Digitalisation – new opportunities to optimise systems in the process industry

This white paper covers the following topics:

- Digitalisation as an opportunity in the process industry
- How decoupling software and hardware opens up completely new opportunities for already established technologies, based on the example of the Festo Motion Terminal
- Why do manufacturers, OEMs and system operators obtain very tangible benefits from analysing the data sent via the IoT gateway to the cloud – and what does this mean for their business?

Executive summary

The digitalisation of the production world is a much discussed topic at the moment; however, it is not always clear what the actual advantages are for system operators. This white paper explains the importance of digitalisation for the process automation industry and how component suppliers, OEMs, and system operators can make the most of it. It focuses on two main areas in particular: digitalisation in the field by decoupling software and hardware using the Festo Motion Terminal as an example, and the possibilities for data analysis in the cloud.

Industry 4.0 today stands for the digitalisation of industry. It creates new decentralised automation functions that are also based on established technologies. This has an impact on process automation.

© Copyright 2018, Festo AG & Co. KG

Digitalisation – collect, network and evaluate data

The world of production is changing. Under the banner of “Industry 4.0”, a so-called fourth industrial revolution has emerged: after the steam engine came the assembly line, followed by the first industrial automation and now digitalisation. The term Industry 4.0 is not always very clear in current discussions, as sometimes it refers to different or even contradictory developments and sub-areas. It is therefore more useful to focus on the term digitalisation. Wherever data is stored and processed digitally, a multitude of new opportunities arise. On the one hand, the separation of hardware and software enables a single hardware product to take on completely separate functions in line with the software app installed. On the other hand, digitalisation has its own unique advantages, making it possible not just to send data, but also to collect, network and evaluate it. Maintenance, servicing and monitoring are just some of the areas that could really benefit from it. In short, digitalisation means that tried-and-tested technologies are even easier to use, are more versatile and more flexible.

> The digitalisation of the production world allows a multitude of completely new possibilities. As data is processed and stored, components can be operated with greater flexibility while analysis provides many new insights.

In recent years, a number of devices and innovations have been introduced that, with the help of software, go far beyond their original function and offer new application opportunities thanks to individually installed apps and networking: from smartphones and vehicles such as the Smartscooter to intelligent homes and the networked factory. Different applications can now be run on a single device; for example, a smartphone now also works as a camera, television and mailbox, among other things. This idea, as will be shown, can also be applied to process automation and pneumatics. In addition, similar to the other devices mentioned, further advantages can be achieved through networking and comprehensive data analysis in the cloud.

Digitalisation is much more than a buzzword or a promise; it is already opening up very tangible opportunities for creating additional added value around the plant and throughout the product lifecycle. Digitalisation can make working more flexible, save costs, and help to optimise and further develop processes. This white paper provides specific examples for process automation.

The software determines the function: the Festo Motion Terminal

The separation of the platform and the function opens up entirely new perspectives. The Festo Motion Terminal is doing exactly that: it is the decoupling of hardware and functionality. As it is the software that determines how a component behaves, in this example only one hardware platform is required, i.e. a universal product that performs a wide variety of functions as needed. “First of all, this means a reduced inventory of spare parts,” says Dr Eckhard Roos, Head of Global Industry and Key Account Management for the process industries at Festo: “You can first buy the standardised valves and then specifically define their function by installing apps. This then clears up the contradiction between standardisation and flexible applications.”

While previously it was necessary to have a variety of components, such as valves, pressure sensors and flow controls to achieve certain functions, everything is now integrated. Intelligent sensors for open- and closed-loop control, diagnostics and self-learning tasks will eliminate the need for additional components. What’s more, by just

© Copyright 2018, Festo AG & Co. KG

pressing a button or modifying a parameter the actual function is changed. Roos calls it “a revolution”, as it “redefines pneumatics”.

