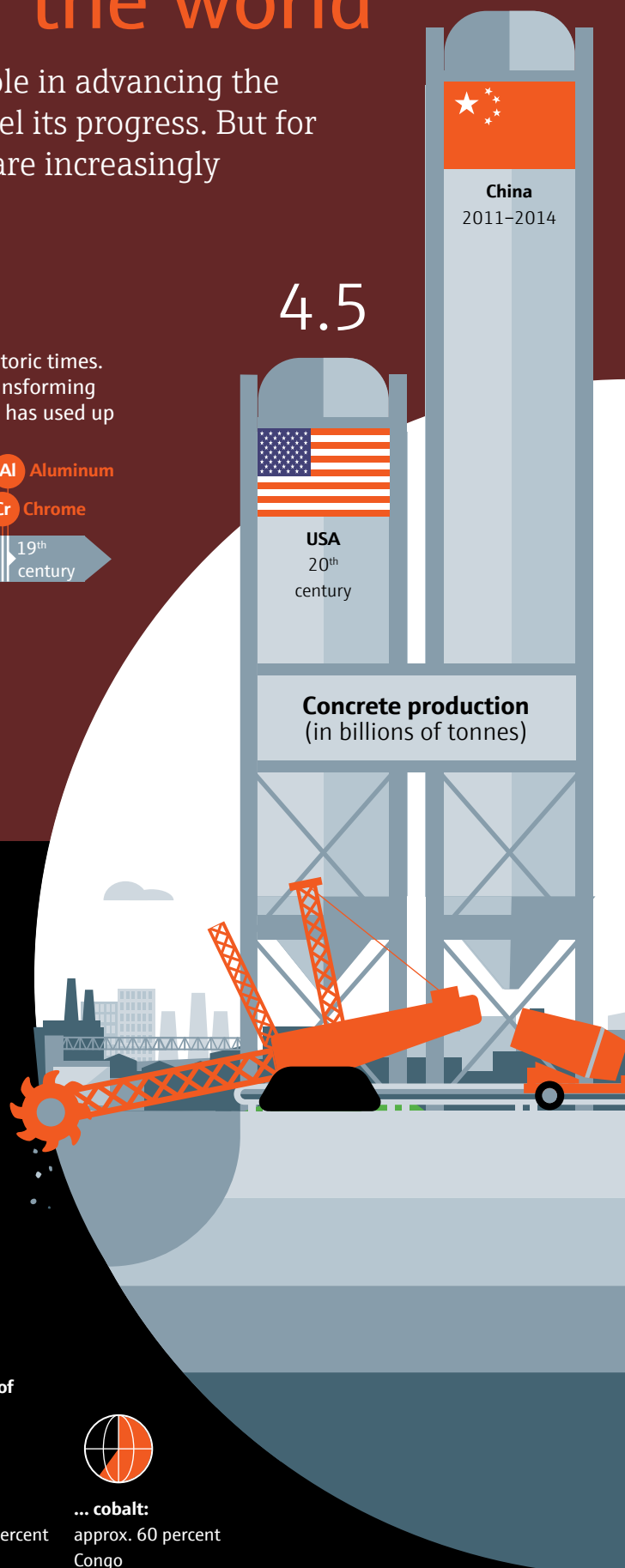


Percent of global production of



6.6

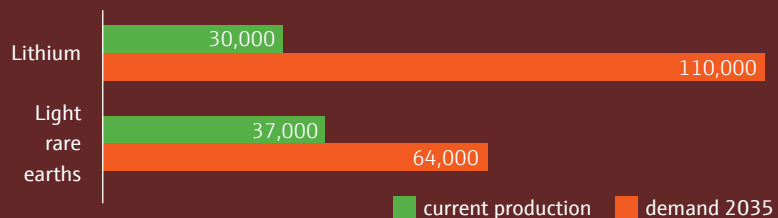
4.5



New fields of application

Given the growing world population and urbanization in emerging countries, cement is the most popular non-natural material in the world. Technologies such as microelectronics and electromobility are driving the demand for metals and rare earths. The demand for many metals could soon exceed the supply.

Demand for metals – Production (in tonnes)



Global electric vehicle production



Urban mining

Recycling is becoming a more important factor in raw material supplies. In addition, recovering metals from scrap requires less energy and creates fewer greenhouse gases than its original production. Sources include the waste piles of the worldwide growing urban areas.

One tonne of mobile phones contains:



300

times more gold

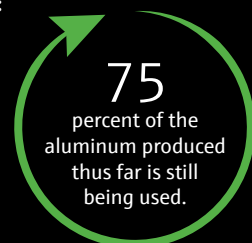
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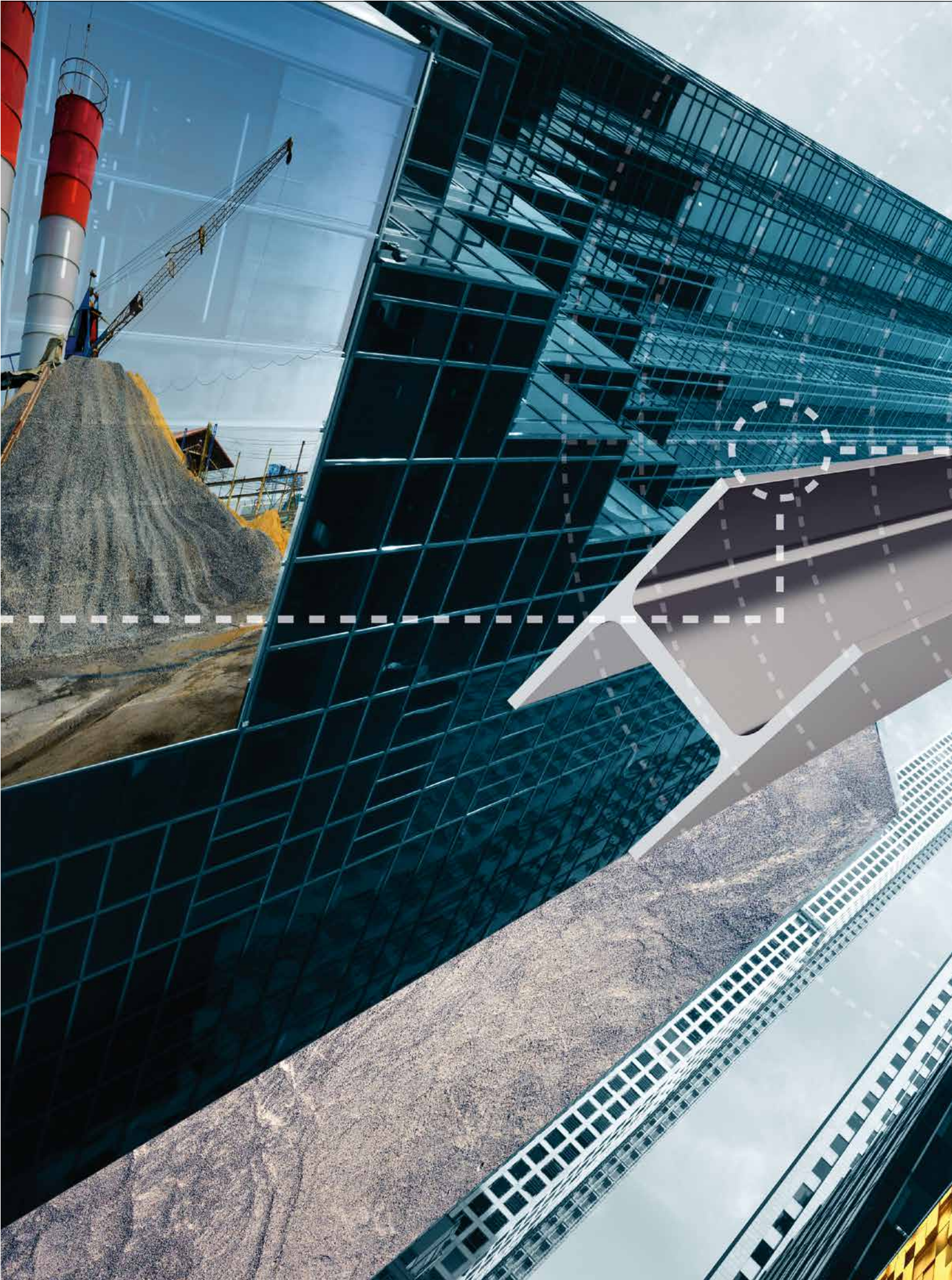
times more copper

6

times more silver

than 1 tonne of ore.





The future calls for efficiency

The demand for raw materials is rising, while reserves seem to be dwindling. Producers around the world are thus working toward the same goal of generating more with less. The result, which seems contradictory at first glance, is that reserves are increasing thanks to technological innovations.





While our planet boasts a wealth of natural resources, industrial nations and the large emerging countries, especially China and India, grow an ever increasing appetite for raw materials. Furthermore, the reserves – those resources that can be extracted economically and with today's technology – are often distributed unequally. Most of the large deposits have already been developed, and the resources in the earth's crust so far cannot be economically used since they are too finely dispersed to be easily extracted or lie in inaccessible regions.

Under pressure from all sides The phrase 'resource crisis' makes the rounds on a regular basis, sometimes with a focus on scarce or uncertain supplies, other times with concerns about the price structure. Geopolitical issues play a role as well, given that access to the deposits is often confined to narrow geographical areas, and on the markets national trade policies consequently meet global industry structures.

On the other hand, the way in which metals and minerals are wrested from the earth is a major concern for environmental protection. The objective is to make the extraction of raw materials more sustainable by reducing both energy consumption and the impact on nature. Not only international companies that process the raw materials, but also more and more consumers call for corporate responsibility.

As a result, raw materials producers are feeling pressure from all sides. Although demand for their products is high, geopolitical frameworks, price sensibility on the customers' side and demands arising in politics and society are making the business anything but simple. Approval processes are becoming more complicated, the necessary investments are increasing and yields are sinking, such as with gold, which can be found in nearly all electronic products in tiny amounts.

Scarce resources won't necessarily mean dark times after all. Perhaps it's just the opposite: a brighter future through better technology.

"Statistics show that mining lost one-third of its productivity between 2004 and 2014," says Andrew Reese, Global Industry Manager Primaries & Metals at Endress+Hauser. "You can only extract about one gram of gold from one tonne of rock." Against this background, the direction the industry has to take is quite clear. "It has to produce more with less," says Andrew Reese. The technical trends are already visible.

Trends and transformations In mining, for instance, complex chemical processes or bioleaching with bacteria aims to make it easier to release the minerals from the rock. The underground mining sector is seriously considering highly automated extraction methods. Real Time Mining, an EU-sponsored research and innovation project, has named two major objectives: decrease environmental impact and increase resource efficiency. Achieving these goals will require continuous process monitoring and highly selective mining operations, thus resulting in less energy consumption and less excavated material.

If the industry is successful in making this transformation, the reserves will continue to grow. This is a trend that has long been observed as a consequence of new exploration and technological advances, such as with copper. In 1970, usable copper reserves were estimated at roughly 280 million tonnes. That number has since risen to between 600 and 800 million tonnes, despite the fact that the industry mined around 520 million tonnes over the past five decades.



Recycling raw materials Reserves also increase when the recycling loops are actually closed. In contrast to other raw materials, metals can be recycled over and over because they are used, not consumed. A third of copper production is already covered through recycling today. At around 800 million tonnes a year, steel is the world's most recycled material. Much-discussed urban mining – the process of recovering raw materials from used products, buildings and waste – has so far turned out to be more of a concept than a reality, however. Electronic scrap stored at old and new waste disposals is viewed as a major source of secondary raw materials for the future. However, it's still unclear how these resources can be systematically developed, not to mention the fact that the mixture of substances requires exceptionally complex separation processes.

Recycling is a topic of discussion in cement manufacturing as well, where enormous quantities are needed to produce concrete for growing cities around the world. The fields of application for recycled materials are limited, but there is much that can be accomplished in other areas. At 65 to 75 percent of the variable manufacturing costs, energy is a critical factor in the burning of the cement clinker. Alternative raw materials, secondary fuels such as sewage treatment sludge, and more efficient kilns, can help to drastically reduce the consumption of rock and fossil fuels, and thus CO₂ emissions.

Steel is no different. Up to 40 percent of the production costs are tied to energy utilization. Both industries are under pressure to develop new solutions to satisfy more stringent environmental regulations around the world. That applies to the mining industry as well, with emerging future technologies changing the needs of the market. Because of the electromobility boom, for instance, the demand for lithium, cobalt and nickel is growing. To date, however, the vast amount of nickel extracted from mines is not suitable

for electric vehicle batteries. This is forcing mine operators to drastically change their processes to satisfy the growing demand.

Data is the key Although the primaries industry operates in a markedly physical world, the various segments have one thing in common: to implement the necessary innovations, precise and continuous data is required – and it has to be linked so that all of the individual processes can be flexibly controlled in minute detail.

"There are a lot of things that we could use this data for, such as faster mine planning, more efficient system operation, automation of the extraction process and improving the processing technologies," says Michelle Ash, Chair of the Global Mining Guidelines Group, which is driving the transformation of the global mining industry (see interview on page 12). Generally speaking, current developments suggest that the real catalyst for fundamental change in the way materials are produced could be cyber-physical systems. Maybe scarce resources won't necessarily mean dark times for the industry after all. Perhaps it's just the opposite: a brighter future through better technology.

Text: Thomas Adolph
Illustration: X-Ray AG



"We have to be much more collaborative"

Digitalization will affect every industry – and revolutionize the primaries & metals industry, says mining expert Michelle Ash. In a joint interview with CEO Matthias Altendorf, she discusses what this means for partnerships and the ability to collaborate.

The interview with Michelle Ash and Matthias Altendorf takes place virtually: The mining expert is currently in Toronto, Canada; the CEO of the Endress+Hauser Group is working at home in Lörrach, Germany after an external meeting.

Ms Ash, you have been dealing with digitalization for many years. So it's fitting that we meet online...

Ash: I still remember well the first video conferences, how fancy we felt because we could have meetings with people all over the world. But the video footage was so bad that it was like talking to robots...

Altendorf: Hello, Michelle... I hear you as clearly as if you were sitting next door!

Ash: Hi Matt! Yes, today everything works on a smartphone in real time.

This shows the technical progress in our everyday life...

Ms Ash, how good is the mining industry when it comes to technical progress?

Ash: The industry has changed only slowly in the past. It has always been difficult for innovations to find their way into the mining industry. Today it is probably the least digitized industry in the world. But digital disruption will also reach our industry. I am confident that we will be able to adopt this change more quickly in the future. A number of companies in the industry are moving forward with digitalization and are undergoing transformation.

What are the challenges the mining industry is facing today – and what are the main drivers?

Ash: There's a number of drivers, both within the mining industry and from outside. Most of the mining companies are digging deeper, exploiting orebodies further away from processing centers and mining lower grade material. Community expectations and government demands are getting more refined. There are greater environmental and safety expectations. Investors require higher returns and better risk management. Finally, we are challenged by companies like Apple that have started recycling their smartphones with ambitious goals in terms of recovering raw materials and saving energy. Together, this puts a lot of pressure on our industry.

Mr Altendorf, do you feel a similar pressure to change in your business?

Altendorf: Megatrends such as globalization, digitalization, demographic change and volatile markets are driving our customers' businesses and thus also our business. And we are realizing that technological change has accelerated as a result of digitalization. We ourselves face similar challenges,



"The primaries & metals business is part of Endress+Hauser's DNA," says CEO Matthias Altendorf.

perhaps in a different context. But digitalization affects us comprehensively, too – in our offering, in our own operations and in the way we do business with our customers.

Ms Ash, what could the digital mine of the future look like?

Ash: There are three main phases. The initial phase of digitalization starts with connectivity. We strive for complete transparency about people, operations and processes. New sensors, more automation, robots, machine learning, big data and artificial intelligence will lead to much more efficiency, a higher yield, less impact on the environment and better safety. In a second phase, we will take people out of the mine. Everything will be automated, robotized and remotely controlled. Today much of the gear is sized because we have people operating it. Without this need, I expect the equipment to change and become smaller. This allows us to just take the ore. Rather than having large processing plants on the surface we will see smaller systems behind the cutting equipment. The third phase is around electrification of mines and carbon neutrality. With solar energy and renewables and batteries for storage, we will move away from traditional diesel for driving mines and generating power.



“We can’t forget that this is still all about people – how we treat and lead them, how we get them comfortable with the accelerating rate of change.”

Michelle Ash, Chair of the Global Mining Guidelines Group

Mr Altendorf, how can a process and laboratory instrumentation and automation supplier like Endress+Hauser support the mining industry in shaping the future?

Altendorf: It takes a lot of sensors to gather all the information about what’s happening in a mine. We have a comprehensive portfolio of products, solutions and services that we are constantly developing. With technologies such as Heartbeat and Memosens, we contribute to operational efficiency and plant availability. We can also support the industry with regards to digitalization. With Netilion, we offer an IIoT ecosystem that provides connectivity and enables digital services.

Ms Ash, what do mining companies expect from suppliers like Endress+Hauser? And what significance do partnerships have for your industry in times of change?

Ash: Historically, the mining industry hasn’t been great in partnerships. In future, we have to be a lot more collaborative and form strong and genuine partnerships with our suppliers. One of the things the new technology will drive and already has driven in recent years is an acceptance that we as mining companies can’t know and develop everything – and we can’t expect our suppliers to do all these things on their own either. We have to work together to achieve good results, including with other mining companies. That’s in our own best interest!

Mr Altendorf, what makes Endress+Hauser a good partner for the industry?

Altendorf: First, we can be found wherever our customers operate facilities to support them, and these are often in very remote parts of the world. Second, we’ve understood the needs of the industry for over 65 years; the primaries & metals business is part of our DNA, so to speak. Third, we are a reliable partner. We invest in innovation. As a family-owned company, we have the staying power. Our mission is basically to improve our customers’ processes every day – in the sense of better quality, higher productivity, lower costs, less time, more safety... That’s why we seek proximity to our customers and cooperation, because we can only improve together if we learn from each other and gain in experience together.

What matters in such a phase of change, both for manufacturing companies and their suppliers?

Altendorf: We need both openness and flexibility at the same time. In a digitized world, things have to be much more agile than we are used to. We have to try things out and, if something doesn’t work, learn quickly. This requires a change

in corporate culture. At the same time, this culture must offer stability. That’s why companies need to learn organizational ambidexterity: On the one hand, we need to take advantage of the opportunities offered by existing business and offer customers what they expect from us today. On the other hand, we need to explore new opportunities to stay in business in the future.

Ash: Absolutely; this is no different in mining. Especially with agile approaches, we don’t always know the outcome at the beginning. This is why transparency becomes so important during any time of radical and rapid change. In our industry, older people fear automation because they are afraid it will take their jobs. But automation can also enhance jobs or make them safer. But these fears must be addressed. After all, we can’t forget that this is still all about people – how we treat and lead them, how we get them comfortable with the accelerating rate of change.

How can we succeed in taking people with us on this road into the future?

Altendorf: Every solution must always be tailored to people, because they are the focus of our actions. But we must provide our people with the tools and the environment for digitalization.

Ash: For employees, mining hasn’t been the industry of choice for a couple of years. But the new technologies will make us more attractive to Generation Z and also to women. If we were operating machinery remotely, if we could take away some of the manual handling, these roles might be more interesting for women even if they have family obligations.

Questions: Martin Raab
Photos: Kathryn Hollinrake, Christoph Fein

Visionary expert Michelle Ash (born 1967) is Chair of the Global Mining Guidelines Group (GMG), a network of companies driving change in the mining industry. She began her career as a blasting engineer and worked in various management positions on business improvement and strategic tasks. Most recently, she was Chief Innovation Officer at Barrick Gold, the world’s largest gold mining company, responsible for increasing productivity in existing operations and developing future business models. Michelle Ash, Australian by birth, holds a university degree in civil engineering and an executive MBA; she also graduated in psychology and philosophy.

