real.times

MAX

EFFICIENCY

MAXIMUM EFFICIENCY

WITH HEART AND MIND – 50 YEARS OF BACHMANN | **PREDICTIVE MAINTENANCE**
CLIMATE-FRIENDLY SHIPS | **STARTING CONDITION MONITORING**
ATTRACTIVE VISUALIZATIONS | **FOCUS ON EFFICIENCY: ENGINEERING TIPS**

DEAR READER,

"Maximum efficiency" is the theme we have chosen for this issue of the real.times. You may think this is a just a buzzword at first. But to us, there is no better concept to describe our company, Bachmann electronic, and our efforts and goals. For 50 years, we've only had our eyes on one goal: to work together with our customers and use our technologies and solutions to make their systems more efficient and productive.

What does efficiency or productivity mean? These are essentially benchmarks for comparison. We make something better than it was, we do something as quickly as possible, we get as much out of it as possible. Somehow this corresponds to the economy of faster, higher, farther, and even cheaper while delivering more. However, these represent a limited view, a short-term way of thinking, which we became aware of even before the coronavirus crisis.

Climate change, too, has shown us the limits of "faster, higher, farther." We recognize that there is something more important. Like mindful cooperation and teamwork. Or regional focus. These values are regaining importance. In many areas, we already try to consume as little energy and as few materials as possible with the goal of conserving resources. Frugality is suddenly all the rage. To put it simply, having an open view and thinking and acting in a way that prioritizes a long-term perspective always helps us.
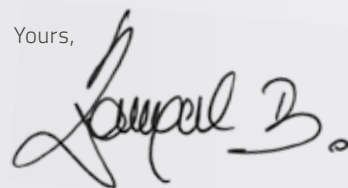
So is it either, or? Finding the best overlap possible of these two approaches is what will help us to progress. Neither is possible without the other. Cheap would be easy, but probably not sustainable. Fast would be easy, but it wouldn't conserve resources.

I think we're all learning now that an overarching perspective is becoming more important. It's not short-term optimization that counts, but a long-term horizon. I find that reflection, even rethinking, is happening here. And I'm glad that topics and industries that we've successfully served for decades are coming more and more into the forefront. Renewable energy sources like wind, sun, hydropower, and biogas are steadily growing in significance. Robustness and longevity are once again becoming valued in industry.

For us as a family-owned company, it's not turning a fast profit that motivates us. It is first and foremost the responsibility that we want to take on. This includes respecting people and the environment as well as as understanding and addressing the challenges of our customers, and constantly asking ourselves: "Which path do we take together?

Read in this issue about what efficiency and productivity mean to our customers. and how we've been able to help them. Because serving them — and you — with the right solutions remains our greatest goal.

Yours,

Bernhard Zangerl
CEO Bachmann electronic

INDUSTRY

ENGINEERING

PRODUCT NEWS

A TICKING CLOCK ...

Reducing the impact of climate change will require fundamental change to almost all aspects of life. Bernhard Zangerl, CEO of Bachmann electronic, believes that we will need to reorient ourselves as a company. We asked him how.

You say that in order to stop climate change, we need to reorient ourselves as a company. Are you seeing much movement in that area?

I am actually seeing a lot of new momentum, or at least serious reflection. Maybe fueled by the automotive crisis in Germany. It's about hundreds of thousands of jobs that need to be saved. Here, the government, as well as the entire industry, is being called on to find alternatives. These might be converting the energy supply network to renewable sources or using alternative fuel sources for vehicles. And that would naturally contribute to climate protection.

I believe that there is a change in thinking, that is also happening in other areas, which has undoubtedly been triggered by the coronavirus crisis. Do we need to fly somewhere to take a vacation, or can we relax closer to home? Do we need to travel so much for work, or can we talk via video conference? Do we buy products online from all over the world, or should we buy from local stores again in the future? Or more precisely: What do we actually need? We don't ask ourselves these questions anymore because excess has become the norm.

Unfortunately, however, a change in thinking does not guarantee a change in behavior.

Yes, that's true. Personal interests are always involved and it is human nature for people to think of themselves first. That's why the change that we're talking about here is a complex, multi-layered task. The economy is connected globally, and intervening in selective areas sometimes has grave consequences. When you push for renewable energy, this has an impact on other industries – oil, gas, coal. What happens in the supplier countries? This is a major political challenge. I think it is the role of politicians to find a smooth way of reconciling different interests and encouraging those affected to participate. Participation boosts acceptance and creates workable solutions. Even if it means having to do unpopular things.

And one thing is also clear: an energy strategy only makes sense for Europe as a whole. Here, interests need to be balanced. There are regions that are mountainous, have water, and pumped storage power plants, such as Scandinavia or the Alpine countries. Others have flat areas and/or coastlines that offer the possibility to operate on- and off-shore wind turbines. The only question is how we distribute the energy, keyword: power line construction. And numerous individual interests are already involved. Everyone is pro-green, but not through my backyard, please!

Is courage missing from politics?

Perhaps the crux of the matter lies in politics. The question of "How do I do as much right as possible?" still remains the primary focus. But fundamental questions are extremely hard to decide on a democratic basis. Furthermore, a system's self-preservation instinct is quite high. Whether it's because of the energy revolution or a cultural shift within a society or a company, people use a lot of energy to initiate change, only to have things fall back into a state of equilibrium.

However, by doing things to support the transition, we at Bachmann are contributing something to this. We are providing technologies that enable change. We bring our knowledge to political committees, the German Engineering Association, the Federation of Austrian Industry, and other associations. Together we can set the course, promote awareness, and create understanding for the necessary decisions.

And what do you wish for?

I wish that the powers in this world – major economic powers, leading politicians, large corporations – would not only be involved vocally, but also take action. In my opinion, this is the basic prerequisite for making change possible. As long as everyone is working on their own agenda, operational pressure is more the driving force and less a view of what is important long-term. For me, it's simply a question of responsibility.

50 YEARS AUTOMATION

WITH HEART AND MIND – 50 YEARS OF BACHMANN

2020 is a year that we are all unlikely to forget. A virus is keeping the world preoccupied, and the economic and societal developments are far-reaching. However, 2020 is also the year in which Bachmann celebrates its 50th anniversary. This will be more of a modest and quiet celebration than a raucous party, as dictated by safety provisions.

Nonetheless, it is still remarkable to look back on 50 years of passion for automation – and at the path that the company has forged since then.

Founding by engineer Gerhard Bachmann

Second factory opens in the Tosters district of Feldkirch (current headquarters)

Branches in China, India, and the USA

Office opened in Peking

Technology site SCADA (Bachmann Visutec GmbH)

Rendsburg office opened

1980 — 1970 — 1984 — 2004 — 2007 — 2008 — 2009 — 2011 — 2012 — 2014 — 2020

First factory opens in the Tosters district of Feldkirch

Branches in the Netherlands and Denmark, expansion of wind and industry segments

Heavy expansion in China, industry offensive engineering (OEM)

Technology site Condition Monitoring (Bachmann Monitoring GmbH)

New marine site in Bremen (D), new headquarters in Boston (USA)

It is a beautiful summer day when we meet with Bachmann's Managing Director, Bernhard Zangerl. He has controlled the company's fate for 15 years. A period in which the company has tripled its staff to around 500 employees and is set to have the best year of its existence in 2020 with a revenue of around 85 million Euros. For Zangerl, this is all a confirmation of what Gerhard Bachmann set in motion with the founding of Bachmann electronic in 1970, and how he shaped his company up to the end of his life.

Do things that make sense

The founder's vision was originally a technological one. At least, he often gave it special emphasis when asked – and was often laughed at. He wanted to build the best controller, the best automation, something that was reliable and fast. This was the major goal. But he was also driven by the idea of leaving something behind in the world and society, making an honest living, and doing things that make sense. This vision came together at the turn of the millenium, when Bachmann automated the first wind turbine, and has since distributed more than 120,000 systems across the

globe. His innovative, long-lasting and safe technology is appreciated in an industry that faces what may be the most challenging task of our time: to decarbonize our world with renewable energy sources and to usher in the energy revolution. "Our skills fit well here," admits Bernhard Zangerl. This is why, in addition to wind turbine manufacturers, manufacturers of hybrid power plants, solar farms, battery storage systems, CHP and hydropower now rely on technology from Feldkirch.

The full solution is what counts

However, controller technology has long since been overshadowed. "We are developing a complete solution for energy providers in order for the revolution to really succeed," says Zangerl. This includes comprehensive network and system protection as well as the efficient management of operations and monitoring for distributed power generators. The Bachmann Group added Bachmann Monitoring in 2011, and Bachmann Visutec has been part of the group since 2012. Together with Condition Monitoring Systems from Rudolstadt, of which more than 9,000 are now

installed in wind turbines around the world, and Web Visualizations from Eisenstadt, Bachmann is achieving what matters most to them: taking a step towards an energy supply that is operated in a sustainably safe, eco-logical, and economically profitable way.

Reliable – and Trustworthy

Furthermore, it is the reliability and partnership that customers experience, along with service, that count. Zangerl is sure of this. These characteristics are also appreciated in the established business of industrial automation. When a system is stable, requires less maintenance, and produces higher quality, then the added value is obvious. "More security for the product, more security for our customers' customers, and that's what we focus on," says Zangerl, confirming Bachmann's clear roadmap.

One thing that matters even more on board a ship than in the energy industry or in mechanical engineering: reliability. A technical system that breaks down, often days or even weeks from the nearest port, can have grave consequences that threaten the crew's safety. Just a decade ago,

Bachmann risked taking a step in this somewhat conservative industry, in which the Austrian systems have since gained an optimal foothold. "We're growing at double-digit rates year after year, and once again, we are at 10% above our own plan for 2020," confirms the pleased CEO.

"We're focusing on the long term."

The company's strategy is the same today as it was 50 years ago: make room for trends, but stick to the principles. Don't jump from opportunity to opportunity. Don't maximize short-term profits, but create conditions for lasting success in business. "This is what we want to achieve for ourselves, but also what we explicitly want to achieve for our customers," affirms Zangerl.

This is how Gerhard Bachmann shaped his company. And the company's founder, who passed away three years ago, prepared Bachmann electronic not only for long-term market survival, but also to continue to write their success story. "He was undoubtedly our father figure, he put his heart and soul into it up to just a few days before his death," says Zangerl, expressing the sorrow that he and his entire team feel at the loss of their founder. But he also began early on to ensure that the family-owned company would be able to stand on its own feet, and took an active and positive role in overseeing this process for more than a decade. With successful results, as can be seen today.

Societal Obligations

Although the company has become increasingly international over the years , and there are now over 20 sites in China, the United States, India, and many European countries that make up Bachmann's map, production has remained at the head office in Feldkirch. "Even if everyone sees where the cheapest location is and where you can manufacture the cheapest, we're not interested. We are committed to the site in Vorarlberg with its excellent conditions," says Zangerl. Over the last several months, this has been a crucial advantage over the competition. Unlike many others who are dependent on international suppliers, production was able to continue with almost no disruptions during the covid lockdown and despite border closings. Zangerl hopes that this phase will lead to a change in thinking in politics and the economy, and "that people will return to focusing on what brings added value to a society and not on what generates more cash for less."

The company's efforts to hire young people for apprenticeships demonstrates their stance on assuming social responsibility. "It is primarily the middle class that forms the foundation here," says Zangerl, who has since quadrupled the proportion of apprenticeship positions. After all, it is also in the company's interest to make up for a shortage of skills.

Proud and Modest

The order books are full and future prospects are looking good in target industries. Yet Zangerl is modest. "Overall we seem to have made more right decisions than wrong ones, and maybe we've made our own luck," says the managing director with a smile. And in any case, it pays to do the things you do best – and that always makes sense.

»Don't maximize short-term profits, create conditions for lasting success in business.«

Bernhard Zangerl
CEO Bachmann electronic

»Challenges can be overcome with foresight, reflection, and consistent implementation.«

Predictive Maintenance

PROBLEM DETECTED, PROBLEM AVERTED

Maximize profits and minimize risks: those are the (at first glance contradictory) goals that preoccupy wind turbine operators. They have to avoid unexpected downtimes in production and keep the costs of value retention low. This can be done using needs-based maintenance.

What risks can be taken? And what efforts should be made to prevent unacceptable risks? The answer to this is the key to a risk management concept which is both specific and appropriate for the plant equipment.

Waiting until breakdown: risky and expensive

The riskiest and, in most cases, most expensive option in these considerations is purely reactive maintenance: you wait until the system breaks down and then replace the defective part. Often the cause of the breakdown is not known, only the result. Unanticipated damage can, in the worst case, take the system out of operation for weeks because last-minute service is impossible, for example due to a lack of spare parts. Production loss is high and the machine sustains maximum damage.

A classic counter-strategy to this is preventive maintenance: critical parts are replaced after a certain amount of operating time as a precaution. This does reduce the risk of a breakdown, but keeps operating costs high, as the time left in which the components could still technically be used is wasted. In some cases, replacing them at this time is simply unnecessary.

Condition monitoring provides information

Condition monitoring counteracts this factor. The operating condition of important machine components such as drives and bearings is continuously observed with appropriate methods. Sensors detect changes in normal operating condition. Vibration patterns, temperatures and mechanical loads provide indication of a deviation from the intended operation. Correctly interpreted, this allows the operator to plan ahead for taking a machine

out of operation and potentially to specifically repair parts that could cause defects. If it is possible to use expert knowledge to correlate the monitoring data provided from a wide variety of subsystems, the path to truly predictive maintenance is clear: action can be taken promptly and planned and implemented with the lowest possible expenditure.

Challenge: Many Subsystems

The various systems for condition monitoring within a plant are in most cases not coupled, nor are they referenced with a common time stamp; they observe in isolation and report in isolation. Therefore the results of other subsystems and diagnostic systems are either unavailable or are only available with little informative value. Correlations between the data collected are difficult to detect, if they can be detected at all. Different, often proprietary interfaces also prevent suitable intercommunication and thus cause unnecessarily high expenses in system and data handling. Overall, this also poses a significant IT security risk,

because each subsystem has to be maintained separately. Moreover, if subsystems are inexpertly combined based on a data technology standpoint, weak points may remain undetected.

A wind turbine can be used to illustrate an example of this: the mechanical vibrations emitted by bearings and drives are monitored, while currents, voltages, and frequencies are monitored on electrical systems. For lubricants, the viscosity is determined and foreign particles counted. Material loads on on tower structures and rotor blades are recorded. Temperatures can be observed in a myriad of ways. From this list, which is by no means complete, you can see how complex not only the subsystems themselves are, but how elaborate the correlation between the measured data and the attribution to a certain result is.

