



APPLICATION REPORTS2026

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Benzinger

Turning and milling machines go digital



Keeping precision machines precise

Benzinger relies on seamless digitalisation solutions from ifm

For more than 100 years, the name Benzinger has been synonymous with high-precision turning and milling machines made in Germany. With around 170 employees at its headquarters in Pforzheim, the mid-sized company serves demanding sectors such as aerospace, hydraulics, toolmaking, and the jewellery industry. Its success is founded on a high degree of in-house manufacturing, modular machine concepts and a holistic perspective.

"We don't think in terms of machines, but in terms of solutions," says Steffen Krämer, expert for turning machines at Carl Benzinger GmbH. "Our aim is always to offer the customer the best possible solution."

To achieve this, the company in Pforzheim opts for a very high level of in-house production. From mechanics and electrics to producing components on its own machines, through to assembly, quality assurance and process implementation – Benzinger covers every step under one roof.

Precision and durability built on tradition

This holistic approach is also reflected in the modular design of the machines. Different models can be flexibly adapted to customer requirements and application scenarios. Components such as stroking units, rotary tables or honing modules for the fine finishing of bores are selected to fit precisely and combined into an individual solution. But whether standard or customised – the focus is always on maximum precision.

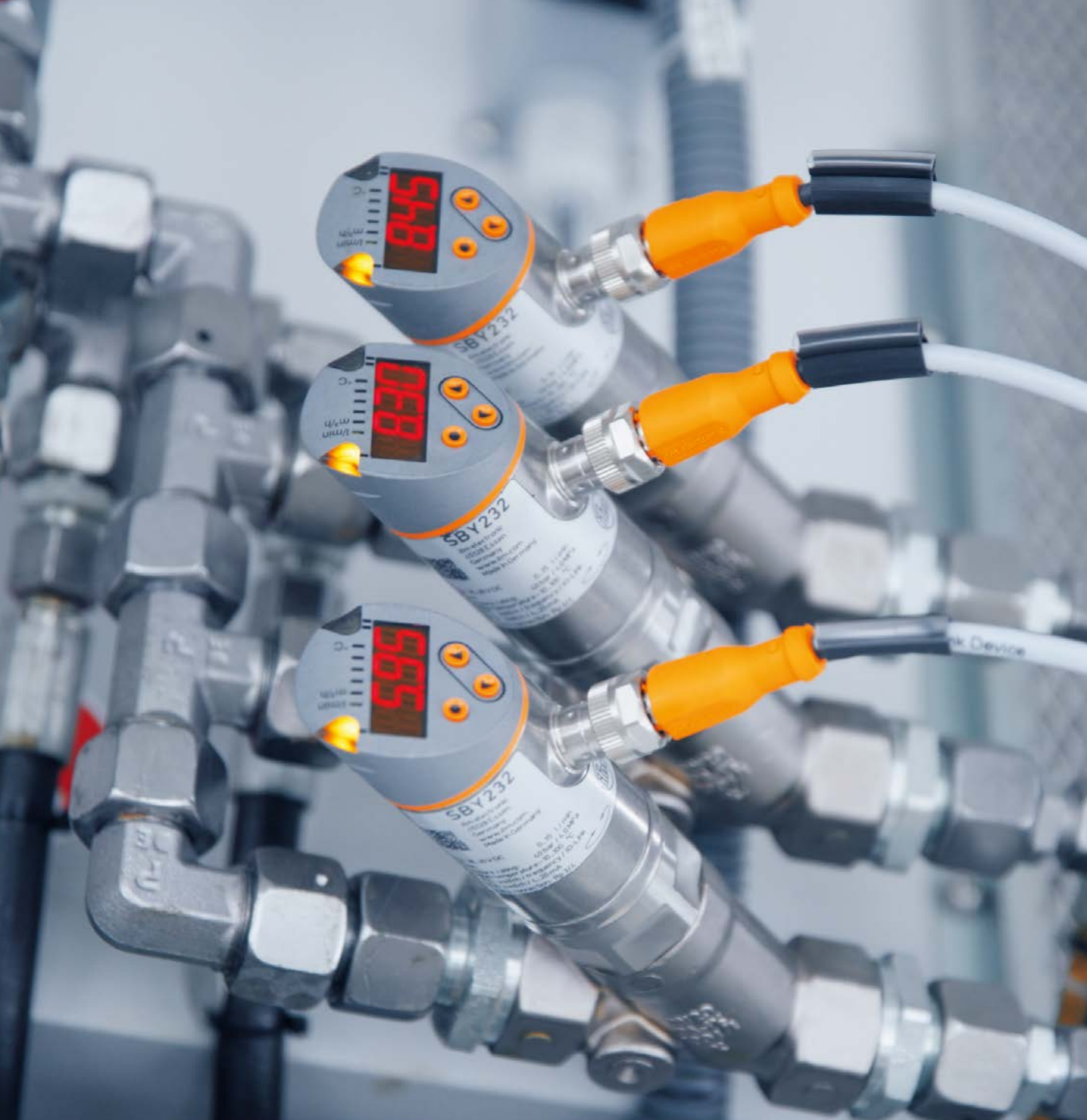
"Our customers are essentially looking for that last micron of accuracy," explains Krämer. "We meet this demand for utmost accuracy through a very rigid, durable mechanical design."

IO-Link: an established industrial standard

In addition to precision and quality, Benzinger is increasingly focusing on digital services and process monitoring. For this, the company relies on sensors and IO-Link solutions from ifm. IO-Link – the open standard for simple bidirectional digital data communication between sensors and actuators – was developed by ifm and other automation specialists and has become firmly established in the industrial environment.



To meet demanding precision requirements, Benzinger relies on a high level of in-house production.



Flow sensors like these provide precise insights into the condition of a Benzinger turning machine.

Since its market launch in 2009, more than 50 million nodes of this point-to-point infrastructure have already been installed. IO-Link offers several advantages that Benzinger can put to profitable use – both internally and for its customers.

“IO-Link gives us many options in mechanical and electrical design that conventional wiring simply cannot offer. Thanks to the decentralised data infrastructure, we can, for example, design more compact overall systems and reduce wiring complexity,” says Krämer.

Sensor data is collected efficiently using field-compatible IO-Link masters. As the sensors are wired and connected to the IO-Link master via standardised M12 connectors, wiring errors are ruled out. The IO-Link master then transmits the data in bundled form via fieldbus or Ethernet to the PLC and IT level. This makes the data readily available both for machine control and for evaluation at the IT level without additional effort. As a result, sensor data is no longer used exclusively for process control, but can be converted into valuable information for process analysis and maintenance planning. Benzinger makes use of this capability, for example, when monitoring its spindles.

From the IO-Link master (centre left) and the evaluation unit for vibration sensors (bottom right), the data is transmitted via the edgeGateway (top right) to the cloud.

"We manufacture the spindles ourselves. Thanks to the installed vibration sensors, we receive valuable information about the quality and robustness of the spindles directly from the field."

The insights gained flow directly into the further development of these key components.

Keeping an eye on machine efficiency and health

Another increasingly relevant topic is condition monitoring, which also relies on sensor data to provide precise and continuous insights.

"Our customers rely on high machine availability," says Krämer.

To ensure full visibility into the maintenance requirements of the turning and milling machines, the health status of the machines is continuously tracked using a wide range of data: For example, continuous vibration analysis helps to detect signs of unbalance immediately, preventing damage to the machine and reduced part quality. Spindle cooling is monitored using flow sensors. As IO-Link also transmits the temperature of the medium, the effectiveness of spindle cooling can be assessed. Level sensors in the second cooling circuit – used for cooling both tool and workpiece – ensure there is always enough coolant available.





Machine data clearly displayed and analysed in the moneo dashboard.

”In the moneo cloud environment, customers can see at a glance on the dashboard whether sufficient coolant is available or whether further maintenance is required.

“The energy efficiency of processes is becoming increasingly important for our customers,” says **Krämer**. “That is why we use compressed air meters to precisely detect the supply to the process. This ensures that compressed air is used as efficiently as possible.”

Electrical power, in kilowatts and kilowatt-hours, is also continuously recorded and analysed. An increase in power consumption can serve as an indicator that maintenance may be required.

Data analysis and remote maintenance with the cloud-based IIoT platform ifm moneo

This wealth of information offers valuable insights into machine health. Using ifm's edgeGateway and LTE bolt, data is transferred to the cloud version of moneo, the automation specialist's IIoT platform. At Benzinger, most data is transmitted via the IO-Link structure. In addition, the optional data interface ifm Agent makes it possible to connect other data sources, such as machine controllers or energy meters, to moneo. moneo enables users to collect and analyse machine and system data centrally, and to derive meaningful actions from it. In the cloud version, this can even be done across multiple sites. For example, the vibration behaviour of pumps, motors,

spindles and fans can be conveniently monitored to prevent failures caused by bearing damage or unbalance. Process values such as temperature, level, pressure, flow and electrical energy consumption can also be tracked centrally via moneo. If values move outside the defined range, the system automatically alerts the user. More advanced, AI-based data analysis is available with the **moneoIIoT-Insights** add-on. Thanks to the Remote Connect function, machines can even be serviced remotely via moneo.

“In the moneo cloud environment, customers can see at a glance on the dashboard whether sufficient coolant is available or other maintenance is required,” says **Krämer**. Not all of Benzinger's end customers, however, have the staff resources for continuous data analysis and the associated maintenance planning. “That's why many customers grant us remote access to their machines for maintenance purposes. We then access the machine via the Remote Connect function in moneo to optimise processes in consultation with the customer, or to recommend maintenance measures.”

Control data enhances analysis capabilities

“If, like Benzinger, you also include the data from the machine controller, which can be integrated into moneo via ifm Agent, you obtain a complete picture of the machine's condition. This ensures the highest possible quality of condition monitoring and at the same time improves the quality of the proactive service offering, which in turn has a positive impact on machine availability and process quality,” says **Christoph Schneider**, Vice President Product Management at ifm.

Conclusion

By integrating digitalisation and automation into their production processes, Benzinger has been able to increase efficiency while reducing costs. With state-of-the-art sensor technology and data analysis, potential issues can be detected and addressed early, before they result in major downtime. This not only helps to extend the service life of the machines, but also maximises productivity and profitability for the customers.



**Heinz Nixdorf
Vocational College**
Retrofit as a study project



Retrofit meets Industry 4.0

How a vocational college and ifm are preparing old machines for the digital future

Heinz Nixdorf Vocational College (Heinz-Nixdorf-Berufskolleg) in Essen is one of the leading educational centres for electrical engineering and information technology, with a strong emphasis on practice-oriented knowledge transfer. In close cooperation with industrial companies, the college implements learning projects that reflect current technological developments.

The aim is to provide future technicians and engineers not only with theoretical knowledge, but also with practical skills in handling modern automation and digitalisation solutions. A particular challenge was the digitalisation and modernisation of an ageing machine tool – a project implemented in cooperation with automation specialist ifm.

Parts of this 1970s lathe were digitalised for demonstration purposes to show how older machines can be modernised with sensor technology.

At the heart of the project was the task of upgrading an older machine tool to the latest state of the art through a targeted retrofit. The assignment was clearly defined: to set up a condition monitoring system for predictive maintenance without major structural interventions in the machine.

“Our goal was a minimally invasive retrofit – we wanted to integrate sensors in such a way that they are barely visible while maintaining compatibility with a wide range of systems,” explains **Patrick Bonneval**, state-certified technician at Heinz Nixdorf Vocational College.

The challenge lay not only in the technical implementation, but also in developing a platform that could function both as a proof of concept for Industry-4.0-compatible upgrades and as a versatile training tool. In particular, the integration of the new sensors into existing structures and the digitalisation of machine data required innovative solutions.

” Our goal was a minimally invasive retrofit – we wanted to integrate sensors in such a way that they are barely visible while maintaining compatibility with a wide range of systems.



Using time-of-flight measurement, an OGD distance sensor determines the slide position with millimetre accuracy and transmits the distance value via IO-Link.



An inductive sensor detects the grooves on the shaft to measure the rotational speed.

Smart sensor technology, IO-Link and Edge connectivity from ifm

The technical solution was implemented using a wide range of ifm components. Central to the setup was the use of IO-Link sensors such as the OGD photoelectric distance sensor and the LT level and temperature sensor. Together with an IO-Link master and an EdgeGateway (AE2100), these formed the basis for data acquisition and processing.

The system was supplemented by a VSA005 vibration sensor and a VSE150 evaluation unit, specifically configured for vibration diagnostics on rolling element bearings.

"With the IO-Link sensors, we not only capture the slide position but also key parameters of the coolant. The core element, however, is high-resolution vibration diagnostics, which allow us to monitor the condition of bearings in detail," Patrick Bonneval continues.



The 'ear' of the machine: the VSA005 vibration sensor captures the vibration spectra of all rolling element bearings in the machine drive.

Power supply, vibration diagnostic evaluation unit and IO-Link master in the machine's control cabinet.

The integration of sensors into the existing machine was particularly efficient thanks to IO-Link. *"IO-Link saved us a great deal of work, since it is very straightforward to implement and allows uncomplicated system expansion,"* confirms **Pascal Heider**, state-certified technician at Heinz Nixdorf Vocational College.

The IO-Link master collects the data from the connected sensors and transmits it in bundled form to the EdgeGateway. The gateway also ensures secure separation of operational technology (OT) and information technology (IT).

"The EdgeGateway is the central data hub for our sensors," explains **Pascal Heider**. *"All data is collected here, pre-processed, and transferred to our server solution, a Raspberry Pi."* For example, the EdgeGateway converts the sensor's level values from centimetres to litres. On the Raspberry Pi, various software instances capture, process, and ultimately visualise the data.





In the EdgeGateway (right), all sensor data are consolidated, pre-processed and then transmitted to the server.



Operating and vibration data can be clearly visualised. If limit values are exceeded, an alarm message is generated.

Transparency, maintenance optimisation and future viability

Modernisation with ifm technology has delivered several key benefits. The machine is now capable of providing real-time data for condition monitoring and predictive maintenance. *"With continuous vibration monitoring, we can not only determine the precise condition of individual bearing components, but also effectively prevent unplanned downtime,"* explains Patrick Bonneval. The ability to detect bearing fault patterns early increases machine availability and significantly reduces the risk of production losses.

Students gain valuable practical experience

For the students, the project offered a unique opportunity to familiarise themselves with cutting-edge Industry 4.0 technologies and to gain valuable hands-on experience. *"Our aim with the retrofit was to show that even long-serving machines can be elevated to modern standards,"* summarises Philip Bourgon, state-certified technician at Heinz Nixdorf Vocational College.

The collected data now serve as a basis for students in automation engineering to perform spectral analyses and develop skills in condition monitoring in an industrial context.