"Data is becoming a new resource"

The primaries & metals industry must produce in a more efficient, environmentally friendly and safe manner. Andrew Reese understands the role modern measurement technology plays.

Mr Reese, which issues impact your industry?

At the moment, efficiency is the biggest buzzword in the primaries & metals industry. Megatrends such as globalization, resource scarcity and volatile markets and prices are forcing businesses to invest in new technologies in order to produce efficiently and be able to compete. Safety naturally plays a major role in the metals industry, although functional safety requirements are on the rise in mining as well. At the same time, energy costs continue to rise and environmental regulations are becoming more stringent. In light of all of these challenges, better process controls and automation are gaining importance.

What demands does this industry place on measurement technology?

Our customers want the highest level of plant availability possible. For that they need robust and reliable measurement instruments that are low maintenance, easy to clean and deliver reliable information despite the harsh operating conditions. These instruments have to integrate into diverse system environments because of different signal outputs and protocols. Commissioning must be simple, even in regions with limited infrastructures. Generally speaking, we are noticing an increased demand for non-contact measurement technology, especially in the slurry handling processes of the mining sector, and multivariable instruments that monitor multiple process parameters.

What are the current trends in the field of automation?

Interest in IIoT applications is growing. More and more companies are recognizing that consistent process and device data is the foundation, which makes it a new and decisive resource for productivity improvements and cost reductions. Capturing, managing and processing this information is the key to better process controls and waste minimization, such as in the area of maintenance. Intelligent sensors with self-diagnostics and monitoring functions, as well as the required connectivity, deliver this type of consistent data. With these smart sensors, the first step into the digital mine and toward IIoT is complete, without having to completely redesign the entire operation.

What other developments are you watching?

In the mining sector, the diminishing grade of ore in the rock and an increase in the recycling of waste flows demand more complex separation technologies and improved quality controls. Inline and online analyses offer a lot of potential in this area. We can already halve the use of chemicals in various processes through the intelligent use of measurements. Optimized processes are becoming more important in water and wastewater treatment, not only to protect the environment, but also because many mines are in remote regions without access to sufficient water supplies. That means they have to first produce the water themselves. Many mineral processing operations even use sea water, which adds additional complexities and demands on field instruments.

How is Endress+Hauser positioned in the primaries & metals industry?

The company got its start 65 years ago in the area of level measurement technology for the cement industry. From there we went on to become a leading full-range provider of industrial process technology. Today we have a comprehensive portfolio completely tailored to the needs and applications of the industry. Since 2007 alone, we have delivered more than 2.6 million field instruments to the primaries & metals industry! In addition, we support this industry with a broad spectrum of services and solutions.

Why should customers place their trust in Endress+Hauser?

Hardly anyone understands the industry and its needs like us! Our colleagues, who are located near our customers around the world, are well positioned to provide comprehensive consulting and advice and project support. The feedback from this global network flows back into the product development process. That means we work hand in hand with our customers to shape the future of the industry!

Questions: Christine Böhringer
Photo: Christoph Fein



Industry insider Andrew Reese (53), Global Industry Manager at Endress+ Hauser, has been coordinating the international network of primaries & metals industry experts since 2012. The Englishman joined the Group in 2002. In his free time, he enjoys badminton and is a fan of Everton FC in the English Premier League.

A good combination

Whether it be in a cement plant, in steel production or in mining, Endress+Hauser helps the primaries & metals industry to bring out the best of their processes – making a real difference in many areas with a custom-fit portfolio.

Solutions for every purpose

Endress+Hauser has known the primaries & metals industry and its processes for over 65 years. Industry experts from sales centers across the globe have a great deal of expertise when it comes to applications, and they provide a broad **instrumentation** portfolio specifically tailored to the industry's high demands. Custom-made **services** and **solutions** complete this offer. Their spectrum ranges from fieldbus engineering to entire automation solutions for core processes and utilities (e.g. full water monitoring or the detection of leaks in pipes). This portfolio helps businesses to increase plant availability, adhere to environmental regulations and operate processes in a more efficient and safer manner.

Safe under any circumstance

Dust, high temperatures, chemicals, abrasion – the often extreme conditions in the primaries & metals industry are not a problem for Endress+Hauser's measurement devices for flow, level, pressure, temperature and liquid analysis. They continue to work just as precisely and reliably under the highest stress, are suitable for safety instrumented systems up to SIL3 and, most importantly, are easy to use. Pressure transmitters of the **Cerabar M** series provide a high level of process safety due to their robust ceramic measuring cells and integrated detection of a broken sensor membrane, for example. Endress+Hauser developed the high-temperature **Omnigrad TAF** range for measuring points with extremely high temperatures. Ceramic thermowells shield the sensors from mechanical and chemical influences, thereby increasing the thermometer's life span compared to stainless steel.



Easy operation

Water and chemicals are common-place in many mining applications, for example during industrial water treatment, or to extract metals and minerals. To ensure that these processes achieve optimum performance, the pH, dissolved oxygen and turbidity values must be constantly monitored. Sensors with **Memosens** technology are ideal for tasks such as these: they digitize the measured value in the sensor before transferring it contactlessly to the transmitter, thereby eliminating external influences. The sensors can also be pre-calibrated in the laboratory and exchanged quickly and easily during operation, saving costs while increasing the availability and safety of the plant and staff.

Unobstructed measurements

Continuous measurement in silos and bunkers represents a challenge to level measurement devices: dust, temperature layers and gas blankets can influence the measurement signal. The new non-contact radar level measurement device **Micropilot FMR67** is unaffected by factors of this kind: the first 80 gigahertz instrument developed according to the international functional safety directive IEC 61508 always provides an unobstructed view – even in narrow silos, with a large number of fittings and under adverse circumstances. This is made possible by the small beam angle of just three degrees and the drip-off antenna, which simply repels any dirt. Endress+Hauser offers a total of 13 measuring principles for level measurement and point level detection, providing the right solution for every task.



Maintenance on demand

Measurement devices can provide more than just measuring values, which is why Endress+Hauser has equipped its latest flow, level, temperature and analysis measurement instruments with **Heartbeat Technology**. It enables the instrument to constantly monitor itself and many process conditions; verification for SIL repeat tests during the running process is also possible at the touch of a button or the click of a mouse. Due to device-specific parameters the instruments detect critical trends early on. Level measurement devices can detect whether any buildup has formed on the sensor antenna, or whether there is a buildup of foam on a liquid surface, for example. Flowmeters meanwhile detect corrosion, entrained gas and abrasion within the measurement tube, among other things. Maintenance services can therefore be better planned while processes can be controlled in a more efficient manner. Coriolis flowmeters in flotation processes, for example, can detect chemical changes to the flocking agents and are able to indicate when a new preparation is required.

A digital addition

Barely any applications in the primaries & metals industry can cope without precise flow measurement. Blast furnace cooling circuits in the steel industry are monitored for leaks through ultrasonic or electromagnetic flowmeters, for instance. In cement manufacturing, Coriolis instruments assist with clinker production and help control the burner by recording the mass flow, density and temperature at the same time as the viscosity of liquid fuels such as heavy fuel oil. The latest addition to the Endress+Hauser flowmeter family is also multi-talented: the **Picomag**, an electromagnetic flowmeter for monitoring smaller pipe sizes used in water distribution around the plant. The smart pocket-sized newcomer simultaneously measures temperature and can be operated easily via Bluetooth in areas that are hard to access. The device is ready for the Industrial Internet of Things through its IO-Link technology, which enables its flexible integration into all fieldbus systems as well as access to many additional device and process data.



Everything well controlled

Water is indispensable to mining operations. Employees require potable water while numerous applications need process water which, once used, is treated before being recycled or returned to the environment. **Water & wastewater treatment** automation solutions allow the measurement and control of these processes. Field instrumentation packages help to increase filtration cycles in seawater desalination applications. Smart aeration control solutions in wastewater plants result in energy savings of up to 30 percent. Analytical measurements that can be accessed wirelessly and over long distances provide support during water body monitoring and therefore assist with environmental regulation compliance.

An eye on material streams

Saving fuel, natural gas and electricity is one of the main objectives for companies in the primaries & metals industry: energy costs account for up to 40 percent of total costs in steel production and as much as 75 percent in cement manufacturing. Mining operations meanwhile use approximately 8 percent of their production costs for lubricants and fuels for trucks, drills, haulers and other vehicles. Endress+Hauser supports efficient operations of these high-cost processes. **Energy monitoring** solutions help to precisely capture and monitor energy use to take targeted measures to reduce energy consumption. **Loading solutions** with Coriolis flowmeters provide a decisive advantage during the delivery of fuel to mining operations: they determine how much fuel is being purchased with exact precision. **Inventory management solutions** also render inventories and expenditure transparent, enabling an efficient logistics chain.

Text: Christine Böhringer
Illustration: Ralf Marczinczik



Full concentration

With Endress+Hauser at its side, the primaries & metals industry can quickly find reliable solutions for every challenge, allowing it to focus completely on its core business activities.



Through fire and flames: The Acciaierie di Calvisano steelworks in Italy produces steel blanks.



© Viktor Mácha / viktormacha.com

Playing it safe

How do you quickly and easily improve plant safety? This was a key question at Acciaierie di Calvisano, a steel works in the Italian province of Brescia that primarily manufactures steel blanks in various qualities as intermediate products that are eventually turned into wire rod or reinforcement steel. A critical aspect of the manufacturing process is the production furnace cooling system. If tensile fractures or small water leaks are not detected early enough in the cooling circuit, this can lead to production outages or system damage – or in the worst case even accidents.

With this in mind, Acciaierie di Calvisano wanted to install a safety system, eventually deciding on a leakage detection solution from Endress+Hauser. The system, which is IEC 61511 and EN ISO 13849-1 compliant, is especially precise and reliable. The solution monitors the flow of liquid as it enters and leaves the cooling circuit as well as the temperature in order to compensate for temperature-dependent volume changes. The volume flows of the inlet and outlet lines are continuously compared. Alarms are triggered whenever defined thresholds are exceeded.

“Endress+Hauser was selected based on positive references and feedback from the other plants,” says Nicola Mora, plant manager at Acciaierie di Calvisano, which belongs to the Feralpi Group, one of Europe’s leading steelmakers. Another plus was the system’s ease of use. At start-up, the user is guided through the individual configuration steps using a touchscreen panel. The high expectations at Acciaierie di Calvisano were met. “The cooperation with Endress+Hauser during the project definition and installation phase worked out extremely well. We look forward to continuing the collaboration in the future,” summarizes Nicola Mora.



Easy to use: The new Teqwave T measures liquid concentrations in the passivation bath.

One for all

'Stainless steel surfaces, from matte to shiny' is the company motto at Swiss-based Hug Oberflächentechnik AG. The company has been treating stainless steel products for more than 40 years and specializes in pickling, electropolishing and passivation. To achieve an optimal result, the concentration of the solutions used in the treating process must be precisely determined. Specialists at the company traditionally measured these values with the help of a hydrometer in the passivation baths, then read and documented the result – a tedious and error-prone method that is now a thing of the past thanks to the new Teqwave T from Endress+Hauser. This portable instrument precisely measures the concentrations in liquids in real time by means of so-called surface acoustic waves and automatically documents the results. Now even employees without specialist knowledge can easily and efficiently test multiple passivation and degreasing baths in succession. Managing Director Marcel Hug is enthusiastic about the innovation. "The Teqwave T from Endress+Hauser fully met our expectations with respect to functionality, performance and engineering design."



Keeping an eye on the pH value: Process water has to be neutralized before it enters the environment.

Clean analysis

Environmental and climate protection are key issues at Aurubis. The world's largest copper recycler and leading provider of nonferrous metals runs a group-wide continuous improvement program in these areas. This includes the plant at Olen, Belgium, where roughly 580 employees produce anodes, cathodes, cast wire rod and special wire. The plant began to get its systems in shape for ISO 14001 as far back as 1998. Today, all the environmental programs in Olen are certified, with heavy investments being made in air emission controls and wastewater treatment processes.

The company was also searching for a (literally) clean solution for neutralizing the process water. Under difficult conditions, measurement points in three reactors and the outlet filter monitor the pH value, a relevant parameter for protecting surrounding waters. Apart from the correspondingly high maintenance and calibration effort, interruptions occurred on a regular basis, and because of moisture, the cabling had to be replaced time and time again.

To improve measurement stability, the company installed pH sensors with Memosens technology from Endress+Hauser. Since the measurement signal is digitized in the sensor and sent to the transmitter inductively, the measurements are impervious to undesired influences caused by moisture or corrosion. The technology furthermore permits precalibration in the lab, thus making it possible to quickly replace the sensors during operation. The highly precise and stable pH measurements have not only reduced system downtime at the Aurubis location in Olen, but have also cut down on the use of caustic soda needed to regulate the pH value, thus improving cost efficiency.



Valuable collaboration

Valuable ore deposits in the hills of the Greek peninsula Chalkidiki have been exploited since antiquity. Spiteful tongues claim that without these deposits Alexander the Great would have remained merely a footnote in history. Today, the Cassandra Mines on the west side of the peninsula belong to Hellas Gold S.A., a subsidiary of Canadian gold producer Eldorado Gold since 2012. The company has invested several hundred million dollars to renovate and expand the operations. Twelve kilometers of new shafts were drilled in the Olympias mine alone, and the ore processing was modernized from the ground up.

“The use of chemicals, a high degree of material wear and lots of slurry and dust require extremely robust instruments,” says Athanasios Chliopanos, head of the maintenance department at the Olympias mine. “Our most important criteria for the instruments are durability and reliability.” This is why Eldorado Gold relies solely on flow, analysis and level measurement technology from Endress+Hauser for the new flotation cells, which are at the heart of the separation process. Storage and supply of reagents and chemicals are also managed with instruments in the blue corporate color of Endress+Hauser.

Customer proximity was an important factor in the decision to go with Endress+Hauser. “Endress+Hauser supported us right from the development phase. It was also important to have technical support here in Greece,” explains Athanasios Chliopanos. In order to find the best engineering solution, the two companies inspected several mines together before signing the agreement. “The specialists from Endress+Hauser developed tailor-made solutions to meet our demanding applications, which clearly set them apart from other providers,” says Athanasios Chliopanos.

The project was a challenge for Endress+Hauser as well. “We had to identify the needs of several responsible departments around the world, quickly find solutions and effectively communicate with all those involved in the project,” says Dimitris Gravanis, Managing Director at Endress+Hauser Greece. The mine is now up and running. Hellas Gold S.A. has been extracting gold, silver, lead and zinc from the mountain since 2018 according to plan. “We’re totally satisfied,” says Athanasios Chliopanos, who adds: “We’re also considering an agreement with Endress+Hauser for on-site calibration services.”

Texts: Christine Böhringer, Alexander Marzahn

Teeming with natural resources

Russia is the world's largest country. And one of its strengths can be found in the ground: Gas and oil form the backbone of the country's economy. It's these two raw materials that will likely guide the Eurasian mega-country into the future.

Space and time

Russia is a country of superlatives: The world's largest in terms of area, it shares borders with 14 other countries and stretches across 11 time zones. Although Russia has a large population, because of its immense size the country is nevertheless extremely sparsely populated. That translates into long transport and travel routes.

Size in millions of square kilometers

17.1
Russia

10.2
Europe

7.7
Australia

Inhabitants per square kilometer

8

Russia

232

Germany

927,700

kilometers of asphalt roads

177,700

kilometers of gas pipelines

87,200

kilometers of rail lines

54,800

kilometers of oil pipelines

Oil and gas

The fundamental strength of the Russian economy is its natural resources. Siberia has enormous natural gas reserves, in addition to vast amounts of oil, coal, iron ore and aluminum. As a result, Russia is one of the world's most important energy producers.

Top oil producers 2017
(in millions of tonnes)



571



USA

562



Saudi
Arabia

554



Russia

Top gas producers 2017
(in billions of cubic meters)



734



USA

636



Russia

224

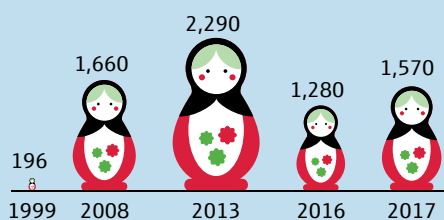


Iran

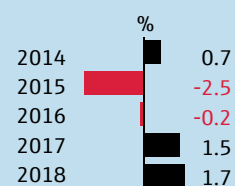
Ups and downs

After the collapse of the Soviet Union in the early 90s, Russia experienced strong growth by opening up its economy to the world markets. Falling oil prices, international sanctions and structural problems led to a recession in 2015, from which the country is slowly recovering.

GDP in billions of US dollars



GDP growth



Highs and lows

Relying on the energy sector, Russia aims to be one of the world's five largest economies by 2024. Because of the large gap in standards of living within the country, the government wants to reduce poverty by half over the same time period while increasing life expectancy, which has so far been low by international standards.

Average life expectancy
for those born in 2016

64.3 years



Russian men

67.4 years



men worldwide

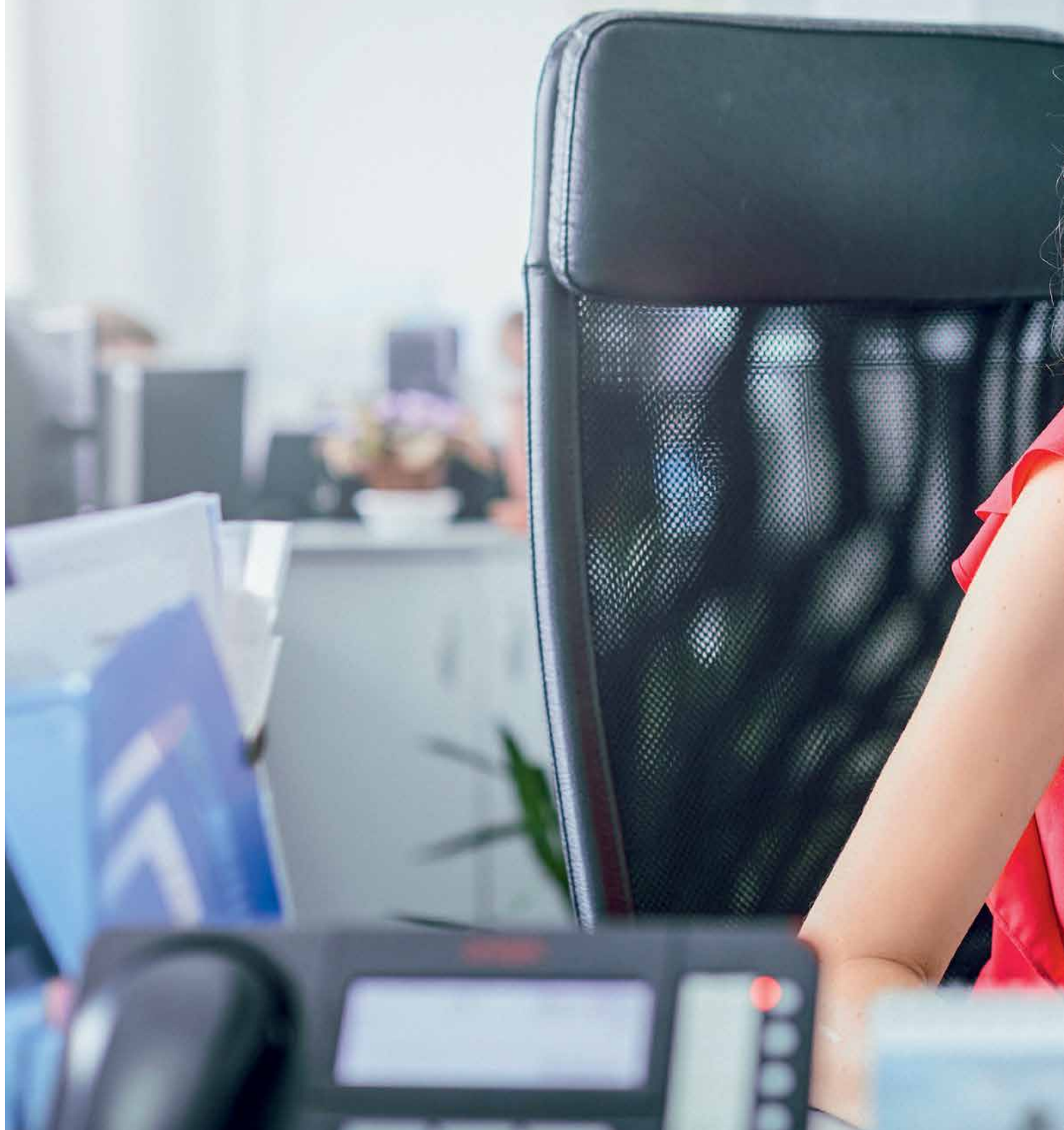


13.3%

of the Russian population
lives below the poverty line

With confidence into the future

It took Endress+Hauser just 20 years to establish a closely meshed sales network in Russia. The 170 employees are never far from their customers, and a production facility close to Moscow will soon ensure even more customer intimacy.





