Expert Report

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How digitalisation will change future process and district heating supply

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Digitalisation is reshaping our world. It is not just in our private lives that SmartHome applications such as voice-controlled systems make life easier for us. Even in everyday working life, digital assistants provide support in tackling daily tasks. Industry 4.0 applications network complete production plants or even the worldwide locations of global corporations with each other. Digitalisation is also increasing in the field of energy supply: Energy management or control technology systems, remote maintenance for systems or digital assistants that make predictive maintenance plans are just the beginning.

Industrial energy and process heat supply trends

Especially in countries with high energy prices, a trend towards multivalent systems has been emerging for several years. Here, various energy sources are combined to cover the total energy demand. In the past, for example, often only one central steam boiler was used simultaneously for process and heating energy. Today, low-temperature heating energy up to 110 °C is mostly generated separately, e.g. by a combination of boilers with waste heat utilisation, heat pumps and combined heat and power units. These systems are often located at different places as close as possible to the main consumer. This requires increasingly more intelligent mechanisms for the dynamic management of multivalent loads based on predictions of different energy demands.

Networked systems, centralised control

A contradictory trend can be observed in the control and monitoring of the same systems. Today, hardly any heat sources are installed in the industrial sector without control technology or remote connection, whereby control and monitoring are often carried out in a central control centre or via the company network. For example, there are corporate groups with locations distributed across various countries in Africa with central system monitoring in their European headquarters.

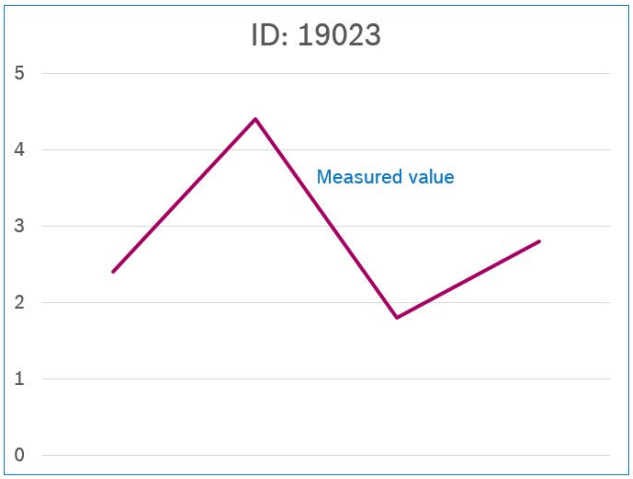
The logical consequence is increasing automation requirements in order to enable decentralised fault management and to reduce operating effort. In some countries, there is even a discussion about unattended operation of pressure equipment over a longer period of time, whereby a maximum of 72 hours is currently permitted. The whole thing has a good reason: The amount of energy in shell boilers with over 70 metric tons of water content at e.g. 20 bar, and accordingly high temperature, corresponds to that of several metric tons of Semtex explosives. Electrical and mechanical safety equipment and regular supervision by qualified operating personnel are therefore essential for safe operation.

In the past, it was common to employ one or more boiler attendants. Today, facility managers often have to take on these tasks additionally to their regular work. As generalists, they should, for example, repair an automatic door in the morning, get cafeteria kitchen appliances up and running in the afternoon, and carry out water chemical analyses on boilers in the evening. The increasing scope of tasks can only be mastered by using external service providers or by supporting automation technology and digital assistants.

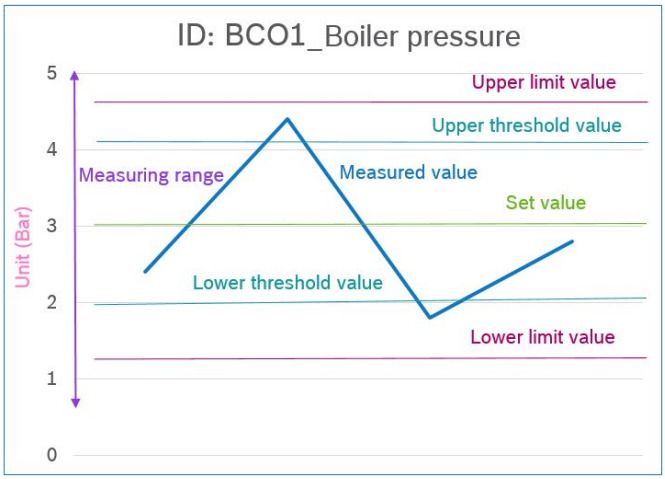
Ethernet-based control technology connection offers flexibility

Therefore in larger companies, task planning is often carried out using ERP/SAP systems. In the 1990s and 2000s, control technology systems frequently transmitted the signals (e.g. 4–20 mA sensor signal) via non-ethernet-based protocols such as Profinet, Modbus RTU or Profibus with PLC-based controls up to the control level. To do this, operating companies must have their system model individually programmed – this is expensive, time-consuming and involves functional risks. Modern systems already provide the data point structure.