The school also benefited from the cooperation: *"The idea for this project stems from our new technical college for automation engineering and digital production technology,"* explains Dr Markus Steffens, head of the technical college at Heinz Nixdorf Vocational College. *"Our goal was to create a learning platform where students can work with state-of-the-art sensor technology, data transmission, and data evaluation in a retrofit scenario. Thanks to the cooperation with ifm, this has been highly successful."*

Tobias Kunze, Director Regional Sales at ifm, emphasises the importance of close cooperation: *"We support our educational partners not only with hardware but also with technical support. This way, young talents can work directly with future-oriented technologies and gain practical experience."*

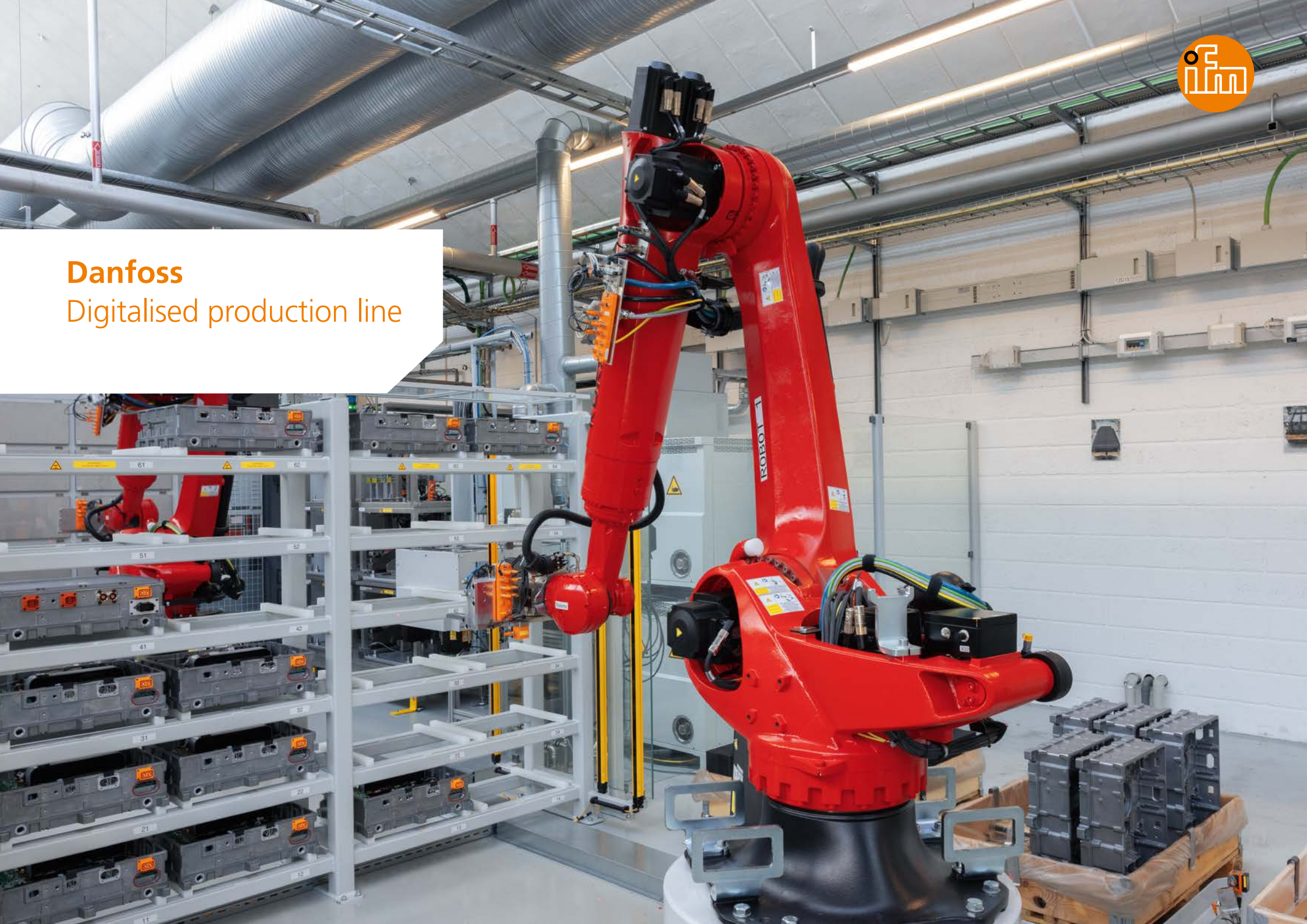


The team: Tobias Kunze (ifm) and Dr Markus Steffens, Pascal Heider, Patrick Bonneval and Philip Bourgon (Heinz Nixdorf Vocational College).

The seamless integration of the ifm solutions and the support in configuring the vibration diagnostics made a significant contribution to the project's success.

Conclusion

The retrofit project at Heinz Nixdorf Vocational College demonstrates clearly how intelligent sensors and modern data connectivity from ifm can sustainably bring existing machines up to Industry 4.0 standards. The collaboration not only promotes digital transformation in industry, but also delivers practice-oriented training concepts that equip future professionals for the demands of tomorrow.



Digitalised production line



Flexibility right from the start

IO-Link for an adjustable production

Danfoss and ifm electronic are successfully working together to advance innovative automation solutions. One example of this partnership is their successful digitalisation of a new production line for robot-assisted assembly of onboard chargers for electric vehicles.

Danfoss is a Danish family-owned company founded in 1933 that today has production sites in more than 100 different countries worldwide. At its Nordborg site, Danfoss manufactures products including powerful onboard chargers for electric trucks and construction machinery.

Mia Parsberg Brumvig, Head of Operations at Editron Danfoss, explains: *"Here in Nordborg we produce the ED3, an onboard charger for off-highway and on-highway applications. It's a three-in-one solution, with the distinctive feature that it delivers up to 44 kilowatts, twice the power of the market standard 22-kilowatt onboard charger. Compared to other*

” *The IO-Link system considerably accelerates assembly on the line because everything is connected by cables and plugs, making manual wiring unnecessary.*

onboard chargers, our 44-kilowatt AC charger reduces charging time by half. Our ED3 also features a 44-kW DC/DC and DC/AC converter that can power ancillary tools on the beds of lorries or construction machines, for example.”

Challenges when setting up the production line

When planning the new production line for onboard chargers, Danfoss faced several challenges to find a future-proof solution.

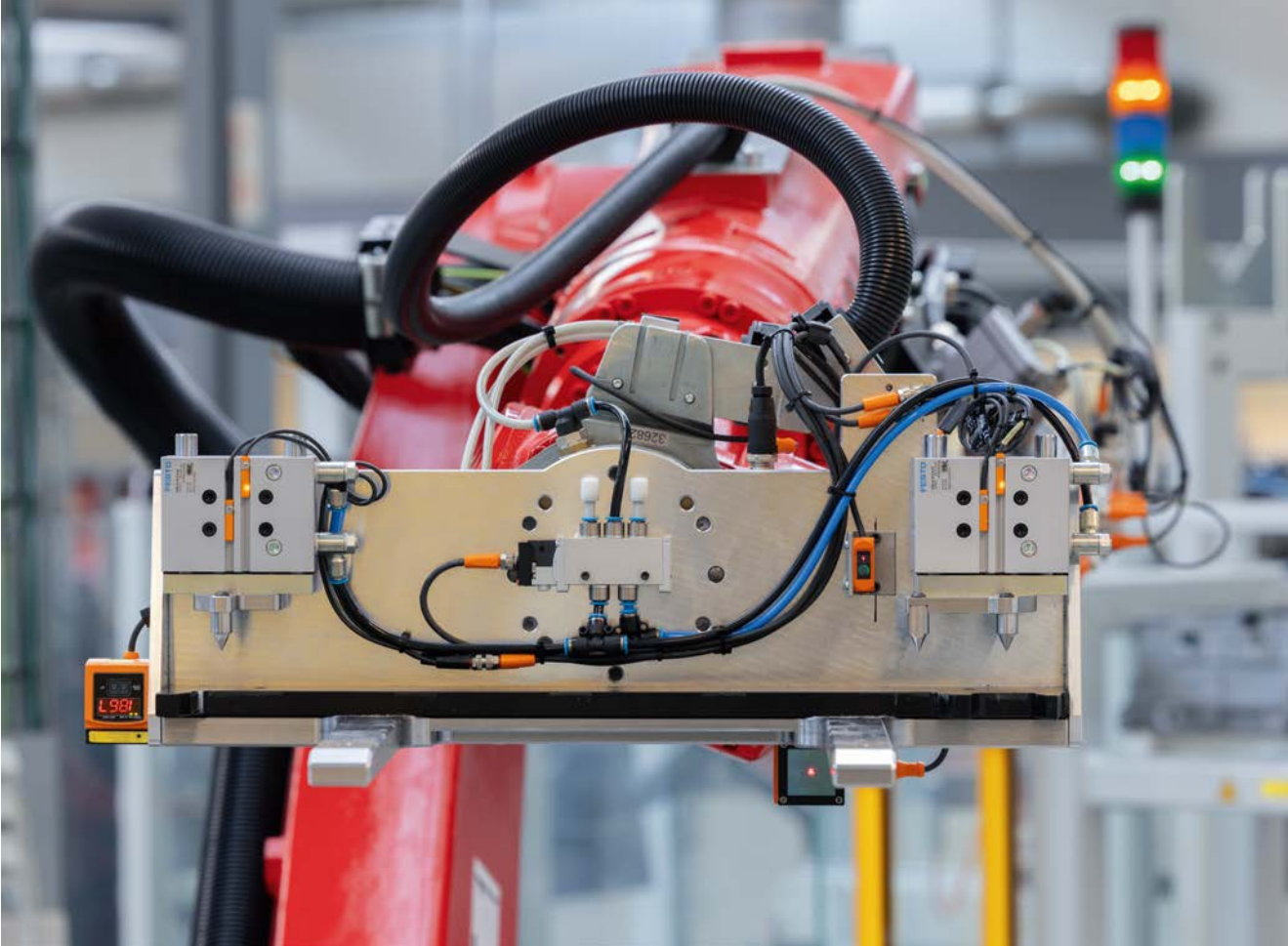
"The initial planning of the production plant was rather tricky because the product hadn't yet been fully developed", explains Karsten Fibiger, Production Engineer at Danfoss. "That meant having to think outside the box, because planning is particularly challenging when the precise size of the part to be produced is not known."

These unknowns made it necessary to design a production line that could be flexibly adapted to meet new requirements. Danfoss opted for an Industry 4.0 approach with intelligent sensors to collect data for predictive maintenance and reduce the number of different sensor types.

Robots assemble the components of the Danfoss ED3 onboard charger.



The IO-Link module on the lifting tool connects all the sensors and actuators. Connection to the controller is by means of Profinet.



Optical distance sensors and cylinder sensors on the lifting tool ensure exact positioning.

Karsten Fibiger: *"One of our aims was to collect data from all the sensors in order to be able to take predictive maintenance measures before a malfunction could occur. Furthermore, using intelligent sensors meant that fewer different sensor types were necessary because the measuring range and the switch points, for example, can be adjusted in the sensor."*

A further challenge was to transmit the numerous signals from the sensors and actuators mounted on the tool change heads via contact surfaces to the robot arm, and from there to the controller. This complex task required an innovative solution that is both efficient and reliable.

Intelligent automation solution through IO-Link

Working closely with ifm electronic, Danfoss developed an intelligent automation solution based on IO-Link.

"We carried out numerous tests together with ifm to determine which IO-Link modules could be positioned together to enable us to change the heads at the end of the robot arm using only three cables", explains Fibiger. "And it worked: it posed no problems, and the test was successful."

This solution simplified the processes considerably and helped increase the production line's efficiency. The successful implementation of IO-Link demonstrates the importance of close cooperation between partners when it comes to developing innovative solutions.

Danfoss deliberately opted for ifm as a one-stop supplier of sensors and automation components.

Karsten Fibiger: *"I deliberately aimed for a single supplier for the entire system because it is simpler to have just a few components from one manufacturer in stock, rather than having to stock numerous variants from different brands. And I knew that ifm had the IO-Link sensors I needed for this system. Therefore, I chose ifm as the supplier for the entire production line."*

Using IO-Link considerably accelerated installation on the line. Cable connectors can now be plugged in instead of manually screwed in, which also simplifies system extension. This simplification of the processes led to considerable time-saving and higher production flexibility.

Karsten Fibiger: *"The IO-Link system considerably accelerates assembly on the line because everything is connected by cables and plugs, making manual wiring unnecessary. And extending the system was also very easy because we could simply install another IO-Link module and then add up to eight more sensors to the line. In view of the fact that we didn't know exactly what the production line should look like, IO-Link offered us maximum flexibility."*

The finally assembled ED3 onboard charger.



In this kind of electric truck, the Danfoss onboard charger charges the drive batteries and supplies their AC and DC devices with power.

” *The use of optical time-of-flight sensors instead of standard sensors in the oven meant we could solve that problem and save ourselves future maintenance work.*

Clever use of sensors

In some places, special ifm sensors were used to solve challenges elegantly. For example, time-of-flight distance sensors on the robot head enable non-contact checking of whether there are parts in the hot oven without exposing the sensors to the heat.

“We concluded that it is better not to have sensors in the oven because it is quite difficult to find sensors that can constantly withstand the high temperatures”, explains Fibiger. “The use of optical time-of-flight sensors instead of standard sensors in the oven meant we could solve that problem and save ourselves future maintenance work.”

This solution demonstrates how intelligent sensors can be used to prolong component service life and reduce maintenance requirements.

Another example is the use of moisture sensors when drying components after water tests. Instead of estimating the drying time and wasting compressed air, Danfoss can now measure the actual residual moisture. This enables more efficient use of resources and higher production accuracy.

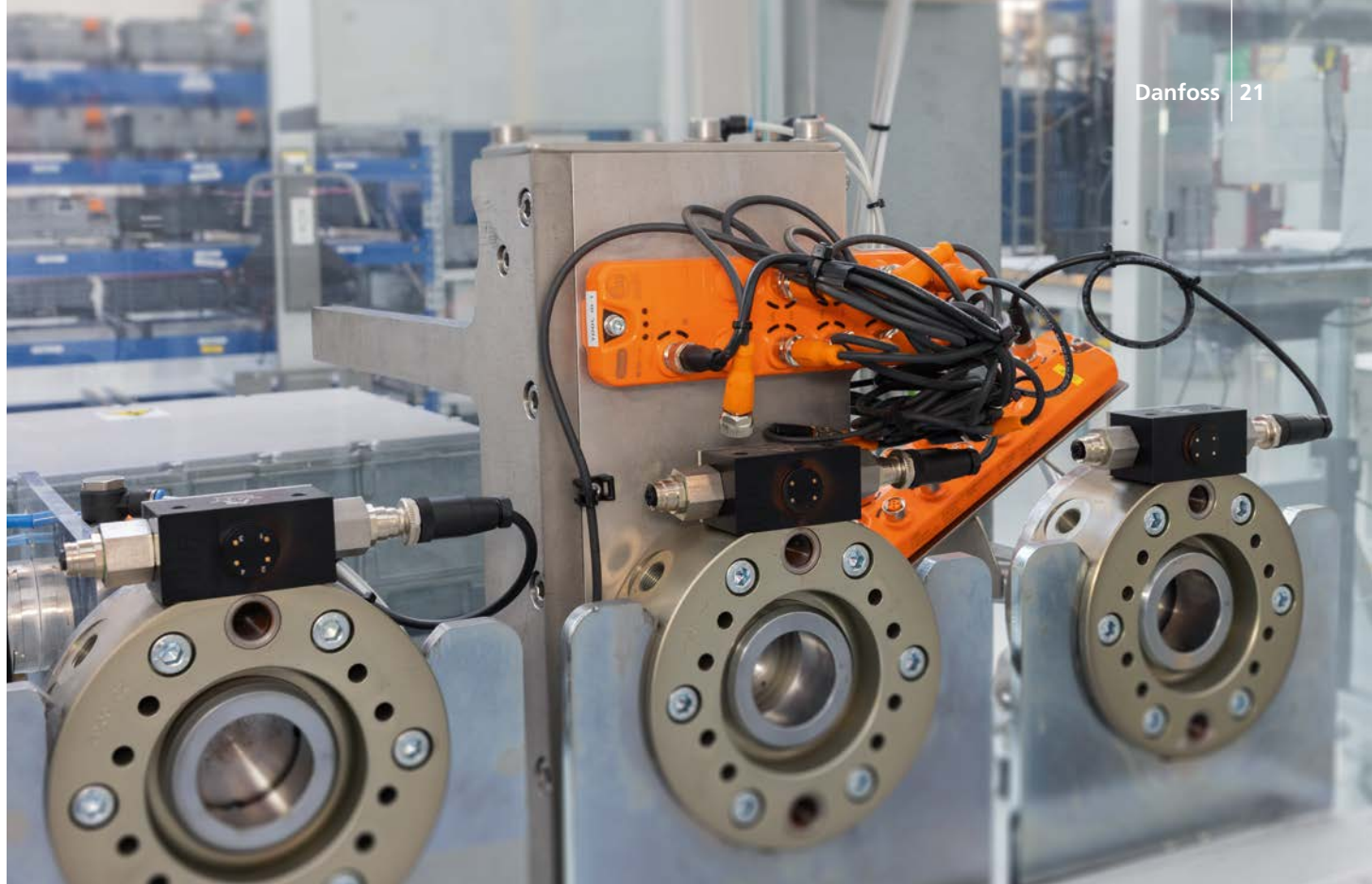
By using an ifm distance sensor to carry out level measurement in a chemical bath, it was possible to replace unreliable float switches. This solution helped increase process reliability and reduce production costs.