Some say that Russia appears so big only because of the way it's distorted on world maps. Optical illusion or not, the former Tsarist empire sets benchmarks in many respects. Its landmass is as big as the European and Australian continents put together. At 9,200 kilometers, the Trans-Siberian Railway is the longest rail line in the world and, at 1,642 meters, Lake Baikal is the deepest freshwater lake. Not to forget the economic potential: Russia is certainly one of the most promising markets nowadays – if you know how to cope with the unexpected. And, of course, if you meet customer needs.

This was an underlying reason why Endress+Hauser opened a sales center in Moscow in 2003. “First serve, then earn,” was one of the creeds of company founder Dr Georg H Endress. This spirit can still be felt today at Endress+Hauser Russia.

With 170 employees, the Russian sales center is one of the Group's 10 largest revenue generators. Russia is one of the most exciting markets with a demand for measurement technology that's as vast as the country's reserves of raw materials. No country in the world produces more steel, aluminum, oil and gas. Every day, plants are modernized and new ones built. Despite geopolitical and economic resistance from around the world, Russia's 144 million people need to be supplied.

“It's not the strongest species that survives. It's the one that does the best job of adapting to the environment. That also applies to the business world.”

Anatoly Lapitsky, Managing Director Endress+Hauser Russia

Dynamics and vastness These dynamics are evident in Moscow, the hub of the Russian economy. In the southern districts, high-rise buildings are springing up like mushrooms, to keep pace with the city's average population growth of 100,000 per year. Directly across from this new development on the opposite bank of the Moskva River, a former textile factory has become a trendy creative zone for architects, software developers and designers.

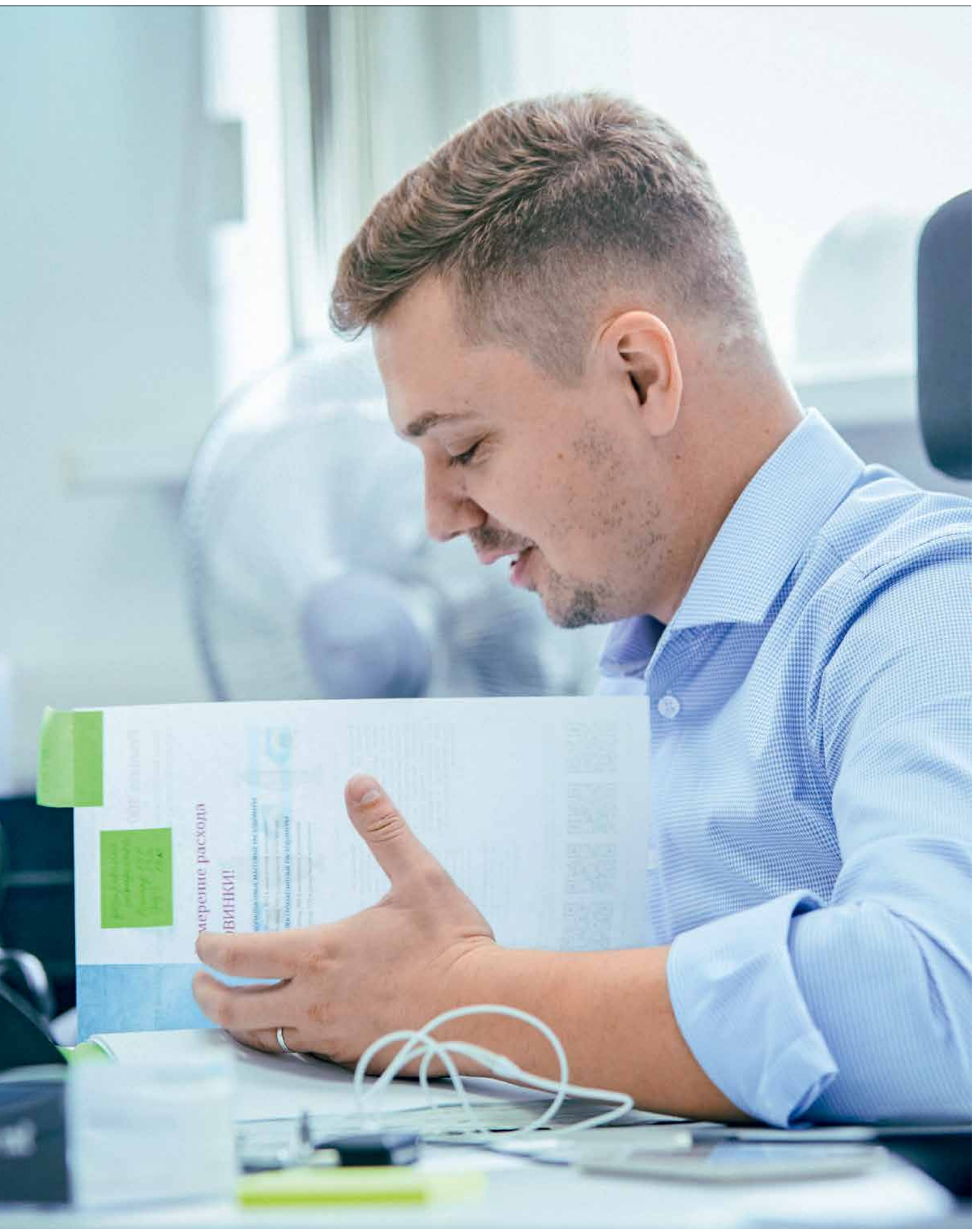
A couple of blocks away is the headquarters of Endress+Hauser Russia, where some 70 employees manage the business in and around the Moscow metropolitan area. Another 100 staff members are located close to customers at 15 branches.

“International companies often operate out of a central location in Russia,” says Managing Director Anatoly Lapitsky. “With our network, we cover nearly all regions across 11 time zones. We're optimally aligned with the size of the country, which allows us to satisfy the needs of our customers in the best way possible!” The concept is working. The company has experienced a rapid ascent, with the team growing three-fold over the past 10 years. Once a small player, Endress+Hauser has become a leading provider of measurement and automation technology in Russia.

Time and money Apart from the extensive red tape that can make it difficult to do business in Russia, western sanctions have cut the country off from the international financial markets. In return, domestic companies were encouraged to prefer Russian products. “Of course this affects our business. Although Russian industry also has a need for security and efficiency, we're not seeing enough investment at the moment,” says Anatoly Lapitsky.

Global players in the food & beverage industry are the ones currently modernizing their measurement and automation technologies. When it comes to process optimization, ‘Made in Switzerland’ is a strong argument in Russia as well. While the extreme environmental conditions call for robust measurement instruments, the Russian mindset demands lots of patience. One resource in ample supply in Russia is time. For good reason, the Russian soul is purported to have a propensity toward fatalism. After all, the art of valiant suffering runs through the national literature, from Tolstoy to Dostoevsky.

For Anatoly Lapitsky, however, another work of literature has more importance: Charles Darwin's *On the Origin Of Species*. “It's the best marketing book I ever read,” he says. “It's not the strongest species that survives. It's the one that does the best job of adapting to the environment. That also applies to the business world and it's precisely the creed we live by.”



Global, but national: Much of the documentation is translated.



Extensive experience and knowledge: The service team understands what customers need.

Aims and abilities Speaking of which, the Endress+Hauser portfolio is adapted to the needs of the Russian customers. “Our customers place a lot of value on robust and reliable instruments that are cost-effective and easy to operate,” explains Director of Marketing Maxim Salnikov. Products must comply with local standards and technical documentation has to be translated. “This is the only way to reach all of the customers in the Russian Federation.”

“Maintaining close ties to our customers allows us to continuously improve our offering.”

Maxim Salnikov, Director of Marketing Endress+Hauser Russia

Customer intimacy is the key to success, since more and more bids to tender are being completed through online processes. Price is often the only criteria needed on anonymous platforms. “Our goal is to create outstanding benefits for our customers,” says Maxim Salnikov.

“Attentive customer management is a prerequisite for being able to convey the added-value of our products to the customer.” Especially with demanding measurement applications and issues such as calibration

traceability, explosion protection or instrument self-diagnostics, Endress+Hauser’s extensive expertise and experience can tip the scales.

The majority of the blue-branded sensors are installed in standard applications, however – and from the customer’s point of view, they should not cause any problems. “Maintaining close ties to our customers allows us to continuously improve our offering and provide targeted training to our sales staff,” adds Maxim Salnikov, who is convinced that “It’s people who make the difference, even in the digital age.”

Google and Yandex Finding these people is not an easy task. No one understands that better than Tatyana Pasechnaya, Head of Human Resources. While many engineers see good opportunities for advancement at western companies, filling positions in the commercial or marketing department is much more difficult. “Automation doesn’t sound quite as sexy as Gazprom, Google or the Russian search engine Yandex.” In addition, Russia’s training and education system never completely recovered after the end of the Soviet Union. Especially in rural areas, engineers with the English skills needed to work in a global market environment are rare.

Endress+Hauser competes for talent by offering excellent hiring conditions, targeted talent management and a ‘European’ corporate



Focus on the customers: Always ready to help.

culture. It boils down to trust and personal responsibility. “In our training programs, we encourage our employees to reflect on the corporate values and their own role in the company,” says Tatyana Pasechnaya. Anti-corruption training is part of this effort as well. “As a Swiss company, we cannot afford to violate the rules. We apply the highest standards.”

Branches and products Although the winters are long and the people patient, something has nevertheless changed. The sales area greatly expanded its industry expertise and aligned the organization more with the needs of the customers. “Today, our specialized industry managers work side by side with the product specialists,” explains Maxim Salnikov. “There are those who understand plants and processes, while others are familiar with the measurement technology. With this combination of knowledge, we can answer any question posed by our customers.”

Getting the service business off the ground is a greater challenge. Many Russian companies have their own service and maintenance specialists. “Tasks that are not part of the core business, such as calibration, are being outsourced more often, however,” says Maxim Salnikov. His team stands ready – across the country.

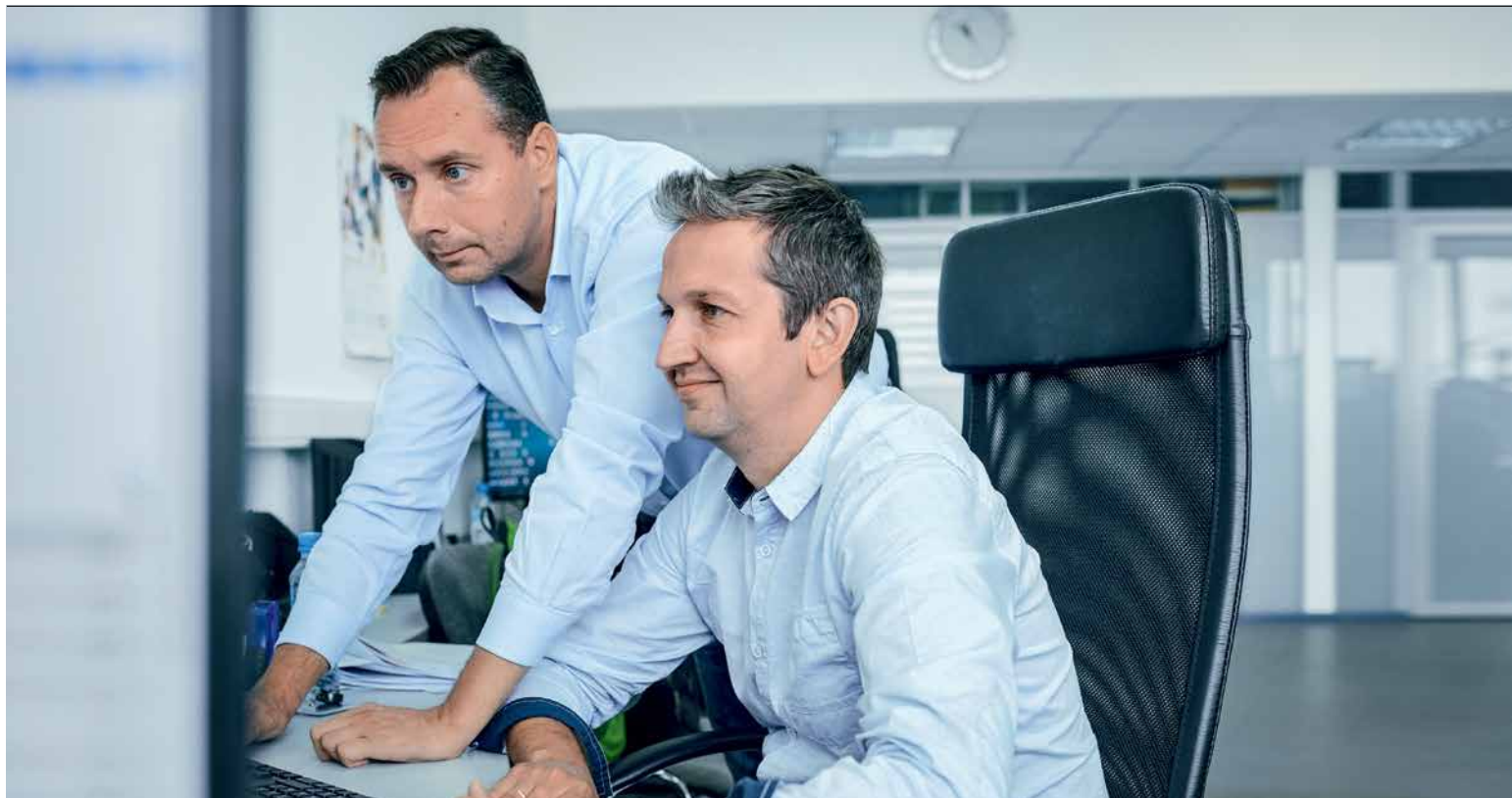
Another challenge is digitalization, which will most probably shift sales increasingly to the internet. “Even here though,” says Anatoly Lapitsky, “we will adjust to the changing conditions.” Plans are already in place to build an Endress+Hauser production site, including training facilities, close to Moscow. This concept, which has been successfully implemented in other regions of the world, shortens the path to the customers even further. “Endress+Hauser stands for quality,” says Anatoly Lapitsky. “If we begin to produce in Russia within a few years as planned, we will manufacture in line with our global standards – just like we already do today in sales.”

Text: Alexander Marzahn
Photos: Christoph Fein

The decision-maker

Anatoly Lapitsky has been leading the Russian sales center since 2005. He studied chemistry at the Lomonosov Moscow State University and acquired an MBA in marketing from California State University. His leadership style is characterized by a razor-sharp view of reality, and a straightforward and tenacious approach. He is the father of two daughters and enjoys music, swimming and reading in his free time.





Moving forward together: Teamwork is crucial at Endress+Hauser Russia.



Friendly reception: A smile for the visitors.



The Group and the Russian sales center: Celebrating 65 and 20 years respectively.



Always on the ball: Moscow is where everything comes together.



For those with a sweet tooth: Russian candy.



Russian lucky charm: Matryoshka doll.



85

political entities make up the Russian Federation – a challenge for sales!



15

regional locations cover vast parts of the country. The headquarters is in Moscow.



170

employees are active at Endress+Hauser Russia; roughly 70 staff members manage customers in the Moscow metropolitan region.



35

is the average age of the employees. Most have been with the company for at least five years.



31

percent of the employees at Endress+Hauser Russia are female – an above-average figure for an industrial supplier.

Riding quality to the top

The roots of Endress+Hauser in Russia go back to 1998 when a representative assumed responsibility for sales activities in the country. Within five years, a sales center with three employees was in place. Although Endress+Hauser is a newcomer to the market, the country's raw materials-based industrial sector was quick to recognize the quality of the blue-branded measurement instruments. Endress+Hauser is now Russia's second-largest provider of measurement and automation technology. The key industries are oil & gas, in addition to chemicals. Most of the customers are located in the European part of Russia where two-thirds of the population resides.

Everything under control

The Republic of Tatarstan boasts one of Russia's largest petrochemical complexes. PJSC Nizhnekamskneftekhim supplies tire and plastics manufacturers around the world. Measurement technology from Endress+Hauser ensures that even the most complex processes run efficiently and reliably.



Petrochemicals as far as the eye can see: The site stretches over several square kilometers.





Superior precision during custody transfer: The company relies on Coriolis flow measurement technology for raw materials delivery.

53

countries worldwide benefit from products from Nizhnekamsk

Nizhnekamsk in the Republic of Tatarstan is roughly two hours east of Moscow by plane. What was an insignificant work settlement 60 years ago has rapidly grown into a city of 237,000 citizens with giant shopping centers, an ice hockey arena, an inland port and an airport. “The city exists due to the complex,” says the taxi driver on the way to the city center. It’s not long before iron and chrome steel sparkles between the trees: refineries, power plants, tire factories and countless suppliers have set up shop near the city. Pipelines on high stilts run along the route. And on the horizon yellow flames shoot out of flare stacks. “The eternal flame of our industry,” says the driver facetiously.

When he says “the complex,” the taxi driver means PJSC Nizhnekamskneftekhim. Founded in 1967, the company is both the nucleus and

the driver of the region’s economic growth. The petrochemical company, with a workforce of 14,000 employees, is the leading manufacturer of synthetic rubber, plastics, olefins and chemical intermediate products. About half of the company’s products are exported. 120 products are manufactured in nine facilities that span the entire petrochemical value chain. The company is the world’s leading supplier of rubber. Products from Nizhnekamsk provide the right rubber mixture for companies such as Goodyear, Michelin and Bridgestone.

Extensive expansion The company’s operations have been undergoing continuous modernization and expansion since 2006. New plants for formaldehyde, isobutylene and isoprene have been built. Pneumatic measurement points, which were the



Latest technology and state-of-the-art processes: The ethylene plant will go into operation soon.

instruments of choice 40 years ago, have been continuously swapped out for electronic instrumentation in the existing installations because of the extensive maintenance effort they require.

A state-of-the-art ethylene complex designed by the German-based Linde Group will soon go into operation. Here, raw materials for production of films and plastics will be manufactured. With 600,000 tons annually, the current capacity will nearly double. By itself, this one facility has an installed base of 400 Endress+Hauser instruments. Almaz Zakizianov, the Endress+Hauser sales representative who manages key customers from the regional office in Kazan, the capital city of Tatarstan, reckons the enormous complex has around 4,000 Endress+Hauser instruments in total. The challenges are dealing with explosive mixtures

and critical processes that must be precisely controlled, as well as operating in the harsh environment.

“We install measurement instrumentation from Endress+Hauser wherever maximum reliability is called for, such as sophisticated chemical processes or custody transfer applications,” explains Konstantin Sergeevich Shabalin, Head of Metrology at the new ethylene plant. Since 2015, the plant has been relying on Coriolis flowmeters to determine to the gram the amount of gasoline transferred from the adjacent refineries. “When absolute precision is required, Endress+Hauser is our first choice,” says the measurement specialist. With so-called alpha olefins, highly reactive liquids, radar measurement technology from Endress+Hauser is the only instrumentation capable of reliable level measurements in the reactor.

14,000

employees work for the company



Access to all parameters: Ease of use is a big plus for the technicians.



“We must be able to rely 100 percent on the measurement technology.”