Even older existing systems can be integrated into modern control concepts and Industry 4.0 solutions.



Profibus DP, Profinet IO, Modbus TCP, etc.
Data points must be individually programmed for specific system models



BACnet/IP or OPC UA
With intelligent protocols, the data points are predefined with certain properties

In recent years, there has been a change of direction towards Ethernet-based protocols that can transmit additional information, similar to the CAN bus in a vehicle. Data signals do not only pass on their current value there. First of all, they identify themselves and additionally provide their setpoints, thresholds and limits. This enables simpler and safer integration of control systems.

The are many influencing factors when operating process heat sources that have massive effects on system efficiency, reliability, longevity and even safety. The expertise regarding the interactions often lies only with the manufacturer on the basis of their decades of field experience and is almost impossible to reproduce in systems control technology programming. This requires signals with additional information, intelligent evaluation at the control level and a sufficiently powerful protocol for transmission to the next highest control level.

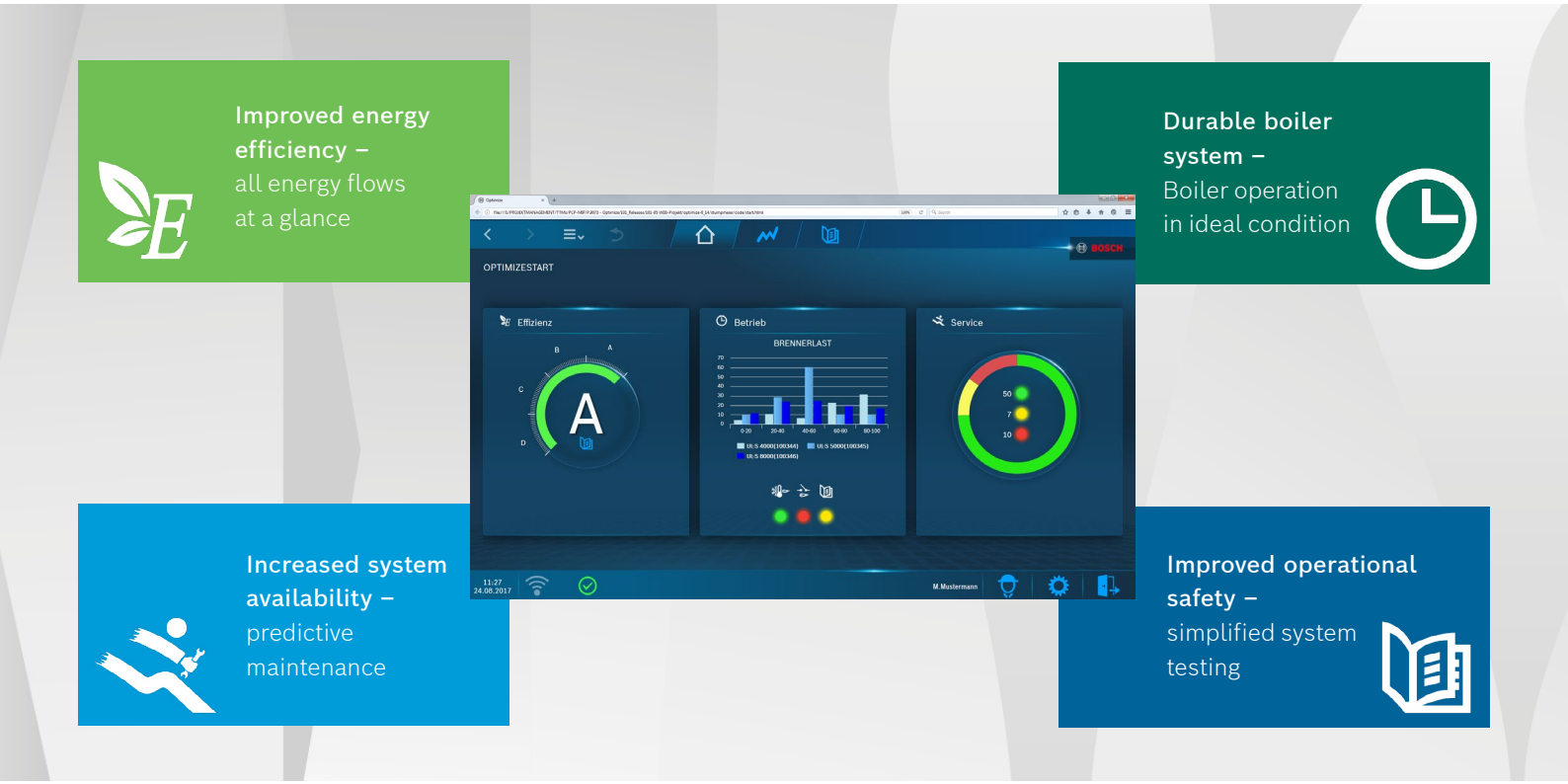
Increasing demand for intelligent control systems