Integrated Predictive Maintenance

Bachmann's response to this is consequently the integration of all condition monitoring subsystems into a central system. This eliminates interfaces and massively reduces

»An optimized maintenance strategy can help ensure profits.«
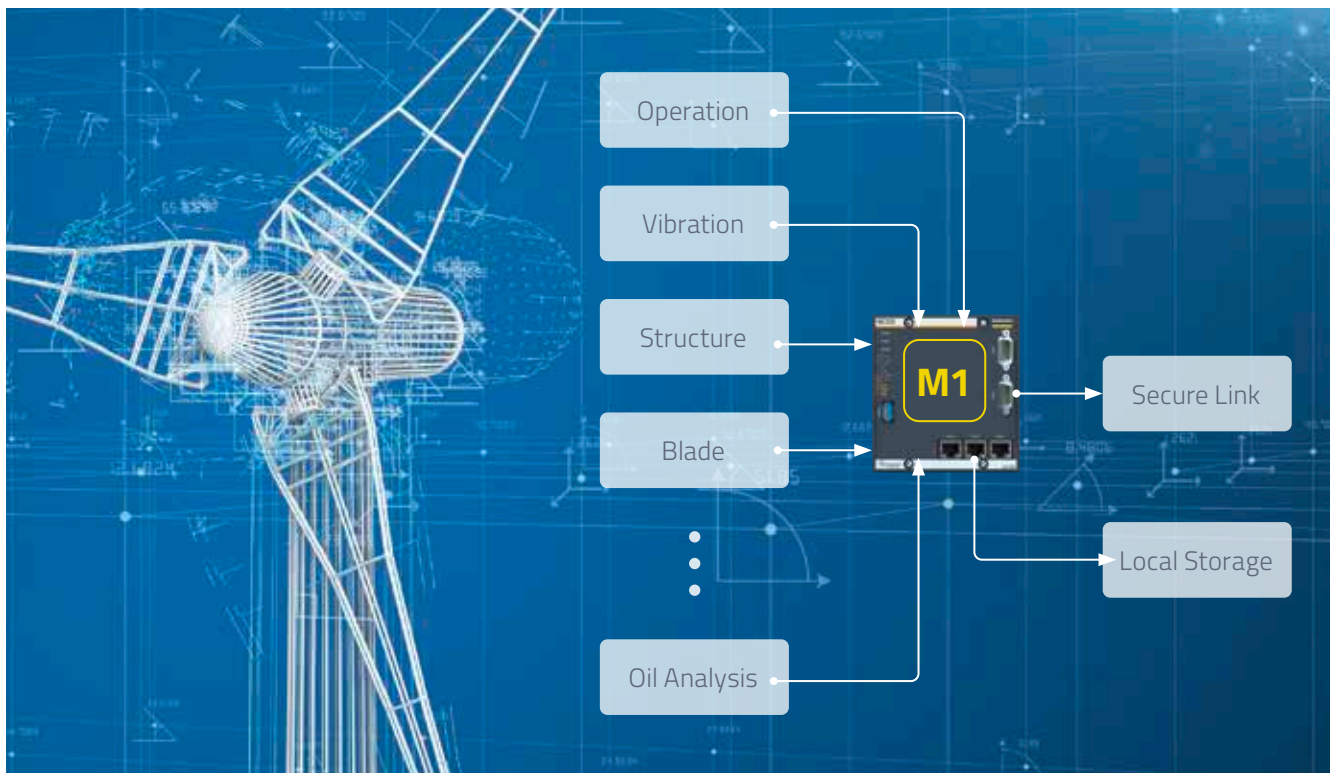
Integrated Monitoring System: All data required is exchanged via a single interface (Gateway) (e.g. OPC UA). This reduces complexity and increases IT security.

complexity. All data collected is also given a unique time stamp so that reports and results are clearly attributed to one another, making them easier to evaluate. Developing errors are detected much sooner, the appropriate replacement parts can be ordered in a timely manner, and service calls can be scheduled early on. For offshore systems, which can only be reached at great expense and on generally tight schedules, this is a crucial advantage.

Another advantage of the fully integrated solution is that operating data from the same systems within a wind farm can easily be compared to one another. This not only allows wear to be detected more quickly, it can aid in the identification of potential power reserves at individual turbine locations.

Multicore Systems Have Sufficient Power

When monitoring systems are ultimately integrated directly into the machine controls, select sensor data is immediately available. They can also be adjusted for turbine and environmental conditions, such as wind speed, turbine power, azimuth angle, and other values. Damage-limiting measures can thus be implemented precisely and without delay. An example: when an impermissible load is detected on the rotor blades, often triggered by partial icing, they can be adjusted immediately, collectively or individually, so as to protect the blade and drives. The deep integration of monitoring ultimately allows for a much more differentiated evaluation than one which is based solely on measured wind speeds.

The concern that monitoring tasks could influence higher priority operational functions is unfounded. The powerful multicore processors of the MC200 series in the Bachmann M1 system simply process the monitoring tasks on a different core than the one used for operations management, so that the one cannot impact the other.

Foresight Pays Off

To sum it up, an optimized maintenance strategy can save cash. Serious damage can be prevented, plants stay connected to the grid longer, and the service life is maximized. The same strategies can be used to evaluate operating data in order to identify performance reserves and further optimize production. Bachmann supplies the monitoring systems and expert knowledge necessary do to this.

Structural Health Monitoring

QUANTIFYING MATERIAL FATIGUE

Environmental protection alone isn't enough; power from renewable energy sources must also be competitive with its fossil-fuel-generated counterparts. Especially for offshore wind turbines, whose production represents a significant proportion of renewable energies, the costs for operation and maintenance are dominant. Data from structure monitoring contains a huge potential for optimizing turbine operations and extending service life.

In the year 2000, wind power only covered 1% of the total demand for electricity in the EU. However, by 2015 this number had increased to 16.5%. The goal is to expand the proportion of renewable energy to 32% by the year 2030. In June of this year, Germany raised their offshore wind expansion goals to 20 GW by 2030 and 40 GW by 2040. To increase the output from these important offshore wind turbines, they are being built ever larger, more efficient, and in deeper waters. Furthermore, in order to make full use of the prime wind conditions in more rugged marine areas, turbines are actually being built on floating platforms that are challenging from a technical point of view. However, if they are to compete economically with power generation from other energy sources, costs have to be reduced – according to studies

by up to 40 percent. DNV GL declared in 2014, that costs could be lowered by 7% by reducing risks and lowering safety margins and a further 6% cost savings could be achieved by improving turbine operations. The systematic evaluation of data from structural health monitoring (SHM) helps to identify these influencing factors.

Identifying – and avoiding – excessive loads

Wind turbines are given an operating license for a predetermined period of time, typically 20 years. The corresponding turbine structures are dimensioned on this basis. After this period expires, they have to be dismantled because, according to the design documents, safe operation is no longer guaranteed. If it can be successfully proven that the structure

of a wind turbine has experienced less fatigue than predicted and that safe operation can still be guaranteed, the turbines can be kept in operation longer. This is why data from structural health monitoring provides an important contribution to reducing the uncertainties in existing expert assessments regarding operational lifetime extension.

In Germany, for example, at least 10% of the wind turbines connected in an offshore wind farm must by law be equipped with appropriate structure monitoring. The goal is to equip all offshore wind turbines with SHM. This is because the evaluation of this data creates a precise image of the structure's behavior in real operation. Changes in vibration patterns provide an indication of critical loads or structural damage that has already

occurred. SHM has long been a method of assessing safe operation and could therefore also serve to optimize the prescribed inspection intervals for wind turbines in the future.

In an additional step, the data from SHM is linked with other operating data from the wind turbine, such as the drive train condition monitoring system (CMS) data. This allows critical operating conditions to be identified and avoided going forward. With this knowledge, however, you can also make better use of the permitted operating window and thus operate the system more productively – for example because you can keep the turbine in the wind longer in more demanding constellations.

The following three examples, demonstrate the possibilities for establishing this type of integrated structure monitoring:

1. Not built as planned

Due to their challenging design – a tall, lean tower with a heavy rotating mass perched at its tip – wind turbines are often structures that are sensitive to vibrations. As a result, they are optimized in regard to their structural eigenfrequency during the design process. This helps to prevent dangerous resonances in the structure that occur due to the excitatation frequencies caused by the rotor speed. This is why the turbine controller is programmed in such a way that resonance-triggering rotation speeds are avoided as much as possible, or at least passed through quickly. However, experience has shown that the eigenfrequency of installed turbines is often noticeably higher than presumed in the design process. This means that the tower construction is actually more rigid than planned. This is often because the stability of the foundation soil often could not

be adequately assessed and thus corresponding reserves were included in the structure design.

Over the lifetime of a wind turbine, the eigenfrequency changes as a result of the material aging process. If the actual eigenfrequency is identified shortly after commissioning and monitored at regular intervals, it is then possible to program the wind turbine controller to avoid the real resonances instead of the calculated ones, thus reducing the risk of material fatigue. The opportunity this provides: lifetime extension (LTE) or the possibility to continue operating turbines much longer than the calculated design service life, thus increasing both their total output and return on investment.

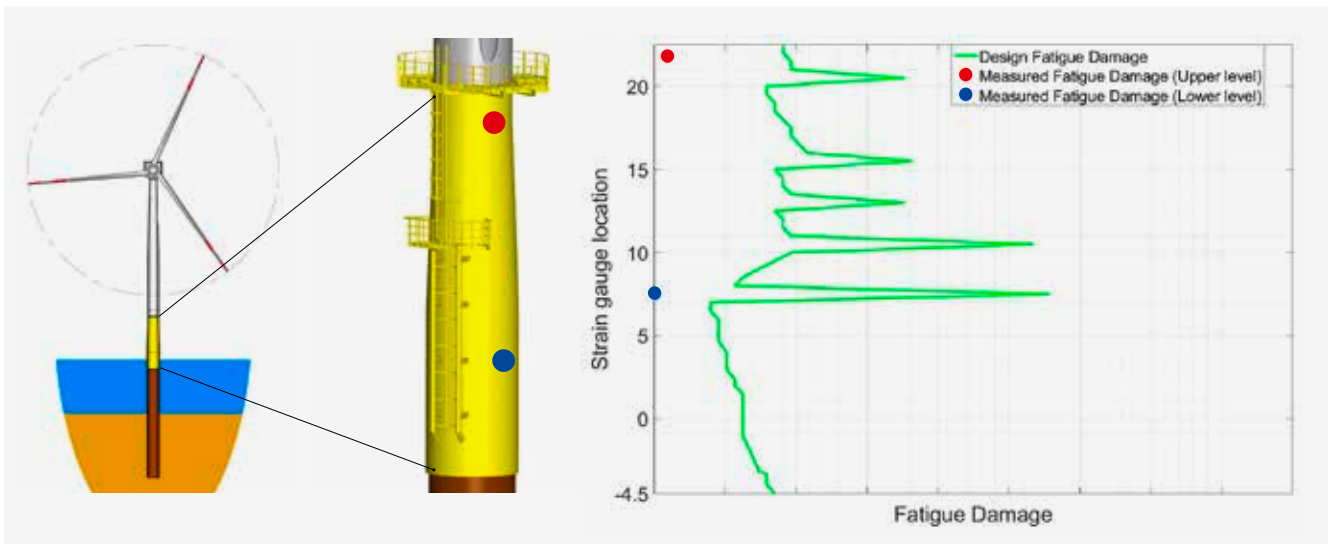## 2. Shutdowns have different impacts

In the event of an emergency shutdown, such as in strong winds, or

» If a turbine feeds power into the grid for longer than planned, then total earnings increase. With Structural Health Monitoring, it is possible to verify that the turbine's structural condition permits this. «

Kirsten Larson
SHM Team Leader, Bachmann Monitoring

for maintenance purposes, the rotor blades turn the wind turbine out of the wind (pitching). Although it helps to reduce the structure's peak load, it also causes fatigue damage to the structure. Not surprisingly, investigations show that shutting down a wind turbine during high wind speeds causes much higher loads than it does in moderate wind conditions. An emergency shutdown just below the threshold speed for shutdown, 30 m/s, results in 10-minute fatigue damage which is more than 20 times higher than a shutdown under milder wind conditions.

Wind farm operators should avoid shutting down for maintenance purposes during high wind speeds at all costs, except in cases of emergency.

3. Even small collisions cause damage

Offshore wind turbines are also designed for extraordinary events, such as storms, violent waves, or ship collisions. Even a collision with a small boat traveling at low speed in low wind conditions can have a much higher impact on the structure than when the system is operating at regular full load. Although such events are extremely uncommon, they always involve serious material fatigue damage to the structure.

Lifetime extension

The three scenarios described here show that an SHM system can not only detect damage, but can also help identify damage caused by extreme weather or accidents in almost real time. An integrated monitoring system thus plays a vital role in the operation and maintenance of wind farms.

However, it also makes it possible to prove that the cumulative loads actually exerted on the structure during operation, and thus the material fatigue, are below the value described in the operating license – and, therefore, the life of the wind turbine can be safely extended.

Detailed information about structural health monitoring and these examples can be found here:

CONTROLLED. STABLE. INDEPENDENT.

Bordesholm, a community of 8,000 inhabitants in the northern German state of Schleswig-Holstein, proves what many doubt: it is possible to supply an entire region with 100% renewable energy. The 15-megawatt storage solution from SMA Solar Technology AG provides important control energy – and secures the power supply in an emergency by forming a stand-alone grid, should the public grid fail.

Grid-connected: the 15–MWh battery storage system can provide the interconnected grid with 10 MW of primary control power in a matter of seconds.

The Bordesholm battery storage is one of the most modern balancing energy power plants in the world – 15 megawatt hours of energy stored, 100% regenerative from photovoltaic systems, biomass power plants, and CHP units in the region.

Versorgungsbetriebe Bordesholm (VBB) use it to provide the European integrated grid with important balancing energy: should critical fluctuations at the 50 Hz frequency in the transmission grid occur, then they can be stabilized within a fraction of a second with energy from the battery storage system, preventing a power failure.

Milestone for the Energy Revolution

Participation in the electricity balancing market opens up attractive business opportunities for public utilities. However, the energy supplier had another motivation: They wanted to prove that with a solution of this kind it was possible to supply an entire region with 100% renewable energy.

In December 2019, a research project in cooperation with the Technical University of Cologne simulated a large-scale power outage: Bordesholm was disconnected from the European grid for one hour using the synchronous coupling switch. The crucial point: no one noticed, because all of Bordesholm was continuously supplied with electricity without interruption.

For Boris Wolff, Executive Vice President Business Unit Large Scale and Storage Solutions at SMA, this is a milestone on the road to the European energy revolution. "With

the SMA Energy System Large Scale, a public power grid was operated at a stable frequency while being supplied with 100% renewable energy. Scaled accordingly, practically self-sufficient power supply grids could be set up – and supply could be implemented completely without fossil energies."

Technology at its best

The storage system consists of seven SMA Sunny Central Storage battery inverters and one SMA Hybrid Controller XL, based on the Bachmann M1 control system, and a 10 MW storage unit. A fiberoptic network ensures stable and fast communication between the individual generation plants, consumers, and the battery storage.

"The controller-integrated, certified network technology and the availability of protocols important in power engineering, such as IEC 60870-5-104, were decisive criteria for us when selecting the Bachmann M1 system as the basis for our hybrid controllers," says Michael Krug, Head of EOS - System Development Off Grid & Storage at SMA. "The M1 is perfectly suited for the control of energy systems."

The entire system is dimensioned in a way so it can provide a cold start following a blackout. If an unplanned power outage occurs in the public grid, a stand-alone grid will be established within seconds – supplied with energy from the battery and from renewable energy producers. If the grid returns after the blackout, Bordesholm can very easily resynchronize with the public grid.

Secure and Regenerative Energy Supply at all times

Bordesholm can be proud: the community's power supply is secured around the clock. Their energy supplier has proven that battery storage systems are not only useful for the grid, but can also supply entire regions using 100% renewable energies.

More information about the isolated network in Bordesholm

SMA SOLAR TECHNOLOGY AG

– Headquarters in Niestetal (Germany), founded in 1981

– More than 3,000 employees in 18 countries

– Made a profit of about 915 million Euros in 2019

– One of the world's leading specialists for photovoltaic system technology

– SMA inverters with a total power of about 90 GW are installed in over 190 countries

www.sma.de

A GREEN INCENTIVE

Ship transportation is believed to be responsible for about three percent of global greenhouse gas emissions. The pressure on the industry to reduce emissions and replace diesel and heavy fuel oil as fuels is rising accordingly. Fuel cells that use hydrogen for propulsion and energy supply systems on board offer a promising approach. A status report.