Marat Faritovich Fatkhullin, Deputy Chief Engineer for Automation

Detailed documentation “When it comes to such fragile processes, we must be able to rely 100 percent on the measurement technology,” says Marat Faritovich Fatkhullin, Deputy Chief Engineer for Automation and Head of Instrumentation for the company. “The more challenging the measurement task, the more important the knowledge from Endress+Hauser is.” The metrology and automation department boasts 1,500 employees, an indication of the significance the company places on process technology. “The market expects high-quality products, stable processes and safe production from us,” says the Deputy Chief Engineer. “That’s why we need superior equipment and reliable partners who can respond quickly when needed.”

“We place our full trust in Endress+Hauser when selecting the type of instrument,” explains Konstantin Sergeevich Shabalin. As is customary in Russia, PJSC Nizhnekamskneftekhim has its own excellent engineers. The company even operates an accredited calibration service. Each measurement instrument has a defined maintenance interval, and the performance is precisely documented – with outstanding results. “Of the 400 Endress+Hauser

instruments in the ethylene plant, to date we’ve had to send only three of them to the repair shop over a period of 10 years,” explains Marat Faritovich Fatkhullin. “The tests in our calibration lab show that after many years, the instruments are as precise as ever, plus the maintenance effort is low.” While every plant used to have its own maintenance staff, today a central department covers the entire operation.

Highest demands “Since the instruments from Endress+Hauser cause so few issues, we are able to extend the calibration cycles,” explains Ravil Shamilovich Ayupov, Head of Instrumentation at the isoprene-monomer (liquid substance processed into rubber) plant. It’s an imposing facility with more than 5,000 measurement points. Here, too, 2,000 blue-labeled devices ensure efficiency and safety: the process is demanding, and all parameters are constantly monitored to ensure consistent product quality. That makes it more important to have easy-to-operate instruments and documentation that satisfies all of the requirements, including being available in the local language. “Even if questions do arise, such as with commissioning, the specialists



Ready to listen The relationship between PJSC Nizhnekamskneftekhim and Endress+Hauser goes back to the 1990s. The former state-owned company, which has grown into a consortium, is now one of Endress+Hauser Russia's largest petrochemical customers. This year Endress+Hauser has introduced the latest blue branded technology to the petrochemical giant directly on-site. The Endress+Hauser Showtruck, a type of trade fair exhibit on wheels, made a stop in Nizhnekamsk during its journey across Russia. "Our specialists do more than just demonstrate the latest innovations. They also listen closely and forward the customer's feedback to our service and product development departments," says Olesya Tarazanova, Head of Marketing Communications at Endress+Hauser Russia. "This way we can learn from our customers and support them even better with new products, solutions and services."

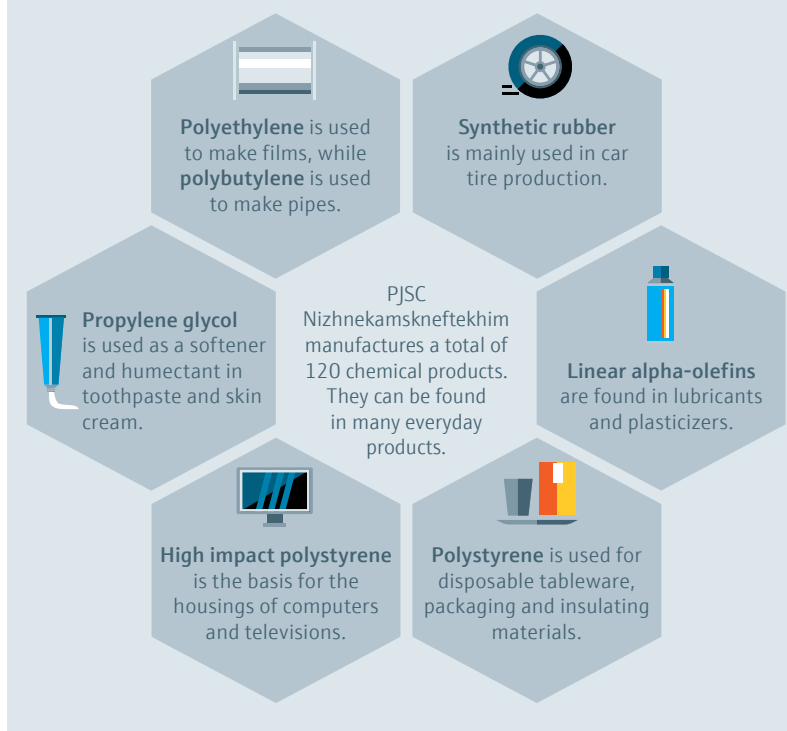
Instrumentation under protection: Winter brings frost to Nizhnekamsk.

from Endress+Hauser are always available. They understand our processes down to the last detail," says the engineer.

Ravil Shamilovich Ayupov is already looking forward to the newest generation of instruments from Endress+Hauser with Heartbeat Technology. These sensors are self-monitoring and can be verified directly in the process without being removed. Head of Instrumentation Marat Faritovich Fatkhullin has no doubt that Endress+Hauser will continue to support PJSC Nizhnekamskneftekhim in the future. "The expansion and modernization of our plant is a work in progress. When it comes to improving our processes and increasing productivity, with Endress+Hauser we have a reliable partner at our side!"

Text: Alexander Marzahn
Photos: Christoph Fein

A wide range of products



Stronger together

Russian companies that extract and process raw materials and crude oil operate under enormous competitive pressure. With Endress+Hauser at their side, they are equipped not only with the right products but also the right advice.



Exact loading: Chemical products are transported in train wagons.

New solutions

Tehnologiya LLC has been an established, reliable provider of equipment to the Russian petrochemicals market since 2010. The products, which are designed for storage and loading terminals, encompass dosing stations, filling and draining systems, breakaway couplings, gas filter separators and filters for liquids. Tehnologiya LLC has 100 employees and annual revenues of around 6.5 million euros.

In Russia, instrument approvals in the petrochemicals industry require a wealth of permits and certificates. "The Endress+Hauser measurement

technology comes with all of the regulatory documents and fully satisfies the requirements of the harsh operating conditions," says Sergey Vladimirovich Shahmaev, head of the instrumentation and controls department at Tehnologiya LLC. Coriolis flowmeters from the Promass line are used to measure the fill quantities of the oil products, while Liquiphant point level switches monitor the tank levels.

"When it comes to the flow rate, what's important is a high level of measurement precision, simple installation and resistance to vibration," explains Sergey Vladimirovich

Shahmaev. "With the tuning fork technology for level measurements, absolute reliability is the top consideration." Despite these high expectations, the company has not been disappointed. "From the very start of the partnership, not a day goes by that we haven't been convinced by the instrument quality and expertise from Endress+Hauser."

The partnership covers more than just individual consultation and on-time delivery. In order to optimize the products from Tehnologiya LLC, joint solutions were developed for specific engineering requirements, such as a



new system for loading trains. The solution is based on a telescope stilling pipe equipped with the Micropilot FMR51 contactless radar level measurement instrument and the Liquiphant FTL51 vibronic point level switch. More than 140 of these systems have been produced.



High temperatures: Liquid copper matte flows out of a flame furnace.

Expectations met

JSC Uralelectromed, a specialist in refined copper, is the flagship company of the Ural Mining and Metallurgical Company (UMMC), one of Russia's leading producers of raw materials. JSC Uralelectromed's core business is the processing of copper matte, which involves melting in reverberatory furnaces and electrolytic refining for the removal of impurities in the metal, as well as treating the so-called anode slurry, which contains valuable precious metals.

Every process relies on field instruments from Endress+Hauser. 90 percent of the devices in the refining process bear the blue logo. The instruments are used to measure level, pressure and flow, as well as temperature and physical-chemical properties. "Without exception, our experience with Endress+Hauser has been positive. The price-performance ratio is spot-on and the instruments and level of support fully meet our expectations," says Project Manager Nadezhda Rubtsova.

The most important criteria when selecting the instrument provider are reliability, maintenance-friendly equipment, measurement stability, expert advice and excellent, agile service. The service, however, is rarely needed. Nadezhda Rubtsova: "Everything runs smoothly – and I believe that speaks for itself!"

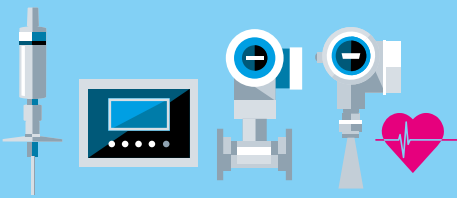
Texts: Alexander Marzahn

More than measured values

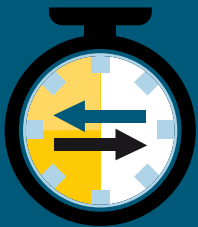
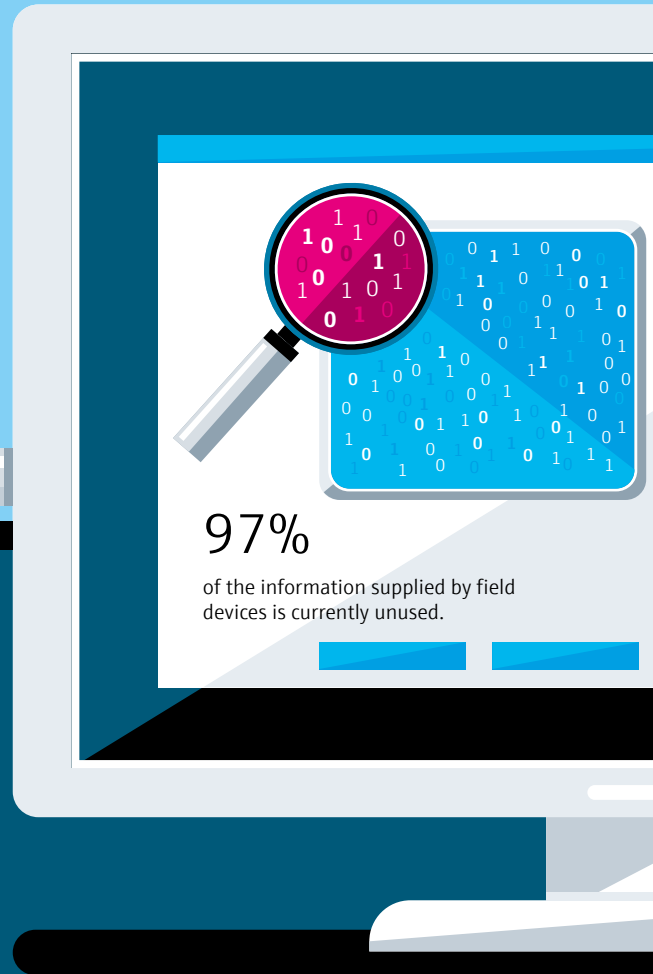
Field devices with Heartbeat Technology do the thinking for the operator. As well as precise measurements they provide a wealth of information offering insights into device and process.

Built-in intelligence

Modern field devices have become small computers thanks to the increased performance of microelectronics. They capture an array of additional sensor signals alongside measured values. Heartbeat Technology uses these signals for diagnostic, verification and monitoring purposes.



A wide range
Heartbeat Technology is available for many Endress+Hauser level, flow, temperature and liquid analysis instruments.



Real-time diagnostics

With Heartbeat Diagnostics, devices continuously monitor themselves in the background, providing clear messages about their status with precise instructions. This enables economic maintenance and safe plant operation with prolonged test cycles.



Permanent monitoring of up to 80 sensor signals



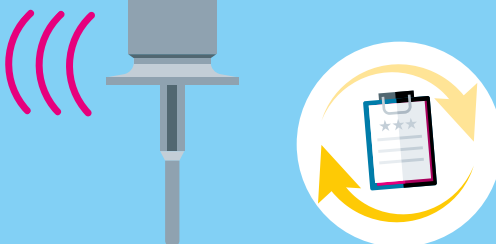
Up to 98% diagnostic coverage: minimal amount of dangerous undiscovered λDU



Plain text diagnostic messages according to NAMUR NE 107

Verification at the touch of a button

Heartbeat Verification validates the functionality of the device during mandatory proof tests without any disassembly and automatically generates a test protocol. TrustSens temperature sensors are even capable of traceable inline self-calibration, increasing plant availability while making processes safer.



Increased availability, reduced costs
Predictive maintenance reduces



total maintenance costs

–30%



unplanned downtimes

–70%



Monitoring for process trends

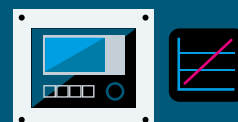
Process influences that have a negative impact on the sensor's measurement performance are detected early on through Heartbeat Monitoring. The intelligent analysis of device-specific trend parameters enables process optimization and predictive maintenance.



Micropilot level instruments detect the formation of build-up and foam based on the strength of the reflected signal.



Coriolis flow instruments detect corrosion, cavitation, build-up or entrained gas by the oscillation behavior of the measuring tube.



Liquiline transmitters calculate performance indicators, which help operators to optimize plant maintenance.



Seeing with new eyes

Endress+Hauser is venturing into the world of mixed reality: the combination of virtual elements and real surroundings are set to make the installation, operation and maintenance of measurement devices significantly easier.

Hooking up a level measuring device? “Not a problem,” according to Eric Birgel, as he puts on his HoloLens glasses. Suddenly he no longer merely sees the device in front of him, but also its digital twin superimposed above the instrument. A virtual menu pops up above it. Eric Birgel clicks through it by tapping his thumb and index finger

together. Red and blue lines now appear in front of his eyes and lead to the cable jack of the real-life device. The virtual screwdriver points at a real screw, while an arrow indicates the direction of rotation: “Wiring an instrument couldn’t be any easier,” Eric Birgel believes.

The software developer has a major goal: together with Product Manager

Tanja Haag he wants to make the installation, maintenance and repair of measurement devices easier through the help of digital services. The duo has already created the SmartBlue app together with colleagues. The app provides customers with mobile access to measurement devices as well as diagnosis and process data. They are



A good combination: Mixed reality places virtual elements in a real room.

currently working on the next step: developing mixed-reality applications for the FMR6x level device as part of the VisionBlue project. “The technology is incredibly versatile and will provide significant added value to companies,” Tanja Haag is convinced.

Two layers at a glance Mixed reality is leading the operation and maintenance of measurement devices into a new dimension by making it intuitive. “By means of mixed reality, abstract technical knowledge and available data can be linked and shown graphically,” explains Eric Birgel. To achieve this,

mixed reality combines the real environment with a computer-aided perception. Image-processing algorithms allow virtual elements to be placed in a room through mixed-reality glasses such as Microsoft’s HoloLens.

Unlike augmented reality, the user is not only able to see these three-dimensional elements but can also interact and control them using gestures – just like in a computer game. “Up until now, mixed reality has not been used to its full extent in industrial applications – they mostly work with information boxes. In contrast, we

want to simulate every work step,” Eric Birgel emphasizes.

Many possible applications

To develop convincing solutions for users, several customers were asked at the start of the project what they would like to use mixed reality for. The responses included training, installation and maintenance, with the transfer of knowledge being the common denominator. “In many manufacturing companies the turnover rates are high, while professionals are scarce,” Tanja Haag explains. “Mixed reality allows devices to be operated with little prior



Visions for the future: Software developer Eric Birgel sees a lot of potential for the new technology in the industry.

knowledge – and experts can work even more efficiently.”

Eric Birgel therefore implemented wiring instructions as the first application. This was followed by a setup function that allows employees to parametrize the measuring device by marking the maximum and minimum level of a tank with two virtual disks. “Previously the technicians first had to carry out complicated calculations,” says Eric Birgel. Another function displays the instruments’ maintenance status with virtual signal lights in different colors that hover above the devices. The app is also able to identify the fastest way to the measuring points, depending on the situation. “The customers were impressed by the fact that the route automatically changes if it suddenly becomes blocked,” Eric Birgel reports.

Simple troubleshooting It is no surprise that the chemical industry, for example, is extremely interested in the new technology. “Production downtimes



“The technology is incredibly versatile and will provide significant added value to companies.”

Tanja Haag, Product Manager User Centric Innovation

in large-scale plants are very expensive, which is why the potentials arising from efficient maintenance are especially prominent in this field,” says Tanja Haag. The VisionBlue functions could help maintenance staff troubleshoot any issues themselves in future without having to acquire additional specialist skills. “We will also be setting up a database of technical faults to allow for automated diagnosis,” Eric Birgel explains.

The application will be able to identify the problem through the symptoms entered by the user and then provide instructions to solve it. Just like all the other VisionBlue functions

it will be fed with data from Endress+Hauser’s Netilion IIoT ecosystem. A remote-call function is also in the pipeline: in this case, thanks to a tablet PC camera, an external specialist will be able to see exactly what the employee on site sees, and provide suitable support.

One approach, many platforms

In order to meet as many customer requirements as possible, there are plans to develop the mixed-reality application for various mobile devices: complex functions such as navigation for the HoloLens and more simple applications such as remote support

Focusing on requirements

Eric Birgel and Tanja Haag pursued the design thinking principle in order to drive the fast development of VisionBlue: rather than presenting customers with a finished product, they were involved in its creation process – an approach that Endress+Hauser consistently takes when it comes to digitalization. Potential fields of application are first identified together with customer companies. Customer feedback is subsequently obtained at regular intervals. Following the feedback, the applications are developed at top speed in two-week ‘sprints’ before being presented to the companies again. “This results in a product with market proximity. And we can guarantee that we develop solutions that precisely meet customer requirements,” says Tanja Haag.

for tablets and smartphones, which have now become commonplace in the industry. The expansion of VisionBlue to further instrument groups is also envisaged. “We will provide our customers with a versatile and adaptable product package in future,” Tanja Haag is convinced.

Text: Joel Bedetti
Photos: Manuel Wittek

A WORD WITH... OLIVIER WOLFF

“Our instruments are ready for the IIoT”

Mr Wolff, how can field instruments help the process industry cope with the digital transition?

Field instruments deliver lots of information beyond the measurement values that make it possible for plant operators to optimize their processes, such as carrying out predictive maintenance to avoid unscheduled downtime. To use the data – in other words gathering it at the field level and analyzing it in the hub – you need a second communications channel. This is the only way to funnel this data from the field past the control system simultaneously in a safe and non-reactive manner.

Do the measurement instruments from Endress+Hauser already enable such a second data channel?

The current measurement instruments are ready for the Industrial Internet of Things. They have the connectivity required to transmit data other than the measurement values. With fieldbus protocols such as PROFIBUS PA and FOUNDATION Fieldbus, this data is transferred to the corporate Ethernet network via Fieldgates, and from there to our Netilion IIoT ecosystem through an edge device. With open interface standards such as OPC-UA or industrial Ethernet protocols such as PROFINET and Ethernet/IP, the information can be read directly from the instrument. The Advanced Physical Layer will open up new opportunities: an intrinsically safe, two-wire solution co-developed by Endress+Hauser. That means field instruments can one day be powered and directly connected via Ethernet even in hazardous environments and in plants covering a wide area. The transmission rate is 300 times higher than with conventional fieldbuses. We’re creating a veritable data highway from the field!

What about older plants? Is there a simple and reliable way for operators to integrate the installed base into IIoT solutions?

In these environments, a second, non-reactive wireless communications channel can be implemented directly at the field instrument. To do that, Endress+Hauser will introduce a new adapter to the market. This solution is based on the HART protocol, which the majority of installed devices can already handle, and supports data transmission via WirelessHART and Bluetooth. This allows you to easily connect all HART devices even in a pure 4–20 mA infrastructure. The adapter is easy to retrofit, powered via the current loop and is intrinsically safe. We can set up the connection to our Netilion IIoT ecosystem via a WirelessHART gateway and an edge device – and in the future even directly through Bluetooth-LTE edge gateways.

Questions: Christine Böhringer · Photo: Christoph Fein

Expert for connectivity Olivier Wolff (31) joined Endress+Hauser as Marketing Manager Industrial Communications after obtaining degrees in electrical engineering and information technology as well as international sales management. His goal is to bring connectivity to every field instrument and get the data transmission technology in shape to meet the high demands of the process industry.