Simple errors like a gas supply fault can lead to a steam boiler safety shutdown. This mostly comes with a risk to the functionality of the entire production, leading to unplanned downtime. It is therefore extremely important to transfer the information to the person responsible, especially when they are not in the boiler house during the incident. Ideally, the control will then not only have reported a centralised fault, but will have already carried out an analysis of the most probable cause of the fault and provided the appropriate instructions for the operating personnel to rectify it.

“True boiler attendants” are becoming increasingly rare, who could rub a water sample between their fingers and recognise the pH value in terms of lubricity and odour, and were able to assess the correct quantity of chemical additives with surprising precision. They could tell from the noises in condensate lines, for example, whether the steam traps were functioning correctly.

There are fewer and fewer genuine “true boiler attendants”. Increasingly, facility management has to take over boiler supervision.

Unfortunately nowadays, it is increasingly common for boiler houses to have unfavourable operating conditions. In particular, frequent burner cycles and poor water quality are seen more often nowadays. In some cases, the values are even recorded correctly, but the analogue boiler paper log book lacks possibilities for automatic trend analyses and alarming. The consequences can range from unplanned production stoppages to major boiler damage, in which entire production batches have to be discarded.



Digital assistants support the operating personnel to increase plant availability and operational safety of energy generators and to operate them more efficiently to ultimately safe natural resources.

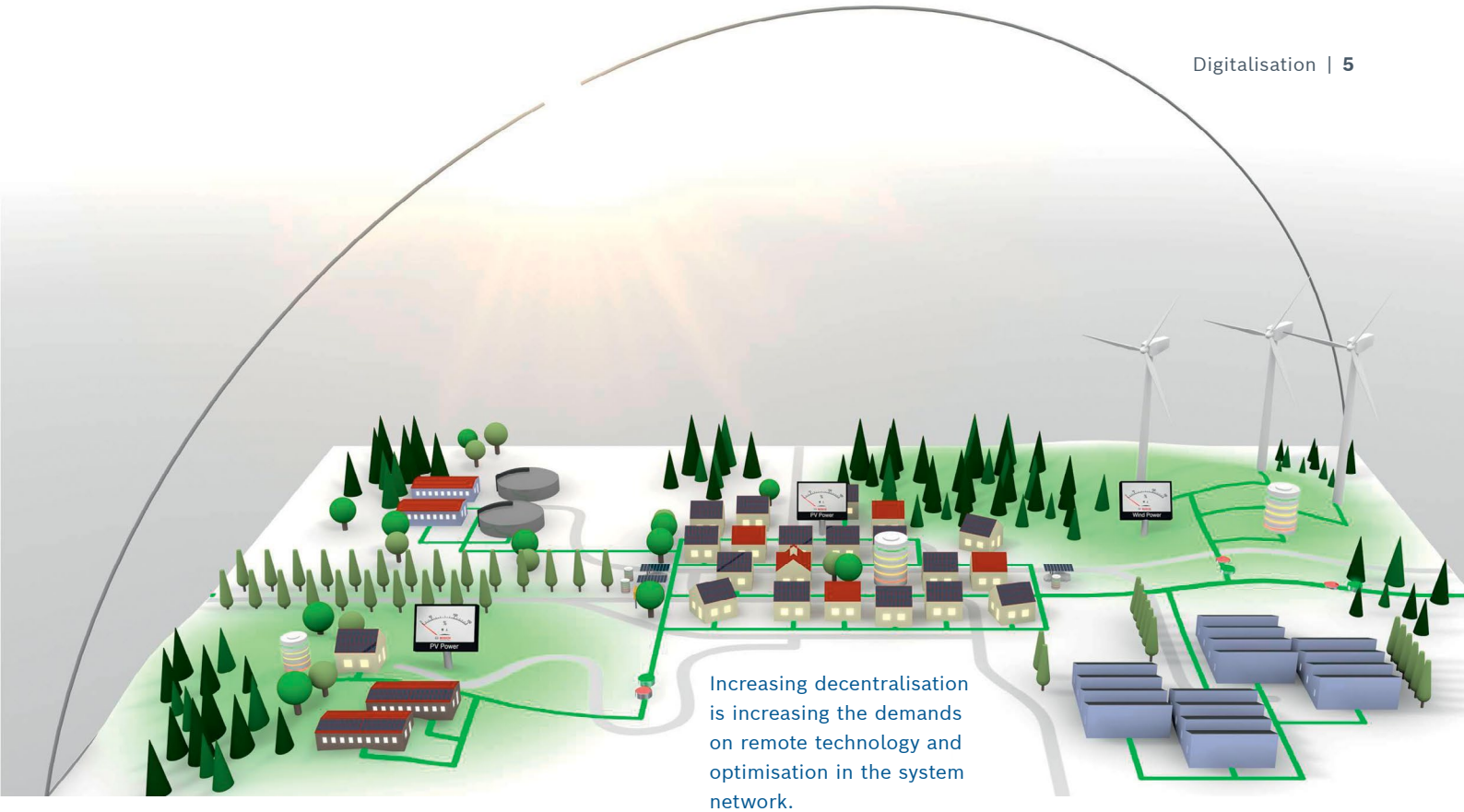
Digital support for boiler attendants through predictive maintenance