Reliable partnership with a future

The collaboration between Danfoss and ifm electronic demonstrates how even complex automation tasks can be solved efficiently by means of innovative sensors and intelligent networking. The reliability and flexibility of ifm products allowed Danfoss to develop a future-proof production line that meets the needs of modern industry.

"The integration of ifm into our MES system also works very well. It's simply plug and play", says Anders Abildtrup Jørgensen, Manufacturing IT Engineer at Danfoss, summing up. "If we have a problem that an additional ifm sensor can rectify, it can be simply plugged into the IO-Link module and will then usually function after only minimal configuration adjustments."



The robot independently changes the different heads during assembly. IO-Link ensures that all the signals are bundled and transmitted by Profinet via four contacts.

This simplicity and the high level of product reliability are decisive factors when it comes to efficient plant operation. And ifm's service and support was also impressive in every respect. If there were any problems, ifm always provided Danfoss with quick, professional support and detailed suggested solutions. This quick, competent support helped to smooth the production processes and keep potential downtimes to a minimum. The company now plans to continue the successful partnership with ifm in installing further production lines. This long-term collaboration demonstrates the importance of strong partnerships to achieve success in modern industry.

Conclusion

The combination of innovative technology, reliable products and close cooperation enabled Danfoss to create a production line that not only meets today's demands, but is also equipped to meet future challenges. The partnership with ifm exemplifies how, through joint effort and the use of modern technologies, sustainable solutions can be developed that offer real added value.



Endesa

Digitalised hydroelectric
power plants



Endesa takes conventional hydroelectric power into the digital age

Automation solutions from ifm deliver greater efficiency, while also ensuring more security and sustainability

The Spanish company Endesa is one of Europe's leading energy suppliers and strongly committed to renewable sources for their energy production. To ensure that their existing power plants, some of which are historic, continue to operate reliably and efficiently in the future, the company is pursuing a consistent digitalisation strategy as part of their transformation towards Industry 4.0. In this effort, Endesa counts on the expertise of automation specialist ifm.

Efficient modernisation of historic power plants

Endesa operates a total of 174 hydroelectric power plants across Spain through their subsidiary Enel Green Power España. With an installed capacity of 5,350 megawatts, these facilities generate around 9,000 gigawatt hours of electricity annually. Many of the plants were built in the early 20th century and were originally operated entirely manually. As a result of advancing digitalisation and increasing demands for efficiency, security and sustainability, Endesa was faced with the complex task of upgrading all sites to the latest standards.

"Our aim is to transform our conventional power plants into state-of-the-art facilities. By leveraging modern digitalisation technology, we gain greater transparency across our plants and can act proactively. This enhances the overall security of the energy supply," explains **Julian Alberto Alonso**, Head of Maintenance and Technical Services Hydro at Endesa.

A century of hydroelectric power – and beyond

One of Endesa's pioneers in digitalisation is the El Carpio hydroelectric power plant in the Spanish province of Córdoba. Here, the link between tradition and modernity is particularly strong: this architectural and technical landmark has been generating green energy for almost a century. A total of three turbines harness the flow of the Guadalquivir river to produce electricity. *"We decided to use advanced instrumentation and automation to optimise operations at this rather remote power plant, monitor it efficiently and maintain it effectively. The aim was to minimise downtimes as much as possible and optimise maintenance cycles,"* says **Antonio Roldán Reina**, Predictive Maintenance Technical Manager at Endesa.

” Our plants face high temperatures and humidity, yet the ifm sensors have performed flawlessly so far.



Today, the condition of the hydroelectric power plant's generators is closely monitored using sensor technology.

Digitalisation with ifm and IO-Link – for good reasons

To meet the ambitious modernisation goals, Endesa and their subsidiary Enel Green Power España decided to work closely with the automation specialist ifm.

"We chose the ifm solution because of its reliability under extreme conditions," continues Antonio Roldán Reina. "Our plants face high temperatures and humidity, yet the ifm sensors have performed flawlessly so far. Moreover, ifm has delivered solid technical support right from the beginning of our cooperation."

Adopting IO-Link for data communication was another pivotal move in the digitalisation journey. The open industrial communication standard IO-Link, co-founded by ifm, has long been

well established in the industrial sector – and for good reason: The bidirectional communication enables flexible remote sensor configuration via the IO-Link master. What is more, IO-Link sensors provide more information than conventional sensors, for example on device status, sensor temperature or operating cycles. They also provide several process values at the same time: Pressure sensors also transmit data on the medium temperature, while flow meters detect the current flow rate, temperature, medium pressure and total volume. This reduces the need for additional measuring points and cuts installation effort, time and costs.

As the data is transmitted digitally and free from interference, the accuracy and reliability of the values is improved compared to analogue transmission. Moreover, IO-Link offers the convenience

of transferring stored parameters from the IO-Link master to a new sensor during replacement of identical devices. This minimises human error and reduces downtime.

Wiring complexity cut by 30 %

Another advantage is the decentralised data acquisition via field-compatible IO-Link masters, which collect information on site and transmit it in a consolidated form. The result is a significant reduction in wiring complexity – whether between sensors and the IO-Link master within the plant or from the master to the controller or IT level. This enables end-to-end digital communication from the sensor to the IT level in the shortest time possible.

"For us, IO-Link cuts wiring complexity by about 30 per cent. Added to this is the increased operational reliability that we gain through the continuous sensor condition monitoring," emphasises Antonio Roldán Reina. "ifm's extensive IO-Link product portfolio also allows us to source all components for our automation solutions from one single supplier, making implementation even simpler."



IO-Link masters and evaluation units for vibration sensors collect the data and transmit it in consolidated form to the IT level.

Analysis of 3,000 real-time data points per plant

"To be able to precisely monitor the condition of the generators in the modernised plants, Endesa relies on a wide range of ifm sensors. Pressure, temperature and flow meters, along with particle and moisture analysis sensors, ensure the correct and reliable use of cooling lubricants at all times. Vibration sensors detect early signs of potential damage at critical points on the machine. The latter, in particular, now form the backbone of our predictive maintenance programme," notes Antonio Roldán Reina.

Endesa collects around 3,000 real-time data points per plant in a central IT system, where the information is analysed using artificial intelligence. *"We are now in a position to detect imminent generator damage, which enables us to plan main-*

tenance proactively, carrying it out during scheduled shut-downs," explains the Endesa maintenance expert, describing the advantages.

A decisive step towards energy production 4.0

The benefits also extend to the organisational level: *"We are in the process of implementing ifm solutions as standard in all our hydroelectric power plants. This enables us to optimise sensor inventory and significantly reduce downtimes in the event of malfunctions,"* reports Julian Alberto Alonso.

Endesa also gains from the partnership-based, trust-driven cooperation with the automation specialist. *"ifm's technology, combined with a solid collaboration based on knowledge, experience and trust, has allowed us to take a major step towards Industry 4.0."*



The data from the vibration sensors is analysed at IT level. This allows maintenance operations to be optimised.

Conclusion

Over the past three years, Endesa has equipped roughly half of its installed power plant capacity with automation solutions from ifm. By embracing comprehensive digitalisation, Endesa is driving greater efficiency and higher security in sustainable energy production.



PROBAT/Bauermeister
Digitalised coffee grinders



Coffee grinders with maximum automation enjoyment

IO-Link makes installation, diagnostics and maintenance significantly smarter

PROBAT SE, headquartered in Emmerich am Rhein, is the global market leader in coffee roasters and grinders. After all, two out of three cups of coffee consumed worldwide are made using the company's machines.

Its subsidiary Bauermeister Zerkleinerungstechnik GmbH is based in Norderstedt, near Hamburg, where they have been developing and producing machines for the comminution (particle size reduction) of foodstuffs for the past 135 years. Bauermeister's clear focus on innovation and quality has established the company as a leading manufacturer of coffee grinders which are valued throughout the world for their reliability and precision. The company's many years of experience and the continuous development of its technologies make Bauermeister — as a subsidiary of the PROBAT Group — an indispensable partner for the coffee industry. The coffee grinders benefit from the parent company's innovative strength and therefore also bear the PROBAT name.

Adapting automation to Industry 4.0

Although Bauermeister's coffee grinders have featured a high degree of automation for a long time now, this used to be based on conventional sensor technology. Signals were individually routed through PLC modules, which made diagnostics and component replacement difficult.

In order to meet the demands of Industry 4.0, Bauermeister looked for a future-proof solution that offered greater convenience and user-friendliness. The challenge was to modernise the existing technology in such a way that it could meet the increasing demands of networked industry without compromising the quality and reliability of the machines. Industry 4.0 requires not only higher efficiency, but also improved data integration and simplified maintenance to make the process as frictionless as possible for the user.

This 3-stage grinder can grind up to about one tonne of filter coffee per hour.





*Gone are the days of the millstone:
the stainless steel rollers of a 2-stage grinder.*



The drive side of a 2-stage grinder.

IO-Link technology from ifm

Working closely with the experts from automation specialists ifm, Bauermeister has developed a new automation concept on the basis of IO-Link technology. The use of IO-Link master modules and a wide range of IO-Link-capable sensors has allowed the amount of wiring to be reduced considerably: instead of many individual signal lines, a single bus cable is sufficient to connect all the sensors to the controller.

IO-Link is a manufacturer-independent, globally recognised communication standard that enables seamless digital communication between sensors, actuators and controllers. As a further development of conventional binary interfaces, IO-Link allows the transfer not only of pure process data, but also of extensive diagnostic and parameter information. This creates a high degree of transparency. Simultaneously, sensors and actuators can be configured centrally via the controller. Stored settings are automatically transferred when devices are replaced, which simplifies commissioning considerably. Communication is completely digital, thus increasing process reliability and measurement accuracy. In addition, the IO-Link technology enables seamless integration into existing systems, thus increasing the solution's flexibility and scalability.



The signals from all the sensors are combined via IO-Link master and transferred to the machine controller via PROFINET.

"The changeover to IO-Link enabled us to wire the sensors directly to IO-Link modules, thus avoiding clamping and installation errors", explains Detlef Krüger, Team Lead Electrical Engineering at Bauermeister. "Thanks to the plug connections, mechanics are now able to replace individual modules, too, as an electrician is no longer absolutely necessary."

This simple replaceability considerably reduces maintenance and operating costs while increasing plant uptime. In addition, IO-Link offers comprehensive diagnostic capability right down to each individual sensor. Potential problems can be detected early on, isolated and quickly fixed, which minimises downtimes and increases productivity over the long term.

Faster installation, simpler maintenance, greater flexibility

Switching to IO-Link has given Bauermeister numerous benefits. Wiring errors during installation have been completely eliminated and installation times reduced by 20 to 25 percent. Thanks to IO-Link, additional functions can easily be integrated on the hardware side without the existing wiring having to be changed. It is often enough to connect sensors or actuators to a free port on the IO-Link module — the actual adjustment takes place subsequently by means of the software.

"We also take our customers' special wishes into account", emphasises Detlef Krüger "Some customers may want to have vibration monitoring integrated, for example. Then we would simply equip the relevant modules in the coffee grinder with vibration monitoring."

This customer-oriented approach underlines Bauermeister's philosophy of always focusing on the users' needs and developing innovative solutions that meet the highest standards.

The advantages of IO-Link technology go far beyond pure functionality. It enables precise data collection and analysis, so that users can make informed decisions and increase the efficiency of their processes over the long term. Access to real-time production data offers new possibilities for adapting machines optimally and reacting flexibly to changing requirements.

A partnership on an equal footing

The success of the transformation to modern digitalisation is in large part thanks to the close, trusting cooperation between Bauermeister and ifm.

Regular workshops and training courses encourage intensive dialogue that benefits both sides. For example, the ifm developers have been able to integrate valuable practical feedback into the further development of their products.

The partnership impressively demonstrates how close cooperation between companies produces innovative solutions that meet the requirements of modern industry.

"I can describe our cooperation with ifm as positive in every respect — especially with the sales team", concludes Detlef Krüger. "Also, the dialogue with the developers has consistently been constructive — for example, when discussing how to integrate new sensors usefully and profitably. I can wholeheartedly recommend ifm."

This positive assessment underlines the importance of a partnership that is based on mutual trust and respect and a common goal: in this case, to develop technologies that help shape the industry's future.

Conclusion

The IO-Link-based automation solution makes Bauermeister ideally equipped for the future. As a technology leader, the company sets standards when it comes to efficiency, flexibility and user friendliness — and thus helps coffee to be enjoyed throughout the world at the highest level. The combination of technological progress and customer-oriented innovation makes PROBAT and Bauermeister pioneers in the coffee industry and reliable partners for companies that focus on quality and efficiency.



PVA TePla

Digitised
single-crystal growth



Semiconductors: ingot production perfected

How PVA TePla optimises single-crystal growth through automation

PVA TePla AG is a global leading provider of equipment and measuring technology for demanding industrial applications. Its high-tech systems are particularly sought after in the semiconductor industry.

“As a solution provider, we operate globally and are present wherever our customers are. Driven by strong demand from the semiconductor industry, we are currently especially well represented in the Asian market and in the United States,” explains Jan Pfeiffer, Managing Director of the PVA TePla Group. With its TechHub in Wettenberg, PVA TePla has positioned itself as a key driver of innovation in materials research for the semiconductor industry.

Silicon carbide – the key to electromobility

The subsidiary PVA Crystal Growing Systems (PVA CGS) can draw on more than 60 years of experience in crystal growing. A particular focus is placed on the production of silicon carbide (SiC) crystals.

The silicon carbide crystals produced on these systems are used, among other applications, in batteries for electromobility.





Silicon carbide puck: The required quality can only be achieved with precisely controlled process parameters.

Because such a growth process can take up to three weeks, process monitoring and control must continuously meet the highest standards.

Intelligent sensors ensure stable process conditions

To ensure the required level of precision, PVA relies on IO-Link-capable sensors from ifm.

"For example, we use the SV4200 flow sensor from ifm to monitor and keep the cooling water flows constant. This is important not only for maintaining a stable process temperature, but also for protecting housings, pipes and components from overheating and thus from potential damage", explains Ewert. In addition, the PV8000 pressure sensor monitors the supply and return pressure as well as the temperature of the cooling medium. "Previously, this monitoring was carried out manually. Now we can also retrieve these values via IO-Link and respond to any fluctuations more quickly and effectively," the team leader adds. The AL1202 IO-Link masters collect all sensor data and forward it for central evaluation. The DV signal lamp, which provides users with a visual indication of the current process status, is also controlled via the IO-Link master.