Since 2009, the German government has promoted the project e4ships (fuel cells in maritime shipping) as part of the National Innovation Programme for Hydrogen and Fuel Cell Technology (NIP). German boatyards, shipping companies, fuel cell manufacturers, and suppliers and classification companies banded together to make fuel cells usable for energy supply in shipping. This involvement proves true in the German Ministry for Economic Affairs and Energy's (BMWi) national hydrogen strategy, which was published in June 2020. It sees hydrogen as an attractive option to replace the fossil fuels that are currently still used – and therefore, a core element of the energy revolution.

Influence on Ship Design

This assessment is understandable. Based on mass, hydrogen has the highest energy density of all fuels with 33.33 kWh/kg. That's about three times more than diesel. By volume, however, the energy density is much lower, condensed by a factor of about 10 to 35 MPa. This would mean much higher tank volumes or a corresponding smaller range.

This is why the plan is to start by producing the hydrogen for longer transport distances on board first, in what is called a reformer. Steam reforming is a sophisticated method that is easy to control. This entails separating hydrocarbons, such as liquefied natural gas (LNG) from ships, from hydrogen in two process steps.

To do this, the hydrocarbon is made to react with water vapor in the reformer at a temperature of 400-500°C and low pressures. A combustion gas is formed on a catalytic converter from hydrogen, methane, carbon monoxide and carbon dioxide after various reactions. The composition depends on the process control and the catalytic converter used, and is adjusted based on the fuel cell used. This combustion gas is primarily converted into electricity and heat in the fuel cell. To improve the efficiency of the overall process, the remaining gas can be fed

back to the reformer for combustion.

Too Little for Propulsion, But Perfect for Power Supply

Another advantage is that fuel cell systems are designed to be modular and composed of standardized units. By interconnecting these units in a stack, they can be scaled up or down as desired. This allows these systems to be distributed on board and a decentralized energy network to be established with high avail- ability compared to the current state of technology.

The power required to propel a large cruise or container ship, which also requires a corresponding range, is not currently economical to implement with fuel cells. It would be about ten to twenty times more expensive than heavy fuel oil. On such ships, how- ever, fuel cells become more important for supplying ship technology, cabins, or the kitchen. And possibly also for

passage in zones where increasingly stricter requirements are in place for air pollution control – near coastlines or at port entrances.

For ships in smaller classes in inland and passenger shipping, however, experts say that such a drive concept could turn out to be profitable in just a few years. There have been pro- totypes for over a decade. As early as 2009, the Dutch Alewijnse Marine Systems Nemo H2 automated with a Bachmann M1 system – one of the world's first hydrogen-powered boats for passenger transport (see real.time issue 04-2009). This and various other projects have been pur- sued since then, delivering impor- tant results for developing this tech- nology further.

Ambitious Automation

Three processes must be controlled on a fuel cell ship: the "reformer" for hydrogen production, the actual fuel

cell for converting the energy stored in hydrogen into electrical current, and the entire energy management system required to do this. Currently these are implemented on separate control systems in independent tasks with their own safety controls. Not only is this costly in terms of hardware, but changes in a process can also hide the risk of unwanted effects on cycle times and other tasks. Bachmann sees a way out of this dilemma by implementing all fuel cell processes on one control system, which would ultimately only require one safety system.

The openness of the Bachmann M1 system, however, allows individual suppliers to program their subsystems in their usual development environ- ment, and then easily port the code to the M1 control system – with full encapsulation of the process and pro- tection of the knowledge. This saves costs for programming, installation, space requirement, and commissioning in comparison to using multiple

control systems. And communication of the individual processes between each other is easier. Furthermore, synchronous signals are available to all processes, which guarantees secure processing of programs. Corresponding topologies in networking also allow for a redundant structure up to SIL safety level 3.

In the MultiSchIBZ project, supported in Germany by the Federal Ministry of Transport and Digital Infrastructure, thyssenkrupp Marine Systems is already relying on the new Bachmann concept, in which safety is an integral part of the controls and the networking infrastructure is shared. This structure is certified by TÜV for industrial applications. A corresponding proposal for certification for a comparable application in shipping has been submitted by thyssenkrupp Marine Systems to the IMO. This should make series application possible in a timely manner.

A green future

Some major rethinking is required on the route to the future of maritime shipping. Ever stronger regulations for environmental protection are forcing this. The member states of the International Maritime Organization (IMO) have agreed to reduce greenhouse gas emissions by at least 50% from 2008 for the year 2050. That is ambitious. On a global scale, ships are the most important means of transport for goods and products. And it is likely to stay that way. This is why ships that are viable for the future tend to be clean ships. Hydrogen-powered fuel cells open up prospects accordingly.

What is used for short-haul ships today can also be safely scaled for larger distances with future technologies. This would be a major contribution to climate protection, and thus to the future viability of the maritime industry.
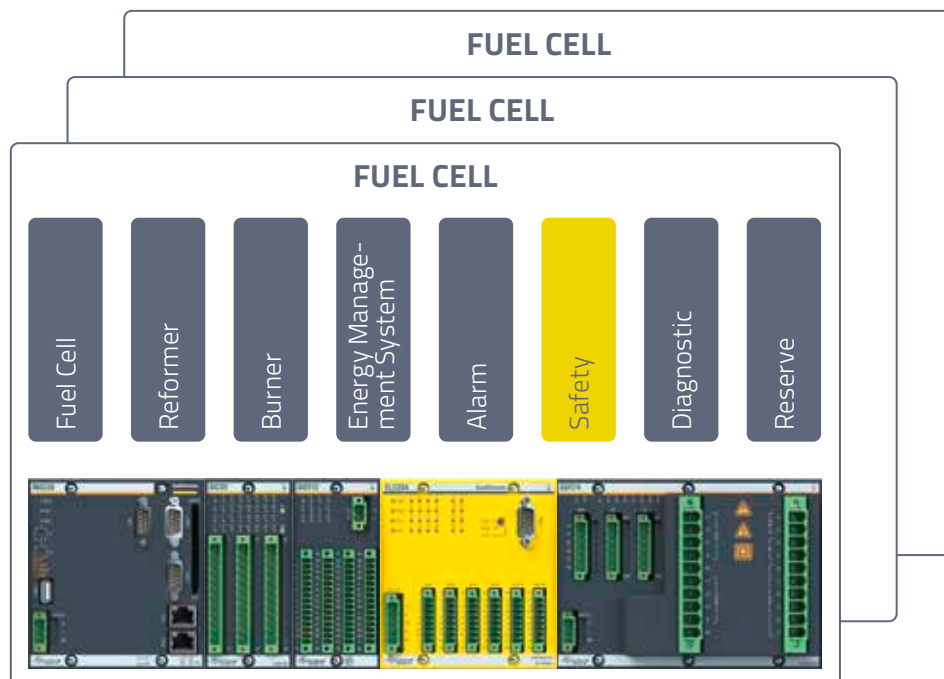
Scalable like the fuel cell system itself:
An M1 control system for all processes that can be programmed in C, C++, PLC according to IEC 61131 and directly via MATLAB®/Simulink®.

Secure Energy Supply

BREAKDOWNS FORBIDDEN!

Many chemical processes react strongly to power supply fluctuations. A power outage can cause considerable damage to materials and even threaten life and limb. AEG Power Solutions GmbH equips manufacturing sites with secure energy supply solutions for this reason. Intelligent control algorithms record peak times and help to minimize energy costs.

If the power fails in a galvanizing plant, then the entire batch in the electrolytic bath is usually lost. Surfaces no longer meet defined quality requirements and the substrate must be disposed of. An additional risk is that the ventilation systems required for secure operation would shut down during a power outage, preventing the controlled discharge of toxic and potentially explosive gases formed during the process.

Secure network, lower costs

It is therfore important to avoid interruptions in the power supply at all costs when it comes to highly sensitive chemical processes. This was also the primary objective for AEG Power Solutions, who recently built a system to secure the energy supply for a major German automotive supplier.

At the same time, the solution had to be able to absorb recurring load peaks and thus help to lower energy costs.

SWB AG from Bremen acted as a general contractor for this project.

Battery storage for standalone supply – and as a buffer

"A conventional uninterruptible power supply would not have fully met the requirements, but a battery storage with backup functionality would," recalls Andreas Becker, Head of Grid & Storage at AEG Power Solutions.

Therefore, a lithium-based battery storage system with the accompanying Convert SC Flex converter was installed. Part of this solution is a Bachmann M1 controller with integrated grid measurement and synchronization module GSP274.

THe module detects grid errors fast enough to immediately disconnect the galvanic system from the grid and safely switch to the battery system. It also supports automatic

resynchronization as soon as supply can be resumed via the public grid.

Peak shaving saves costs

At the same time, the power currently drawn from the grid is measured at the central coupling point. If the power consumption exceeds the defined time schedule, then the supply from the grid is limited and the required difference is compensated by the battery. This so called "peak shaving" saves costs, because higher prices must be paid if the power consumption is higher than agreed. The battery storage recharges during periods where less power is demanded or when energy prices are low.

Fast adaptation

AEG Power Solutions was particularly impressed by the free programmability of the controller and the extensive protection and monitoring functions already integrated in the GSP274. "Last but not least, the cooperation with Bachmann was excellent. Whenever we needed support, our contacts were there, competent and always prompt," praises Andreas Becker.
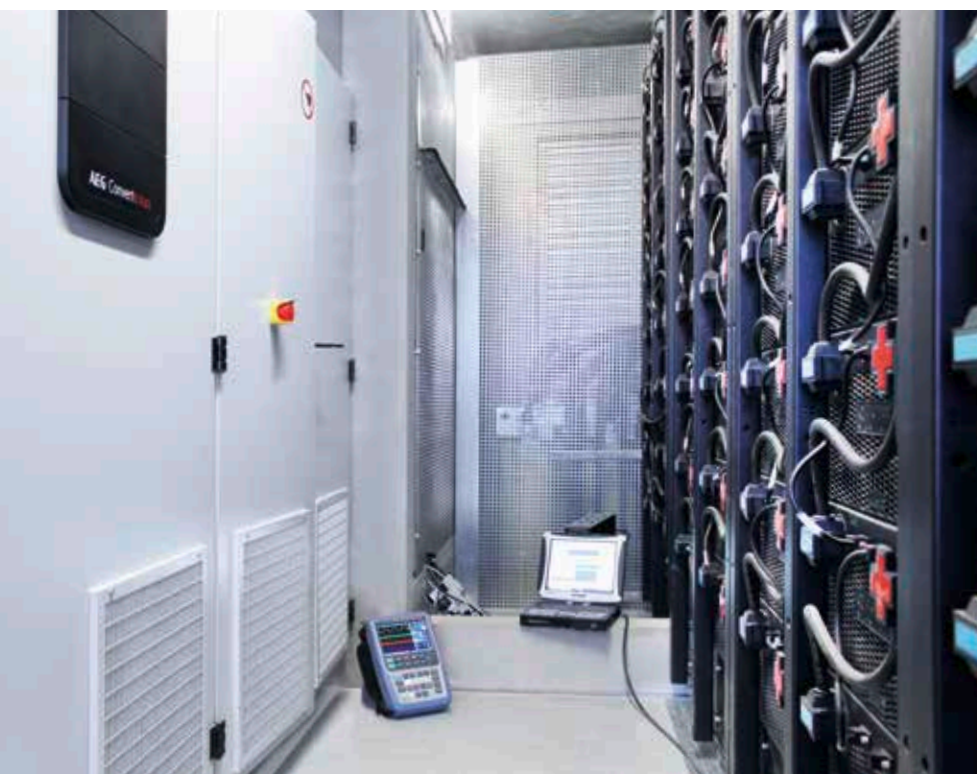
Secured: energy supply for a highly sensitive chemical process.

AEG POWER SOLUTIONS

– Headquarters in
  Warstein-Belecke (Germany)

– 700 employees at
  14 locations worldwide

– Supplier of power supply
  systems around the world
  for industrial, critical infra-
  structures and innovative
  power electronics applications

www.aegps.com

Starting Condition Monitoring

A LIFESAVER IN THE WAVES

Condition Monitoring (CM) is still a fairly new discipline in shipbuilding. Critical components are monitored, of course, but it is rare for the data collected to be connected to each other in a CM System (CMS), which adds value. The initial cost hurdle still appears to be too high for shipyards, shipping companies, and fleet operators to overcome. With Bachmann, it is possible to start at a lower cost, which can easily be scaled up to a high-end solution if need be.

Defects in the power train or drives are preferably avoided on the high seas. Such an incident would not only entail high costs, but also pose a risk to the life and limb of the ship's crew. This is why critical components generally need to be replaced preemptively according to a set maintenance schedule – regardless of whether a defect is apparent. This renders unnecessary effort and expense.

Continuous monitoring and corresponding evaluation of operating conditions allows changes in core components to be detected, and targeted maintenance carried out during planned downtime. What's more, not only can outages be avoided, but the operating life of essential components is extended while saving considerably on costs.

Dead end!

At least to some extent, CMS has already been implemented at many important points on ships. Sensors provide continuous measuring and trigger an alarm when measures pass a certain threshold. A service technician can inspect the area and identify causes. A frequent problem with this is that the monitoring solution is isolated and limited to monitoring a single assembly group.

Typically, the previous history of the values measured is unknown, and the alarm cannot be chronologically referenced to other events on the ship. To do this, a corresponding networking of systems and data is required, which isn't provided at all for most stand-alone monitoring

systems, rendering these solutions a dead end for true condition monitoring.

Affordable start

With the CMSSTD solution from Bachmann integrated into the control system, CM can be started inexpensively as of version 2.00, and expanded incrementally as needed. The initial investments remain protected, as the installation doesn't have to be rebuilt; plug-ins in the form of individual licenses can expand capacity at any time.

This allows CMSSTD to grow into a comprehensive monitoring solution that provides a complete status overview of monitored system parts, in turn allowing informed decisions about maintenance to be made.

Upon request, trained personnel from Bachmann Monitoring GmbH will remotely evaluate diagnostic data.

Basic version on board

The software is already part of the M1 system's standard toolbox and is therefore quick to install. With it, all process variables available to the control system are analyzed, and the analog and digital input signals from the AIO2xx, GIO2xx, and grid measurement GSP274 and GMP232 modules are monitored. With additional AIC214 vibration sensor modules, up to 48 piezo vibration sensors can be integrated, measurement data can be recorded with up to 50 kHz sampling rate, and the effective values of which (RMS) are calculated and logged round the clock. Alarm thresholds can be set by the user in accordance with the standards under DIN ISO 20283-4. Value trends and alarms can be displayed on an optional web terminal.

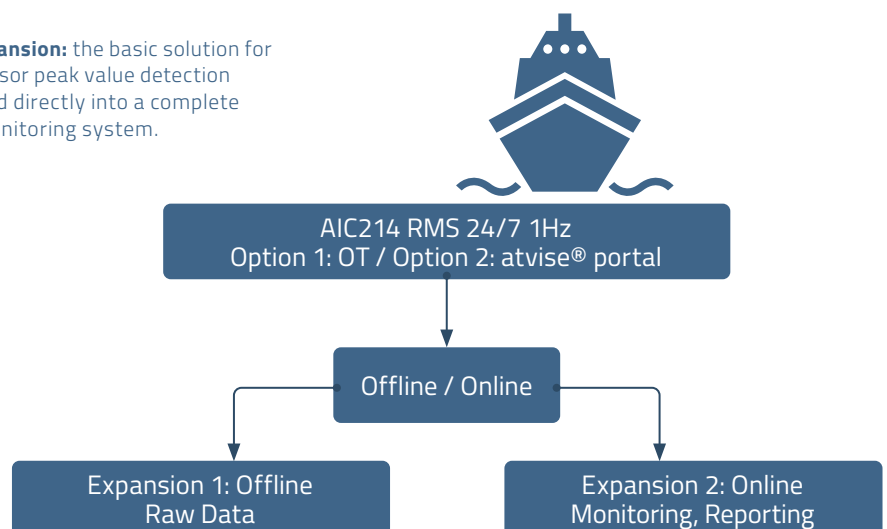### Plug-ins open up high-end Condition Monitoring

With offline plug-in licensing, it is possible to add to the basic features and define trigger events for logging other data – such as temperature, engine performance, and speed.