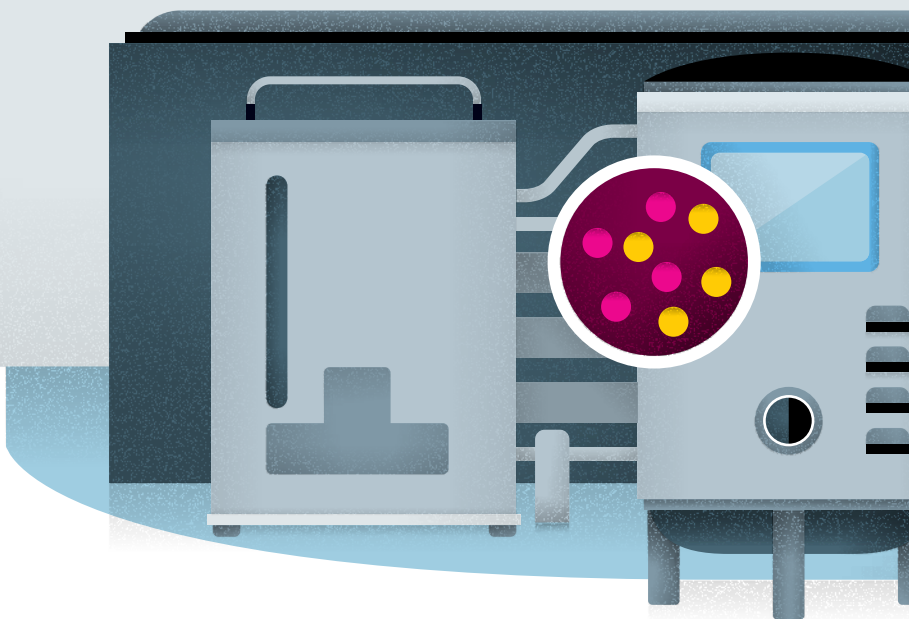
Results without detours

Until now, complex substance analyses have had to be carried out in laboratories. Nowadays, new inline and online measurements provide answers within seconds. This allows quality-related parameters to be monitored even in running processes.

Every sample that is examined in a laboratory takes time, during which a potentially faulty batch might be produced. "To improve control of their processes, our customers therefore increasingly want to relocate quality-relevant measurements and analyses from the laboratory to inline and online measurements during production," says Wolfgang Lubcke. He is developing the global business with advanced process analysis at Endress+Hauser.

Until now, these methods were often not fast enough, too prone to failure in harsh process environments or inefficient. Advanced technologies now offer continuous real-time monitoring of relevant parameters: The miniaturization of optical and electronic components and the implementation of complex chemometrics models have enabled the development of innovative field devices capable of analyzing even heterogeneous mixtures in a highly selective manner.

Whether it be time-domain reflectometry, surface acoustic wave measurement or Raman spectroscopy, Endress+Hauser has recently expanded its portfolio with techniques that can be applied directly in the process, offering new possibilities in process optimization and batch release analysis. "This means tangible progress and a significant increase in productivity, safety and efficiency for numerous industries and applications," Wolfgang Lubcke is convinced.



Raman spectroscopy

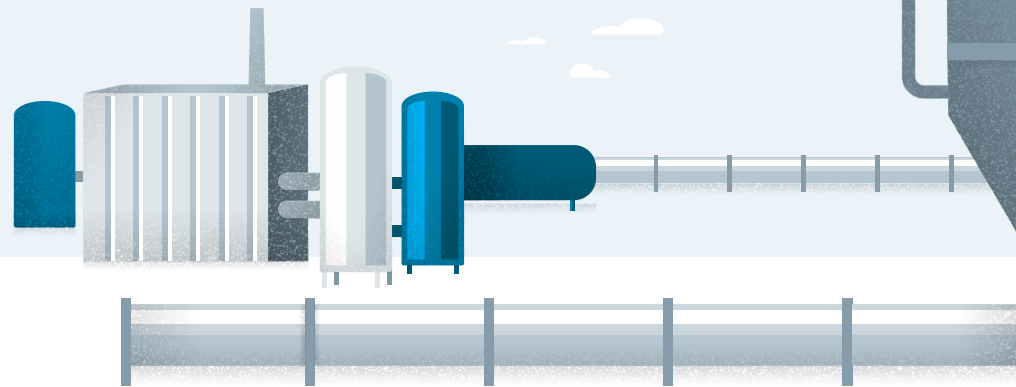
Real-time multiparameter analysis

Raman spectroscopy has repeatedly proved its worth in the laboratory when it comes to complex substance analyses. It is now also available as a reliable and robust inline process solution. One of the advantages is its rapid signal processing: Measured values are now provided in less than 13 seconds – while gas chromatographs take minutes for the same process. This enables the natural gas composition for the operation of a gas turbine to be controlled virtually in real time, thereby keeping the engine's efficiency within optimum range. It also opens up new opportunities in biotechnology, such as for the control of cell growth in bioreactors by precisely detecting the concentration of glucose and metabolites. Inline measurements can also replace time-consuming laboratory batch release with real-time batch release. Batches therefore no longer need to be held back for days, and the risk of losing a valuable batch to contamination is eliminated. The process provides comparable advantages during the production of synthetic rubber. Quality parameters such as polymer structures and residual monomer content can now be captured in just a single measurement during ongoing processes. Immediate intervention can be carried out in case of any deviation, minimizing waste.

Laser absorption spectrometry

Quality under control

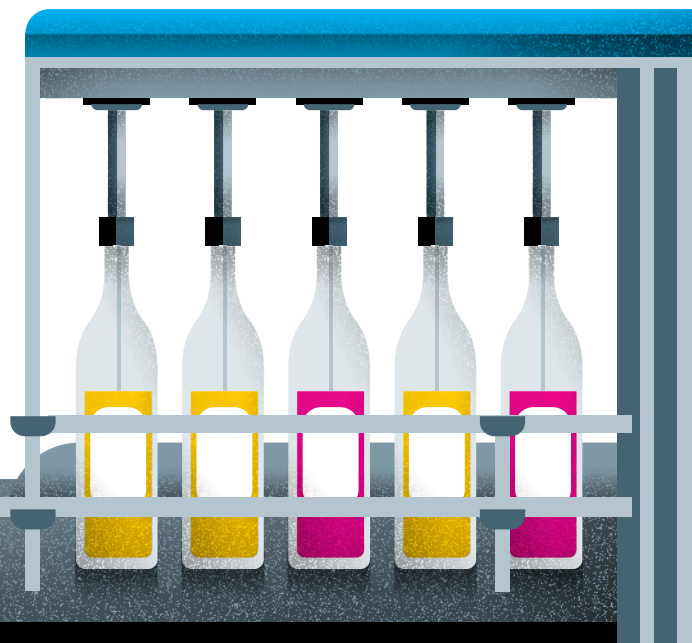
As the third-largest energy source, natural gas plays an important role in the supply of energy. Before being fed into the networks, the gas is processed to eliminate impurities in order to adhere to the limit values. Tunable diode laser absorption spectroscopy, or TDLAS, enables the continuous measurement of critical gas components such as water, hydrogen sulfide and carbon dioxide with the highest level of precision even with concentrations below 1 ppm, unlike previous procedures. The extractive maintenance-free online method provides real-time measurements. Any deviation from the required level of natural gas quality is detected immediately, allowing the process to be adjusted accordingly.

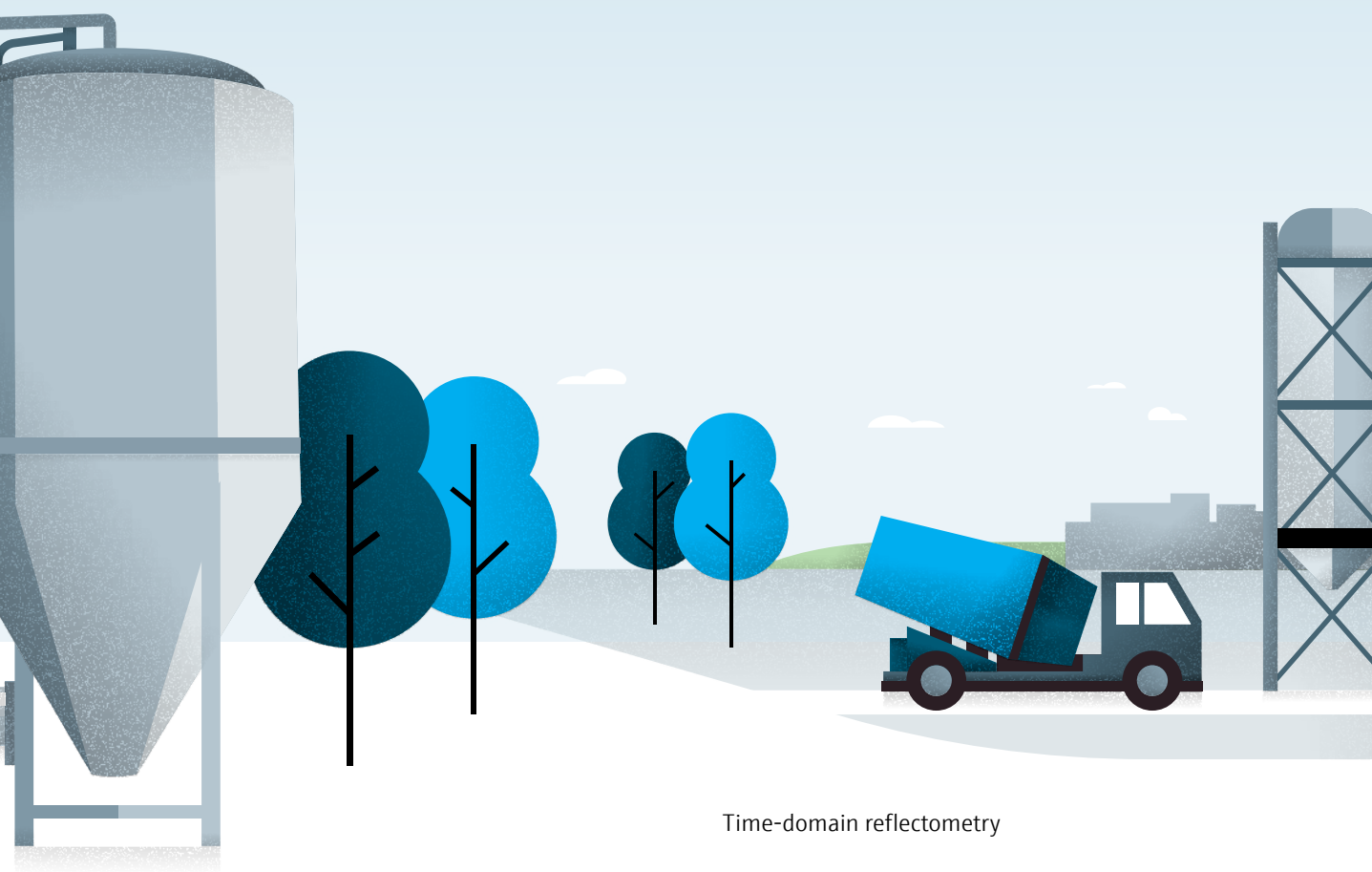


UV/VIS and NIR spectrometry

Precise color analysis

Color is a fundamental indicator of the quality of food, as consumers are sensitive to any changes. Color measurement during the production and filling process helps ensure product consistency while preventing the presence of significant traces of previous batches following a product change. Process spectrometers have one advantage over the more commonly used photometers: they measure within the ultraviolet and visible area (UV/VIS), therefore covering the entire color spectrum rather than just one or two wavelengths. Near-infrared (NIR) measurements furthermore allow additional quality parameters such as water content to be determined. There's just one issue: While UV/VIS provides precise results, it has been expensive and cumbersome to use up until now. The delicate measurement device therefore had to be positioned outside of the process before being connected to the measurement probe through a fiber-optic cable. Innovative inline spectrometers have now integrated the previously separate measurement components consisting of the probe, fiber-optic cable and sensor into one compact and sturdy device. This allows its direct installation in the process and its integration into the process control system.





Surface acoustic wave measurement

Revealing the true composition

The precise detection of the concentration of liquid mixtures is key to many industrial applications, for instance when monitoring cleaning agents in hygienic areas, or when treating metallic surfaces in a passivation bath. The concentration is normally determined by titration in a laboratory. A new method now allows the measurement to be carried out in running processes. This involves measuring the transmission time and amplitude of surface acoustic waves (SAW) in liquids. SAWs are high-frequency soundwaves similar to the seismic waves of an earthquake. The app concept is an unprecedented feature of the new method: The characteristics of the liquid mixture that requires measuring are first determined in a laboratory with a probe before this 'acoustic fingerprint' is transferred to a mobile measuring probe or an online measurement system. This allows the concentration of the mixture to be precisely examined on-site.

Time-domain reflectometry

Guaranteeing the right consistency

The water content and conductivity of pore water are crucial parameters for the quality of fresh concrete: the load capacity of the hardened concrete could be affected or cracks might occur if the values are too high or too low. Until now, in order to determine the water content, fresh concrete samples had to be dried and assessed in a time-consuming process. Time-domain reflectometry with intelligent microelements (TRIME-TDR), a special variant of time-of-flight radar measurement, allows the consistency of the concrete to be measured during the process – for instance with the assistance of an online moisture sensor directly in the concrete bucket or mixer. The consistency can also be determined through a probe in a sample bucket on the construction site. The precise high-tech measurement procedure is not only reliable and representative but also simple: the sensors and probes require almost no maintenance, and there is no need for recalibration.

Texts: Reinhard Huschke
Illustration: Pia Bublies



From the laboratory to the process

In recent years, Endress+Hauser has expanded its portfolio for monitoring quality-relevant process parameters through spectroscopic methods in particular:

- Inline UV/VIS and NIR spectrometry for the analysis of liquids, gases and solids
- Online tunable diode laser absorption spectroscopy (TDLAS) in gases
- Inline Raman spectroscopy of gases, liquids and solids
- Time-domain reflectometry (TDR) for online moisture measurement in solids
- Surface acoustic waves (SAW) for real-time concentration measurement in liquids

These new technologies help to capture product characteristics virtually in real time and develop optimized control strategies for processes in the life sciences, food & beverage, chemical and oil & gas industries.



Innovations with a vision

Endress+Hauser continuously develops its range of products, solutions and services together with its customers. This makes everyday life in the process industry easier, safer and more efficient while creating new opportunities – even in outer space.





Universal use: Platinum temperature sensors with thin-film technology are produced in a clean room.

Qualified for outer space

Endress+Hauser's measurement engineering doesn't only provide its reliable services here on Earth: Sensors from Innovative Sensor Technology IST AG, which is part of the Endress+Hauser Group, have been successfully used in aerospace projects for many years. A series of platinum temperature sensors based on thin-film technology has now received the ESCC Qualification from the European Space Agency (ESA). The sensors are therefore standardized for use in space and can be deployed on any mission.

In the past, the ESA has mainly relied on wire-wound temperature sensors. They feature a thin platinum wire that is wound around a ceramic plate until it reaches the desired resistance. However, these sensors were often unable to withstand the heavy vibrations and enormous temperature fluctuations in space. The ESA therefore began searching for a sturdy alternative and found it in the thin-film technology of Innovative Sensor Technology IST AG. The temperature sensors can deal with the harsh conditions in space easily

as the platinum structure that makes up the resistor is firmly connected to the sensor's ceramic surface.

In order to meet the high requirements of the ESA, the sensor specialist adapted and developed a product series. Tests have shown that the sensors continue to provide stable measurement results at 70,000 measurement cycles of minus 200 to plus 200 degrees Celsius. They are also built in a compact and lightweight manner without moveable parts. One of the next missions the sensors will be used in is the Euclid space telescope. The ESA wants to use the telescope for six years from 2022 onwards to research dark matter and dark energy in space.



For maximum beer enjoyment: System supplier Krones is testing process engineering solutions at the Steinecker Brew Center.

High-tech brewing

Any time that beer, soft drinks, spirits or milk is produced anywhere in the world, there's a good chance that it is being made in a Krones plant: the German system supplier equips beverage manufacturers and bottlers as well as food producers across the globe both with individual machines and entire production facilities. Krones has now opened a state-of-the-art research brewery in Freising, Bavaria in order to optimize processes specifically for customers in the brewing industry. The Steinecker Brew Center relies on Endress+Hauser's measurement technology in particular.

"While fitting out our pilot plant it was important to us to have a strong partner at our side with whom we have a long-term, close-knit and excellent relationship," says Dr Konrad Müller-Auffermann, Head of Breweries Product Development at Krones. "With Endress+Hauser we opted for a partner with unparalleled support services in addition to a comprehensive product basket and an excellent reputation." Reliable and precise measurement engineering plays a crucial role in the

research brewery. The high-tech plant is fully digitally networked and provides real-time information. Technical solutions for every step of the process, from the processing of raw materials and boiling the wort all the way through to the cleaning of the plant, can be tested at the Steinecker Brew Center. Here, Krones can develop formulas together with customers, carry out tests and try out new technologies under real conditions. Training sessions in the field of automation engineering, for instance, complete the range of offers.



Digital service: Netilion Health helps rectify device errors on-site.

Fast help in case of emergency

Every minute counts when a measurement device malfunctions in a plant. Service personnel often lose additional time deciphering the field device's diagnostic code on-site. A new digital service from Endress+Hauser's Netilion IIoT ecosystem is now enabling faster reactions: The service app Netilion Health knows 25,000 device diagnostics for over 350 instruments. Entering the displayed code into the app on a smartphone or tablet shows technicians what's going on at a glance, while also providing them with specific instructions on how to solve the issue.

"With Netilion Health I know that I have all the information I need to eliminate potential errors," says Jan-Marten Claus, Production Engineer at the German steel group Salzgitter AG. "I no longer have to spend time running around searching for certain documents – the solution is right here in my pocket." The app provides even more advantages: because it stores the devices' status history, operators can analyze longer time periods to find out more about the larger correlations in their facility. If multiple measurement devices with Endress+Hauser's Heartbeat Technology are connected to the Health web application through Edge devices, the app will also display the live diagnosis data of the field devices. This helps optimize maintenance and reduce plant downtimes.



A clean job: The Nereda process is revolutionizing the biological purification stage.

Sustainable wastewater treatment

The 352,000-inhabitant city of Utrecht in the Netherlands is investing in its wastewater treatment. A completely new sewage treatment plant has been under construction on the site of the old one since 2017. Once it becomes operational, the facility will represent a revolution in sustainable wastewater treatment: Compared to its predecessor, the smaller facility can remove twice as much nitrogen and phosphate from the wastewater. Besides, the installation eliminates the usage of chemicals and cuts energy consumption by one-third.

The secret behind the sewage plant's efficiency lies in a new biological treatment named Nereda that is marketed internationally by the Dutch engineering firm Royal HaskoningDHV. Instead of being conveyed into an aeration basin, the wastewater is pumped into reactors following its mechanical treatment. The specific process ensures that the bacteria are growing in natural granulates rather than in flocs as usual. These granulates allow for several biological degradation processes to take place at the same time and deposit faster. Thanks to the fast sedimentation the reactors can be filled with untreated water while the treated water is simultaneously discharged, so that secondary treatment is no longer required.

For optimal and reliable control of the overall process, Royal HaskoningDHV relies on Endress+Hauser, the preferred supplier of critical measurement points in Nereda facilities since 2017. The wastewater treatment facility in Utrecht was fully equipped with Endress+Hauser instrumentation. "In addition to our offer of a comprehensive solution, the advantages of the Memosens technology, the Liquiline platform and the Liquiline system analyzers were also convincing," says Niek Brink, Area Sales Manager Water & Wastewater at the Dutch sales center. "In our joint projects, reliability is just as important as good service and the cooperation in advancing new technologies to continually optimize the Nereda process."



Secure supply: The new LNG terminal in Kuwait Bay uses Endress+Hauser's instrumentation.