IO-Link: more information, greater system transparency

IO-Link has long been established as a manufacturer-independent standard for digital sensor communication in automation technology. Compared with conventional binary and analogue interfaces, IO-Link enables the transmission of high-resolution process values as well as comprehensive diagnostic information. Users benefit from standardised data structures, reduced cabling effort and seamless integration into control systems and IIoT architectures. The technology supports the transmission of multiple measured values per device, event-driven

"What sets silicon carbide crystals apart is their ability to handle extreme power densities," explains Lukas Ewert, team leader Electrical Design at PVA CGS. "Compared with conventional silicon, the use of SiC enables, for example, the design

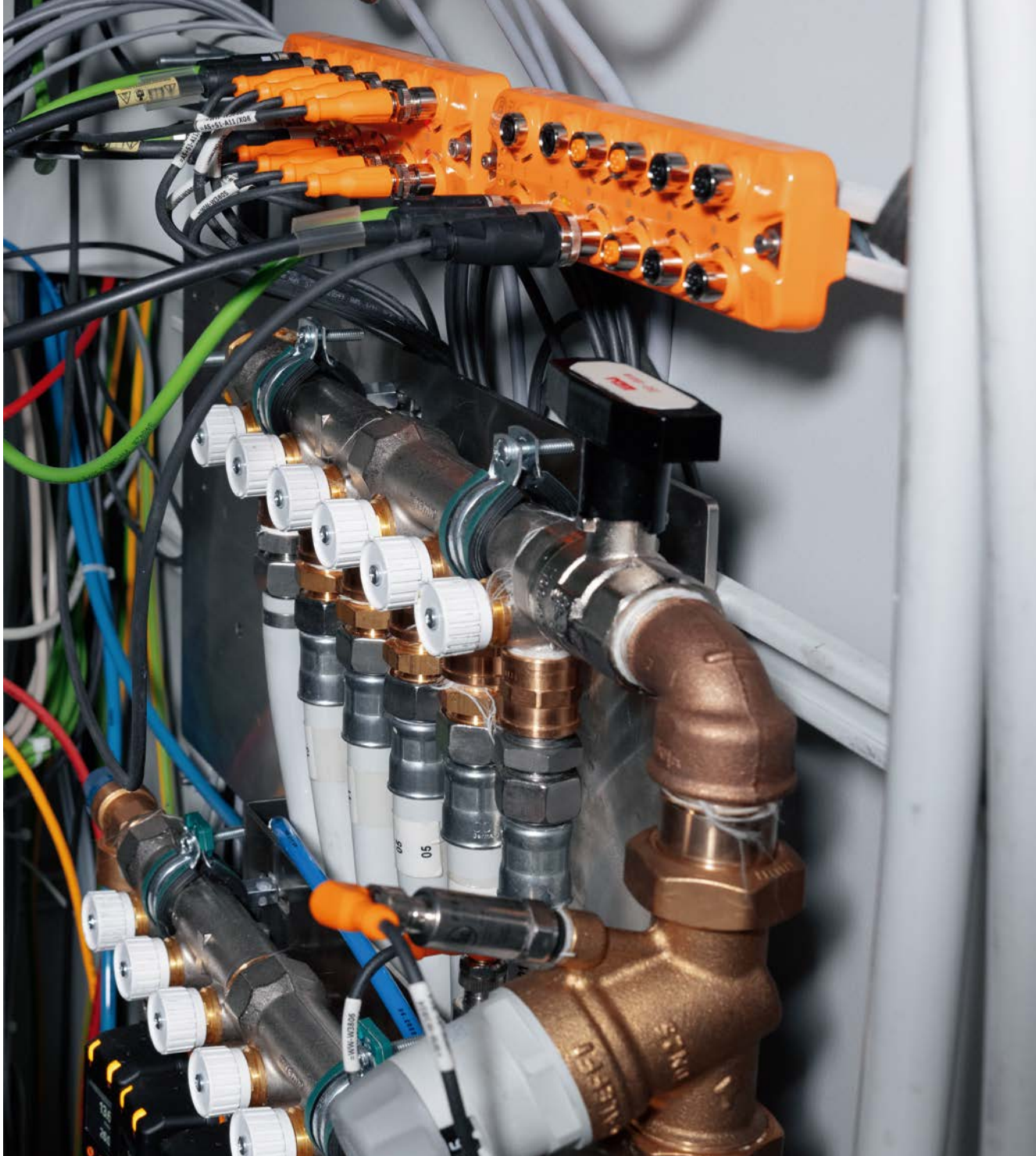
” *We use IO-Link wherever we want to extract more detailed information from the sensors. For example, we use the SM8000 for monitoring and controlling the cooling circuit.*

of smaller batteries with the same power output. The resulting weight reduction is particularly beneficial for electromobility applications."

Extreme conditions require maximum precision

For the production of SiC crystals, PVA TePla designed the SiCma system, which operates according to the Physical Vapor Transport (PVT) method.

"In this process, a silicon carbon powder mixture undergoes sublimation in a graphite crucible at around 2,300 °C and deposits onto a seed crystal to form a boule," explains Ewert. "To achieve a high-quality result, temperature and pressure in the process chamber must be precisely controlled throughout the entire crystal growing process. Even the smallest deviations can jeopardise the entire process and lead to significant quality losses."



The IO-Link master (top) collects and forwards data from the pressure sensor (centre, front) and the flow sensor (lower left).

diagnostics and remote device parameter setting. This results in improved system transparency, optimised maintenance and measurable savings in set-up and operating costs.

Digitalisation as the key factor for system availability

These aspects also play a central role at PVA TePla.

"Digitalisation is extremely important for us, especially with the SiCma system," emphasises Lukas Ewert. "These systems are often installed in large numbers in production halls. Loading and unloading are usually fully automated. Our systems must be able to communicate with higher-level systems so that operators can monitor the process status centrally at any time." PVA TePla uses ifm's comprehensive IO-Link portfolio as the basis for this.

Predictive maintenance for maximum production efficiency

PVA is also working intensively on predictive maintenance concepts in order to provide early indication of upcoming maintenance requirements or process deviations.

"This allows operators to maintain maximum machine availability while consistently achieving the highest possible product quality," explains Ewert. The sensors from ifm supply the data required to continuously monitor system condition and to detect potential issues before they result in costly downtime.

Silicon crystal growth using the Czochralski process

PVA places similarly high demands on silicon crystal growth using the Czochralski process. In these systems, silicon ingots up to 3.50 metres in length are grown by slowly pulling a seed crystal from molten silicon at a temperature of around 1,400 °C. The resulting wafers are used primarily in the semiconductor industry and form the basis for a wide range of electronic components.



Silicon ingots up to 3.5 metres in length are "pulled" in this system for wafer production.



Flow sensors monitor the cooling circuit of the Czochralski system.

Low-vibration processes for the highest product quality

"In the SC32 system, automation technology is implemented as a combination of IO-Link and ProfiNet," explains Ewert. "We use IO-Link wherever we want to extract more detailed information from the sensors. For example, we use the SM8000 for monitoring and controlling the cooling circuit."

This magnetic-inductive flow sensor measures not only the flow rate but also the temperature of the medium. In addition, PVA uses the three-axis IO-Link vibration sensor VVB3 to monitor the two process drives. The VVB3 detects vibrations along three measurement axes and calculates indicators for evaluating the machine condition. Information on fatigue, friction, impacts or bearing wear is transmitted conveniently via IO-Link.

"Extremely low vibration levels during the pulling process are essential to ensure ingot quality. The transmitted data also allows us to monitor the condition of the gear units and the drive shaft very precisely and to schedule maintenance activities at an early stage."

Reliable components for long-term operation

PVA TePla's systems are designed for continuous operation over many years.

"For this reason, all components, sensors in particular, must deliver consistently precise performance over the long term", emphasises Lukas Ewert. "Over many years, we have had only positive experiences with ifm in terms of robustness and reliability in long-term operation. Likewise, when new questions arise or new automation approaches are considered, we can rely on our direct contact at ifm and receive expert support at short notice."



Under high pressure, individual layers are bonded together into a single structure in this machine.

Diffusion bonding for the most demanding material requirements

ifm solutions are also used in diffusion bonding technology, another business area of PVA TePla. This solid-state joining process is used, for example, to produce cooling plates for the semiconductor industry, which must meet the highest requirements in terms of strength and corrosion resistance.

Patrick Müller, Team Leader Diffusion Bonding at PVA Löt- und Werkstofftechnik GmbH, explains: *"To achieve the desired results, process conditions such as temperature, pressure, vacuum and the applied force must be closely monitored throughout the process, which can last several weeks in some cases. The flow sensors from ifm we use to monitor the cooling circuit ensure that the system does not overheat at any point during the process, but remains in a safe operating state."*

User-friendliness as added value

Another advantage of ifm's solutions is their ease of use. **Müller** highlights the clear, intuitive design of the sensors: *"As an operator, you can see at a glance what condition the machine is in. Another clear benefit is how easily older machines can be retrofitted with the sensors. It is effectively plug and play."* This user-friendly design not only simplifies day-to-day operation, but also reduces training requirements for operating personnel.

A collaborative partnership as the foundation for innovation

At PVA TePla, the long-standing cooperation with ifm as an automation partner is highly valued: *"I'd describe our collaboration with ifm as very cooperative, reliable and based on trust,"* summarises **Lukas Ewert**. *"We can always approach our contacts directly and work together to drive innovation and automation projects forward."*



Easy to read: flow sensors on a diffusion bonding system.

Conclusion

The requirements in high-tech materials manufacturing are extremely demanding, particularly in terms of precision, reliability and availability. With ifm as its automation partner, PVA TePla successfully meets the challenges associated with advanced crystal growing processes.

Boehringer Ingelheim

Vibration monitoring
secures uptime



Ensuring availability of stacker cranes through vibration diagnosis

Pharmaceutical company Boehringer Ingelheim relies on condition monitoring from ifm electronic

Boehringer Ingelheim is a biopharmaceutical company active in both human and animal health. As one of the industry's top investors in Research and Development, the company focuses on developing innovative therapies in areas of high unmet medical need. Independent since its foundation in 1885, Boehringer takes a long-term perspective, embedding sustainability along the entire value chain. More than 53,500 employees serve over 130 markets to build a healthier, more sustainable, and equitable tomorrow.

Stacker cranes up to 40 metres high and 130 metres long handle loads of up to one tonne.

In a state-of-the-art, fully automated high-bay warehouse with a capacity of 16,000 storage locations, valuable raw materials, intermediates, and finished goods are stored securely and efficiently. Continuous availability of these products for production and shipment is essential to maintain an uninterrupted supply chain. The logistics in the warehouse are handled by four high-performance stacker cranes, each 130 metres long and 40 metres high. Capable of moving pallet loads of up to one tonne, they are key components of the internal material flow.

The challenge: preventing unplanned downtime

A key challenge for Boehringer Ingelheim is to prevent unplanned downtime of the stacker cranes. If one of them fails, access to the required products is no longer possible, since storage locations are allocated at random. In the worst case, entire production lines could come to a halt. Such disruptions not only cause financial losses but may also endanger the supply of life-saving medicines to patients.





Vibration data is preprocessed by a VSE evaluation unit and analysed by the diagnostic software moneo.

To prevent this, wear-related damage to components such as bearings, drives and mechanical parts must be detected as early as possible. The aim is to enable predictive maintenance and reduce unplanned downtime to an absolute minimum. Regular inspections and maintenance cannot fully account for the cumulative stress the equipment undergoes during continuous operation.

The solution: permanent vibration monitoring

To address this challenge, Boehringer Ingelheim partnered with condition monitoring experts from ifm to implement a cutting-edge system for continuous stacker crane condition monitoring. Highly sensitive acceleration sensors continuously monitor vibrations at critical components such as running and guide rollers, gearboxes and hoist motors. The sensors are designed to detect even the slightest deviations in vibration patterns – allowing potential damage to be identified at an early stage.

The vibration data is pre-processed by diagnostic electronics of the VSE series and sent via optical data link to a dedicated



The diagnostic software moneo interprets vibration data and alerts the team in case of anomalies, supporting on-site adjustment and alignment.

industrial PC, where the intelligent diagnostic software moneo performs detailed analysis and interpretation. To ensure precise detection, the sensors are mounted as close as possible to the components being monitored. In addition, reference runs are carried out in an unloaded state to provide baseline data for detecting anomalies.

Warning and alarm thresholds are predefined in the system. When these thresholds are exceeded, the maintenance team is automatically notified via email. This enables a rapid response to prevent damage before it leads to costly failures.

The benefits: increased machine uptime and targeted maintenance

The aim is to prevent unplanned downtime during ongoing operations. Thanks to early detection of wear, maintenance activities can be scheduled in advance – for instance, during planned downtimes or over the weekend. This proactive maintenance strategy has already proven successful: In one case, increased vibration levels revealed that a guide roller had been set too tightly during maintenance. The issue was quickly iden-

tified and corrected – before any further damage occurred. The condition monitoring system thus makes a valuable contribution to improving equipment availability while enabling maintenance without disrupting operations. Encouraged by the positive results, the company now plans to retrofit all their stacker cranes with ifm's monitoring solution. It not only provides a clearer picture of machine health, but also significantly improves operational reliability by helping to avoid unplanned downtime. From the outset, ifm impressed with its in-depth expertise and holistic solution approach.

ifm as integration partner

Throughout the project, ifm went far beyond supplying hardware. The company acted as a full-service integration partner, supporting the Boehringer Ingelheim team through all phases – from the initial idea through detailed planning to successful commissioning. In addition to supplying the vibration diagnostics hardware, ifm assisted with the configuration of the diagnostic electronics and ensured smooth integration into the IIoT platform moneo.



The diagnostic software moneo enables automated analysis and visualisation of all vibration data in the control room, issuing early warnings of emerging damage or wear.

Conclusion

Thanks to predictive vibration monitoring using advanced condition monitoring components from ifm, Boehringer Ingelheim can now identify and address potential issues before they lead to stacker crane failure. This safeguards logistics processes and keeps production lines running. At the same time, wear is reduced and maintenance processes are optimised.

The investment in innovative monitoring technology – backed by a close partnership with ifm – highlights Boehringer Ingelheim's ongoing commitment to optimising its operations and upholding the highest standards in pharmaceutical production and logistics.



Jungheinrich

Mobile robots shaping
the future of intralogistics



AMRs with vision: seeing more, acting autonomously

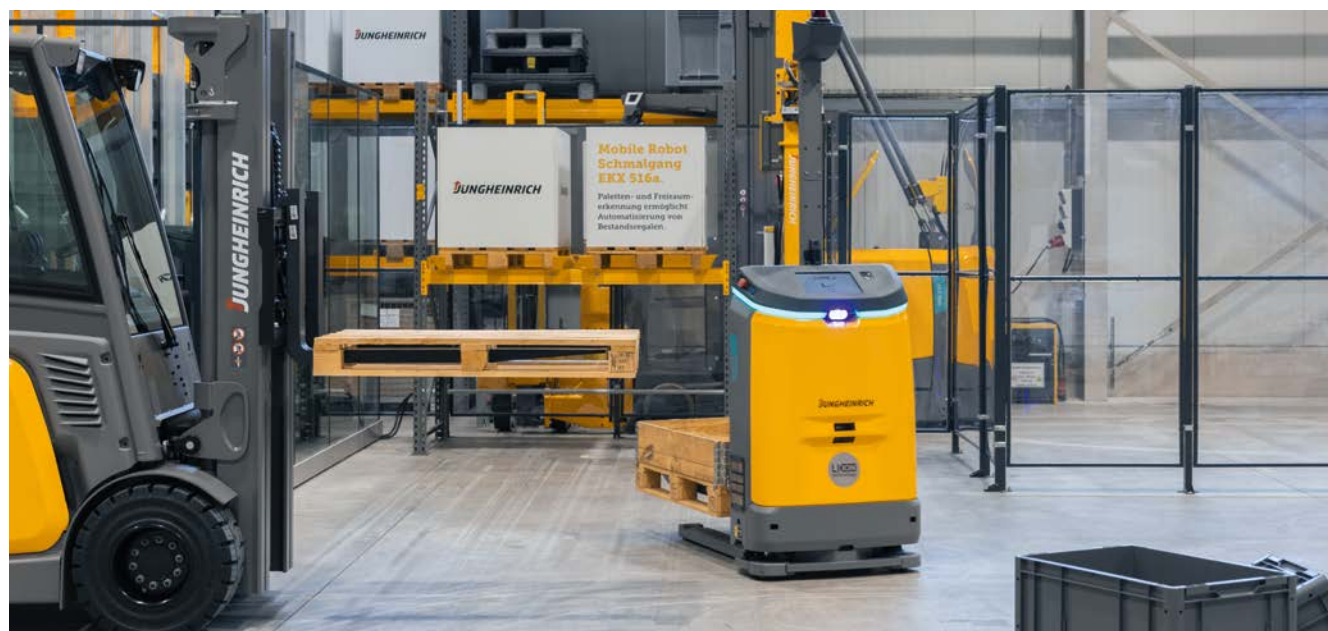
How Jungheinrich is accelerating mobile robotics with ifm's O3R 3D camera platform

Jungheinrich has been a leading provider of intralogistics solutions for more than 70 years. Alongside its established manual intralogistics portfolio, Jungheinrich is placing a strong focus on automation. The company is consolidating its robotics expertise and uses the 'Home of Mobile Robots' showroom at its site in Eching near Munich as a dedicated space for hands-on customer interaction.