All raw data from the connected sensors is stored, and the measured value and alarm history can be transferred to a USB stick if needed. This allows the operator to evaluate the data with an appropriate tool, or to hand over to an external service provider for analysis. Mechnical vibration recordings, triggered by an event, can be saved as a WAV audio file using the online plug-in. The continuous recording of vibration data and its RMS values calculated online enables direct recording for operation management in addition to longtime diagnostics. Fine-spectrum analysis in the frequency range can selectively detect damage to the kine-matics of the drive train and forms the basis for in-depth analysis by experts on land.

Goal: Condition Based Maintenance

The Bachmann Condition Monitoring System makes it possible to start condition monitoring without complication or high costs. It lays the groundwork for comprehensive monitoring and assessment of the operating condition of critical components – and opens the door to condition-based maintenance. This result can be highly compelling. Higher availability of the ship and systems, better safety for the crew – and all this at lower costs.

Modular expansion: the basic solution for vibration sensor peak value detection can be turned directly into a complete condition monitoring system.

AIC214 RMS 24/7 1Hz
Option 1: OT / Option 2: atvise® portal

Offline / Online

Expansion 1: Offline Raw Data

Expansion 2: Online Monitoring, Reporting

ACCESS AT ALL TIMES

In order to quickly fix malfunctions or faults in wind turbines, owners, operators and service companies must have physical access to the structure and plant technology at all times. Furthermore, technical access to the command and signal interface is essential for status detection, control of operating processes, and intervention in case of malfunction. If this access is lost, the consequences could be dire. Bachmann presents the solution with customer-oriented access management.

In practice, access rights to the controls of a wind turbine, and therefore its data, are determined by the manufacturer. This situation becomes critical whenever the business relationship between customer and manufacturer ends, leaving the turbine owner or operator without access to their own turbines.

"In our case, we still had access to the turbines after our plant manufacturer went bankrupt, but our access was very limited. We were able to access individual display functions, but barely had the ability to operate and maintain our system with any degree of reliability or efficiency. This situation was life-threatening to us," recounts Ulrich Kreuzberger, Managing Director of KS Energiesysteme in Baden-Württemberg (Germany).

Full access enabled

There are a variety of solutions available to avoid such situations. One option is to retrofit the plant. This entails installing completely new software in the turbine's control system. However, this has far-reaching consequences. "The turbine's control system is part of its type certification.

Retrofitting would involve a lengthy recertification process. We haven't even considered replacing the entire control system or even just the plant's software," summarizes Ulrich Kreuzberger. "We were lucky that the control hardware wasn't a proprietary product of the wind turbine manufacturer, but instead was branded with the name "Bachmann". So we turned to them to ask whether there was any possibility of regaining access to our wind turbines."

Bachmann then succeeded in developing a software package that allowed the operator the desired access again. "Access to the system was generalized to the point that the system operator could take over user management. The plant manufacturer's management software wasn't changed, so we were able to avoid the recertification process," says Gabriel Schwanzer, Director of the Wind Business Unit at Bachmann electronic.

SCADA solution and IT security included

With the M1SenAccessBasic solution, wind turbine operators get the

same access to their systems as KS Energiesysteme, with the corresponding access levels. They can manage the turbines themselves without changing the current management software. "The manufacturer's IP rights and patents are not infringed," explains Gabriel Schwanzer.

FACTBOX

– Solution for all Senvion turbine models equipped with the Bachmann M1 control system

– Quick installation/setup

– Doesn't interfere with existing turbine software, therefore no validation or recertification necessary

– Complete access to all turbine parameters

– Individual user/access management

– Full SCADA functionality with Wind Power SCADA (WPS) from Bachmann

– Standard communication interfaces (IEC 61400-25 / OPC UA)

– Security and access protection (TLS / SSL encryption and authentication)

»We now have complete access to our wind turbine controls and can maintain and operate them independently once more.«

Ulrich Kreuzberger
Managing Director of KS Energiesysteme

With the newly available extension to the Wind Power Scada System (WPS) from Bachmann, operators are given full access to all systems. "With M1SenAccessSCADA, plant operators now have a complete SCADA solution that, in addition to covering operation management requirements, also covers remote monitoring, and thus guarantees complete access protection," says Gabriel Schwanzer.

In the extension, the Smart Power Plant Controller (SPPC) replaces the existing park controller and ensures access to data, including access protection. No hardware modifications are required. IT security is a top priority at Bachmann. With the Bachmann Operator Solution, IT technology for windturbines is brought back to the current level so that even older systems meet all the current requirements for cyber security.

Satisfied customers

KS Energiesysteme appreciates the collaboration they've had with Bachmann: "We now have complete access to our wind turbine controls and can maintain and operate them independently once more. Direct remote access is also much faster than the previous solution via web portal," says a satisfied Ulrich Kreuzberg. "We are also able to determine for the first time which people have which access to the wind turbines and even block access completely."

Now that access to essential control parameters has been opened, KS Energiesysteme sees even more potential. By optimizing performance curves individually, according to estimates, the turbines' rated output could be increased by about 5% for this system type. Kreuzberger is pleased: "The return increases, and we can re-amortize investments much more quickly."

Further information about independent access solutions for Senvion wind turbines can be found here:

K&S REGENERATIVE ENERGIE GMBH & CO.KG

– Headquarters in Dunningen-Seedorf (Germany)

– Wind energy project developer since 1997

– Services include project planning, construction, maintenance, and retrofitting as well as management of regenerative power plants

www.ks-regenerative-energie.de

Condition-based Maintenance

ALWAYS ONE STEP AHEAD OF MACHINE BREAKDOWNS

Unexpected power outages on a ship are expensive. The costs associated can sometimes reach six-digit amounts per day in Euros. If impending defects are detected early, then it becomes much easier to plan their targeted repair. Schottel, a global leader in drives and control systems for ships, has developed a system to reduce downtimes as much as possible. And it doesn't stop there.

The Schottel IoT Gateway MariHub systematically records condition data for the ship's drives and evaluates them for specific criteria. The measured values recorded are processed, archived, and regularly analyzed for trends. If an irregularity occurs in the drive train, it will be signaled to the crew via a warning or alarm notification. Then the crew will decide together whether to order a replacement early or prepare to repair it. "The added value of condition-based maintenance lies in the fact that the intervals between the prescribed inspections at the dock can be extended. This is arranged with the relevant classification society," explains Jan Glas, Sales Director of Automation and Digital Products at Schottel.

Standardized – but a perfect fit

MariHub uses Bachmann's M1 system as its base. The GIO212 module is used to record temperatures, pressures, and flow rates (fuel consumption). Vibrations on the drive train are recorded with up to 51.2 kHz using the AIC206 or the AIC214. System configuration is modular and can be set up in a variety of ways, allowing it to be adapted to the ship type and its various drive train models in just a few steps.

Controls – programmed in a different way

Because ships are often in transit for

days and weeks at a time, the signals recorded are evaluated directly on the ship. The specialists at Schottel programmed the algorithms required to do this with MATLAB®/Simulink®. M1 hardware blocks are a central component of the Simulink® model. With them, vibrations in the drive train can be recorded synchronously and then delivered to the subsequent analysis based on a frame. The AIC206 and AIC214 blocks are used for this, and they are now part of the M1 hardware library of M-Target for Simulink®.

"The M1 hardware is optimally integrated into Simulink®, which allows applications to be created in Simulink®. This approach saves considerable time in software development, because external functions and modules don't have to be integrated as additions," says Dirk Neumann, Development Engineer at Schottel. A team made up of Schottel experts certified by internationally recognized standards supports ship operators in evaluating the data recorded.

Central data collection

Schottel sees the refined damage early detection system as just the beginning, says Jan Glas. "The support for various communication protocols makes it possible to record numerous data from external components and correlate it, in addition to current operating data from drives. This includes, for example,

the ship's speed, it's position, and the performance or consumption of the drives." This expanded database enables new services and business models that go beyond classic condition monitoring.
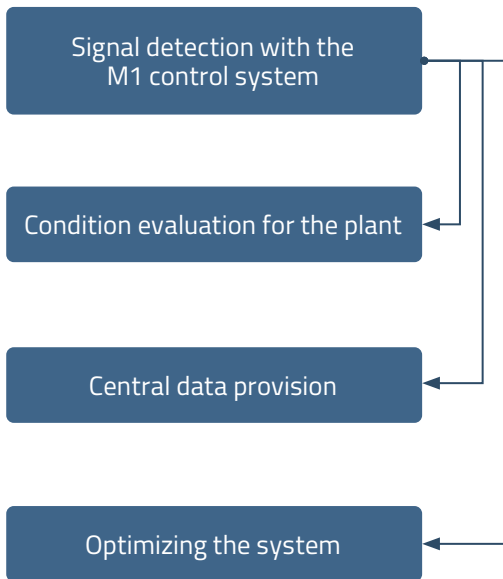
Basic data service

For the operator on land, the continuous availability of ship data in the office often involves a great deal of effort. Even for data that should be simple, like drive operating hours, the processes usually have to be performed manually. In contrast, data collected through the existing M1 control system and transmitted to the internet can be accessed by the operator directly as history. Operating hours, consumption, and pressures are thus conveniently available for further analysis in the web-based Schottel portal MariNet.

Future: a superior view

Data is the gold of the 21st century. However, it must first be converted into usable information before it can fulfil this role. This allows the analysis of a ship propulsion's operation profile to lead to optimized operation with lower fuel consumption. Even within an entire fleet, it's important to tap into optimization potential in order to use the right ship for a specific task. This results in financial added value for the customer, which can also be directly quantified.

Machine data is centrally recorded via the M1 control system.
This data forms the basis for new digital services to offer.

Signal detection with the M1 control system

Condition evaluation for the plant

Central data provision

Optimizing the system

SCHOTTEL GROUP

– Headquarters in Spay am Rhein (Germany)

– Founded in 1921

– Employs over 1,300 employees at around 100 sales and service locations worldwide

– Global leading manufacturer of drives and control systems for ships and offshore applications

www.schottel.de
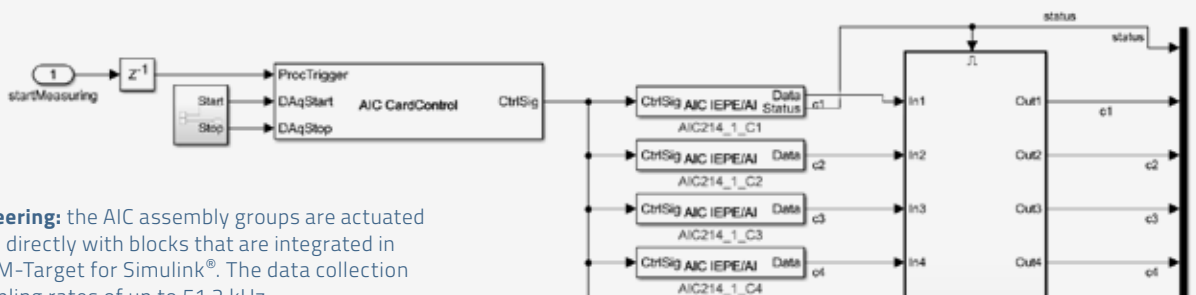
Lean Engineering: the AIC assembly groups are actuated in Simulink® directly with blocks that are integrated in Bachmann M-Target for Simulink®. The data collection allows sampling rates of up to 51.2 kHz.

LOWER COSTS, BETTER CLIMATE PROTECTION

Ideal indoor climates, low costs, and the lowest possible environmental impact – these are the objectives pursued by Swedish company Nordomatic AB with their building management solutions. Analytics tool Ecopilot detects weak spots in energy consumption and room temperature control, as well as much more. Combined with atvise®, users can clearly visualize where and how to save up to 40% of their operating costs.

Nordomatic, headquartered in Stockholm (Sweden), is a leader provider of building automation in the Scandinavian market. The company specializes in solutions for intelligent buildings and energy-efficient operation. The central drive for Nordomatic, which has seen strong growth over the last ten years, is to achieve the European Union's climate and energy goals. "Buildings represent 40% of the EU's energy consumption and 36% of CO_2 emissions," says Joachim Bähr, Business Developer at Nordomatic

such as HTML5, .NET, SQL, and OPC. "Our solutions are not tied to specific manufacturers or technologies, but communicate with virtually every building technology control system on the market," says Joachim Bähr, confirming the company's principal philosophy. Another important success factor is the userfriendliness of their systems. An intuitive and easy to use interface makes it easier for users to assess indoor climate and energy consumption, and thereby effortlessly implement corrective measures.

Terminal Bundles with atvise®

For local visualization, Nordomatic relies on Bachmann's inexpensive OT1200 web terminal series. Building data is generally conflated on a central control station computer, for which the high-performance, widescreen multitouch terminal featured by the OT1300 series is ideal. Nordomatic uses Bachmann control units for this as part of the bundle with atvise®: the visualization is pre-installed and pre-licensed, which greatly reduces cost and effort during commissioning.

With Nordomatic Smart Cloud, customers are offered a future-proof cloud service: the third-generation SCADA system likewise builds on atvise® scada and reinforces the company's claim to provide the most energy-efficient and simultaneously most user-friendly building management solutions.

Cloud Solutions. More than 75% of existing buildings have energy efficiency weak spots, according to the European Commission. For the ambitious goal of a 40% reduction in greenhouse gas emissions by 2030 is to be achieved, considerable process must be made. "An intelligent building management system (BMS) is an important lever for this," believes Bähr.

Consistently open

In developing its systems, Nordomatic consistently relies on globally established standards in IT communication

Vertical continuity

Nordomatic heard about atvise® while looking for an attractive web visualization. The object-oriented engineering and easy scalability of the Bachmann system architecture won them over. Process data, alarms, and history are all fully cascadable, data and visualization objects can be reused 1:1 in local visualizations, on the central control station, and in their cloud-based portal. "With this, we were able to noticeably reduce our development, integration, and even maintenance costs," says Bähr.

NORDOMATIC AB

– Founded in 1967

– Employs more than 400 employees at 20 locations in Sweden, Denmark, and Norway

– The company turned a profit of 85 million Euros in 2019

www.nordomatic.com

WIRE ROD MILL INNOVATION

SMS Group GmbH is an international leader in steel and rolling mill technology. With the revolutionary MEERdrive® drive concept for wire rod mills, material speeds of over 100 m/s can be achieved - while maintaining high precision and flexible production. When it comes to automation technology, SMS Group relies on Bachmann.

The family-led SMS Group specializes in plant construction and engineering for processing steel and non-ferrous metals. Whether it's auto parts, tubes for pipelines, heavy sections for use in building, wheels for high-speed trains, or aluminum for facade construction, the group's custom-made machines and plants ensure flawless component production.