Gas for Kuwait

At Kuwait Bay, with a view of the Zour Mountains in the distance, a South Korean consortium led by Hyundai Engineering is building the country's second liquefied natural gas (LNG) terminal. The emirate has significantly increased its gas imports since 2012 and signed international contracts covering long-term deliveries to ensure economical energy supplies for the country. The heart of the terminal is a re-gasification facility with a daily capacity of 30 billion cubic meters, plus eight cryogenic LNG storage tanks.

Endress+Hauser was selected as the measurement technology partner thanks to its convincing product portfolio, its range of services and the consortium's experience with Endress+Hauser on other ambitious oil and gas projects. "Given the potential hazards and risks, safe and environmentally sound operation of plants like this is a top priority. That's why the customer expressly requested SIL-certified instrumentation. We were able to provide support in creating the foundation for safe processes," reports Wooyoung Jeon, Senior Outside Sales

Engineer at Endress+Hauser, who is responsible for managing the contract.

In the bid to tender, safety was not the only factor that called for unusually high-performance solutions and literally 'thinking big' concerning the comprehensive instrumentation. For the re-gasification facility, 24 electromagnetic flowmeters for large-diameter pipes (NPS 48) were part of the design. "It was a gigantic project. The participating teams put in an enormous amount of work and effort," says Endress+Hauser Project Manager Yeon Ji. "We have partly developed completely new solutions and expanded our capacities."

Calibration with hydrocarbons

Around 90 million barrels of crude oil and liquefied natural gas (LNG) are produced around the world every day. This corresponds to 14.4 billion liters that are transported, temporarily stored, distributed, cracked and refined, shipped and finally used as an energy supply or as a raw material in manufacturing. The quantities are measured at every transfer point, a process that should be as precise as possible: given the immense volumes, the slightest deviations quickly add up. The highest possible accuracy is therefore desirable, especially for custody transfer applications.

Verifying custody measurement systems against an on-site reference is a common practice in the oil & gas industry in order to comply with national custody transfer regulations and international standards such as OIML R117 or API. This can be done with a master measurement device, a prover or a truck scale, for instance. This process can be exceptionally complex, time-consuming and costly, depending on the design of the facility and the assembly situation. The level of complexity increases substantially if any measurement deviations exceed the tolerance limit.

Endress+Hauser is therefore now offering its customers state-of-the-art ex-works hydrocarbon flow calibration as a new service. The Coriolis mass flowmeters are calibrated in accordance with ISO/IEC 17025 at the accredited and traceable calibration facility in Reinach, Switzerland, with media of various viscosity under various flows. The adjustment factors for the measuring system's flow computer in the customer's plant are thereby determined. The calibration provides the data for the Reynolds number correction, which increases the measuring precision to the best possible technical level when it comes to complex media such as crude and heavy oils.

"Factory calibration results in considerable cost savings in comparison to on-site calibration and, in addition, to the best possible measuring performance," says Jörg Zacheres, the Product Manager in charge at Endress+Hauser. "By offering our customers this additional quality milestone they are able to significantly reduce their project risk."



Ex-works precision: Endress+Hauser can calibrate flowmeters with hydrocarbons on request.



Fast assistance: A cloud platform is improving Endress+Hauser's technical support.

Intelligent support

To handle the roughly 200,000 technical support cases that occur each year, Endress+Hauser is breaking new ground. Before the end of the year, the Smart Support platform will be in place globally. The cloud platform is creating a more efficient network of Endress+Hauser support specialists around the world and serves as a tool to handle any type of support inquiry. The core of the intelligent IT solution is an enormous knowledge database that will assist service experts in solving reported problems even faster. The platform also features a tool that simplifies collaboration and helps to draw on the expertise of specialists from every part of the company to address specific issues. "Smart Support redefines the meaning of customer service at Endress+Hauser and brings it to the digital age," says Franck Perrin, Corporate Director Service Excellence at Endress+Hauser. "The portal allows us to react more precisely to our customers' concerns and align ourselves even better to their individual needs. That means we can generate significant added value for them."

By relying on this knowledge base, which grows with each incident, Endress+Hauser will also be able to develop new services in the future. This includes plans to create a self-service portal, which customers can access around-the-clock to find a solution to their problem, directly pose support questions and manage their own support situations. The Industrial Internet of Things also offers new perspectives: "At some point, measurement instruments will automatically trigger support processes or store data in the Smart Support database," explains Franck Perrin. "That will enable us to offer proactive service and make predictive maintenance possible for our customers."

Texts: Thomas Adolph, Christine Böhringer

Photos: Christoph Fein, Endress+Hauser,
Innovative Sensor Technology IST AG, Hyundai Engineering,
Royal HaskoningDHV, Stefan Schönenberger

Globalization leaves its mark

Endress+Hauser experienced strong growth in 2018. The Americas and Asia were especially dynamic. The USA surpassed Germany as the company's largest sales market and the significance of the international markets was further reinforced.

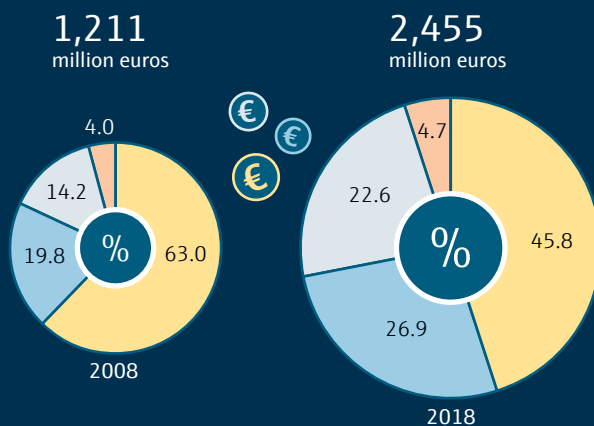
In the fast lane

Although Germany was Endress+Hauser's uncontested sales leader for 65 years, the US took over the top position in 2018. China, making up ground in a very dynamic fashion, might overtake the US and Germany within just a few years.

Booming markets

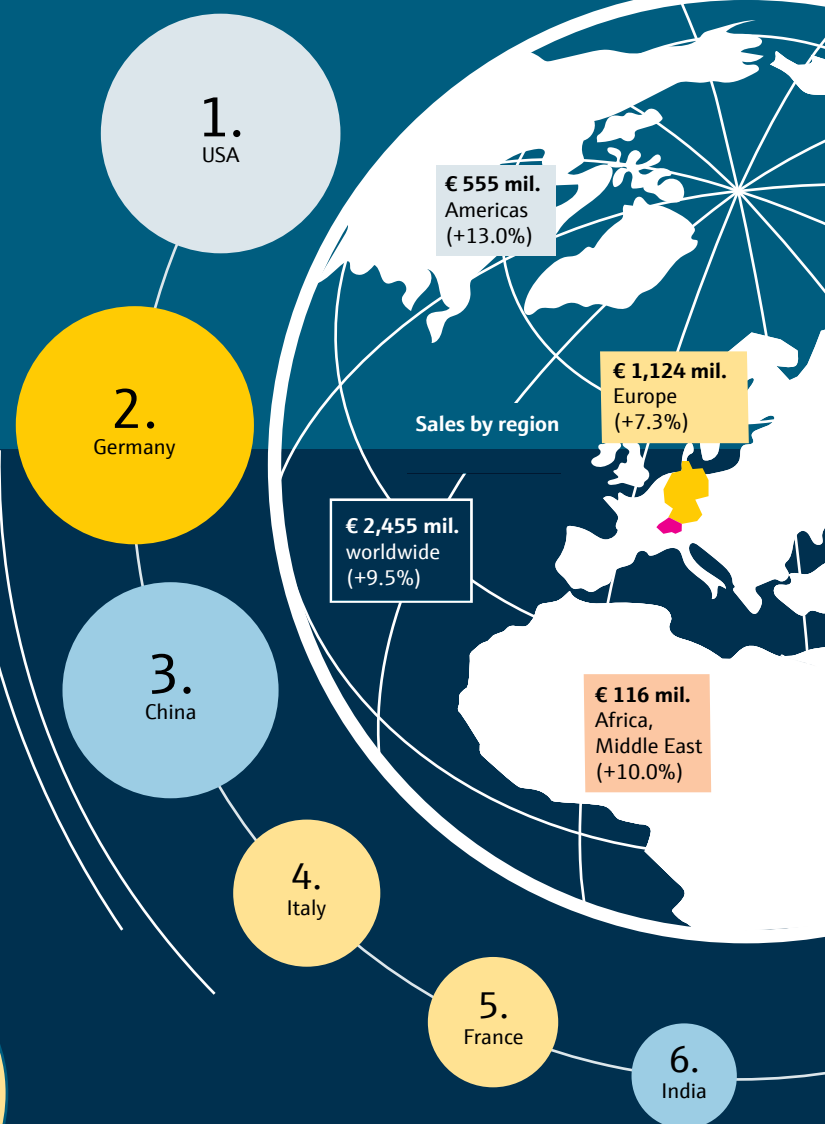
2014 was the first year Endress+Hauser generated more sales outside of Europe than within. Since that time, the balance has continued to shift due to the more dynamic growth in many of the international markets.

Sales by region (percentage)



■ Europe ■ Asia-Pacific ■ Americas ■ Africa, Middle East

Top ten markets for Endress+Hauser



International spirit

Endress+Hauser still employs more people in Europe than elsewhere. The largest share of products still comes from Europe, where core components are manufactured and products are developed. The workforce is nevertheless growing disproportionately in the rest of the world. The People for Process Automation are becoming more and more international. A second center for research and development is located in the US.

Employees by region



A network spanning the globe

Endress+Hauser established its first foreign subsidiary in 1960, only seven years after the company was founded. In 1970, the company took the step into the USA and Japan. Today, the Group operates a tight sales, production and support network across the globe.

countries are served by national sales centers

48

>75

more countries are covered by sales representatives

12

countries are home to 26 production sites



"The balance of the markets has shifted"

What's behind the solid business figures for 2018? And what will it take to lead the company to a successful future? Supervisory Board President Klaus Endress and CEO Matthias Altendorf provide their insights.



“This is the biggest responsibility that we have: handing over a healthy and sound Endress+Hauser to the next generation of the family.”

Matthias Altendorf, CEO of the Endress+Hauser Group

Mr Endress, Mr Altendorf, the process automation industry had a good year – and Endress+Hauser had an excellent year. What characterized 2018?

Endress: We got off to a very good start and maintained this pace until the end of the year. We can be very satisfied. For us, 2018 was another ‘best year ever’, and of course we’re pleased about that!

Altendorf: The manufacturing industry experienced a strong global economy. People want to eat, drink, consume and stay healthy, but also save energy, conserve resources and protect the environment. These factors have always been in our favor. There were virtually no unpleasant surprises, regardless of the industry or region.

The strongest growth occurred in the Americas and Asia...

Endress: It’s worth noting the way the balance of the markets has shifted for us. Germany has been our market with the highest sales ever since Endress+Hauser was founded. The US took over this position in 2018.

Altendorf: That of course represents the size of these markets. The US still offers great potential, and the same goes for China. The fact that we’ve had a manufacturing presence in these markets for more than two decades, and that the customers also view us as a local company, has paid off.

Compared to the industry, Endress+Hauser experienced above-average growth and gained market share. Which are the reasons behind this?

Altendorf: We have outstanding, extremely dedicated employees who take care of our customers around the world, plus we boast a highly innovative portfolio. We introduced 54 new products last year to support our customers even better in improving their business processes. We accomplished a lot in the area of digitalization and our investments in analytical technologies pay off. We’re making good progress in this field and all of this is contributing to our growth.

Endress: It makes a difference if people enjoy their work. Other suppliers have good products as well, so that can’t be the only reason for our results. When people feel at home in a company and their work is valued, this is when they are capable of excellent performance, and that goes for the area of innovation as well. Even products that have proven their worth over decades can be improved.

Digitalization is electrifying the industry. How relevant is the topic for Endress+Hauser?

Altendorf: It all begins with the fact that the manufacturing of our measurement instruments is to a large extent digitized.

From the first entry in our device database, we monitor every step and can make this information digitally available. We provide connectivity, both wired and wireless, via a variety of communication protocols. And with Netilion, we offer customers an ecosystem for the Industrial Internet of Things that enables them to exploit the potential of digitalization for their own purposes, for instance in web-based applications or by using entire packages for certain tasks. From a technical point of view, we’re very advanced. As a next step, it will take joint efforts with our customers to develop useful applications.

How does this approach differ from other suppliers?

Altendorf: One key point is that we are independent of the control system. We offer whatever benefits our customers, and not just what fits neatly into our own system architecture. Furthermore, we have always relied on open standards and we collaborate with a wide range of system partners. Just one example: Our partnership with SAP helps to get the information from the field instrument into the ERP system.

The topic of analytics is also getting a lot of attention. Does Endress+Hauser make progress in strengthening process analysis and bringing new analysis and measurement methods for quality-relevant parameters to the field?

Altendorf: We’ve had consecutive record figures in the analysis business for ten years running. Why? We focused on making it easy for customers to deploy analytical technologies. Our philosophy is to integrate the complex parts into instruments that are quite easy to use. Where possible, we have also established standards, so that customers have to learn things only once. The new technologies that we gained through acquisitions are developing very well. They help our customers reduce costs on a massive scale.

What’s the situation in the field of laboratory analysis?

Altendorf: We will continue to enhance the laboratory analysis area, which on the one hand impacts our offering. The Analytik Jena products that are designed for chemical analysis will be enhanced with further innovations and supplemented with new technologies. On the other hand, we’re reinforcing the sales area. We’d like to address the market more broadly and offer customers superior service. It will take some time before this strategy completely takes hold, however.



Matthias Altendorf

Endress: This area is certainly a challenge, but we are still convinced by our strategy. With that in mind, the changes within the Executive Board are a positive development for Analytik Jena. When the CEO of the Group puts emphasis on laboratory analysis, this is a clear signal that we want to make this business a success.

You have just touched on the changes within the Group management... Andreas Mayr now has responsibility for the operational business as COO. What's behind this step?

Endress: This frees up more time for Mr Altendorf to work on issues that are important to the future of the company. And with Mr Mayr, the day-to-day business couldn't be in better hands.

Altendorf: We want to focus on three areas in particular. When it comes to digitalization, we want to stay out in front: with our products and processes and in our own systems. Second, we want to strengthen the laboratory analysis business and bring laboratory technologies to the field. Third, we want to strategically develop the company over the long term. These are the issues I want to focus on. But that will require time and effort, and Mr Mayr is giving me exactly the space I need. On top of all of this, Endress+Hauser has grown over the years. Today the Group has 14,000 employees, a presence in 50 countries and production facilities on five continents. One of the key tasks is to convey and anchor our corporate culture across the world so that the customers perceive us as one company. The corporate culture binds us together and builds trust with the customers – that's extremely important for us.

The Family Charter was revised. One of the changes involves working at the company. Where does this stem from?

Endress: Family members had limited career opportunities at Endress+Hauser, because it's not a simple thing for a shareholder to hold a normal position within the company. For this reason, we always said that members of the family are only allowed to work as a managing director at one of

the companies, or as CEO of the Group. In hindsight, however, we have to admit that we haven't been particularly successful with this approach. Only one member of the third generation of the family took this path. My nephew Steven Endress is currently Managing Director of the UK sales center. If we want to have more members of the family active within the company – and that's important because it helps them identify with Endress+Hauser and reinforces the bonds – then we have to open the door at all levels.

How will this work?

Endress: In principle, we will treat members of the family like all others. They will have to contribute and perform just like every other employee. The Family Council will supervise these people very closely and the Executive Board and Supervisory Board will be involved as well. Mr Altendorf and I gave this issue a lot of thought and developed the concept together. We are in total agreement.

Altendorf: This is the biggest responsibility that we have: handing over a healthy and sound Endress+Hauser to the next generation of the family – not only with respect to the operational business, but also when it comes to the relationship with the shareholder family.

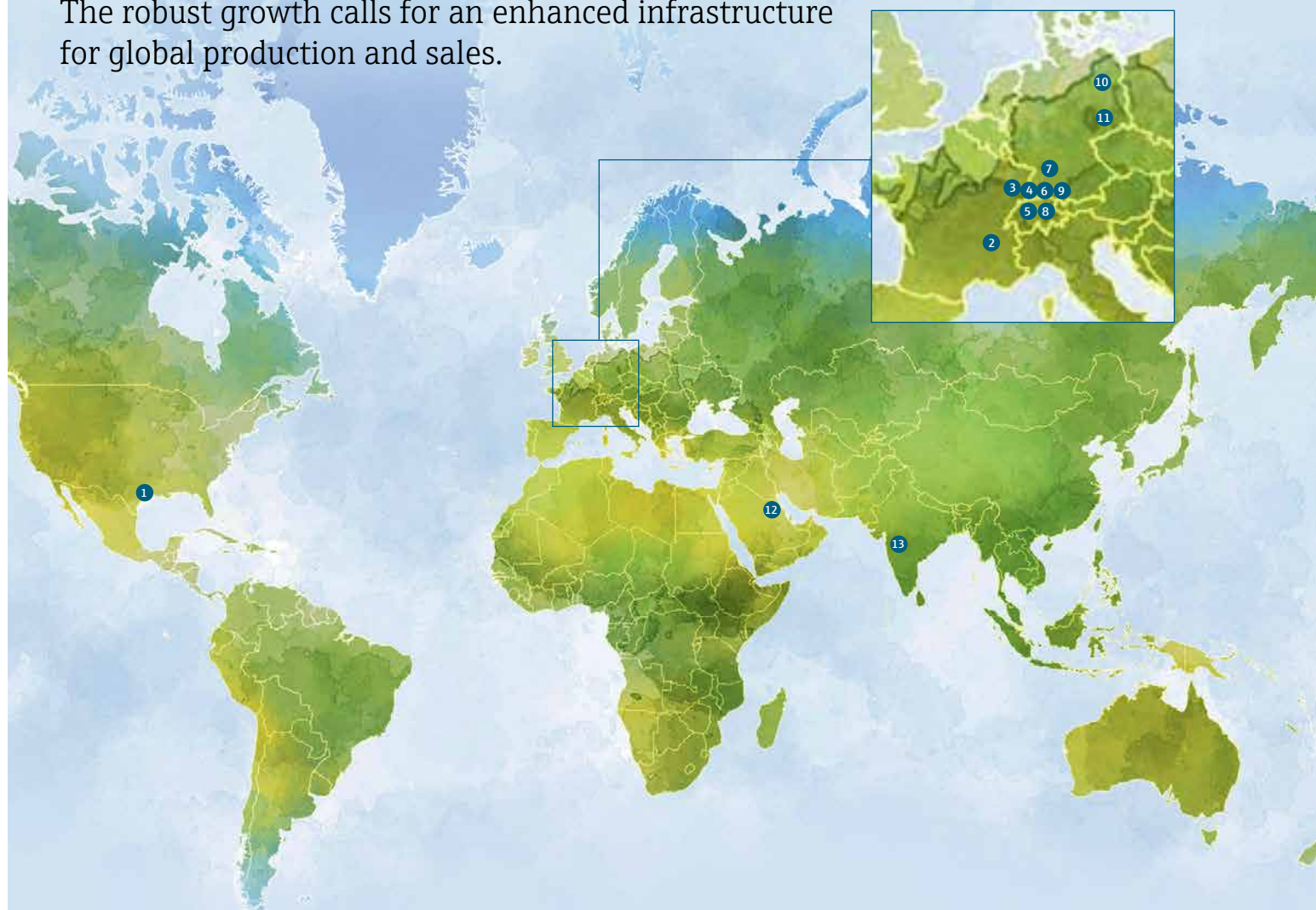
Questions: Martin Raab
Photos: Christoph Fein

Link to the family Klaus Endress, born in 1948, obtained a degree in industrial engineering from the Technical University Berlin. He joined his father's company in 1979, took over Group management in 1995 as CEO and moved to the Supervisory Board in 2014 as President. Klaus Endress is married and the father of two grown children.