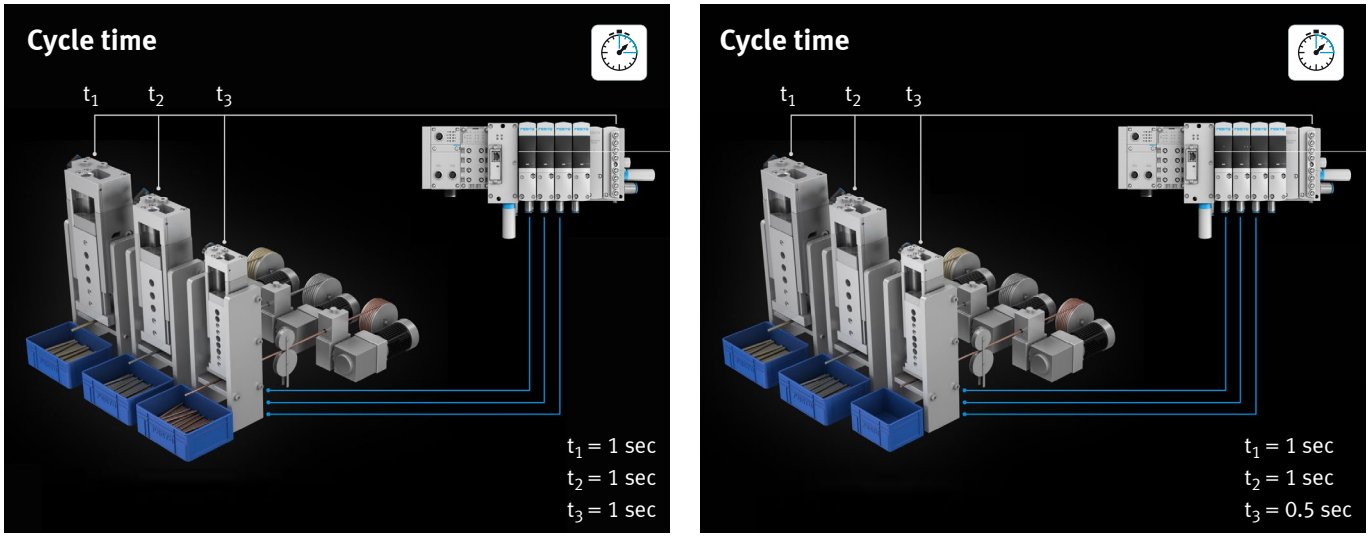
The decentralised outsourcing of functions to apps opens up a multitude of opportunities. Currently around 50 different functions can be carried out by a single hardware platform. Further applications are possible and the range of apps will continue to be expanded in dialogue with users. The three examples in this white paper are of the Motion Terminal which doesn’t just replace existing mechanisms in day-to-day operations, but also provides additional benefits that had previously been unattainable with conventional means.

> Precision, energy efficiency, diagnostics: the separation of software and hardware enables numerous different functions that go far beyond today’s possibilities, among other things because sensor technology monitors the functions and adapts them independently if deviations from the required function occur.

A) Flexibility and precision: the presetting of travel time

In some industries, extremely high levels of precision are required for the working stroke, as it plays a decisive role in whether a valve opens for one second or only half a second. By presetting the travel time, it is possible to specify exactly how much time the valve requires for switching. The pharmaceutical industry is a classic example, but there are many other sectors worth mentioning in this context, such as the cosmetics industry, for example, where it is essential neither to overfill nor underfill containers. After all, one would be economically unviable, while the other would be unacceptable to buyers. The particular strong point of presetting the travel time lies in the fact that the application monitors itself. As soon as the switching times change during the product lifecycle, for example due to increased friction because of wear, the system automatically adapts the values so that the exact duration is achieved again.

This then leads to another opportunity: the presetting of travel time also allows systems to be reconfigured quickly and to be adapted to the actual conditions in a simple and elegant way. In the last few years, the requirements for rapid changeovers have increased in numerous industries and across many production lines, in particular where different products are produced on one system. Here, too, the cosmetics industry is a classic example: because of the different container sizes for different products, the system must be changed over frequently.



Exact cycle rate: by presetting the travel time, it is possible to specify how much time the valves require for switching.