Identification of breakdown risks before something happens: Digital assistants evaluate locally stored data and thus support the operating personnel. If the manufacturer knows the signals and properties of installed components, the remaining service life can be predicted adaptively based on the individual load profile. Statements about possible increases in efficiency can also be quantified. If, for example, the flue gas temperature rises, an intelligent control can suggest suitable remedial measures and provide illustrated instructions.

For example, the system automatically provides information if a relay has to be replaced after ten years. This may prevent possible accidents and helps the operator to fulfil their duty of care. Optimisation or replacement of wearing parts can be carried out during scheduled maintenance and can ensure maximum availability, especially in power plants without redundant heat sources.

Short response times due to secure remote access

While it is now standard to connect production systems‘ controls to the systems control technology or the company network, many companies are still very restrictive when it comes to using remote control technology. This is mainly due to concerns about security and data management. However, if a lack of process heat causes the production line to shut down, the advantages quickly become clear: Quick response, remote troubleshooting and identification of required spare parts without service technicians on-site promise reduced maintenance costs and maximum system availability.



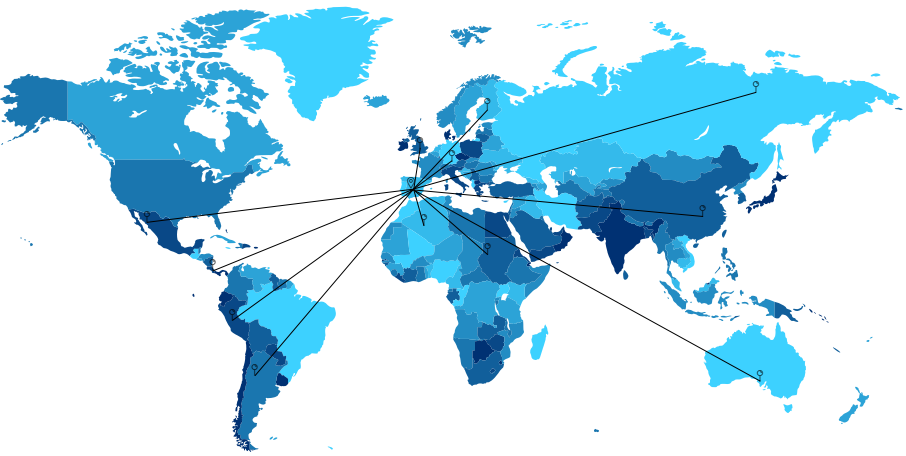
Increasing decentralisation is increasing the demands on remote technology and optimisation in the system network.

When it comes to remote support, the right type of connection is important. The easiest way to implement this is often a dedicated Internet connection for a system, e.g. wired via its own dedicated DSL connection or via a UMTS module (like a SIM card in the mobile phone). The connection via the company network usually places the highest demands on the IT or is often limited to visualisation via company computers. Additional safety is provided by a key switch for activating the remote connection in the boiler house. Regardless of which type of connection is selected – for safety reasons, operators should always obtain information on whether the provider has their remote technology regularly checked and certified for safety.

Summary

Modern control systems already use intelligent data at the field level and support operators with digital assistants during operation and optimisation. At the same time, they offer their own remote technology as well as open interfaces via common data protocols to systems control technology and automation systems. Ideally, pre-configured interfaces save the need for time-consuming manual integration.

Digitalisation is not an end in itself, neither is data transparency. Both are just means to an end. In most cases, the goal is optimisation – be it of efficiency, reliability or quality. Factors that should have a positive impact on customer satisfaction, profitability and global competitiveness. Continuous technological developments, especially in the direction of self-learning systems with artificial intelligence, leave a lot of room for future innovations.



System management is increasingly controlled centrally across locations.

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