Roots in the company Matthias Altendorf, born in 1967, began his career at Endress+Hauser with vocational training as a technician, followed by studies, stays abroad and further education. He was promoted to the Executive Board in 2009 and became the Group's CEO in 2014. Matthias Altendorf is married and the father of a grown son.

Visible growth

The Endress+Hauser network is constantly expanding. The robust growth calls for an enhanced infrastructure for global production and sales.



① Houston, Texas, USA

Gas analysis division office, calibration and training center, sales office
32 million euros
Construction started in 2019

② Lyon, France

European support center for analysis technology
2 million euros
Opening in 2019

③ Cernay, France

Expansion of production facilities for flow measurement technology
13 million euros
Construction to start in 2019

④ Weil am Rhein, Germany

Modernization of sales center building
12 million euros
Construction started in 2018

⑤ Reinach, Switzerland

Expansion of production facilities for flow measurement technology
56 million euros
Construction started in 2018

⑥ Maulburg, Germany

Expansion of the production center for level and flow measurement technology
46 million euros
Construction started in 2017

⑦ Gerlingen, Germany

New office building for the production center for liquid analysis
10 million euros
Construction to start in 2019

⑧ Ebnat-Kappel, Switzerland

Expansion of the sensor production facilities
15 million euros
Opening in 2019

⑨ Nesselwang, Germany

Expansion of production facilities for temperature measurement technology
10 million euros
Opened in 2018

⑩ Stahnsdorf, Germany

Expansion of production facilities for pressure sensors
12 million euros
Opening in 2019

⑪ Waldheim, Germany

Expansion of production facilities for analysis sensor technology
19 million euros
Construction to start in 2020

⑫ Al-Jubail, Saudi Arabia

New calibration and service center
3 million euros
Opened in 2018

⑬ Aurangabad, India

Expansion of production facilities for flow measurement technology
8 million euros
Construction to start in 2019



Dr Andreas Mayr



Jörg Stegert

Changes at the top

Within the Executive Board of the Endress+Hauser Group, Andreas Mayr will be in charge of the operational business. Jörg Stegert is the new head of personnel.

Dr Andreas Mayr (58) is already a member of the Executive Board of the Group. He has assumed additional responsibilities within the family-owned company effective 1 March 2019. Andreas Mayr, who holds a doctorate in physics, is now responsible for sales, production and support as Chief Operating Officer. In this role he will also serve as deputy for CEO Matthias Altendorf.

Matthias Altendorf, CEO of the Group since 2014, will focus his activities on aligning, growing and strengthening the Group, as well as further anchoring the corporate culture and values into the global network of companies. Apart from strategy, business development and digitalization, he will also concentrate on further expanding the laboratory analysis business.

The impetus behind the reorganization is, among other things, the Group's continued growth. "We want to continue to actively shape this transformation," emphasizes Klaus Endress, President of the Supervisory Board. "By bundling the operational responsibility of the Group in the hands of a COO, we can free up more time for the CEO to focus on his responsibilities."

HR under new leadership New to the Executive Board effective 1 October 2018 is Jörg Stegert, Chief Human Resources Officer. The 48-year-old previously headed human resources at Knorr-Bremse AG in Munich, Germany, where he supported the company's top executives and oversaw projects in human resources such as the establishment of international structures and a state-of-the-art HR IT landscape.

The Executive Board of the Endress+Hauser Group also includes Dr Manfred Jagiella (Corporate Director, Process Analysis Business), Chief Information Officer Pieter de Koning (IT), Chief Sales Officer Nikolaus Krüger (sales, service and engineering), Chief Financial Officer Dr Luc Schultheiss (finance) and General Counsel Dr Heiner Zehntner (legal).

Close cooperation with SAP

SAP and Endress+Hauser will in future collaborate in IIoT applications for the process industry – from developing joint solutions and sales activities to customer implementation. The goal is to fully integrate Endress+Hauser field instruments as digital twins into the SAP cloud platform. Both companies want to take advantage of the services and apps from SAP's Leonardo system as well as Endress+Hauser's Netilion IIoT ecosystem. An open platform concept forms the basis for this approach.



Awards for TrustSens

The iTHERM TrustSens self-calibrating thermometer has been recognized by as many as nine industry awards. The groundbreaking innovation was honored during the Hannover Messe trade fair with the Hermes Technology Award. In addition, it received the prestigious AMA Innovation Award given out by the German Association for Sensors and Measurement (AMA), not to mention further awards from organizations in the Czech Republic, France, the Netherlands and the US.



Close bonds

The Endress family has revised its Family Charter. New guidelines open up further opportunities to get involved for the younger generation, with the aim of strengthening their relationship with the company.

The Endress family has relied on a charter since 2006 to govern its relationship with the company. The most important goal, which is expressed in the vision statement, remains unchanged: "Endress+Hauser will remain a successful family company." The charter provides the framework to achieve this goal. With clear principles and established institutions, the document is designed to strengthen solidarity within the family, introduce young members of the family to Endress+Hauser and keep family disputes away from the company.

The most important committee in this respect is the Family Council, which in essence forms the bond between family and company. "The Family Council decides on all matters of importance," says Klaus Endress, President of the Supervisory Board and Chairperson of the Family Council. Both the older and younger generations each have three representatives. "Each member of the Family Council assumes specific responsibilities."

The shareholder family, which is widely spread over several countries, organizes a series of events each year to bring the family together for business and social reasons. The Family Seminar revolves around specific company-related issues. The Family General Meeting is structured to address the Group's development, while the Annual General Meeting is an opportunity for the Executive Board and Supervisory Board to give the shareholders an account of the business.

Good cohesion The Family Day, which is held each year at a different location, offers a chance for the family to bond while gaining insights into the company. At the Family Camp, the younger generation learns more about the business and each other. The family also comes together each year at Christmas time. "Like any family, we sometimes have differences of opinion," reports Klaus Endress. "Overall, however, we have a very good mutual understanding. We always look forward to seeing each other again!"

New opportunities The family has now completed the second revision to the charter since its inception in 2006. The recent changes focus on family participation in the operation of the company. "To date, we've had little success in drawing members of the family into the company," admits Klaus Endress. Although family members have always been encouraged to work at Endress+Hauser, the possibilities have been limited to managing director positions at one of the Group companies, or as CEO of the Group. These are all top-level positions that place correspondingly high requirements on the candidates.

"We will make it easier for the younger generation in the future," explains Klaus Endress. "We want to make it possible for members of the family to work at any level of the company – not only as an intermediate stop on the way to a leadership position." And like any other employee, family members will be given the chance to work their way up the ladder.

Shareholder family Company founder Dr Georg H Endress and his wife Alice left the company to their eight children, each receiving an equal share. Four percent of the company is held by the Georg H Endress Foundation, a non-profit organization. The family currently has more than 70 members. One member of the third generation – Steven Endress (40) – has operative responsibility as Managing Director of the UK Sales Center. In addition, three members of the second generation are active in the company: Klaus Endress (70), longtime Group CEO and current Supervisory Board President; Hans-Peter Endress (72), head of the UK Sales Center for decades and now a Supervisory Board member; and Urs Endress (65), longtime Managing Director of Sales Center France who is now active in various capacities for the holding company.



Farewell: Endress+Hauser shareholder Yvonne Endress passed away after a long illness.

To head off conflicts in cases where a family shareholder is not active at the higher levels of the company, the Family Council will closely guide the person's career. The charter also has clear guidelines for such situations, one of which is that the candidate must be judged alongside other applicants for the respective position, since expectations for family members are just as high as for all others. "Anyone who wants to lead the Group will have to work at the managing director level for several years at large Endress+Hauser companies in Asia or America," adds Klaus Endress.

Important step "What we want to achieve when we offer easier access is to ensure that more members of the family bond with the company," emphasizes Klaus Endress. This was also a concern for CEO Matthias Altendorf who was involved in revising the charter. "I believe it's important that members of the shareholder family continue to work in the company. It reinforces the relationship between the family and the company – and that can only mean good prospects for a family company like Endress+Hauser."

Text: Martin Raab

Photos: Dominik Plüss, Andreas Pohlmann



Klaus Endress



Hans-Peter Endress



Urs Endress



Steven Endress

Mourning Yvonne Endress

The Endress+Hauser Group is mourning the death of shareholder Yvonne Endress, who passed away on 16 May 2018 at the age of 68 after a long illness. After battling her serious disease for many years with unshakable optimism, she died peacefully in her sleep in the presence of her family.

Yvonne Endress was born in Zurich in 1950 as the third of eight children of company founder Georg H Endress and Alice Endress. After attending school in the French part of Switzerland, as well as England, she graduated from the school of commerce in Basel. In 1994 she joined the German sales center where she was active for 16 years in various capacities.

Yvonne Endress ended her professional career in 2010. As a member of the shareholder family, she continued to maintain close ties to the company. Shortly before her death, she was pleased to participate in the Endress Family Day activities, passing away only three days later.

Breeding ground for innovation

Endress+Hauser is charting new paths to innovation. In Freiburg, multiple company units are working together in a university environment to develop sensors, technologies and automation solutions for the future.

Dr Adnan Yousaf is proud of his creation. "It's a prototype for a sensor that transmits data electromagnetically without a power source," says the engineer, grabbing a disc that fits easily in the palm of his hand. The microelectromechanical systems expert had already dealt with wireless instruments like this within the scope of his doctoral thesis, long before the topic reached the lecture halls. Adnan Yousaf then acquired industry experience during his postdoctoral activities. He now works next door to other sensor specialists, computer scientists and automation experts at one of three new creative hubs established by Endress+Hauser in Freiburg, Germany. With these hubs, the company intends to establish an innovative environment for sensor development and automation.

"Our goal is to build a type of collaborative campus," explains Matthias Altendorf, CEO of the Endress+Hauser Group. "We want to forge a creative space that experts in various disciplines can use to work in the vicinity of the university and other research institutes to develop new products, solutions and services and inspire each other." To initiate this effort, the company recently set up a series of spin-offs and start-ups in Freiburg, such as the Optical Hub, which is involved in optical analysis and measurement methods; the IIoT Lab, which works on solutions for the Industrial Internet of Things; and the Sensor Automation Lab, which is developing novel sensor technologies.

It's no coincidence that these agile units were set up in recent years outside of the well-established product development model. "To generate something completely new, you should start small and from scratch," says Dr Mirko Lehmann, who is responsible for the Sensor Automation Lab and also serves as Managing Director of Innovative Sensor Technology IST AG, which belongs to the Endress+Hauser Group. "The Endress+Hauser centers of competence are world-class facilities for creating innovations within their own product lines. However, our aim in Freiburg is to give innovations the necessary drive that would not always be possible within existing structures. We want to take momentum from the Endress+Hauser Group and feed back inspirational ideas."

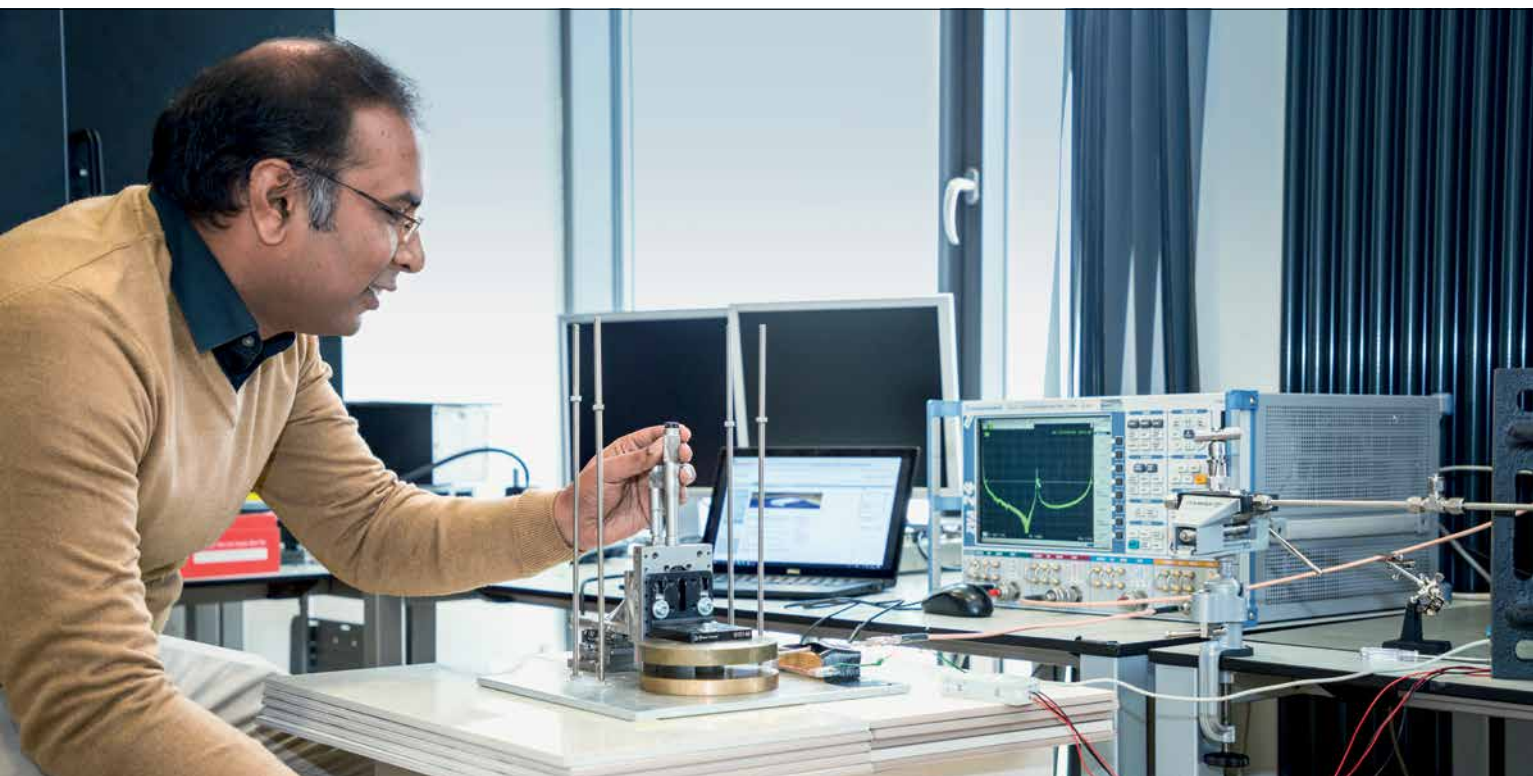
Substitute for the human senses Apart from the individual core topics, one of the common goals is to operate outside the boundaries of established disciplines and bring together two completely different ecosystems. In Freiburg, researchers are striving to combine the opportunities that digitalization offers with new sensors and sensor technologies. The experts are especially interested in technologies that improve

the qualitative and quantitative determination of substances and bring laboratory measurement technology closer to the process. "We want to use innovative elementary sensor technology in plants to replace human senses such as smell or taste," explains Dr Benjamin Scherer, team manager at the Sensor Automation Lab. These new sensor technologies can be combined with artificial intelligence, cloud computing and digital integration to better control industrial processes while reducing the amount of resources used, improving product quality and increasing plant availability.

Besides, the specialists in the units have direct exposure to the latest scientific developments. The location of the labs alone puts them within arm's reach of academic research environments. The labs are situated on the campus of the technical faculty of the University of Freiburg, one of Europe's strongest research-oriented engineering schools. At the renowned Department of Microsystems Engineering, researchers maintain excellent relationships with the various university chairs. The Georg H Endress Foundation is furthermore funding an endowed professorship for Smart Systems Integration. "The school has an excellent reputation in the field of artificial intelligence," adds Hans-Jürgen Huber at the IIoT lab. Seven university chairs cover all the relevant topics. As well as other well-known institutes, nearby is the Fraunhofer Institute for Physical Measurement Techniques (IPM), a member of the German Fraunhofer-Gesellschaft research network that collaborates with the Optical Hub, which develops special optical measurement processes.

Open-minded collaboration "Our location gives us direct access to research and university resources," says optics expert Dr Marc Winter, who highly values the close cooperation with his colleagues. "We're currently working together to further develop spectral-based analyzers. Among other things, we want to utilize artificial intelligence to reduce the complexity of the analyzers for the user." Other factors make the activities in the small think tank unusual: the trust that Endress+Hauser places in the experts and researchers, most of whom have never had anything to do with the company, plus the creative atmosphere. All of this encourages people to part from old ways of thinking and spurs innovative energy. As Benjamin Scherer emphasizes, "We have lots of freedom to take a look at new things!"

Text: Kirsten Wörnle
Photos: Thomas Hansmann



Room for creativity: Sensor experts have abundant freedom to carry out their research activities.



Lively exchange: The campus employees operate between the disciplines.



Learning and developing together: Apprentices discuss an electronic circuit with an instructor.

Practitioners for the world

Endress+Hauser is deploying a vocational education model to locations around the world. A pilot project in Aurangabad in India is to provide young people with better qualifications and new career opportunities.

India once had an education system referred to as Gurukul. A student would live with a master craftsman for several years to learn the trade. During the colonial period, the Gurukul principle was replaced by a theory-driven school and university system that still influences the country to this day. “We’re actually more of a practical nature here in India,” says Sriram Narayanan, Managing Director of the Endress+Hauser production facility for level and pressure measurement technology in Aurangabad. That explains his enthusiasm for the success of Endress+Hauser’s latest education initiative, which aims to export the Swiss and German dual model of vocational training to production locations around the world.

The model, in which schools and companies work hand in hand, was first rolled out in India. In Aurangabad in November 2018, eight apprentices began a one-year program under the guidance of five vocational trainers to become electronics technicians. The young men aged 16 to 18 train and work at the level and pressure, temperature and flow measurement technology plants in India. In a modern training workshop, the apprentices acquire the basics of electrics and electronics as well as mechanics. In addition, they gain insights into the sales center. “This promotes a customer-oriented approach to the job,” says Kailash Desai, Managing Director of the Endress+Hauser sales center in India.

Investment in the future The driving force behind the project is Urs Endress. “By exporting the dual vocational training model, we’re also continuing one of the company’s traditions,” explains the Endress+Hauser shareholder, who led the French sales center for many years. Endress+Hauser has offered a trinational training program in Germany, Switzerland and France for more than 30 years. The program gives the apprentices an opportunity to acquire



Applying knowledge: The program includes many hands-on phases.

experience in the neighboring countries. The transfer of the dual training to other countries is also designed to ensure quality and promote the exchange between production locations all over the world. In addition, the trainees become familiar with the company from the ground up.

“We want to invest in young people and offer them good prospects for their future.”

Urs Endress

The training concept is adapted to the respective local environment. In India, for instance, the program is structured around a two-year vocational training course at a technical school, of which there are many in the country. The instructors come from within the company’s own ranks. “This helps us

increase the acceptance of the project,” says Narendra Kulkarni, Managing Director of the temperature measurement engineering production facility. Five company veterans completed a course at the German Chamber of Commerce office in Pune or at the center of competence for level and pressure measurement technology in Maulburg, Germany. Sudhir Patil, an engineer and one of the instructors, observed that “in these environments the apprentices and the instructors interact with one another on equal footing. That’s something we want to replicate here.”

Knowledge for the real world The goal is to mold the apprentices into independent employees who enjoy developing their skills and can apply their knowledge to real environments. “India’s current technical school system only satisfies the needs of modern industry to a limited extent, because it relies too much on theoretical knowledge,” explains Project Manager Jens Kröger, Head of Personnel Development at Endress+Hauser in Maulburg. “Vocational students learn to copy circuit diagrams for instance, but not the underlying principle. Working independently is not encouraged.” For this reason, they are often assigned routine responsibilities after graduating.

In Aurangabad, however, the apprentices analyze and develop electronic circuits on their own, then discuss their findings with the instructors. “With this approach, they learn to solve problems, how to assume responsibility and how to scrutinize processes within their own company,” explains Jens Kröger. The effects of such an approach were evident not long after the course was started. “Our apprentices wanted more English classes to better understand the training contents and to be able to tap into additional knowledge on the internet,” explains Milind Shrikhande, an electrical engineer and one of the instructors. His protégés are highly motivated. “I’m learning a trade from the ground up,” says Akash Kale enthusiastically. “Here we work on machines in teams of two instead of in groups like at our technical school,” adds Vijay Padol.