"Customers need to experience mobile robots and engage with them directly. This hands-on approach is essential – for us, for our customers, and for the future development of automated intralogistics," emphasises **Manuela Schmidbauer**, Portfolio Manager Mobile Robots at Jungheinrich.

Greater autonomy in brownfield environments

Intralogistics requirements have changed considerably. Customers in manufacturing, retail and logistics are looking for solutions that address labour shortages and cost pressure without adding complexity to their processes. Autonomous mobile robots (AMRs) must be integrated into brownfield environments – existing facilities where mixed operation is the norm.



Practical scenario: AMRs must operate reliably in mixed operation alongside manually operated vehicles.



The Jungheinrich AMR reliably detects pallets using the O3R camera head (centre of the image).

"A high degree of autonomy and intuitive interaction with the vehicles are key requirements," explains Manuela Schmidbauer. AMRs operate side by side with operators of manual vehicles, conveyor systems and pedestrians. This creates demanding requirements in terms of perception, safety and responsiveness. "Our vehicles must keep pace with the capabilities and responsiveness of human operators," says Schmidbauer.

Agile development requires agile partners

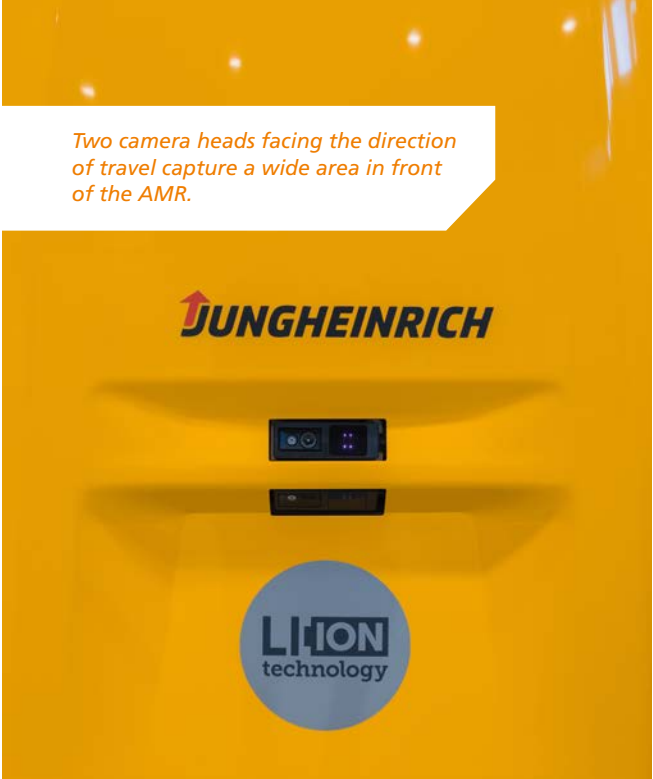
To respond quickly to these market requirements, Jungheinrich develops its solutions in close collaboration with customers, using agile methods and shorter development cycles than in the past. *"This requires partners who can keep pace with this level of dynamism," Schmidbauer continues. "With ifm as an automation specialist, we have found a partner that provides suitable sensor and control solutions for our mobile robots."*

Greater perception thanks to the O3R platform

With the EAE 212a, Jungheinrich is introducing its latest generation of AMRs, designed to enable even greater autonomy while noticeably simplifying the integration of these vehicles into customers' existing processes. A central element of this AMR is the O3R platform from ifm. The O3R system comprises a central Video Processing Unit (VPU) capable of connecting up to six 2D/3D camera heads. The VPU synchronously processes the image data and, in conjunction with algorithms developed by Jungheinrich, enables reliable detection of load carriers and other objects.

Powerful dual control unit

In the EAE 212a, Jungheinrich relies on ifm's ecomatController CR710S featuring a total of 37 inputs and outputs. The controller is not only highly robust against vibration, heat and cold, but also offers high performance. A 32-bit microcontroller ensures short cycle times. In combination with its large pro-



Two camera heads facing the direction of travel capture a wide area in front of the AMR.

gram memory, it reliably and efficiently executes even complex algorithms. Another advantage is that the ecomatController combines two independent PLCs in a single device: one handles standard control tasks, while the other is dedicated to safety applications and is TÜV-certified up to SIL 2 or PL d.

Robust PMD point cloud for pallet detection and obstacle detection

"We use the O3R for two core functions: pallet detection and obstacle detection along the travel path," explains Sebastian Gangl-Spethmann, Senior Development Engineer at Jungheinrich. Two cameras are mounted in the direction of travel, while an additional camera monitors the load area at the rear. In both cases, the AMR benefits from the point cloud generated with high precision by the camera heads using PMD technology: "We reliably detect pallets, even when they are offset or rotated. The AMR can approach and pick them up consistently."

This robustness increases flexibility in warehouse processes by allowing pallets to be handled reliably even when they are not placed with millimetre precision.

With a central processing unit and support for up to six camera heads, the O3R camera platform provides sufficient capacity and flexibility.



Improved environment perception compared to safety scanners

Thanks to the two forward-facing cameras used for obstacle detection, the EAE 212a operates with predictive navigation rather than reactive stop-and-go behaviour.

"The required safety laser scanners reliably detect people, but they have the limitation that they operate only in a single plane and close to the ground," explains Gangl-Spethmann. "The 3D cameras monitor a much larger area in front of the vehicle. This allows us to detect people at an earlier stage. In addition, the 3D cameras also detect elevated objects protruding into the travel path, such as forks or crane hooks, in time to avoid them and continue driving without stopping. This increases throughput and reduces process times."

More robust information than 3D LiDAR systems

Compared to 3D LiDAR systems, the 3D cameras used also provide reliable object detection on reflective surfaces. The additional 2D stream enables more precise segmentation and visualisation of the captured scene. *"Overall, this gives us more information to achieve robust object detection,"* summarises Gangl-Spethmann. This broader data basis enables more reliable detection and handling of objects across a wide range of environments – a decisive factor for flexible use in real-world applications.

Robust perception, smooth traffic flow, fast integration

A key development objective was to simplify commissioning of the AMR at the customer site. Thanks to the interfaces and tools provided with the O3R platform, the system is ready for operation quickly – including extrinsic calibration and basic configuration. For operators, this means shorter downtime during rollout, reduced engineering effort and predictable scalability.

O3R: capacity for future AMR evolution

The O3R platform itself is designed to grow with changing requirements: additional fields of view, extra cameras or new function modules can be added step by step, without the need to rethink the overall system architecture. For Jungheinrich, this technical foundation supports a key objective: designing human-machine interaction to be safe and intuitive.

"The requirements of our customers will continue to evolve as automation and autonomy increase," says Manuela Schmidbauer. With the EAE 212a, Jungheinrich anticipates this change – and ifm's sensor technology provides the necessary depth of environmental understanding that is crucial in brown-field environments.

Partnership as a key success factor

The close cooperation between Jungheinrich and ifm electronic was a key factor in the success of the project.

"The collaboration with ifm is very good," says Gangl-Spethmann. *"For important topics, we can get in touch with the developers quickly, which allows us to resolve even technically complex questions without delay."*

This direct line between the development teams of both companies enables short decision-making paths and fast solutions – a decisive advantage in a dynamic market environment shaped by rapid technological change.

Conclusion

The high-performance 2D/3D camera platform enables Jungheinrich to build highly capable AMRs that support higher levels of autonomy in intralogistics and considerably simplify human-machine interaction.



Kollmorgen

3D camera system
for pallet detection



More flexibility in pallet handling

How Kollmorgen and ifm are making AGVs and AMRs smarter

Kollmorgen is an international company specialising in drive technology and automation solutions.

The innovation and development centre for mobile robotics and vehicles in logistics is located in Mölndal, near Gothenburg. There, Kollmorgen is developing a comprehensive automation platform for leading manufacturers of automated guided vehicles (AGVs) and autonomous mobile robots (AMRs). This ranges from vehicle software and hardware to tools for set-up and fleet management systems that enable safe and efficient operation in intralogistics.

At its test centre near Gothenburg, Kollmorgen validates and optimises automation platforms on various AGVs and AMRs.

New functions are continuously tested and optimised under real-life conditions at the company's own test centre which provides the ideal environment for working with sensor specialist ifm to develop a camera-based solution for dynamic load handling and bring it to series production.

The challenge:
precision in mixed human-robot environments

Many warehouses today rely on AGVs, AMRs and manual processes in parallel. Where people place pallets and vehicles later pick them up, precision determines efficiency. In classic rigid systems, pallets must be placed precisely within a defined field; deviations lead to downtime or manual reworking.

"Yet vehicles depend on precision – and the human factor is not always reliable enough," explains **Johan Loebbert**, Application Engineer, Kollmorgen AMS, describing the initial situation in rigid systems.

Typical problem areas range from unloading a truck in the receiving area to transferring pallets to buffer zones: the ideal

"The collaboration with ifm demonstrates how adaptable and scalable our solution is – in principle, anything can be integrated into the platform."

parking spot is often occupied, markings are worn, angles and depths vary. This results in delays in the flow of materials. At the same time, there is increasing pressure to operate heterogeneous fleets in a scalable manner without compromising process reliability. Kollmorgen was looking for a solution that would bridge the gap between human flexibility and vehicle-side precision, prevent failures and, at the same time, be easy to integrate into existing vehicle architectures.



With dynamic load docking, the drive and lifting systems interact optimally to efficiently pick up or set down the load.

At its heart is an app that recognises the position, orientation and dimensions of a pallet in the camera's field of view. *"In this case, we use ifm's 3D camera system with PDS function in conjunction with our solution for dynamic load docking,"* explains **Johan Loebbert**. *"In the receiving area, a person can place the pallet in a general area in a variable position and at any angle. The AGV then takes a 3D image, determines the exact position and generates an individual travel trajectory to safely pick up the pallet."*

The technical added value is already evident in the integration: install the camera, connect it to the vehicle CPU and controller, perform a quick calibration process and some fine tuning – done, virtually plug and play. The development was a joint project between Kollmorgen and ifm: *"The collaboration with ifm was outstanding. ifm developed the PDS solution while we tested our dynamic load docking. Thanks to continuous feedback, we were able to further optimise the functionality,"* concludes **Johan Loebbert**. Even after the market launch, the teams remain in contact to ensure quality and support globally.



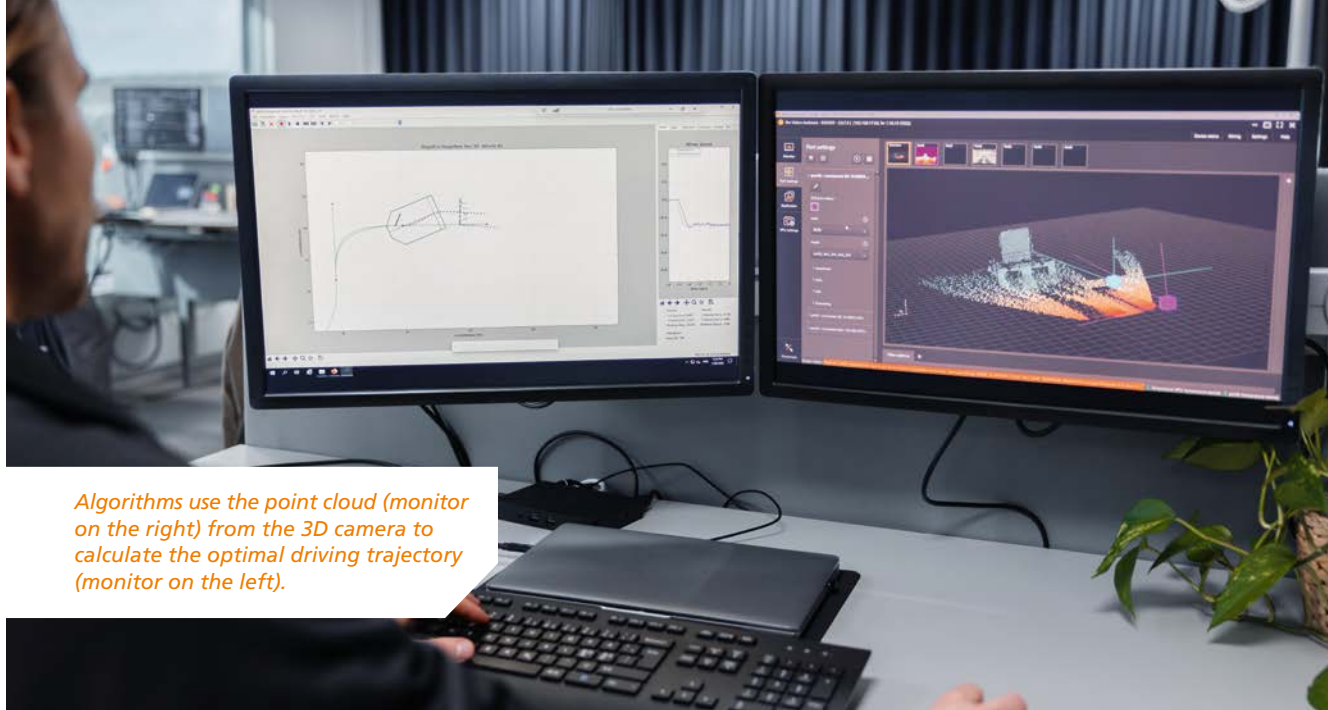
The solution: **dynamic load docking with ifm camera and PDS app**

The answer lies in the combination of Kollmorgen's Dynamic Load Docking and an ifm camera system with PDS (Pallet Detection System) functionality. Dynamic load docking refers to a process that is primarily used in automated guided vehicles (AGVs) to pick up or set down loads precisely and efficiently, even while the vehicle or load is still moving slightly.

The electronic eye of the system is the PMD camera from ifm which uses time-of-flight technology to precisely detect the pallet in front of the vehicle.

Camera platform from ifm

The versatile O3R perception platform forms the technological basis for reliable pallet detection on autonomous guided vehicles (AGVs). The central processing of image and sensor data in the integrated Video Processing Unit (VPU) allows up to six 2D/3D camera heads to be operated synchronously, enabling complete 360° environment detection.



This hardware runs the specially developed "Pallet Detection System" (PDS) software which recognises all standard pallet types regardless of their position and with high precision. The combination of a powerful processing unit, the latest time-of-flight imager with high extraneous light stability and a high frame rate ensures robust and dynamic object detection – even under challenging lighting and movement conditions. Thanks to its standardised Docker architecture and support for common development environments such as Python, C++, CUDA and ROS, the system can be flexibly integrated into existing AGV controllers. The O3R platform enables efficient and safe pallet detection, supporting the autonomous approach, positioning and picking up of pallets with precision and reliability – a decisive contribution to the automation and increased efficiency of modern intralogistics processes.

The benefits:

greater flexibility, less downtime, higher availability

Camera-based load handling shifts the focus away from rigid rules towards robust processes adapted to the respective situation. The greatest leverage is flexibility: pallets no longer need

to be placed in fixed areas. This reduces rework and shortens cycle times in mixed zones where people and vehicles work together. For operators this means: fewer blockages, fewer manual interventions, higher throughputs – with consistent safety. In addition to its process benefits, the solution also impresses in practice with its simple and quick installation. This simplicity facilitates roll-outs across fleets and locations. Another advantage arises from the openness of the Kollmorgen platform: *"Our collaboration with ifm demonstrates just how adaptable and scalable our solution is – in principle, anything can be integrated into the platform,"* explains **Per Hansson**, Partner Channel Coordinator at Kollmorgen AMS.

For users, this results in technological sovereignty: the fleet remains expandable, and new functions can be added gradually.

"The most important points are efficiency and reliability. There must be confidence that the system will work over time. This is precisely the quality we deliver. We can pool our experience and turn it into a product. It is great to see the problems this solves for our customers," says **Per Hansson**.

At the heart of image processing is ifm's Video Processing Unit which runs the "Pallet Detection System" (PDS) app.



Sensor intelligence and fleet expertise thus combine to create a practical complete package with tangible added value in everyday intralogistics.