The company manufactures wire rod and bar mills for the section rolling mill sector. Wire is a true all-rounder — it is found in high-quality components for the automotive sector, the chemical industry, mechanical engineering or for fastening elements. Different materials and alloys are processed into products with a wide variety of dimensions. To ensure flawless production, rolling mill processes must interact smoothly. "With the MEERdrive® technology, we've created the ideal system," says Jürgen Falk, Automation Long Products at SMS Group.

Flexible Equipment

The MEERdrive® is the core component in rolling lines for manufacturing wire with a diameter of 5.5 to 25 mm. "The idea behind MEERdrive® is very simple," explains Falk. "The group drive in a wire rolling block has a relatively high energy consumption and requires a lot of maintenance. We wanted to re-place it with intelligent individual drives." A rolling line consists of several production stands arranged one after another. With the MEERdrive® drive technology, each stand — containing at least one pair of rollers — is driven by a separate motor. To keep everything running smoothly throughout the entire rolling line, the drives are synchronized at a higher level.

With MEERdrive®, each stand can be considered a separate, self-contained unit. "This allows calibration to be adapted to individual customer require-ments, the dimensional program, and

the steel quality. Thanks to the elim-ination of the large motor with com-plex transmissions, fixed reduction ratios between stands are no longer neces-sary and wire manufacturers gain more flexibility," explains Jürgen Falk.

Roll ring management is likewise simplified, as individual pairs of rollers can be replaced separately. Individual speed settings for the different stands allow the use of roll rings with different diameters. "The roller pairs required for an annual production can be reduced by up to 60%," emphasizes Falk.

Attractive Total Package

The SMS group has relied on Bachmann's M1 automation system since 2012, with great benefit to their customers: "Thanks to the high rolling speed of over 100 m/s, our systems are extremely productive. The individual drive technology also makes storage and spare parts

Modern rolling line: in order for production to go smoothly, the processes in rolling mills have to mesh perfectly with each other.

inventory more cost-effective," explains Guido Sonnenschein, Senior Expert Electrics, Automation Long Products at the SMS group.

The system's core is the MH212 control system from the M1 toolkit. The SMS Group relies on M-Target for Simulink® for model-based development and the simulation of drive concepts. "The seamless transition from offline to online operation has proven successful here," says Guido Sonnenschein. "This way, we can develop controller characteristics offline, test online, pre-assemble, and optimize for run time."

In addition to the visualization software and other I/O components, the ISI222 module from Bachmann is also used. It is used to read the rotary encoder and actuate the inverter in the MEERdrive®. "Bachmann has impressed us with the robust quality of their system, and also with the openness regarding programming languages and fast cycle speeds," emphasizes Guido Sonnenschein.

But also the company's competence, straightforward support and fast delivery times are proof for the drive specialist that SMS Group has chosen the right partner. "This is why we also rely on the M1 automation system in the bright steel product range for peeling, grinding, and drawing machines."

SMS GROUP GMBH

– Company headquarters in Düsseldorf (Germany)

– Part of SMS Holding GmbH, which generates a turnover of more than 3 billion Euros with around 13,500 employees worldwide

– An international company in plant construction and engineering for processing steel and NF metals

www.sms-group.com

EVERYTHING UNDER CONTROL

The latest version of the VDE-AR-N 4110 connection rules in Germany went into effect in May 2019. With them, the use of a certified power controller became mandatory for operators of energy farms with a total output of 135 kW or more. S.-S.B. Systemtechnik GmbH & Co. KG found themselves facing several new challenges. With the Smart Power Plant Controller, certified in accordance with VDE-AR-N 4110/4120, Bachmann offered the perfect solution.

SMART POWER PLANT CONTROLLER (SPPC)

– EZA Controller certified in accordance with the new version of the VDE-AR-N 4110 (May 2019) as well as VDE-AR-N 4120

– Supports up to 100 power generating units in heterogeneous energy parks

– Balanced generation

– Proven Bachmann M1 control system with powerful CPU and high-precision grid recording and protection modules

– Communication and energy protocols standardized in accordance with IEC 60870-5, IEC 61850, DPN3, and OPC UA

– Access control with rights management based on the highest security standards

– Web-based visualization for fast commissioning and monitoring of the controller

– Computer simulation model that for complete system certification, integrates into popular network simulation programs

– Expandable with additional hardware and software

An energy farm typically consists of various power generation units such as combined heat and power plants, photovoltaics, wind turbines, and even battery storage, which appears as a large power station at the outlet to the network. The power plant controller is a central component. It ensures that the energy farm runs efficiently, that the network is stable, and that the network quality required is adhered to.

The park controller controls power and transmits required control variables to the various generating units based on specifications from higher entities, such as the grid operator or a direct marketer.

Certified Controller Required

Energy farms are equipped by S.-S.B. Systemtechnik with electrical control systems. "In a seminar on the new version of the VDE technical connection rules, we realized that we had to include a certified power plant controller in our product range," recalls Michael Meyer, Sales Director at S.-S.B. Systemtechnik. "We had recently met with Bachmann at nergyDecentral and were impressed by the company's experience and expertise in the field. Therefore, we knew who to turn to with our inquiry."

At that time, Bachmann was already working on the development of a compliant power plant controller for energy farms: The Smart Power Plant Controller (SPPC) is a software module that runs on the proven Bachmann M1 controller. In addition to the full range of functions required by the standard, the controller also enables other features, such as SCADA connectivity and primary control.

Easy Project Planning Thanks to Standards

The advantage of Bachmann's power plant controller is that communication with network operators, direct marketers, and other network users is easy to configure. The Bachmann control system supports a multitude of communication protocols. The product is rounded off by a user and access security concept based on the latest standards as well as a web-based commissioning and diagnostic interface.

"The controller's many interfaces and its flexibility are truly fascinating and have impressed us," says Meyer. When configuring the power plant controller, groupings can be created to account for the park's topology in the best possible way and to map higher-level structures. Depending on contractual requirements, different priorities can also be assigned to these groupings.

Successful Pilot Project

The first project with the power plant controller was implemented by S.-S.B. Systemtechnik for an industrial customer. To improve the company's ecological footprint, a photovoltaic plant was commissioned. "Our customer was already using other power generation units. They didn't want to rule out the possibility of adding others in the future. For this reason we decided to use a prototype of the Smart Power Plant Controller."

The controller, equipped with the GMP232 grid measurement and protection module, records the required data and controls the various generating units, while taking the require-

ments of the grid operator into account. "By using the power plant controller, we were able to certify the entire customer system according to the new connection rules in one go. That was a huge advantage for us."

S.-S.B. Systemtechnik was the pilot customer for the Smart Power Plant Controller and had no regrets about this decision. "We trusted Bachmann completely. The team actively supported us in our project and implemented the necessary software adaptations reliably and quickly. We were particularly impressed by the comprehensive know-how, especially regarding the VDE standards."

S.-S.B. Systemtechnik now uses Bachmann's certified SPPC infeed system as a standard and has already successfully completed several dozen projects.

S.-S.B. SYSTEMTECHNIK

– Headquarters in Cloppenburg (Germany)

– Founded in 1997

– Full-service provider for all questions about electrical engineering

– From automation systems to switchgear construction and electrical engineering, the company is active in various sectors

www.s-sb.de

DELIVERING MORE, AHEAD OF SCHEDULE

If a wind turbine manufacturer increases order volumes by one third, then under normal circumstances the challenge can be solved. But what if the integrator is in China, the system supplier is in Austria, the timeframe is tight – and the whole world is holding its breath because of coronavirus? A situation extremely well handled by Bachmann.

The China Shipbuilding Industry Corporation (CSIC) is a Chinese consortium of companies home to around 150 scientific research institutes, private companies and publicly traded firms. China's largest shipbuilder is now one of the country's ten biggest wind turbine manufacturers. Their portfolio includes double feed turbines with outputs of 2-10 MW. A new platform for gearless wind turbines is currently in development.

More Parts, Faster Delivery

In November 2019, CSIC signed a purchase agreement for the supply of Bachmann M1 control systems to equip 1,500 turbines, to be delivered in 2020. This was about triple the volume of previous years. In February of this year, CSIC realized that the original delivery schedule and number of parts ordered would not be enough to cover their needs. Delivery dates would need to be advanced and quantities increased significantly. But there was a catch: the coronavirus pandemic had just hit Europe. "Our Chinese customers were concerned about whether we would be able to meet delivery commitments under these conditions," recalls Frank Mitschke, Managing Director of the Shanghai branch.

Braving the Pandemic

Meanwhile, Bachmann in Austria did everything to meet CSIC's expectations: "An emergency plan for the plant in Feldkirch was developed practically overnight," says Werner Elender, COO of Bachmann electronic. To minimize the risk of infection, all employees who don't work directly in Logistics and Production were asked to work from home. "We also made sure to separate shifts strictly by time and place in order to limit direct contact and avoid having to close the entire company," says the COO, describing the procedure during the nationwide lockdown. According to Elender, the fact that Bachmann has a considerable vertical range of manufacture at the site was a decisive advantage: "In contrast to other companies that obtain semi-finished products from abroad, we were largely independent of suppliers and were able to manage the situation alone."

Ahead of Plan

In July, production was already around one-third higher than originally planned in the purchase agreement. CSIC was visibly pleased with the successful logistics performance during such challenging circumstances. Besides the functionality and robust quality of Bachmann's solution, timely installation cemented CSIC's position in the highly competitive Chinese market for offshore wind turbines.

„IT'S ALL ABOUT POWER FLOW"

The primary fuel source for ship propulsion is diesel. Additional power required for auxiliary drives, as well as the on-board power supply, is often also generated from diesel . Due to growing environmental concerns, the search is on for alternative fuel sources. But finding an alternative isn't so easy. Jeroen van Tilborg, founder and Managing Director of Dutch company D&A Electric, explains to us the challenges involved and highlights some potential solutions, with applications that extend beyond shipping.

Van Tilborg has spent decades working with ship propulsion technology, including the development of construction methods that are both energy-efficient and environmentally friendly. He also builds battery storage devices to stabilize power supply systems. The technology behind electric propulsion systems and grid stabilization is actually quite similar.

Mr. van Tilborg, why is it so hard to replace diesel ship propulsion systems with renewable systems?

Jeroen van Tilborg: the power requirement at the ship's propeller is cubic to the speed of the propeller. This generates a very steep load curve, and a diesel engine can supply this amount of power at any time. The disadvantage is the engine's inefficiency and its exhaust emissions. A gas engine, fuel cell, or other renewable energy source alone is not enough to solve this dilemma. Rapidly changing loads, along with the accompanying power surges, always have an impact on the entire on-board power supply. Controlling the total power flow on a ship is a major challenge.

One of the suggestions you made was to use a type of battery buffer.

Indeed; energy flow can be controlled this way. You can offset peaks in one direction or the other – during vessel acceleration and deceleration, for example, but also in the event of individual unit malfunctions, which also lead to instability. Even a fuel filter blockage can cause serious problems. The issue with fluctuation is that combustion engines are sluggish, and load peaks cause their speed to fluctuate. This is a minor problem when it comes to the ship propulsion system. But a downstream generator is much too slow to offset an electrical system and the control systems are not designed for these requirements. You have to bring the two worlds together.

Furthermore, marine diesel has very high energy density. No renewable energy sources can match it. Furthermore, if you can't supply the propulsion system with power in a similar form to what shipmasters use today, then you end up with an entirely different power curve – and the ship's handling changes. Now, you can try to adjust the propulsion by adapting the propeller's mechanical design and using a corresponding controller system. But the power density of an LPG-powered or fuel cell engine has its limits, which

»The major challenge lies in controlling all the power flow on the ship.«

Jeroen van Tilborg
Founder and Managing Director, D&A Electric

is why you need reserves, such as a battery. However you look at it, it's all about power flow!

Can you say something about the controller requirements?

Engine controller systems typically have cycle times of 200 to 500 ms. To protect an energy system in the event of a malfunction, though, you need to be one hundred times faster. Simultaneously, you have to prevent machine-driven generators from reacting too slowly. And, presumably, the machine will always react to instability, even after the event. When it comes to overall energy flow control, different instabilities caused by different systems must be taken into account. This makes automation rather challenging.

You need an energy source that reacts quickly, such as a battery. But it's also important to be able to take grid measurements as fast as possible. That's exactly why the Bachmann M1 system is so valuable to us. We can use it to measure and monitor the energy network quality directly in a PLC environment, instead of a se-

parate measuring system. We also have real-time access to a lot of information that helps to determine the actual energy flow – so that we can intervene when required.

Network operators on land are facing a similar challenge. How can your findings be transferred to the public network?

Almost 1:1. Up to now, the distribution network has mainly been supplied by large power stations, which also ensure the corresponding network stability. Now electric utilities, wind turbines, and photovoltaic systems are becoming increasingly smaller. At the same time, uncontrollable power consumption, for example through electric cars and ovens, is becoming commonplace. Many industries increasingly rely on electric power sources instead of gas or oil and local instabilities are continuing to rise throughout the network. In this environment, we can draw on our expertise from expanded standalone ship power grids, where we often spend an entire day managing instabilities.

If you have a network subset, in which there are several energy sources as

well as large, uncontrollable energy consumers, then we'll set up an accompanying battery system. We measure the local grid, supplying or withdrawing energy to stabilize the network locally. As long as the power required in the monitored section remains below a certain limit, it will draw from the standard network. If it exceeds a certain level, then it will be buffered from the battery. Local instabilities can therefore be corrected locally, without affecting the entire grid.

The best part is that it can be set up as a locally controlled system, but still with a connection to the network. Isolated, and secure.

Thank you so much for talking with us.

GETTING THINGS JUST RIGHT

Twinson Industrial Automation, based in Barendrecht in the Netherlands, develops customer-specific automation solutions for the maritime and offshore industries. Efficiency, reliability, and scalability are the company's top priorities. To achieve them, Twinson relies on the Bachmann M1 automation system combined with atvise® scada.

The goals of the engineers at Twinson are as simple as they are logical: the right hardware and software for projects of every size and complexity level. To fulfill this demand, Twinson relies on close partnerships with their system suppliers. "Automation with current technologies presents so many possibilities, which are often not used to their full extent. We believe that a combination of knowledge and experience is the only way to utilize the latest technologies efficiently every time, and thus to work efficiently," says Erik van Os, founder of Twinson Industrial Automation, summarizing a principle he considers vital.

Simply put, "why should we focus on problems that fall under someone else's core competence, especially if they are already solved?" asks van Os. "We feel that our role is to bring these abilities together in our projects. This gives us more freedom and we can concentrate on our core service, which is the actual control architecture."

Integrated From the Start

Conception, development, implementation, and testing are mapped in a continuous workflow for Twinson. Object-oriented functional and technical designs build upon one another, but are then separated.

In the engineering platform, all technical documents, such as schematics, PLC and SCADA software, or test reports are stored along with the construction and function principles. They can be generated from the database at any time. "This guarantees reliable project documentation from the start and throughout a plant's lifetime," emphasizes Erik van Os.

Essential Virtualization

In order to adhere to specifications and ensure that the final product meets applicable standards and regulations, van Os argues that hardware and software engineering must run in parallel. He considers simulation and validation of hardware and software through virtualization to be an indispensable part of modern automation. For this reason, Twinson also relies on Bachmann's M1 automation hardware. "The hardware platform is robust, modular, and open for software tools – like the 20-sim simulation

package from Controllab, which we also use," van Os explains this decision. "Thanks to hardware-in-the-loop simulation (HIL), we can practically test our control systems in advance. Most importantly, this significantly reduces commissioning time."