On the right path Once the apprentices complete the program, their career prospects will be particularly good. “An apprenticeship offers young people from rural areas of the country a real chance to progress,” says Jens Kröger. The managing directors at the Endress+Hauser plants in Aurangabad are hoping to reap long-term benefits from the project as well. “Even though we’re a relatively small company here in India with around 500 employees, we are able to make a significant contribution to the development of this region,” says Kulathu Kumar, Managing Director of the flow measurement engineering plant. “With this project we will become a trailblazer in vocational education.” And his colleague Sriram Narayanan adds: “The Indian economy is growing at a rapid pace. We not only need more people in the future, we need better trained ones.”



Full concentration: In the training workshop, fundamental skills such as soldering are learned.

Next steps It’s no accident that Endress+Hauser chose India as the first place to establish the dual training model outside of Europe. The subcontinent is suffering from a serious shortage of skilled labor, especially in the trades. With this in mind, the government established the goal of providing better training to 500 million people by the year 2020. The German vocational training system is considered one of the keys behind the success of German industry and thus serves as a role model. The next project will begin this year in Greenwood, Indiana in the United States, where sales and production, including development, share a common campus. In Greenwood, Endress+Hauser will offer the complete three-year apprentice program. Like in Germany, apprentices will alternate between hands-on training within the plant and theoretical classes taught at an educational center over several weeks.



Highly energized Daniel Richner (20) built his first LED controller at the age of 10. Today he teaches electronics courses to young people, thus passing on his knowledge and passion for electronics. The four-year electronics technician apprenticeship in Switzerland is a demanding program.

“I got a great opportunity”

To date, more than 2,300 people have completed an apprenticeship at Endress+Hauser. One of those is Daniel Richner, a young native of Switzerland who graduated with top grades.

Mr Richner, you completed your apprenticeship with a grade of 6.0, the top mark in Switzerland. Are you a natural-born talent?

Not really. Rote learning is not my thing at all! I'm more of a pragmatist. Even at an early age, I wanted to know how technical devices work and build them on my own. I learned a lot just by trying a lot of things out. Once you understand the underlying principle, you can easily transfer that knowledge to other issues. I recently developed a robotics vehicle together with my classmates at school, which can be controlled via a web server.

What made you decide to pursue an apprenticeship as an electronics technician?

I knew at the age of 12 that this is what I wanted to do. Back then I attended a course at a youth electronics and technology center. My course instructor at that time works at Endress+Hauser and he drew my attention to this apprenticeship. What I like about this profession is the variety. Electronics

technicians implement electronic circuits or software or work in research, product development or production. They need a good technical understanding, logical thinking and the ability to work in a team.

Did your training at Endress+Hauser increase your enthusiasm about the apprenticeship?

Absolutely! There were five of us during the first year and all of us were supervised very closely. We learned the fundamentals in the workshop. After that we became familiar with various departments and other companies within the Endress+Hauser Group. Everywhere I went, the people placed their trust in me and fostered my skills.

What did you enjoy the most?

My final project. I designed a machine that loads software onto prototype circuit boards to simplify and automate a previously complex and manual process. This was a really great opportunity. It was a terrific challenge

being allowed to develop a machine from the ground up. It combines mechanics, automation, informatics and electronics – in other words, everything that I learned during my four-year apprenticeship.

What's up next for you?

I was offered a position in research and development after the apprenticeship, and in fall 2019 I will begin studying electronics and computer science engineering. I'm glad that I completed the apprenticeship. For me it provides the ideal foundation to continue my career.

Questions: Christine Böhringer
Photo: Christoph Fein

Equal standards

For Endress+Hauser, environmental, social and ethical awareness is part of its corporate responsibility. That's why the company relies on uniform criteria to determine how sustainably its suppliers operate.

"We want our suppliers to take their share of responsibility," says Martin Nigg, Head of Logistics and Procurement at Endress+Hauser Flowtec AG, as he stands in one of the production halls at the center of competence for flow measurement technology. He is surrounded by stacks of large wooden crates with instruments ready to be shipped to customers. One thing that the recipients can be sure of: the measurement instruments were produced by a family-owned company that is fully aware of its responsibility to society. And this responsibility does not stop at the boundary of the company's premises. "For us, it's very important that our entire network acts in an environmentally, socially and ethically responsible manner," emphasizes the head of division.

Endress+Hauser Flowtec operates a vast network. With a workforce of 1,900, the company produces not only in Switzerland, but to varying degrees in France, the US, India, China and Brazil. Around 350 direct partners supply the company with thousands of components, from electronic parts and screws to measurement tubes and flanges. "Against this backdrop, there are a lot of interesting questions," explains Martin Nigg. Were the raw materials in use mined and produced under safe working conditions? Is there a guarantee that the minerals did not originate from conflict-affected regions? Were the products sustainably manufactured?

Complex audits "To make sure all of these issues are addressed, we carefully choose our suppliers with a view toward long-term relationships," says Martin Nigg. Every supplier has to sign the Endress+Hauser Code of Conduct, a document created by the company in 2010 that indicates that the supplier is committed to legally compliant, fair and ethical behavior. Suppliers must undergo an audit before the first order and are re-evaluated from time to time once things are up and running. "We use these on-site audits to reassure ourselves on a regular basis that our partners are not only meeting the quality benchmarks but also the diverse sustainability requirements," adds Martin Nigg.

The visits nonetheless demand extensive time and effort. "We complete around 50 audits each year," says Martin Nigg. And there is a wealth of sustainability measurement scales since each country has different regulations in place. "This is why we eventually want to rely on a structured approach and work with a common set of sustainability indicators, which we can use to measure the performance of our suppliers." The production center wants to work together

with the independent global platform EcoVadis, which Endress+Hauser has used since 2013 to evaluate its own sustainability. "We plan to launch a pilot project to assess our suppliers in line with this system," says Martin Nigg.

In direct comparison Martin Nigg expects that these measures will provide more transparency for all participants. "For the first time, we're now in a position to monitor all of our suppliers and carry out direct comparisons. This is a big step forward," he says, underlining the importance of the matter. The head of division and his colleagues will soon be able to call up various parameters and benchmarks with just a few clicks. By going online, the suppliers participating in the pilot project can also learn how well they are scoring in specific areas and see where there is still room for improvement.

The data from EcoVadis will be incorporated into the Endress+Hauser global digital procurement platform, providing a 360-degree view of the suppliers. "We take just as hard a stance on how seriously our suppliers view their corporate responsibility as we do other success benchmarks like quality, adherence to delivery schedules and price transparency," says Martin Nigg. "After all, our customers also evaluate us according to how much value we place on sustainability."

Text: Kirsten Wörnle
Photo: Christoph Fein

Recognized platform EcoVadis operates a global platform that evaluates suppliers based on ecological, ethical and social indicators, while simultaneously highlighting improvement potential. The rating agency's analysis system is built on international CSR standards and covers 21 sustainability criteria across the four topics of environment, fair labor and human rights, ethics and sustainable procurement. More than 50,000 companies work together with EcoVadis to reduce risks, foster innovation and build trust and transparency.



When it comes to sustainability, Head of Logistics and Procurement Martin Nigg has an overview of the entire supply chain.

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Strong growth

Endress+Hauser took advantage of the strong market conditions and made progress in all fields. CFO Luc Schultheiss explains what's behind the Group's best ever year.

No question about it, 2018 was an outstanding year for Endress+Hauser. Sales reached a new high, earnings improved significantly on an already high level, we created hundreds of new jobs and incoming orders grew considerably. Additionally, we have made record investments and further improved our solid position with respect to sustainability.

At first glance, the numbers appear to conflict with the negative headlines that currently dominate the business news. The trade conflict between the US and China and dissent within the European Union, not to mention Brexit, are all creating uncertainty. Although low interest rates and unemployment levels make a recession unlikely, the slump in stock markets at the end of the year illustrates just how little it takes to make the financial and stock markets nervous.

So why was 2018 nevertheless such an excellent year for Endress+Hauser? First off, the process automation business was carried by a strong economic environment in our industry. Behind this development are ongoing catch-up effects from previous years as plant operators put off large-scale projects and cut back on maintenance. The consumer business is still strong, however. The subsequent demand has now triggered new investments. Another contributing factor is the price of oil, which is high enough to make more projects pay off again.

Substantial boosts Endress+Hauser even managed to outperform the industry's strong growth and gain market share again last year. This success is closely tied to impulses spurred by our strategy and our portfolio. Year after year, we are introducing a wealth of innovative products, solutions and services to the market. We are also helping our customers to make their installed base part of the Industrial Internet of Things, whether it involves new or existing plants. And we can use our devices and systems to measure and analyze more and more quality-relevant parameters while the production process is running.

We have aligned our offerings with a wide range of different industries and boast a worldwide sales and production presence. This allows us to counter market fluctuations and pays double dividends when, as in 2018, nearly all industries and regions are performing well. Over the years, we have seen the balance shift strongly in the direction of Asia and the Americas. After 65 years of being our undisputedly largest market in terms of sales, Germany was overtaken by the US for the first time in 2018. This change is tied to growing currency risks. Foreign exchange developments once again cost us revenues in 2018.

Calculated in local currencies, growth would have been a good four percentage points higher. On the other hand, the strength of the euro against all other major currencies helped us on the cost side. And because we were operating at a high level of capacity, we were able to significantly raise productivity and increase return on sales. This allowed us to achieve a new high on the income side despite the extraordinary revenues we generated in the prior year. The equity ratio rose slightly once again.

Ambitious goals We have to admit, the economic and political climate has certainly not improved over the past several months. Looking forward, our business environment is once again marked by more uncertainty. We are nevertheless confident about our prospects for 2019. We anticipate growth will be slower, but still solid. However, we will continue to follow a prudent path in order to act swiftly in case of serious developments.

The target for this year's consolidated sales growth, in euros, is in the mid single-digit range. In local currencies, we are once again looking at two percentage points on top of that – certainly an ambitious goal. We want to keep productivity, as well as profits, at a high level. We are investing heavily in order to expand production, and as result our capacity, and to accommodate future growth. We want to create several hundred new jobs around the world at the same time. And finally, in 2019 we again want to make good use of any arising opportunities to the benefit of Endress+Hauser.

Photo: Christoph Fein



2018 HIGHLIGHTS

Sustainable business

Endress+Hauser defended its Gold Status in the EcoVadis 2018 sustainability audit. With 68 out of 100 points, another two-point increase from the previous year, the Group placed in the top five percent of the participating companies. The audit encompasses 21 criteria covering the environment, labor conditions, business practices and procurement. Endress+Hauser scored above average in all areas. EcoVadis operates a global platform for evaluating suppliers in accordance with ecological, social and ethical aspects.

Innovative strength

When it comes to new instruments, solutions and services, Endress+Hauser put on a brilliant display in 2018 with the introduction of 54 product innovations and 452 significant new device options. Behind this performance are more than 1,000 research and development employees who submitted 287 patent filings, 26 more than 2017. Ninety-seven of these patent filings originated from the electronics, diagnostics, digital communications and Industrial Internet of Things areas.

Growing diversity

By the end of 2018, Endress+Hauser employed exactly 13,928 people, an increase of 629 over the previous year. The percentage of female employees rose once again and now exceeds 30 percent. The workforce is also becoming more and more international. By far the largest group is German (5,323 employees), followed by French (952) and Chinese (951). Regardless of gender or nationality, with an average 10-year tenure at Endress+Hauser, the People for Process Automation are exceptionally loyal.



A knack for numbers

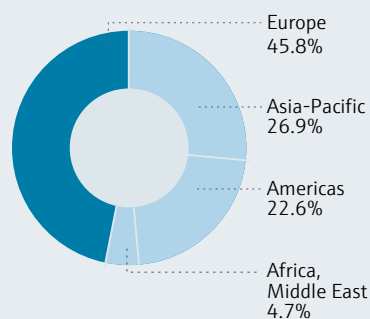
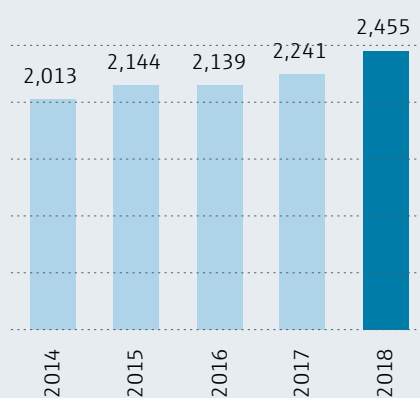
Dr Luc Schultheiss (57), who holds a doctorate in business administration, worked as a university lecturer and consultant before joining Endress+Hauser in 1999. He was appointed Chief Financial Officer and member of the Executive Board in 2011. Luc Schultheiss is married and the father of three grown children. He is an avid fan of FC Basel and enthusiastically involved in the Carnival of Basel.



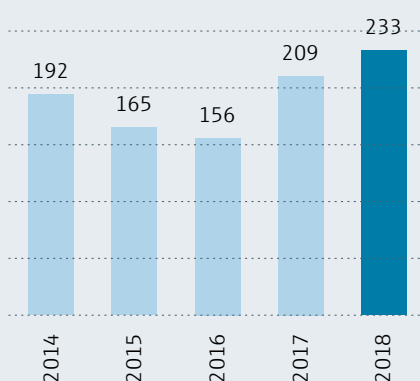
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Fiscal year 2018 at a glance

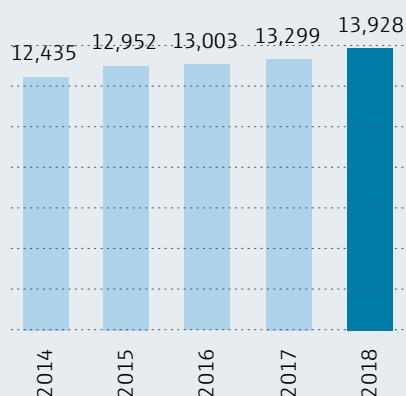
Net sales and net sales by regions (in million euros)



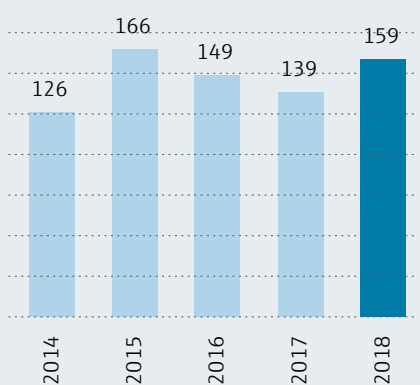
Net income (in million euros)



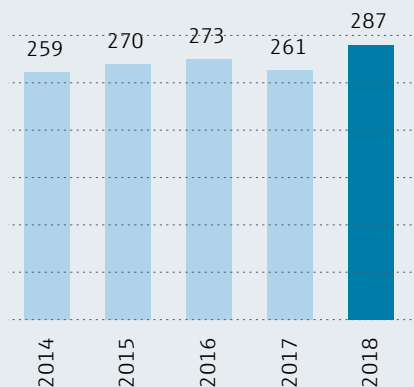
Employees of the Endress+Hauser Group



Capital expenditures (in million euros)

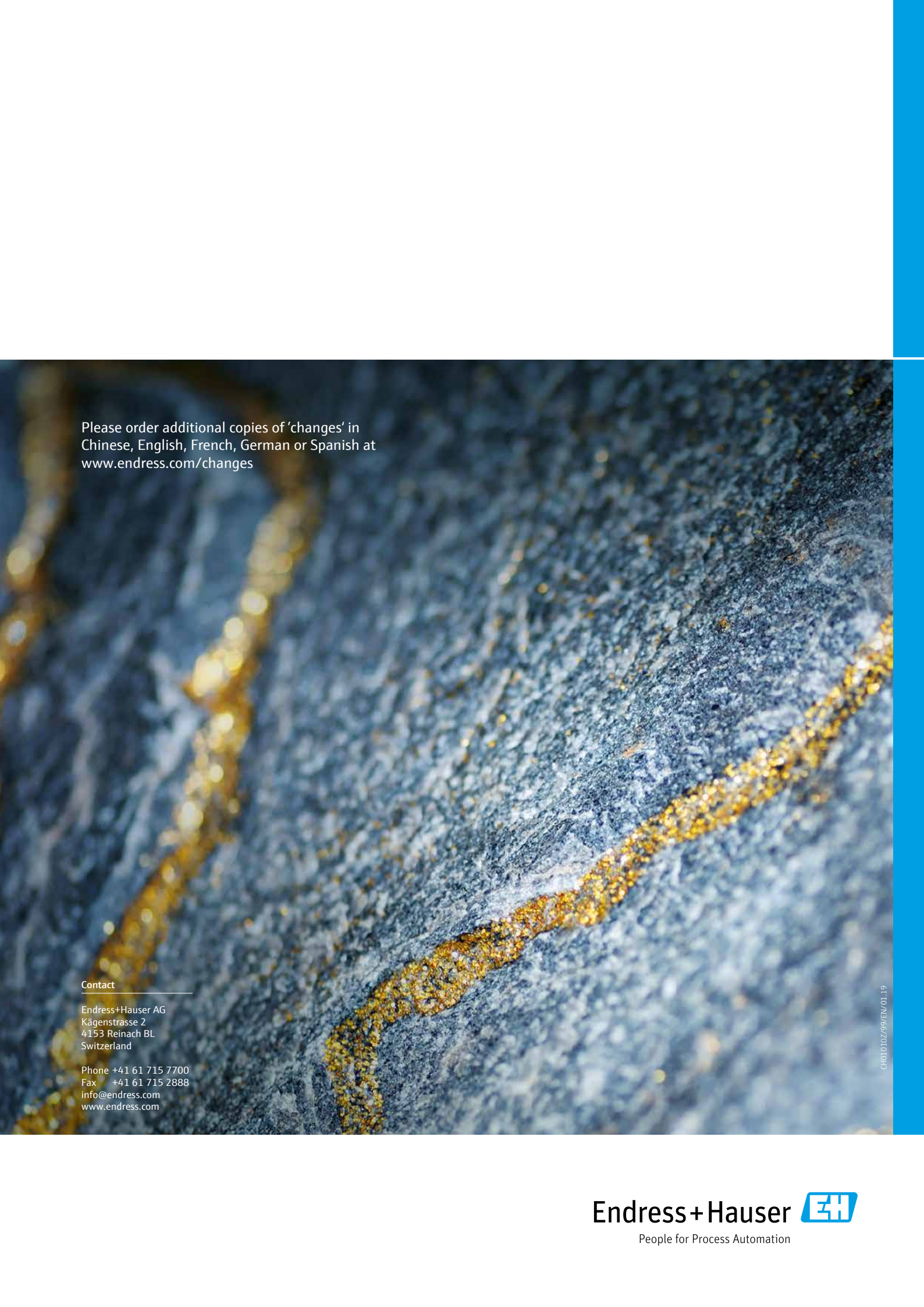


Patent applications of the Endress+Hauser Group



Financial highlights 2018

	(in million euros)					
	2014	2015	2016	2017	2018	Change
Net sales	2,013	2,144	2,139	2,241	2,455	9.5%
Operating profit (EBIT)	268	251	219	252	331	31.4%
Profit before taxes (EBT)	274	234	221	276	316	14.6%
Net income	192	165	156	209	233	11.2%
Return on sales (ROS)	13.6%	10.9%	10.3%	12.3%	12.9%	
Productivity	1.37	1.30	1.27	1.31	1.34	
Equity	1,465	1,718	1,779	1,820	2,067	13.6%
Equity ratio	68.3%	73.0%	70.5%	70.2%	71.0%	
Total capital employed	2,146	2,353	2,524	2,593	2,913	12.3%
Capital expenditures	126	166	149	139	159	14.4%
Cash flow from operating activities	261	260	237	237	304	28.2%
Number of employees	12,435	12,952	13,003	13,299	13,928	4.7%



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