Conclusion

The joint solution from Kollmorgen and ifm combines the best of both worlds: robust, industrial-grade camera sensor technology with a sophisticated automation platform for AGVs and AMRs. If you want to make your intralogistics more resilient, efficient and future-proof, you will find a pragmatic approach here: pallets can be placed flexibly, cameras capture the situation, vehicles operate intelligently – keeping the flow of materials moving.



Arcusin S.A.
Automated harvesters



Efficient harvesting

How Arcusin boosts machine performance with ifm automation

Arcusin S.A., a leading manufacturer of specialised machinery for agricultural logistics, has stood for robust technology and innovative solutions for decades. The Spanish family-owned company develops and manufactures high-performance bale accumulators that operate under demanding field conditions all over the world. Particularly during the peak harvest period, these machines must run reliably around the clock – any downtime would mean not only operational standstill but also significant financial losses.

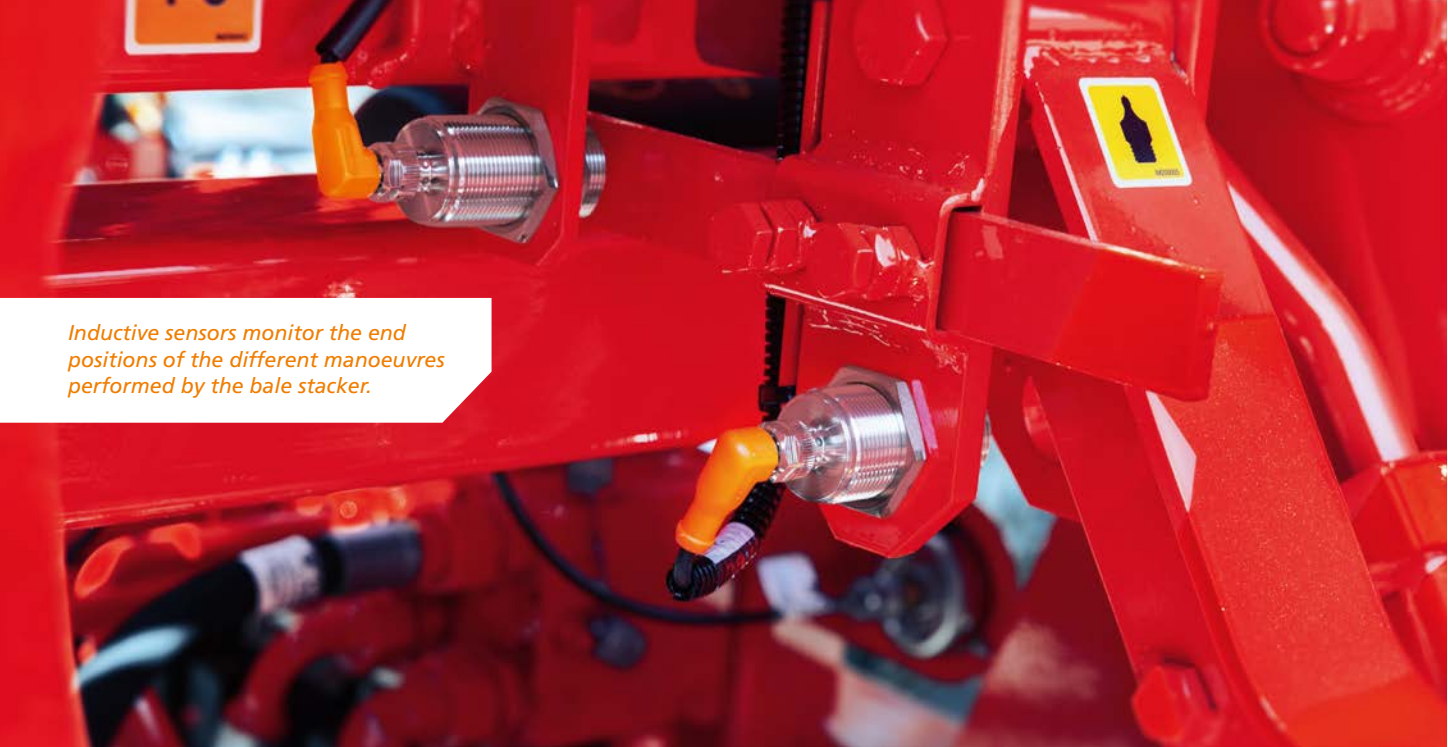
Reliability and ease of operation as key challenges

The demands Arcusin places on its machines are high. *“Our machines have to be reliable, robust and safe. They operate under extreme conditions – dust, vibration, and very high or low temperatures are part of everyday field operations,”* explains Ferran Masamunt, Marketing Director at Arcusin S.A.

The machines are used in many different regions and often run continuously for months during the harvest season. Moreover, they must remain intuitive to operate and minimise the risk of operating errors, even for less experienced users assigned during times of staff shortage.



Levers and I/O modules from ifm ensure simple and reliable machine operation.



Inductive sensors monitor the end positions of the different manoeuvres performed by the bale stacker.

"We want to give our customers the confidence to get through the harvest season without interruption," Masamunt continues. Efficiency, a high degree of automation and intuitive operation are among their top priorities.

Customised automation solutions from ifm

To meet these demanding requirements, Arcusin has consistently relied on automation solutions from ifm since 2014. What began with a few individual components has developed into a fully fledged system partnership over the past decade.

"After more than ten years, we can say that ifm products are as reliable and robust as we need them to be. This experience has convinced us to rely entirely on ifm for the automation of our machines," emphasises Pere Corral, Technical Office Director at Arcusin S.A. The combination of durable hardware, easy integration and ifm's dedicated technical support is what makes the difference.

In its current machine portfolio, Arcusin uses a wide range of ifm components – from cabling systems, inductive sensors and pressure transmitters to the robust HMI of the ecomatDisplay series, the ecomatPanel and I/O modules. Arcusin places particular emphasis on the long-term availability and compatibility of the control components.

"It was important to us that key elements such as controllers and I/O modules are based on standardised formats and that the manufacturer actively supports their continued development. When a component is replaced by a new model, it must remain backward compatible and interchangeable – this is crucial for the long-term viability of our machines," continues Corral.



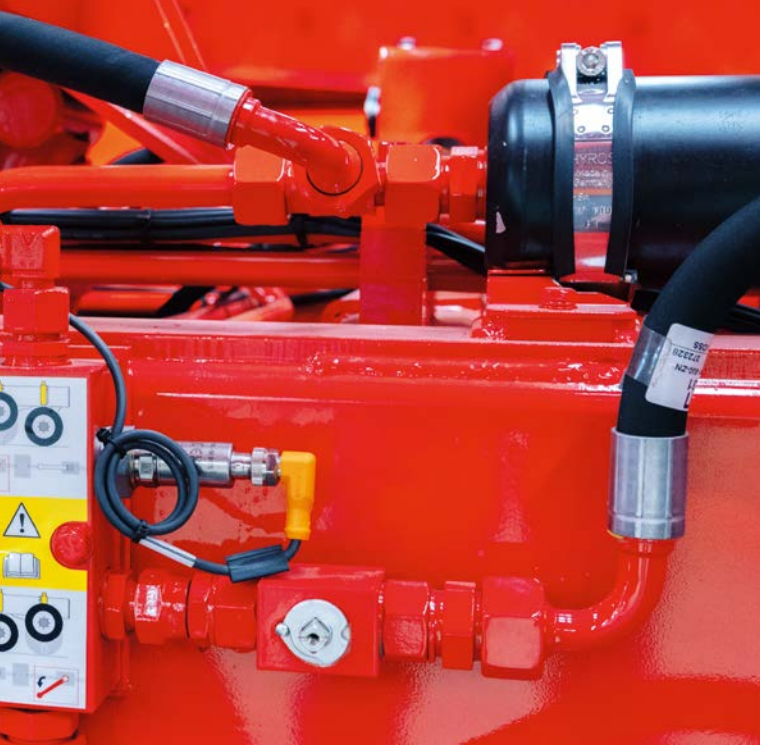
A pressure transmitter monitors the hydraulic system that raises and lowers the additional axle.

Displays and radar technology enhance safety and user convenience

At the heart of user interaction are the ecomatDisplays, which act as the operator's "command centre". They provide a clear overview of the machine status, enable quick adjustment of settings and give the operator real-time feedback during machine operation.

"The ecomatDisplays have significantly improved machine interaction and reduced the number of enquiries to our after-sales service. Thanks to integrated warning messages, guides and help texts, many situations can now be resolved directly in the field," emphasises Corral.

Another highlight is the use of ifm radar sensors on the Auto-Stack trailers. Unloading the bales is a particularly demanding task that used to require considerable experience.



The robust HMI and control panel from ifm provide an excellent overview and intuitive operation from the driver's seat.

"Many of our customers report that it is becoming increasingly difficult to find experienced operators for AutoStack trailers. The biggest challenge is usually unloading the bales precisely and safely. That's why, in the latest version of our AutoStack trailer, we've integrated a radar sensor at the rear that helps the operator maintain the optimal distance when approaching the unloading point," Corral explains. The result: the work becomes easier, safer and less prone to error – a real benefit for both operator and machine.

Years of experience, measurable improvements

The feedback on ifm solutions at Arcusin has been consistently positive.

"We are very satisfied with the performance of the components. Their robustness and reliability are particularly important to us, as our machines operate under the toughest conditions worldwide. In more than ten years of using ifm solutions, we have had no complaints due to manufacturing defects or serious failures – a clear proof of quality and a key reason for us as a manufacturer to continue placing our trust in ifm," says Corral.

The close cooperation with ifm in development projects has also proven its worth.

"Our experience with ifm's support has been excellent throughout. The team quickly understands our requirements, provides competent assistance with technical questions and is always committed to finding the right solution."

Corral particularly highlights the close collaboration: "As a manufacturer, we greatly value having an automation supplier who shares our customer-oriented philosophy. A good example of this was the radar project, where ifm's specialists were on site to fine-tune the solution precisely to our application. This proactive support gives us the confidence that ifm is the right partner for us."

Conclusion

By integrating ifm's automation solutions, Arcusin has raised the reliability, ease of operation and safety of its machines to a new standard – benefiting farming operations worldwide.

” After more than ten years, we can say that ifm products are as reliable and robust as we need them to be. This experience has convinced us to rely entirely on ifm for the automation of our machines.

Banke

Conversion from diesel
to electric drive



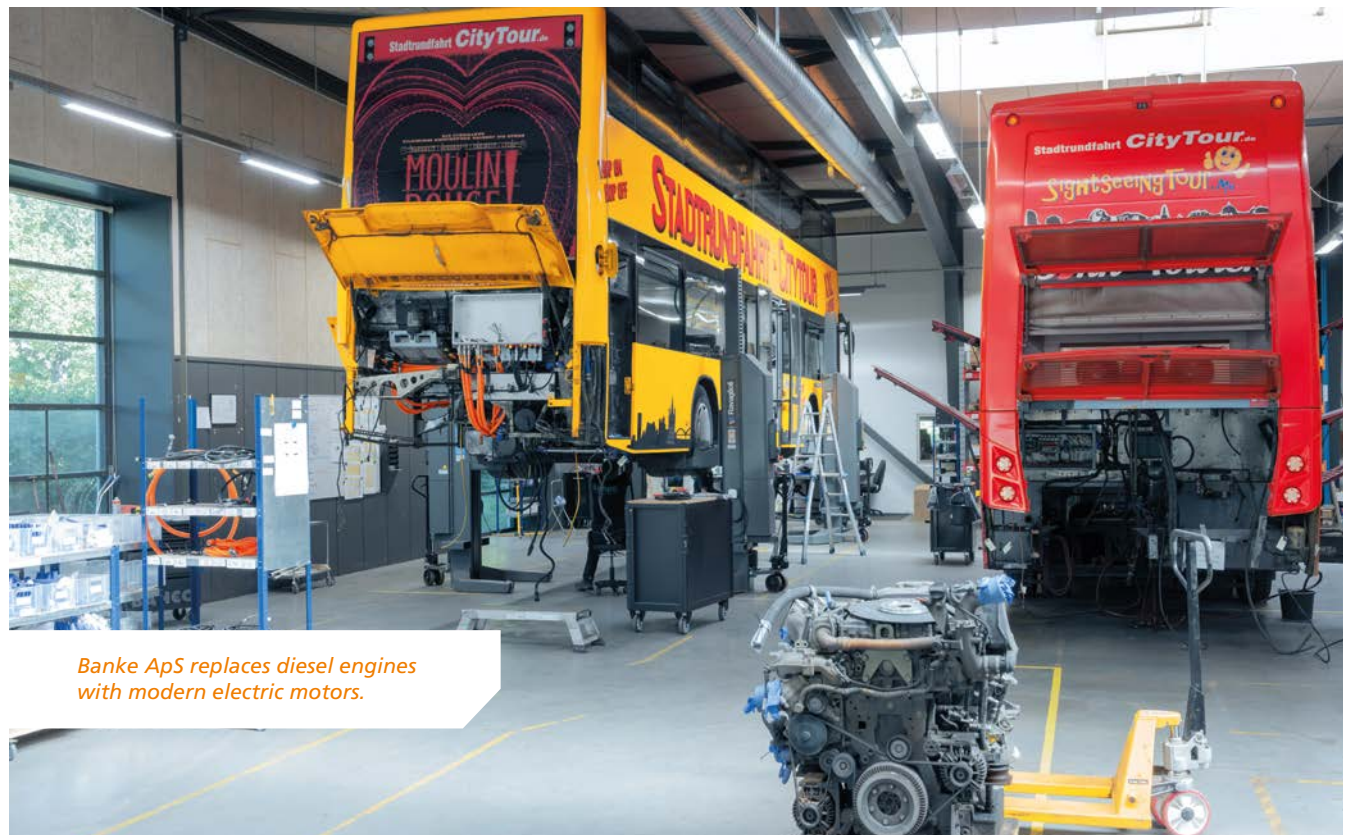
Cleaner driving in cities

Electrification of commercial vehicles for emission-free urban transport

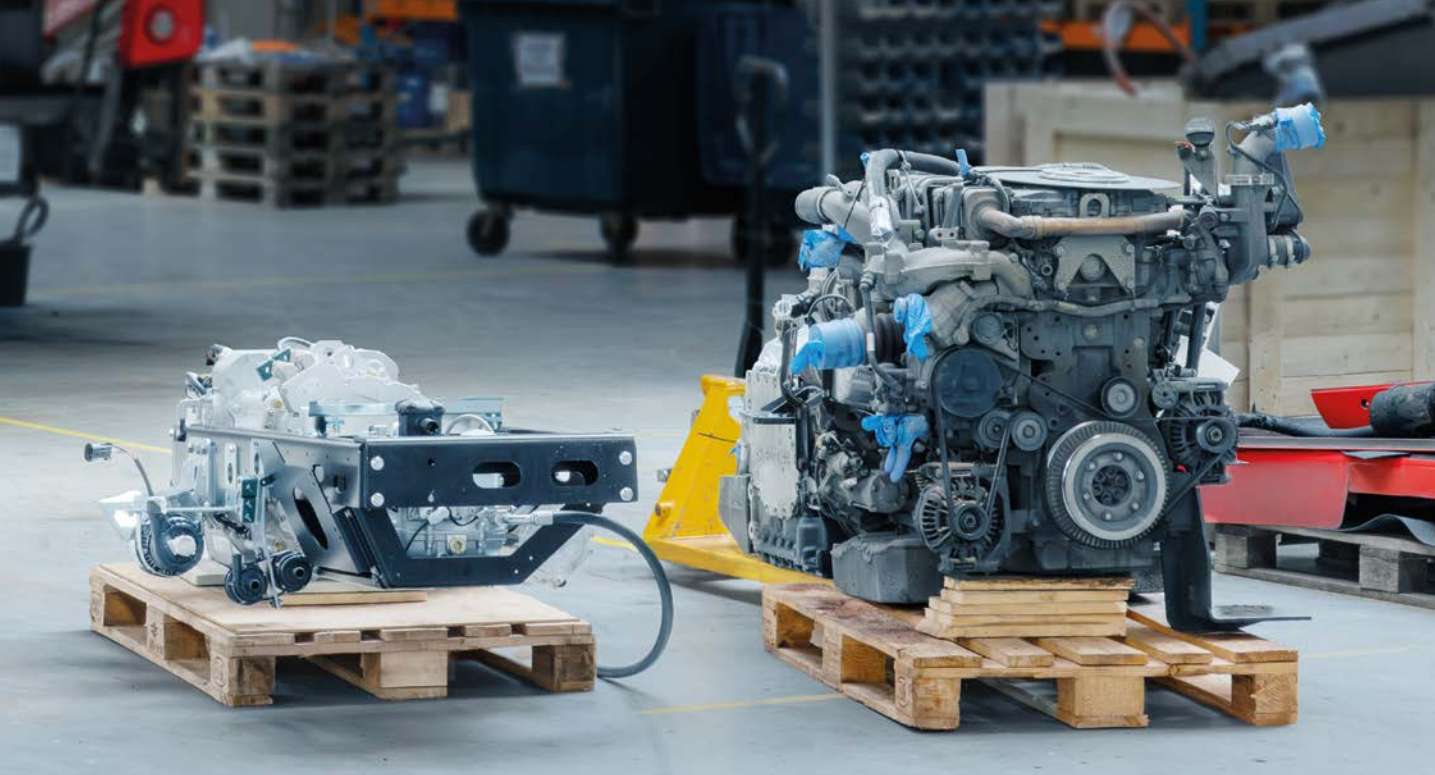
Traffic in large cities is one of the main causes of poor air quality. Diesel vehicles in particular emit pollutants such as nitrogen oxides and particulate matter, which not only pollute the environment but also pose a considerable risk to public health. Electric vehicles offer an effective solution for improving air quality in urban areas. An increasing number of commercial vehicles, aside from passenger cars, are being equipped with electric drives to make urban transport more sustainable and environmentally friendly.