Erik van Os was also impressed by the modularity and openness of the M1 controller because this allows him to use it for both large and small projects. "This gives us a single platform pm which we can solve everything. Engineering becomes much more efficient, which is also cost effective, and ultimately produces higher quality."

Simple Connection, Strong Design

The company uses atvise® scada from Bachmann for the user experience, visualization, and data storage. In addition to the availability of the OPC UA communication protocol, flexibility and scability were also at the top of the criteria list in selecting a modern operating solution. "We really appreciate the rendering and intuitive operability of atvise®," confirms the managing director. It was also important to use standards such as HTML5 or JavaScript

»We believe first
and foremost
in the power of
partnership.«

Erik van Os
Founder and Managing Director
Twinson Industrial Automation BV

as the basis for implementation, as this provides access to a large pool of developers. "Thanks to its pure web technology and responsive designs, atvise® also delivers a flawless display on any computer, tablet, or smartphone," adds van Os.

Achieving Goals Together with Passion

Passion for automation, dedication, and an open culture are what distinguishes Twinson. Together with their customers, they search for the answers to questions and consider which solution is best suited to achieve a specific goal. "At Twinson, we believe first and foremost in the power of partnership," says Erik van Os. "After all, when we inspire and energize each other, everyone wins. In Bachmann we have a great partner, one that is close by and always available."

TWINSON INDUSTRIAL AUTOMATION BV

– Headquarters in Barendrecht (NL)

– Develops and supplies complete automation solutions for maritime applications

www.twinsonindustries.com

THE SHIP PROPULSION OF TOMORROW

To achieve efficient and environmentally vessel operation, control system requirements are diverse and manifold. Controllers should allow the integration of hybrid drive systems, offer the highest reliability, be internet-enabled and as flexible and economical as possible. Almost every ship is unique and in this process, and the optimal interaction of individual components places high demands on interface connection, communication, control and regulation.

This is why the Schottel group relies on high-performance control systems such as Bachmann's M1 system.

The 31-meter cruiser Vanadis has a hybrid propulsion system with both diesel engines and electric motors. The latter are integrated directly into the drive train's shaft line. (Photo CCN)

Complex Ships – Intelligent Systems

The award-winning motor yacht Vanadis is a complex vessel. The 31 meter yacht is powered by a hybrid propulsion system consisting of diesel and electric engines. Both drives act mechanically coupled on the same drive train – either sequentially or simultaneously.

Depending on whether the goal is to optimize fuel consumption or reduce noise emission, either the electric or combustion engine can be used for propulsion. In combined operation, the speed and torque of both drive units must be synchronized. During this process, both the load distribution as well as the leading system change. The frequency converter and engine control unit must be adjusted so they do not interfere with each other.

Redundant Design for Full Control

A failure of the propulsion system or the maneuvering elements would in many situations prove fatal. Therefore, modern propulsion control systems are fully redundant. The transition between the systems should be as smooth as possible. Thus the hardware components, including the PLC as the core element of the system, are doubled.

Modular Software Architecture

Just as important as reliable hardware is the error-free functioning of software. The prerequisite for this is a process-reliable development including extensive and standardized tests. On the other hand, there are the large variety of components to be integrated plus requirements for real time, redundancy, and cyber security, which require a high level of flexibility. A modular software architecture provides a solution to this challenge.

Meanwhile it is possible to implement this flexibility centrally and in a standardized way on the CPU through multitasking.

In addition to increasing the software quality through recurring function modules, this centralized approach reduces the total number of components. This results in a lower probability of failure and a lower risk of errors. Manufacturing activities for the construction of switch cabinets can be optimized, and the expense for future maintenance will be reduced.

Many Applications, Easily Expandable

Thanks to the flexible combination of newly developed applications in the form of standardized modules with Bachmann's Component Manager Framework, a wide range of applications can be covered, from a tugboat to a mega yacht and even a tanker. Because the individual components have been compiled and tested during development, the full application can be assembled through configuration alone and easily expanded later on. The variety of protocols supported by the Bachmann M1 facilitates integration into the architecture of the control system.

Secure Data Transfer

The system architecture is designed based on the security-by-design principle and divided into different zones. The individual zones are separated from one another by a hardware firewall. All communication between data collection and data evaluation systems runs through the specially hardened HMI. Security for file transfers is further enhanced by certificate-based signing and AES-256 encryption. Local storage (ring memory) prevents data loss, even if the internet connection is lost.

Optimum use of Potential

Operating data such as ship movement and environmental conditions combined with corresponding status data of the propulsion system, such as the propeller speed, form the basis for discovering, implementing and ultimately even quantifying efficiency improvement potentials. If the high-resolution data is processed directly at the source, the information is available to the crew even when operating offline. This ›on-board post-processing‹ on the Bachmann M1 controller together with the IoT Gateway can also be retrofitted as a standalone version in a switch cabinet on existing ships.

The mobile communications standards now globally available near the coast allow cost-effective networking. This offers the possibility of introducing a future-oriented, data-based lifecycle management even for smaller units such as tugs, work boats or ferries. The most important key figures on fuel consumption, speed, drive maneuvering, and environmental factors can be visualized at a glance in an online portal.

SCHOTTEL GROUP

– Headquarters in Spay am Rhein (Germany)

– Founded in 1921

– Employs over 1,300 employees at around 100 sales and service locations worldwide

– Global leading manufacturer of drives and control systems for ships and offshore applications

www.schottel.de

GENTLE COUPLING

Most marine transmission couplings are still controlled hydraulically and mechanically. Coupling processes are sluggish, with unwanted bumps during engaging and rerouting. With proportional valve control, however, power transmission is precise, fast - and gentle. Noris Group has the solution.

The globally active Noris Group GmbH, based in Nuremberg (Germany), develops and produces products, components, and custom solutions for measuring technology and automation in the shipbuilding industry, traffic engineering, and meteorology. In the latest reversing gear units, proportional valves were used for monitoring and control instead of the complicated mechanics: "This enables us to implement complex and dynamic controls and to adapt the power transmission precisely to the drive train behind it", explains Felix Weiss, Head of Sales Marine at NORIS Group.

Challenging Conditions

The specific challenge in finding a solution were the harsh conditions in the engine room, especially the vibrations. In the Bachmann M1 automation system, Noris not only found the right hardware, but a solution that meets their high

standards for performance. "With VxWorks as an operating system, we get robust hardware integration with reliable real-time tasks, but with all the interfaces of a modern automation platform for maritime applications," Felix Weiss confirms their decision for the system.

Flexible Hardware

The employed MX213 processor module already includes the most common interfaces such as Ethernet, CAN and serial interface. Furthermore, all protocols required in shipbuilding such as Modbus (RTU, ASCII, TCP, UDP), CAN, J1939 and OPC UA and MQTT are implemented, which made integrating the clutch control straightforward.

Finally, a module from the PVA20X series was selected for the precise control of the proportional valves. Its functions were developed by Bachmann in close cooperation with established shipbuilders.

Burkhard Staudacker, Key Account Manager Maritime at Bachmann electronic grins: "With the GIO212 universal input/output module, you always have a joker in your hand during startup." This module can be used to capture, process and output the most common signal types in the small signal range. Analog and digital input or output signals can be assigned to each channel.

Plethora of Advantages

The control system performs tasks that are usually carried out by mechanical assemblies. This not only reduces the weight and installation effort on board, it also makes start-up and subsequent maintenance easier and cheaper. All the settings are made electronically on site – keeping mechanical components available and replacing them is a thing of the past.

"The PVA module offers many standard functions such as a ramp

NORIS GROUP GMBH

– Headquarters in Nuremberg (DE)

– Founded in 1925

– Globally active in shipbuilding and traffic engineering (rail and special purpose vehicles)

www.noris-group.com

function and dither, but can also be operated directly via code," Weiss explains the decision for Bachmann. "With the M1 system, we can also execute precise control processes with response times of 1 millisecond without any problem. All this offers us the highest possible comfort and flexibility."

The Future in Front of Us

Felix Weiss is convinced that advancing digitization and networking will open up many more possibilities in ship automation. The most urgent goals are to operate systems as efficiently as possible, save costs, and protect the environment.

This is why he believes that condition monitoring solutions will become the standard. "It takes the right expertise and high-performing systems that satisfy the growing requirements for data collection and processing power," says Weiss. "With Bachmann we have the right partner at our side."

OPENING THE BLACK BOX

Belgian company VMA specializes in ready-to-use automation solutions. Their customer, an electric vehicle bumper supplier for a major European automotive group, needed to update to a cost-effective, just-in-time production line. atvise® delivered a clear visualization.

Spread-out Production Plant: bumpers "just-in-sequence" thanks to atvise®.

The expansion and migration of an existing assembly line installation for French automotive supplier Plastic Omnium required a new SCADA system. Functionality had to be as close as possible to the former solution so that employees would require minimal retraining. The existing PLC had to be updated, but not replaced. "The risk of a production delay was unacceptable for the supplier," explains Dirk Stradiot, Software Engineer at VMA.

Openness Grants Flexibility

Up until now, the supplier had relied on a propietary SCADA system. "The existing system was a black box for us," Stradiot explains the challenge. Accordingly, a lot of flexibility was required when it came to integrating the new solution. A number of customer-specific solutions also had to be integrated, and communication with data-

bases, barcode scanners, and other systems ensured. "We quickly realized that we were barely able to achieve our goals with a standard SCADA solution," says the engineer. Ultimately, control logic accounted for 90% of the total development costs in atvise®. The remaining 10% was attributed to classic visualization. Stradiot is pleased: "Thanks to the openness of atvise®, we were able to create custom-designed, clearly comprehensible user interfaces based on pure web technology for every step of production. atvise® automatically scales to different display sizes without any losses."

Clear Communication, Reliable Delivery

With direct API accessibility, orders and production details, including the current position of individual bumpers in the production line, can be exchanged between the manufacturer and supplier in real time. Sequence control factors

in various production times of individual parts and takes care of reliable, just-in-sequence delivery at the right time and in the correct order. "This industry does not forgive mistakes or delays. With atvise®, control logic, database access, and data exchange have so far run without errors and with total reliability," says a clearly satisfied Dirk Stradiot.

Deadline: 2 Months

The installation covers an area of about 2,000 m². "This was not by any means a small project. It's due to the scalability of atvise that we were able to dismantle the entire plant, build new expansions, and start it up in less than two months." The software specialist is convinced. Online engineering was particularly helpful for the engineers during start-up. They were able to make all changes directly during continuous operation, without having to stop or restart the system. "That was a major benefit for us."
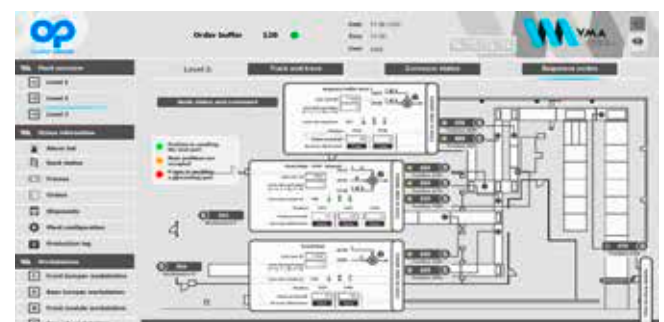

VMA

– Around 850 employees worldwide

– Develops and integrates complete electrical and mechanical solutions in industrial production, for infrastructure projects, and technical building installation

– Turnover of 170 million Euros in 2018

www.vma.be/de

A clear tracking system for all stands and car parts was one requirement for the new SCADA.

Sequence Overview: both the individual parts of a vehicle and the corresponding vehicle models are automatically sorted into the correct order before delivery with the logic integrated into atvise®.
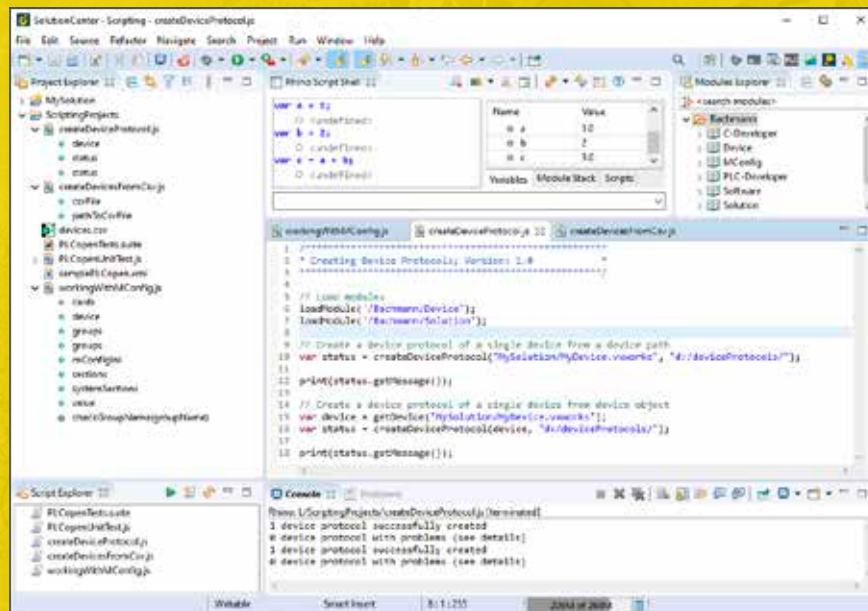
»Tips and Tricks are welcome shortcuts to achieving the goal.«

FOCUS ON EFFICIENCY

It's the little tips and tricks that make day-to-day work easier. This applies just as equally to Bachmann's engineering tools. Over the next few pages, we've compiled some ideas that save time and help to improve project efficiency.

WORKING WITH **SCRIPTS IN SOLUTIONCENTER**

The scripting view includes views for creating and running scripts.

was expanded to include a number of Bachmann-specific functions.

Sample scripts can be selected under *File > New > Example*, saved to any project, and then edited. All specific Bachmann module functions are used in the templates.

Manual execution of repetitive engineering tasks costs time and increases the risk of a mistake, which is why such processes are preferably automated. The SolutionCenter's libraries contain functions that generate application programs from a database and execute fully automated, completely integrated tests. The start takes place either at the push of a button or automated on the Build Server.

To automate as many work processes as possible, the Scripting Framework

We recommend using the scripting views for efficient script programming. These include special views, such as the Script Shell for directly running script code, and the Modules Explorer, which provides an overview of all existing functions.

WORKING WITH **SHORTCUTS** IN SOLUTIONCENTER

HELPER		DEPLOY	
Show **Tooltip** Description	F2	**Start/Attach** Debug Session	F11
Quick **Fix**	Ctrl + 1	**Deploy** Module	Ctrl + F11
Quick **Outline**	Ctrl + O	**Disconnect** Debug Session	Shift + F11
		Terminate Debug Session	Ctrl + F2
BUILD		**DEBUG**	
Build Project	Ctrl + B	Step **Into / Over / Return**	F5 / F6 / F7
Build All Projects	Alt + B	**Resume**/Run	F8
		Run to Line/Block	Ctrl + R
NAVIGATION		**CHANGE VALUES**	
Open **Declaration**	F3	**Write** Prepared Values	F10
Backward/Forward **History**	Alt + ⬚	**Force** Prepared Values	Shift + F10
Last Edit Location	Ctrl + Q	**Release** Forced Values	Ctrl + Shift + F10
Find References	Ctrl + Shift + G	**Clear** Prepared Values	Alt + F10
Open Call **Hierarchy**	Ctrl + Alt + H	**BREAKPOINTS**	
EDIT		**Toggle** Breakpoint (Line/Block)	Ctrl + Shift + B
Rename Element	Alt + Shift + R	**Skip all** Breakpoints	Ctrl + Alt + B

Example shortcuts for SolutionCenter Workbench Window and Navigator.

