

# Industry 4.0 in Compressed Air Systems



**Companies in many sectors are struggling to capture real value from Industry 4.0 technologies. At BOGE, the benefits increasingly come as standard.**

## **A connected world**

Industry 4.0, the industrial internet of things (IIOT) or simply advanced manufacturing. Whatever you call it, integrating digital technologies – like low-cost sensors, robust networks and advanced analytics technologies – into industrial assets has the potential to transform the efficiency, reliability and flexibility of individual machines and complete production systems.

## **The missing link**

So far, however, the rewards for most companies have been more theoretical than real. One UK industrial services company surveyed its customers' experience of Industry 4.0 in 2017, for example. It found that, while more than 80 percent of them thought Industry 4.0 initiatives could have a positive effect on the performance of UK manufacturing, less than 14 percent rated their own knowledge of relevant technologies as "very good". And 30 percent of respondents suggested that a lack of specific knowledge about the potential benefits was a primary roadblock to implementation.



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## Bringing intelligence to the network

At BOGE, we've always looked at the industrial environment from a network perspective. As a leading provider of compressed air systems and technologies, it is our job to provide clean, reliable and cost effective compressed air to our customers' machines and processes. In all but the very smallest applications, a compressed air system involves a distribution network: the pipes and valves used to deliver air from the compressor installation to the point of final use. It also involves an interconnected network of machines. A customer may have one large, fixed speed compressor to provide the base-load of air they use in their operations, for example, together with a smaller variable-speed machine that acts to meet peaks in demand. In addition, systems may include other machines such as dryers, filters or storage devices.



For these systems to work efficiently, the different components have to talk to each other. An installation with multiple compressors, for example, must make decisions about which machines to switch on, and how those machines should be run to meet the customer's requirements while minimising energy consumption and maximising the reliability and longevity of the equipment.

## Smart comes as standard

The control systems installed on our standard products today have a large number of networked features. The controller on one machine can act as the master for a wider network, for example coordinating the operation of multiple machines via integrated fieldbus connections. Built-in internet links allow operations and maintenance staff to monitor machine and overall system performance remotely using a web browser or mobile app. Those kinds of capabilities are immensely useful for users of compressors. They reduce the cost and complexity of installing, configuring and operating a compressed air system, and make it easier to keep that system performing efficiently.

For larger, more complex systems, we have developed a new generation of networked control systems. Our airtelligence provis 2.0 system continually and automatically monitors a compressed air system, anticipates changes in demand and operates proactively to activate the optimum combination of compressors and other components to fulfil that demand. The system is fully configurable to account for the characteristics of every installation. If a system includes one or two older and less efficient compressors, for example, it can be set to activate these last. Similarly, provis 2.0 can monitor the running hours of different system elements and adjust their usage to extend the time required between maintenance intervals and keep maintenance schedules aligned.

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## Predictive maintenance

Today, many of our compressors use a secure internet link to share operating data with our central analytics centre in Germany. The service is inexpensive for end-users, typically free for the first year of operation and just a few euros per day thereafter. The links sends around 70 data points a second on pressure, temperatures, motor speeds and energy consumption collected from sensors around the machine.

We analyse that data using “learning” algorithms. Over time, the system gains an understanding of the normal operating conditions at the customer’s site. If it sees a condition that varies significantly from those normal conditions, it will immediately alert one of our specialist engineers. The engineer will review the data and decide if it suggests an issue with the machine or with the wider system.

If there is an issue, the engineer can contact the customer to suggest appropriate corrective actions. If the data represents an unusual, but acceptable operating condition, the engineer can teach the system to ignore such occurrences in the future.

Significantly, this monitoring is a two-way process. As it builds its understanding of machine performance, our algorithm can update the parameters inside the controller on the machine itself, allowing the machine to alert the on-site operators to indicators that might suggest a developing problem.



## The spirit of technology

Drinks manufacturer Nordbrand Nordhausen has adopted the BOGE airtelligence provis 2.0 compressed air management system as part of a comprehensive upgrade of its compressed air network. Built to deliver high-quality Class 0 oil-free compressed air across its bottling plant, the new system uses ultra-clean stainless-steel distribution piping, assembled using grease-free connectors at every joint. Air is supplied by three frequency-controlled type SF 60 BLUEKAT catalytic compressors, which eliminate any hydrocarbons present in the incoming air, for example from lorry exhaust fumes around the plant.

The provis 2.0 system independently determines the company’s total network volume and trends, such as a sudden rise in compressed air consumption, and counters this by automatically starting the compressors before the demand peak is reached. The internal network forwards all the control data to the relevant work stations, which is then accessible via state-of-the-art communications tools.

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## On-sight expertise

Digital technologies also help us improve our service and support capabilities. We are already using data-glasses, for example, to guide field engineers in upgrade and troubleshooting operations. With their aid, an engineer can have the virtual support of specialist engineering teams from our HQ working alongside them, seeing what they see. That capability allows us to guarantee to our customers that we can get any machine back into operation within 24 hours, wherever in the world it is located.

## Advanced reporting

One of the most accessible benefits of Industry 4.0 is a greater degree of transparency – and insight – into machine performance. The latest networked control systems provide a wide range of monitoring and reporting tools, allowing system operators to see and understand energy consumption, system reliability and available capacity at the touch of a button.

The continual monitoring of system performance is also transforming the kind of reporting and analysis that's possible. For any machine connected to our analysis system, we can provide a detailed annual report on its performance. That helps customers in multiple ways. They can see at a glance how much their compressed air system is costing them, how demand varies over time and how the operating efficiency of the system is influenced by those demand variations.

As end user operations inevitably change over time, so does their demand for compressed air. Using the data from these reports, we can show them how changes to system design or configuration could deliver efficiency or performance improvements as usage patterns change.

## Continuous improvement

Perhaps the most exciting thing that industry 4.0 technologies allow today is the use of data to drive continuous improvements in the machines themselves. This can work in a number of ways. First, online monitoring allows us to build up a detailed picture of a customer's real-world usage. We can take that data and use simulation techniques to evaluate the potential impact of changes to a machine. Doing that will allow us to show, for example, that a different type of motor will provide significant annual reductions in energy consumption.



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## From optimised to customised

The potential for tailored product improvements goes even further, however. We have made use of a number of smart technologies and approaches to radically improve the flexibility of our own design and manufacturing systems. Those changes have allowed us to greatly increase the degree of customisation available to make specific products suit particular customer requirements.

Today, for example, a customer operating their compressed air system at a pressure of 7 bar may be able to adjust their processes to allow that pressure to be reduced to 6.5 bar. Any pressure reduction will provide useful energy savings, but if the customer's compressor is optimised for 7 bar operation, some of those savings will be lost since the efficiency of the compressor will be slightly compromised.

Now, it is possible for us to design components optimised for the customer's precise usage requirements, to simulate their performance using the customer's real usage data, and then to use 3D printing and other digitally-enabled techniques to produce the part for installation in the customer's machine.

The approaches described in this paper aren't just experiments, they are real product and service offerings, driven by Industry 4.0 technologies, that our customers are using today.

Most significantly, those customers haven't had to develop new capabilities or invest in costly additional infrastructure to capture these benefits. Industry 4.0 is already built into the heart of BOGE product and service offerings, and that makes it easy to build into the heart of your manufacturing operations too.

To find out more about BOGE Compressors and specialist gas generators, please contact us or visit our website:

[www.boge.com](http://www.boge.com)