The Danish company Banke ApS specialises in converting commercial diesel vehicles to fully electric. This complex process involves replacing the diesel engine with a compact, powerful electric motor and integrating advanced batteries and control electronics for efficient and reliable operation. Automation specialist ifm electronic is an important partner in this ambitious project, supplying robust components such as controllers and displays. Their collaboration demonstrates how innovative technology can revolutionise urban mobility.

*Clean through the city:
sightseeing on an electric bus.*

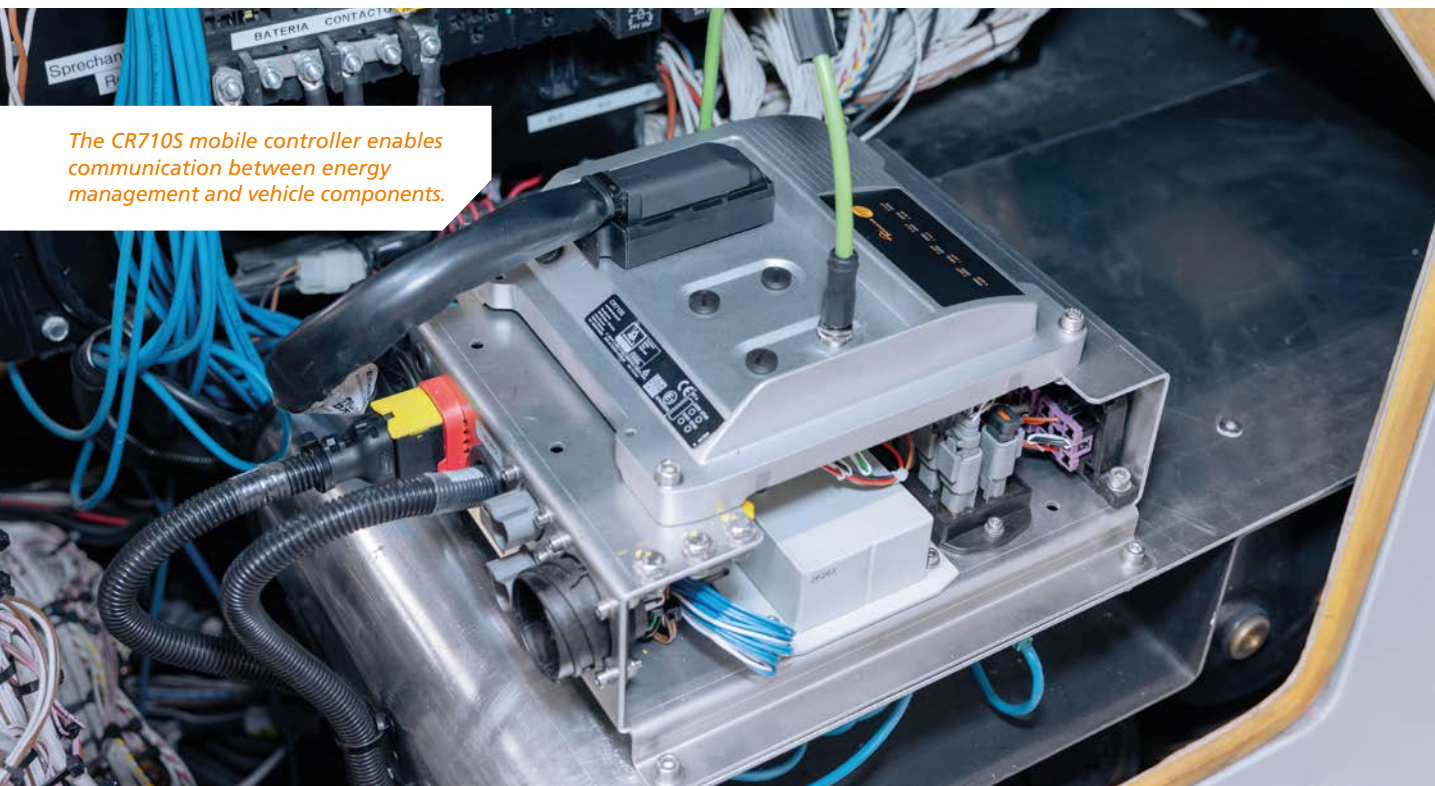


*Banke ApS replaces diesel engines
with modern electric motors.*



” *Electrifying heavy-duty transport is a crucial step in reducing CO₂ emissions across the entire mobility sector.*

*Size comparison:
electric vs. diesel.*



The CR710S mobile controller enables communication between energy management and vehicle components.

The challenge of electrifying heavy commercial vehicles

“Electrifying heavy-duty transport is a crucial step in reducing CO₂ emissions across the entire mobility sector,” explains Rasmus Banke, Managing Director of Banke ApS. He sees significant potential especially in urban environments: “What we are mainly seeing across Europe is that urban transport companies in particular want to electrify their fleets. This could apply to buses, as well as to refuse collection vehicles and truck-mounted cranes.”

However, converting heavy commercial vehicles to electric drive poses particular challenges. The high technical demands on power electronics, battery management and charging systems require innovative solutions and close cooperation among specialists. This is precisely where the strength of the partnership between Banke and ifm lies, with both companies working together to ensure an efficient and reliable transition to electric drives.



In the cockpit, the robust CR1203 graphic display provides the driver with all key parameters of the electric drive system.

A partnership in action: retrofitting sightseeing buses

In a current project, Banke has converted a fleet of double-decker sightseeing buses operating in German cities along the Rhine, including Bonn, Cologne and Düsseldorf. These buses now run on emission-free electric drives and are a compelling example of how electromobility can be successfully implemented in demanding urban environments. A range of customised components from ifm are used to meet the specific requirements of these electric drives.

For example, ifm's CR710S mobile controller, a dual control unit with safety certification, manages a wide range of control tasks between energy management and vehicle components, thus ensuring smooth operation.

Besides communicating with decentralised IO modules, the compact ifm CR0403 controller performs important control functions in the battery management system, which controls both the charging and traction currents. This system is crucial for the efficiency and reliability of the electric drive, as it ensures the battery capacity is utilised optimally while extending the batteries' service life.

In addition to these components, ifm offers a variety of other solutions that optimally meet the special requirements of electromobility. These include sensors that monitor the temperature and charge status of the batteries, as well as controllers that facilitate the integration of charging infrastructure and vehicle technology. These technologies play a key role in the electrification of commercial vehicles and help bring the vision of clean, sustainable mobility to life.

From local projects to a global movement

"We are now seeing strong growth almost everywhere in the world, at least in China, Europe and the USA – and this is a rapidly expanding sector," says **Rasmus Banke**, commenting on the industry's rapid growth. The electrification of buses, refuse collection vehicles and other urban commercial vehicle fleets is a decisive step towards cleaner air in cities and lower CO₂ emissions.

The collaboration between Banke and ifm goes beyond technical innovation. It stands for social progress and shows how targeted partnerships can use state-of-the-art technology to

improve the quality of life in cities. Projects such as the conversion of German sightseeing buses prove that widespread electromobility in cities is no longer a distant vision, but can already be implemented today.

Conclusion

By combining powerful electric motors, intelligent battery management systems and robust automation components, pioneers like Banke and ifm are paving the way for a future in which urban transport is both sustainable and environmentally friendly and the vision of clean city centres becomes a tangible reality.



H+H Engineering

Effective emission control
through sensor technology



Clean shipping

H+H Engineering relies on ifm products for exhaust gas aftertreatment systems

Global trade, as we know it, would be unimaginable without shipping. The worldwide fleet consists of more than 100,000 vessels, transporting around 90 per cent of all internationally traded goods across countries and continents. With its innovative solutions, H+H Engineering & Service GmbH is helping to make this form of transportation significantly more environmentally friendly, both now and in the future.

According to the International Maritime Organisation (IMO), shipping currently accounts for around three per cent of global CO₂ emissions. However, this is set to change: The IMO's goal is to reduce emissions from the global merchant fleet to net zero by 2050. Also in focus are the emissions of nitrogen oxides (NOx). Here too, the IMO has defined limit values. The currently applicable stage, Tier III, must be met by vessels operating in designated Emission Control Areas ECAs. Such ECAs already exist off the coasts of the United States and Canada, as well as in the North Sea and the Baltic Sea. Starting in 2025, an additional ECA will come into effect off the coast of Norway. Other regions, such as the Mediterranean, Central

America, Japan, and Australia, may follow. However, the strict limit values are only mandatory for more modern vessels whose keel was laid after a cut-off date individually defined for each ECA. The Tier III limits do not apply to older vessels.

On vessels and in cars: exhaust gas purification with urea

Still, the message is clear: Shipping companies that want to remain competitive in global trade – or operate in ECA waters – must invest in cleaner vessels. Selective catalytic reduction (SCR) systems, such as those developed and integrated by H+H in Sonnefeld, Germany, offer a practical alternative to converting the entire fleet.

"The diesel engines on vessels are not designed to meet NOx limits internally. This is why exhaust gas aftertreatment takes place outside the engine, using SCR systems," says **Arne Tädcke**, Project Manager and Sales Marine SCR at H+H.

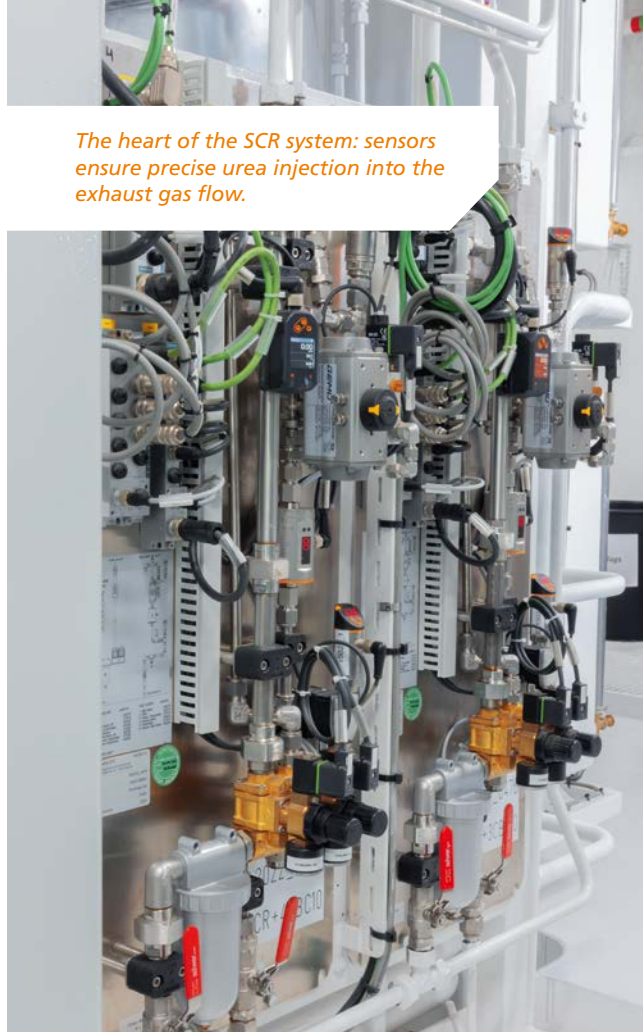
"We use urea for the aftertreatment, just like in the automotive industry. The urea is converted into ammonia in the exhaust gas flow, which in turn reacts with the nitrogen oxides on the catalytic surface, converting them into molecular nitrogen and water."

"In practice, the sensors from ifm have convinced us due to their reliability and measuring accuracy. Both are essential in maritime exhaust gas aftertreatment."

This process relies on accurate dosing: *"We have to inject the urea very precisely. On the one hand, we want to comply with the strict NOx regulations; on the other hand, overdosing must be avoided as any excess ammonia would be released unused into the atmosphere. And ammonia is just as harmful to the environment as nitrogen oxides."*



As nitrogen oxides cannot be broken down within the engine, this process takes place in the downstream SCR system.



The heart of the SCR system: sensors ensure precise urea injection into the exhaust gas flow.

Precise sensors for precise dosing

The SCR system from H+H uses sensors from automation specialist ifm to ensure accurate dosing. *"We measure and control the pressure and flow of both urea and compressed air in order to continuously ensure the exact supply of urea," says Tädcke. „In practice, the sensors from ifm have convinced us due to their reliability and measuring accuracy. Both are essential in maritime exhaust gas aftertreatment. If our system were not consistently accurate, vessels could either be fined for exceeding emission limits or denied access to an ECA. Either scenario would result in significant financial losses for the shipping company."*

Emission-reduced use between wind turbines

One of the vessels that depend on a reliable SCR system is the Norwind Hurricane. As a Commissioning Service Operating Vessel, the vessel commutes on the North Sea between Eemshaven in the Netherlands and the offshore wind farms off the West and East Frisian Islands. The Norwind Hurricane is therefore located in the centre of an ECA. For vessels with keels laid after 1 January 2021, the use of an SCR system is one way of achieving compliance with the Tier III NOx limit values. But that was not the only reason for the Norwegian shipping company Norwind Offshore to operate its five service vessels to date with as few emissions as possible with the help of the exhaust gas aftertreatment system from H+H. After all, the fleet indirectly contributes to the successful energy transition.

"All five vessels, as well as the three currently under construction, are involved in green projects and contribute to the expansion and maintenance of wind energy infrastructure," says Jon Carlos Farstad, Chief Engineer aboard the Norwind Hurricane.

"This is another reason why our shipping company strives to minimise the environmental impact of our vessels. This is achieved through advanced SCR systems and by running our engines as efficiently as possible. Advanced energy and power management systems help us to run the diesel engines in the optimal and most efficient mode to keep our emissions as low as possible."

SCR systems reduce social costs

Jürgen Müller, Managing Director at H+H, explains in the video magazine "Impulse - the ifm show" how much the reduction of nitrogen oxide emissions benefits not only the environment but also society: "Recent studies from the EU and the USA have shown that one tonne of NOx causes social costs of around 10,000 euros. This is because nitrogen oxides do not simply dissipate. They enter various atmospheric layers and can also be carried by the wind from the high seas to the mainland, where they pose a risk to human and animal health. Our SCR systems are capable of reducing Noxx emissions by more than 90 per cent. If we look at the emissions reduction of the Norwind Hurricane alone, we have calculated that the average operation of the vessel saves around 700,000 euros in social costs every year."