By using specific keyboard shortcuts in the SolutionCenter engineering tool, you can increase efficiency during programming. The shortcut CTRL+S to save the current editor is the most familiar shortcut, while the F11 function key to start a debug session might be a little less well-known. However, the more shortcuts become second nature, the less you have to use the mouse to select or perform actions. An overview of all available shortcuts in the SolutionCenter is available under the *Help menu > Guide to key settings*. Alternatively, you can access the guide by pressing CTRL+SHIFT+L.

Preset keyboard shortcuts can be personalized however you like in the User Preferences under *General > Keys*. With a cheat sheet by the keyboard, you'll quickly learn how to work with them. The most important shortcuts for the PLC developer are listed together on two pages that can be downloaded using the following QR code:

PLC Developer Shortcuts

WORKING WITH **EXTERNAL** PLC LIBRARIES
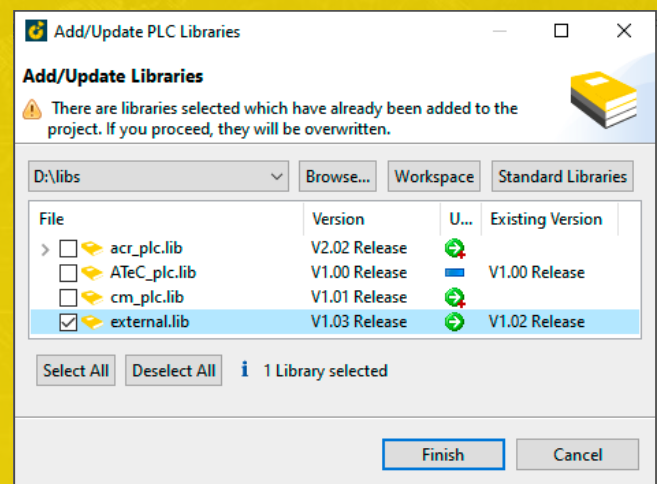
The wizard for incorporating libraries into a PLC project: dependencies and version information are displayed here.

To run an application task, developers have the choice between different programming languages depending on the platform.

Library availablility often plays a crucial role in the selection, as does real-time capability, performance during execution, and flexibility.

It is undisputed that IEC 61131-3 offers the shortest path to an executable application with a complete runtime environment, the corresponding hardware process map and the existing libraries. In order to retain the advantages of other languages, it is possible to integrate them as a precompiled library in an IEC 61131-3 application.

We explain step-by-step how to create an external PLC library in the SolutionCenter and incorporate it into a PLC application in this presentation:

PLC Developer Libraries

WORKING WITH
COMPONENTS
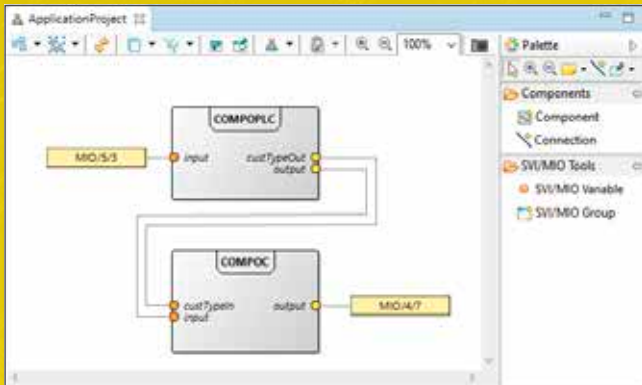
The pre-compiled components are graphically connected in the application developer.

SolutionCenter is Bachmann electronic's all-in-one engineering tool. It includes the component manager framework, which enables modular construction up to application level.

Each component runs independently, communicating with other components via a variable interface that is defined by a description language. The implementation language can only be defined later, according to the component task. This makes it easier to collaborate with external service providers to implement the components.

The Code Generator creates the boilerplate code, allowing programmers to devote their full attention to business logic. Thanks to the defined interface, individual component behavior can be verified directly on the control system via the component test framework.

Component interconnection to form a complete application takes place later and exclusively via the configuration. For analysis and diagnosis, it is possible to connect to running components using the development tool and debug them simultaneously.

Working with the Component Manager framework enables model-driven, test-driven, and component-based software development. The tutorial shows the structure and possibilities of the framework:

Component-oriented Programming

MORE EFFICIENT
MULTIRATE MODELS
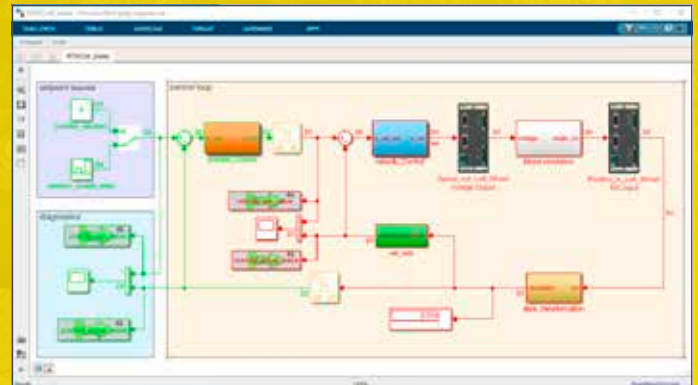
The Simulink® model includes two sampling times. They are processed as independent tasks on the M1 control system.

Control applications often contain contradictory requirements. The control part requires a short cycle time, while the CPU-intensive target value prediction may be processed more slowly. These contrary needs can be combined in a multirate model.

Using this simulation model, M-Target for Simulink® installs a real-time application on a predetermined M1 multicore CPU at the click of a mouse. Two M1 tasks are started automatically for the assigned model. Due to individually definable task priorities, the high-priority control is processed in the specified cycle. If necessary, it can also interrupt the target value prediction.

This multitasking software module combines the best of both worlds: the engineering PC enables simple, collaborative engineering over several cycle times. And the individual subtasks are processed according to their actual real-time demand on the M1 controller.

M-Target for Simulink® Product Sheet

PROCESS EVALUATION
AT A GLANCE

Transient response progress over time is depicted in a diagram. Limit violations are highlighted in color.

Scope 3 is used to record and display signal paths as time series. In many cases, however, you may want to know how signals have changed over time. This can, for example, be used to investigate the behavior of a controlled system depending on various controller parameter sets. If the step responses are recorded with a trigger condition, then the transient response will always be found at the identical point in time.

In the Scope Navigator, two data sets can be selected and compared by right-clicking the context menu. Visualized simultaneously in one diagram, the user can easily measure and analyze data with the cursor.

As an alternative, control behavior for 3 successive recordings can be displayed together in one diagram. To do this, the number of recordings must be set to 3 in the diagram configurator. With the resulting display, users can read progress over time directly based on curve color saturation.

Another useful evaluation function is the ability to flood areas. This can, for example, be used to visually highlight limit violations. They are easy for the user to comprehend and provide a clear overview.

Scope 3 Product Sheet

DEVELOP NON-PROPRIETARY
APPLICATIONS
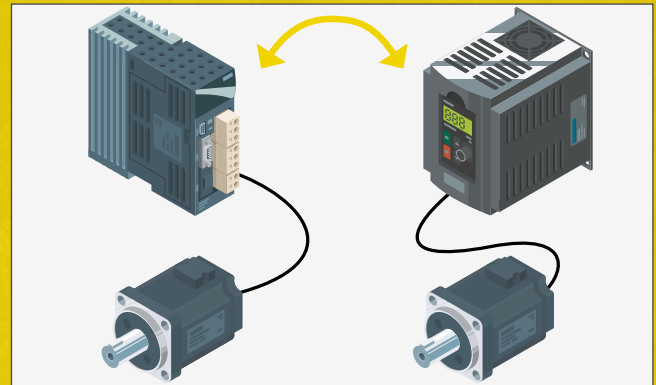
Drive Middleware: even if a servo controller or drive manufacturer is replaced, the application remains unchanged.

To control drives, their complete state machine is usually embedded directly into the application. This includes start-up, shut-down, error acknowledgement, and referencing method handling. Changing the drive supplier then typically requires significant adjustments to the program.

Drive Middleware offers the solution. Drive Middleware captures and handles manufacturer-specific drive characteristics. This provides developers with an application program interface that is drive-independent.

The application remains unchanged even if a new servo controller is qualified as a second source, for example. All necessary adjustments such as drive type, scaling factors, and available operating modes are configured directly in the Drive Middleware. Should the motor's installation position change in future, target and actual values remain centrally invertible.

Drive Middleware provides two crucial advantages. Available drive templates significantly reduce start-up time and drive selection flexibility remains unchanged throughout the machine's entire life cycle.

Drive Middleware Product Sheet

REACTIVE FRONTEND FRAMEWORKS IN atvise®
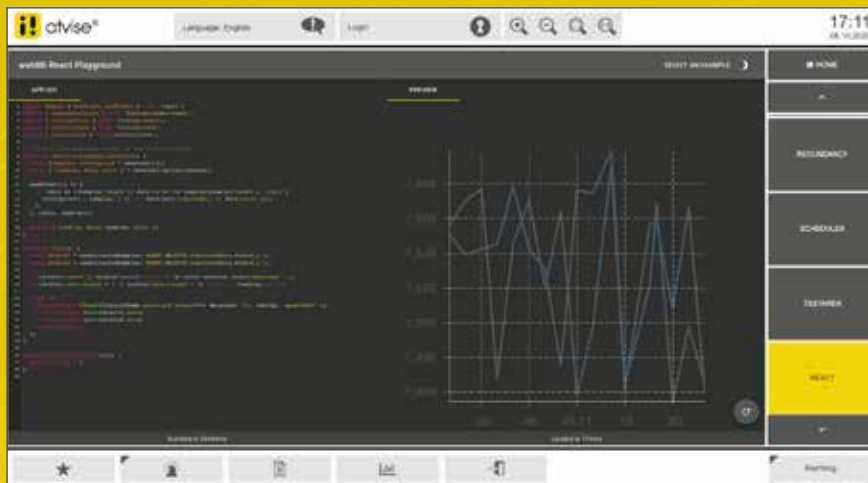
Demo application for a React-based atvise® application.

When creating atvise® applications, users have a variety of options when it comes to frontend design. One of these is implementing visualizations based on modern frontend frameworks such as React. With the help of frameworks like React, interactive and component-based user interfaces based on Java-Script can be created. The advantage is that prepared interfaces for data connection and integrated lifecycle met-

hods can be used to implement highly dynamic and flexible user interfaces.

In this setup, the visualization is completely separate from the existing atvise® engineering environment and developed directly in the JavaScript editor. The newly released create atvise app makes it easier for users to start working with such frameworks. With the use of these tools, a development

environment for creating React-based atvise® applications is set up fully automatically so that you can start implementation immediately. Instructions on how to create a simple demo application using the tools can be accessed at the following link:

create-atvise-app

HIGH-PERFORMANCE COMPRESSION OF RAW DATA

atvise® offers a wide variety of options for high-performance data compression with its integrated aggregating functions. There are 40 functions available that can be combined in any way. For example, flat or multiple nested aggregating hierarchies can be implemented. To achieve the highest processing performance for large quantities of data, the setup of nested aggregates is recommended.

Average values can, for example, be calculated as follows: raw data arriving

in the system are processed directly with one-minute average value calculations. Other averages with larger intervals will be calculated based on this, with access to the database for the preceding aggregate level. This guarantees that aggregates are calculated quickly and efficiently.

It also offers another advantage: in this way, calculated aggregates offer a finer granularity and provide correspondingly higher informational content for trend analyses.

AMOUNT OF DATA TO AGGREGATE		
Aggregation Interval	**Flat Aggregation**	**Nested Aggregation**
1 minute	150	150
1 hour	9.000	60
1 day	216.000	24
1 week	1.512.000	7
1 month	6.480.000	4
1 year	78.840.000	12

RAW DATA
60 value changes/min

Efficiently condensed: nested levels considerably reduce the data to be aggregated.

QUICK SETUP FOR **PROFINET®**
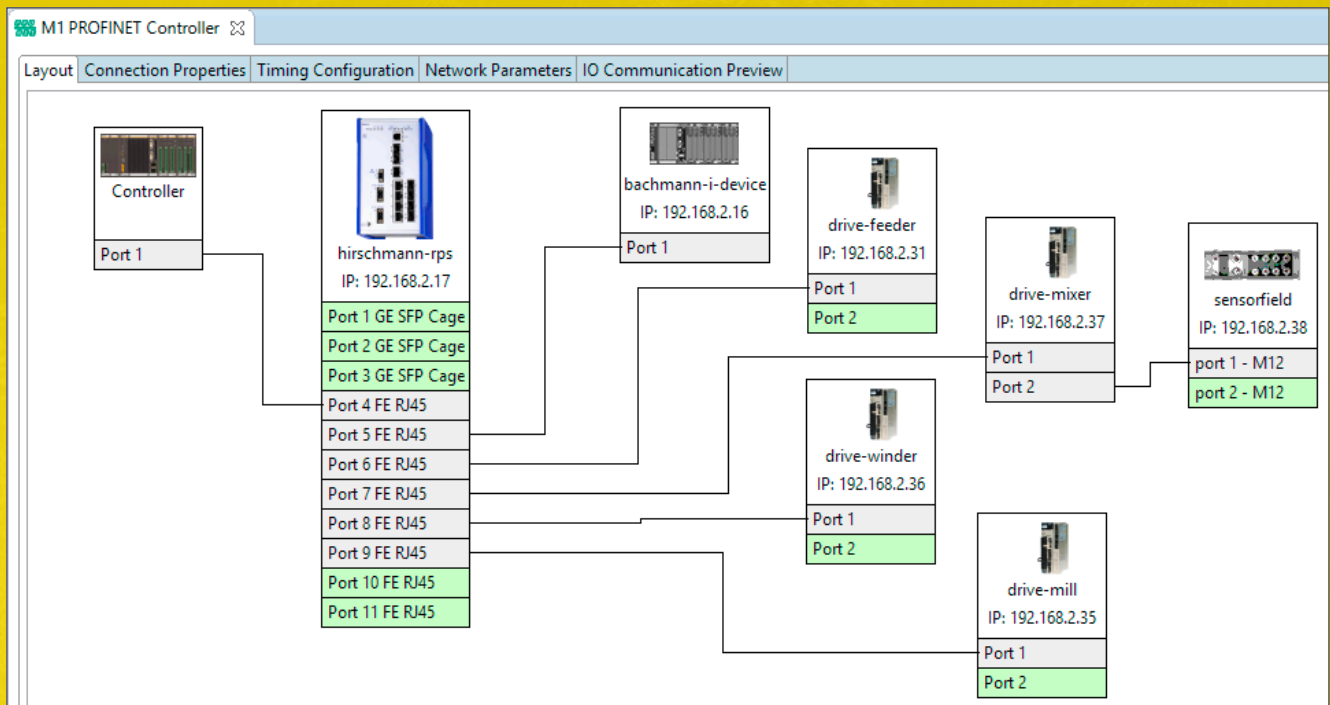
Clear and manageable: the Profinet® network configuration in SolutionCenter.

With the current, certified Profinet® driver for the M1 control system family, the start up of Profinet® networks is now much faster. If desired, the system automatically carries out topology detection and device naming.

The only requirement is that network participants are topologically connected in exactly the same way as they were drawn in SolutionCenter during project planning. (The participants are the M1 controller as the Profinet® Controller, the Profinet® Devices, and any other additional Profinet®/Ethernet switches.) Any combination of star and linear topology may be used.