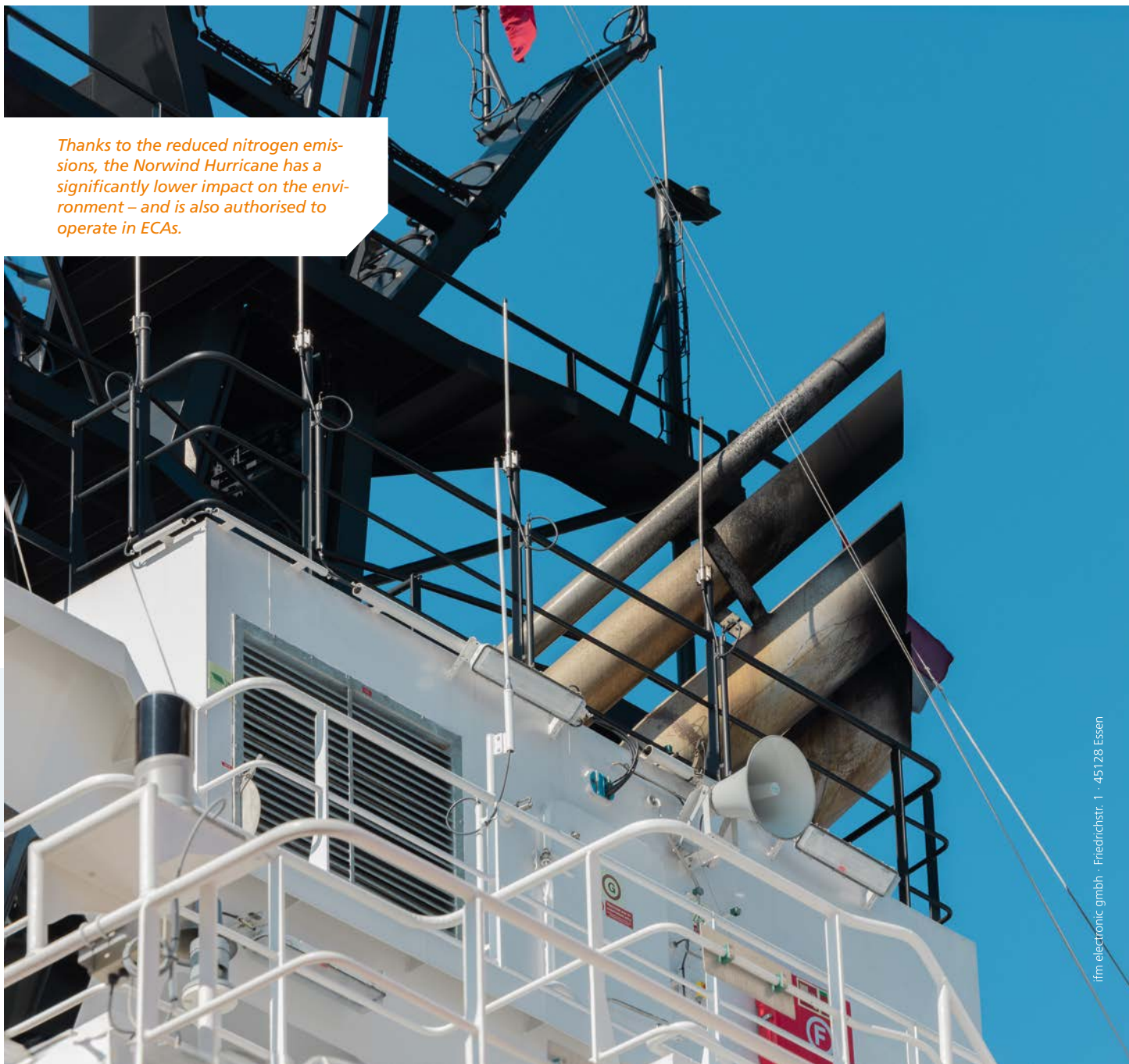
Conclusion

With its SCR systems, H+H is helping to significantly reduce the burden on the environment and society. This is also made possible thanks to the precise and reliable sensors from ifm.

Thanks to the reduced nitrogen emissions, the Norwind Hurricane has a significantly lower impact on the environment – and is also authorised to operate in ECAs.



Watch episode 18 of "Impulse – the ifm show" to discover the latest in ship automation:
ifm.com/cnt/impulse-ship





Lentner

Digitalised emergency
vehicles



Everything a firefighter's heart desires

Lentner digitalises emergency vehicles with robust sensor solutions from ifm

From vehicles with telescopic masts or for use on airfields to equipment vehicles or auxiliary fire engines: Lentner, a family-owned company headquartered in Hohenlinden near Munich, develops and manufactures firefighting vehicles for every requirement. Just as the vehicles themselves are built to be robust for their intended purpose, the digitalisation technology used must also be robust in order to ensure reliability even in the most demanding of emergencies. That is why the company has been relying on ifm solutions for many years.

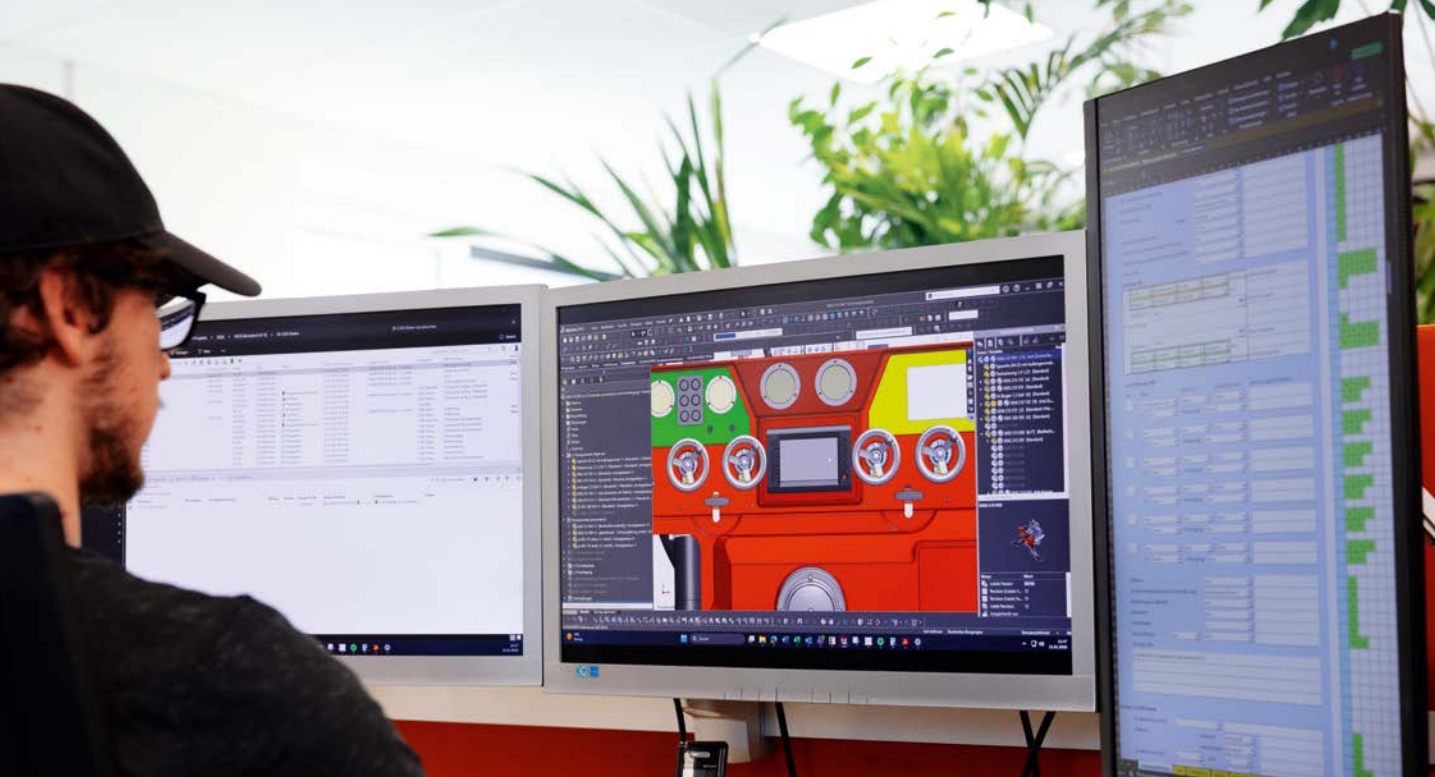
Individuality and quality combined

Up to 150 firefighting vehicles leave Lentner's production facilities every year.

"The vehicles range from 7.5 tonners to large airfield fire engines. In short: we produce everything a firefighter's heart desires", says Chief Operating Officer Mathias Hausmann. And no two vehicles are alike. "Nothing we produce is off-the-peg because we tailor each vehicle to meet our customers' demands and needs. Our aspiration to attain the most practicable solution in the highest quality always remains the same. Because when it comes to a call-out, the firefighters can only perform as well as the vehicle they have at their disposal."



*From telescopic masts to Unimogs:
the requirements and firefighting
scenarios for the vehicles are varied.*



Automation technology is becoming increasingly important in the development of modern fire engines.

An increasingly important partnership

ifm has been supporting Lentner as an automation partner for nearly 20 years now. *"We began with the development of our first CAN bus system in 2008, developing it together with ifm", says Hausmann. "Since then, we have been consistently working with ifm and will continue to do so in the future."* The reason: *"The vehicles are becoming increasingly more digital and are being equipped with more and more sensors. That's why it's good to have a reliable partner at your side. Today, ifm is one of our most important suppliers."*

More sensors, more digitalisation. The development is clear: the performance of modern rescue vehicles is increasingly being measured in terms of the information that is available to the firefighters.

"Digitalisation is becoming more and more important to us. The entire process is now digitally controlled. If the driver engineer has a clear overview of pump pressure, the mixing ratio in foam units and the amount of water in the tank, it helps him to optimally support his colleagues who are fighting the fire and to react in good time, if necessary", says Julian Bauer, head of digitalisation at Lentner.

Haptic feedback provides clarity during firefighting operations

For example, the PIM pressure sensor with pump diagnosis function detects not only pressure but also any cavitation that might occur. *"Prolonged or severe cavitation can cause damage to the pump and lead to its failure, which must be avoided at all costs", says Bauer.*

The driver engineer uses the Human Machine Interface (HMI), a robust type-CR1081 7-inch control display, to access the relevant information and control the pump and other vehicle functions. It is no coincidence that this is not done via touchscreen, but by means of six buttons and a rocker switch.

The pressure sensor (in the background) transmits pressure and cavitation data to the control unit (in the foreground).



"When it comes to vehicle handling, we attach great importance to clarity and simplicity of operation. The ifm display, with its buttons and haptic feedback combined with a simply structured settings menu, ensures short response times during firefighting operations."

All of the vehicle's functions can be controlled and monitored from both the pumping unit and the driver's cabin. If the vehicle is fitted with a foam mixing unit, a separate display on the pumping unit shows the mix ratio of water and foaming agent. But not only the pumping unit is completely digitalised: the position of the roller shutters, steps, ladders and other access hatches is also monitored by sensors and shown on the HMI. The emergency lights, siren, vehicle perimeter lighting and work lamps are also operated by means of interaction between the HMI and the control unit.

"This enables the driver to check at a glance before driving off whether all the equipment crates are closed and the steps retracted. This simplifies checking and protects the vehicle and equipment from damage."

Space-saving, robust automation technology

Because the vehicles are designed for optimum space utilisation, the sensors and data infrastructure must also be housed in the most space-saving way possible. Therefore, compact sensors such as those in the IS series and C-slot cylinder sensors from the MK series are used. The information is collected by I/O modules and transmitted via CAN bus to the control unit, where it is processed and forwarded to the HMI for visualisation.

"The electronics must all be extremely robust", continues Bauer "The vehicles face rough treatment on the job, and therefore each individual component must be built to last. In this respect, ifm's products have been impressive all round from the very beginning."

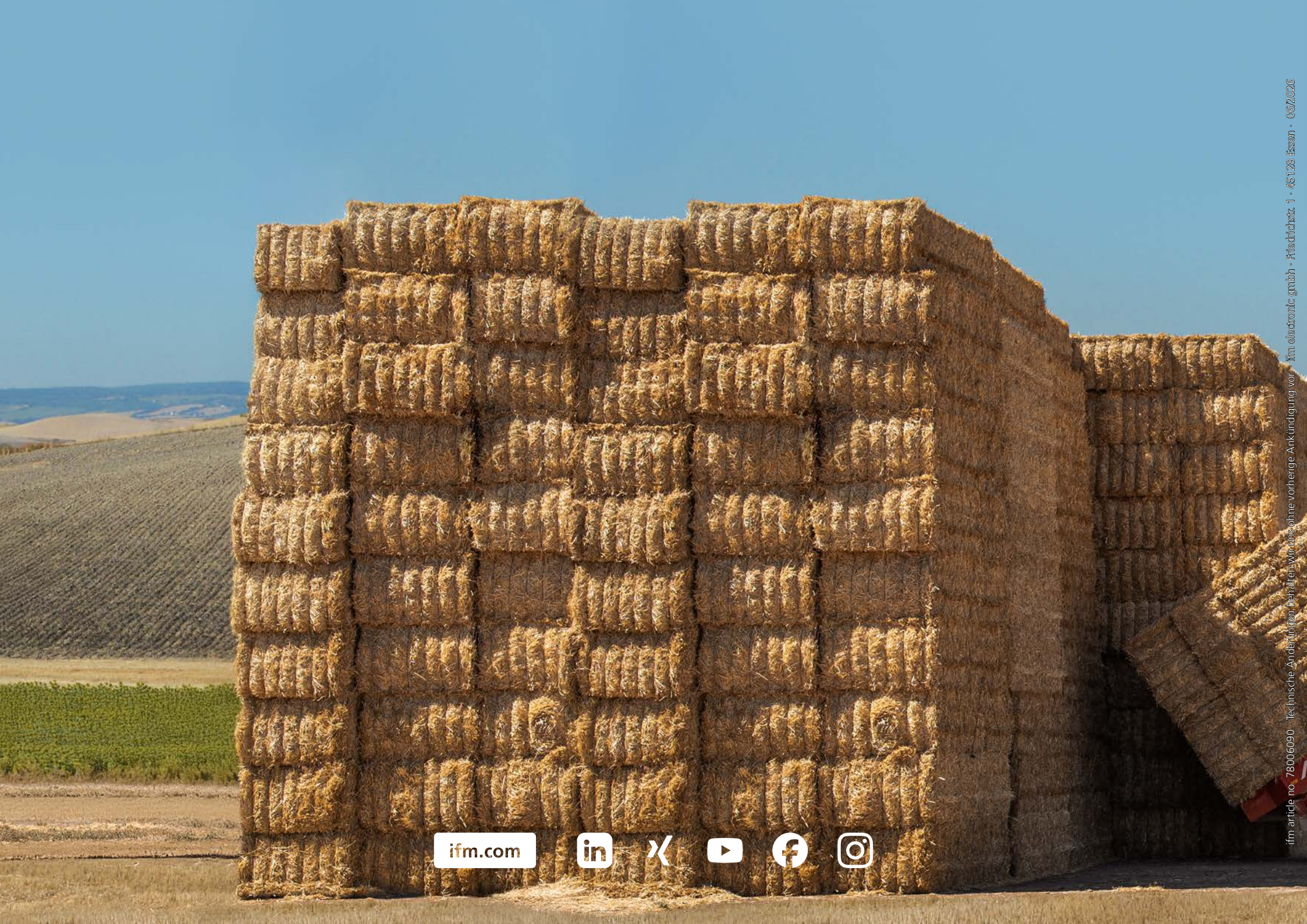
The central control display enables simple operation of all vehicle functions including pump control.



And **Julian Bauer** values the automation specialists as a partner in general: *"The collaboration is extremely good and very close. Not only do we get good support, but we can also contribute our expertise when it comes to developing new solutions for our sector. It's a true partnership."*

Conclusion

Automation specialist ifm's mobile-compatible digitalisation solutions fulfil Lentner's requirements regarding sensors and data infrastructure. Thanks to its robust, durable and reliable products, ifm contributes to ensuring that fire brigades worldwide can rely on the quality of the Lentner brand.



ifm.com