For switch cabinet builders and industrial electricians, there is absolutely no question that wiring must be done exactly according to plans. The crucial advantage of the new Profinet® driver is that start-up (device naming) for the individual Slaves is now automatic. The controller automatically scans the identified network and compares its devices with the stored configuration.

This allows the controller to automatically identify each device on the network and check if it is in the expected position. If the device does not yet have the expected name, then the name

and other communication parameters will automatically be set and the network started. This happens regardless of whether it is a completely new series machine, or after a replacement part has been installed by an electrician during the night shift.

The connection parameters for all devices are assigned in SolutionCenter.

»For us, product diversity is more than just a portfolio dimension. It is a value proposition down to the finest detail.«

ALWAYS PRACTICAL

The MQTT client facilitates data exchange on the M1 automation system and was first released in spring of 2019. We spoke with Helmut Ritter, Product Manager at Bachmann electronic, about his experiences, feedback and acceptance, and practice-oriented application of technology.

What does MQTT stand for?

Helmut Ritter: The Message Queueing Telemetry Transport (MQTT) standard was co-developed by IBM – they are traditionally very cooperative when it comes to disclosing standards. MQTT is part of a full series of queueing protocols, which IBM uses to address objectives for data exchange between machines (M2M).

The standard has been in place for a long time having been accepted by the Organization for the Advancement of Structured Information Standards (OASIS) in 2013, and it is still maintained there.

Why does Bachmann offer this solution?

Many of our customers use the M1 control system not only to control their machines, but also to link them. A simple, low-threshold data exchange is a task for which we have long offered solutions. They range from naked socket communication to the high-performance solution bluecom, integrated into the process map.

Field buses like Profinet® are sometimes used to connect control systems to one another and exchange status information on a cyclical basis. MQTT has gained strong momentum in the course of Industry 4.0 and is now increasingly used in the manufacturing industry.

Where is MQTT prevalent?

The 4 biggest Cloud providers (Amazon AWS, Microsoft, IBM, and Google) all offer a native MQTT interface. This means that the M1 control system can be connected directly to the cloud and its data can be archived there without other devices in between, such as IoT Gateways or Edge devices, among others.

So MQTT always leads in to the cloud?

Cloud providers sell storage space for data as well as processing power to evaluate it. However, because an MQTT server (broker) also runs on a simple industry computer, MQTT can be run completely in isolation – even on an island, or on a ship – without internet access.

What differentiates MQTT from other systems?

A field bus like Profinet® or CANopen follows a clear data hierarchy: one master, many slaves. This always requires that the entire field bus network has been planned and that the maximum configuration must be known in advance. The quantity of data and data types must also be permanently configured.

With MQTT, on the other hand, a participant only has to know the broker. It sends status information there, and can draw information as well. When receiving data, no address other than the broker's needs to be known. The subscription to interesting new data is done exclusively via a text identifier (the message topic).

The central administrative unit thus acts as the broker, which responds dynamically to the client's queries and manages, controls and archives the flow of information as required.

The network topology may change, the coming and going of participants on the running system is provided for, and the number of participants and quantity of data can change without planning. These are ideal conditions for future expansion while preserving compatibility.

Is MQTT secure?

Encrypted communication and the exchange of TLS certificates is included in MQTT Standard, which is in line with current security requirements. Independently selectable QoS (Quality of Service) ensures that data reaches the right recipient.

Are there any disadvantages?

In other words, is it an advantage that the user can make completely free decisions regarding the data structure? MQTT is low-threshold and can send virtually everything. Any participant can send and receive information.

If you start without a clear concept in the application, there is one risk: more and more powerful systems will be built over multiple versions of the system, for which all the participants will bidirectionally publish their own actual

values and send other participants' commands and parameters. The connection status will also be monitored via timeout, and at the end, you'll either have replicated a field bus or a Scada protocol – both of which were already available.

And then you would have benefited from substantially more, interoperable features, and you would have saved extra time.

However, if you require maximum flexibility in the number of participants and the ability for 1:n communication in the application (one sender to one recipient), then MQTT is a good solution. The user does need to be able to answer a few questions alone: How do I pack my usage data, how can the recipient parse it? Do I need the protocol's QoS features, or do I want to fire-and-forget as fast as possible with the risk of losing individual data?

How do customers get on with MQTT?

Some very creative solutions have been implemented in every industry. However, it has been noted that for MQTT applications, customers more frequently seek out contact with our application engineers to talk about an optimal application.

Solutions with an OPC UA server on the control system and an OPC UA visualization like atvise®, by contrast, raise fewer questions – because the boundary conditions for communication are fully defined.

COMPLIANCE VERIFIED!

Certified network and plant protection

Power generation plants feeding directly into the power grid must meet the strict requirements of VDE-AR-N 4105. TÜV NORD CERT issued the first component certificate in accordance with the new version of the application rules for the GSP274 grid protection and synchronization module.

The three-phase measuring systems from Bachmann with expanded measuring and overload range, high accuracy and unique measuring dynamics are specially designed for use in generation plants.

The GSP274 enables their secure, reliable and automated synchronization to the power grid. As a plug-in module for the M1 automation system, it works seamlessly as part of the operating management control. The adjustable grid and plant protection is set up to be fail-safe, eliminating the need for adequate secondary protection.

Synchronization – and Monitoring

Furthermore, a number of monitoring functions for generator and grid protection are integrated. All network measurement and network quality figures are available to the PLC application programs, such as protection events and switch settings. Automatically recorded fault logs, the event protocol, and the highly precise clock synchronization make fault analysis easier.

Simplified Approval

In addition to the new certificate, the existing ones for VDE-AR-N 4110 (DE), ENA G99 (UK), and IEEE C37.90 (USA) make the approval process easier, especially for CHP stations, mobile power generators, hybrid stores, and hydroelectric power stations.

Verified compliance with the new VDE-AR-N-4105:
The GSP274 is certified according to the revised application rules for power plants on the low-voltage network.

DIAGNOSTICS – REDEFINED

Visualization for monitoring – generated by CFC-programmed logic
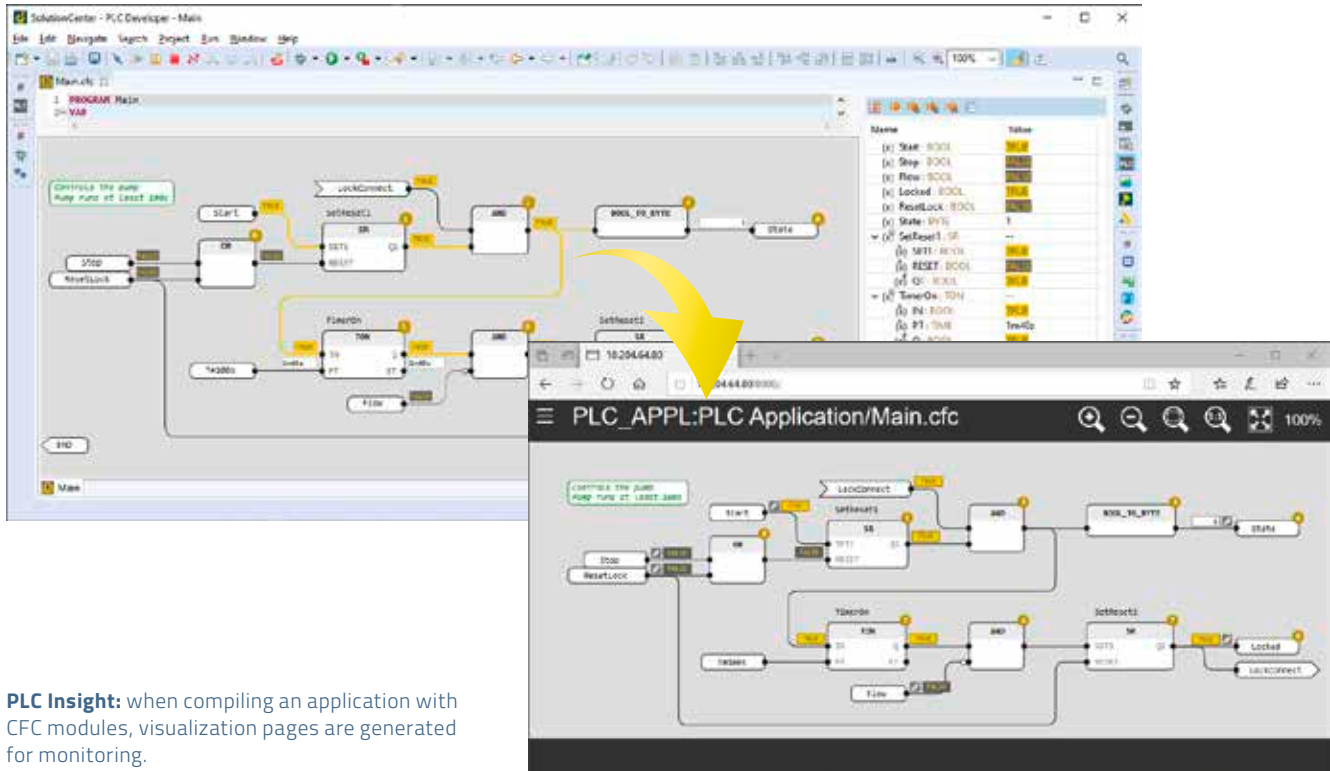
PLC Insight: when compiling an application with CFC modules, visualization pages are generated for monitoring.

When starting up machines or troubleshooting on a large system, diagnostic options play a crucial role. With PLC Insight, service visits that cost lots of time and money are avoidable, as selected application parts and corresponding signals are embedded as graphic elements in the operating visualization.

Most operating visualizations are designed to provide an overview of the entire plant. If an error occurs, the machine part affected by the fault will be displayed. If the plant is at a standstill and the error code does not provide sufficient remedial information, it is often helpful to take a look into the application logic, for example to determine the absence of an enable signal.

Up to now: Troubleshooting in Partially Unprotected Source Code

Until recently, in order to monitor a PLC application, the complete and current source code had to be available in the engineering tool. If the source code is also stored on the controller for this purpose, then it represents a high security risk for the manufacturer of the system, as know-how is largely unprotected. In the Bachmann M1 automation system, the application logic is usually programmed in PLC Developer, which is integrated into SolutionCenter. Along with textual programming in Structured Text, it also offers the function block based programming language CFC (Continuous Function Chart). The advantage of graphical programming is that it is simple and intuitive, while complex logic can be abstracted. It is also possible to clearly analyze the data flow for cascaded Boolean operations.

New: Detailed and Secure Diagnostics

Using the new PLC Insight feature in PLC Developer, a complete monitoring visualization can be generated from selected CFC diagrams of a PLC project. This web-based visualization is transferred to the controller together with the PLC application and can be displayed on any web browser. The display corresponds 1:1 to the debug mode in PLC Developer. The diagrams are created with SVG images (Scalable Vector Graphics), so that the relevant application part can be zoomed without loss, even with a large number of function blocks.

User-defined Permissions

The visualization configuration defines which modules should be available via the visualization. For a PLC application, several different visualizations can be configured, transferred to the controller and loaded. The read and write permissions for the data points in the form of variable values are derived from the symbol configuration of the PLC project. Writeable variable values are specially labeled in the visualization and can be edited directly via an edit dialog. In order to better understand the relationships, additional information is displayed in the form of tool tips by hovering over the function and variable blocks.

Edit variable values: clicking a value labeled for editing opens a modal dialog in which a new value can be assigned.

More clarity and security at the same time

PLC Insight allows service engineers to monitor the PLC application at a glance. The source code is not required and remains protected. Thanks to the combined transmission of application and generated visualization, it is ensured that they match and correct current values are delivered. By selecting the function block diagrams to be displayed, know-how remains protected in the best possible way, while manipulation of the source code via the visualization is impossible.
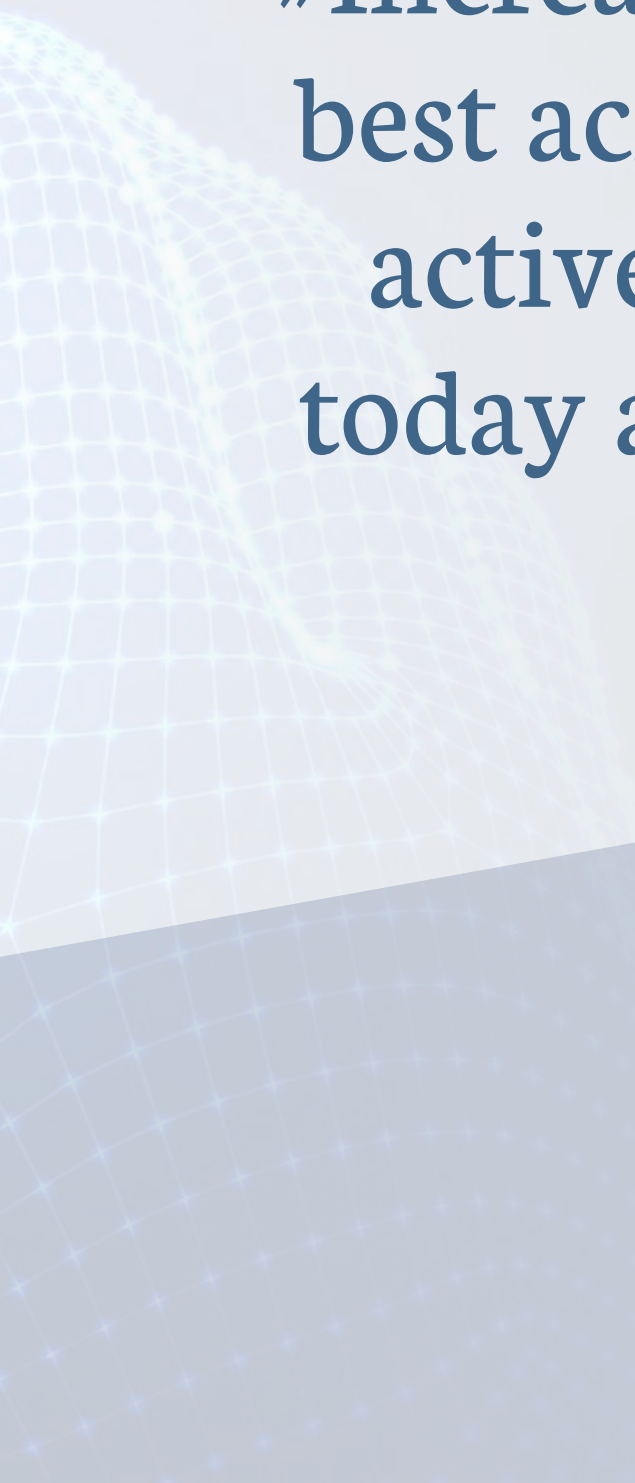
OPC UA WITH ALARMS & CONDITIONS

Manufacturer-independent, standardized and secure communication

The OPC UA Alarms & Conditions (A&C) server, which is fully integrated into the M1 automation system, makes it possible for threshold value configurations, status data, and alarms to be exchanged across manufacturers and hierarchies.

With the A&C server, alarms and status information can be transmitted from the control and field level of a PLC to other machines, operating units, monitoring control systems, and ERP systems regardless of manufacturer or platform. Critical values or status changes are automatically detected without requiring programming. Changes in the alarm status can likewise be triggered by an API from the control program. All changes forwarded to operating units, control consoles, or A&C clients have the option of secure encryption.

The advantages are obvious: authorized users can respond to changes at any level, while user actions are visible to all connected systems.

MAX

EFFICIENCY

»Increased efficiency –
best achieved through
active sustainability,
today and tomorrow.«

bachmann.

50 JAHRE AUTOMATION

1970 – 2020
With trust comes responsibility –
innovative automation technology
for over 50 years