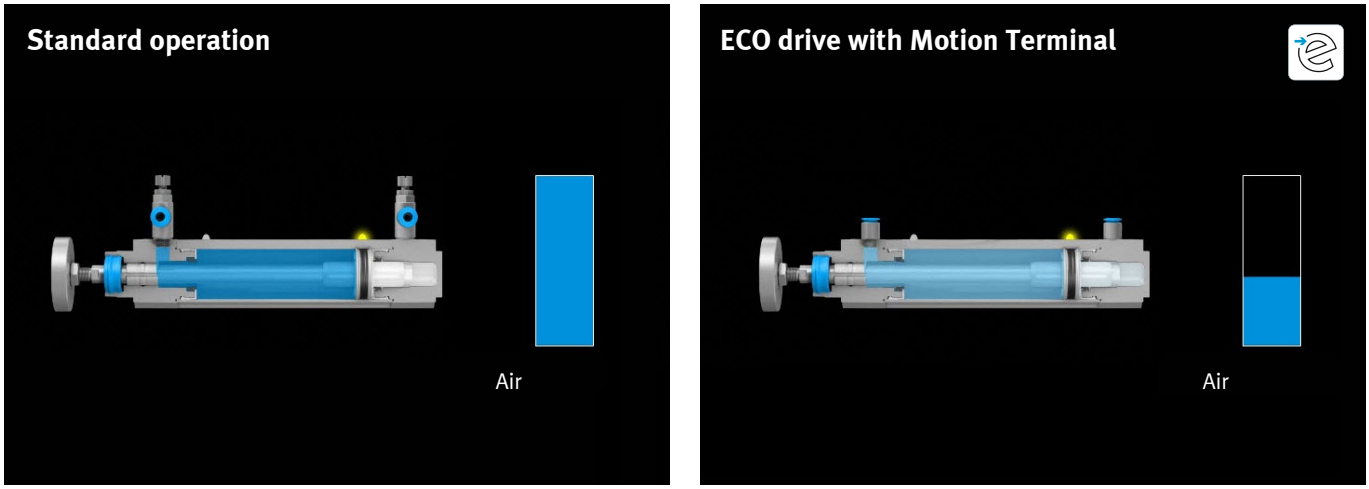
© Copyright 2018, Festo AG & Co. KG

At the moment, this would need to be done manually using flow controls. Obtaining an exactly simultaneous closure speed is a technical and time-consuming challenge, and constantly changing parameters is an even greater challenge.

B) Reduced compressed air consumption: the ECO drive

It is not necessarily common knowledge that every pneumatic actuator is designed for more torque or more force than would be necessary for the actual working stroke. The reason for this is that a safety factor is normally taken into account, which usually amounts to half of the required force. Where, for example, only 300 Nm torque is required for an actuator, a 450 kN actuator is selected in order to have sufficient reserves for production. This is particularly noticeable in the compressed air consumption of systems in continuous operation.

The “ECO drive” motion app is able to pare down the increased compressed air consumption caused by the safety factor and the actuator size and reduce the pressure in the actuator to a minimum. This means that less compressed air is needed. Experience has shown that energy savings of up to 70% are feasible. “There are industries that continuously consume compressed air,” Roos explains. “For example, filling systems for cement”. Although in theory it is possible to program a lower compressed air consumption using the software in the system controls, this would generate an additional load in the open-loop control and in the communication to the field. With an app in the Motion Terminal, however, processing is decentralised and the function does not burden the normal control system.



Intelligent air consumption: the ECO drive reduces the amount of compressed air – an interesting option for energy savings, especially for systems in continuous operation.

© Copyright 2018, Festo AG & Co. KG

C) Saves time and money: leakage diagnostics

These days, leakages are not something you have to put up with. But identifying them in day-to-day operations usually requires a certain amount of time. However, many production plants are set up in such a way that any interruption means a loss of production and therefore costs money. This is where the app for leakage diagnostics helps. It enables faults to be detected rapidly as the leaks can be actuator-related and thus accurately located. Extensive searches are not necessary. In normal system operation, a certain number of switching cycles for actuators can be defined individually. Then the test for possible leakages is carried out.

No more time-consuming searching: the app automatically diagnoses leakages, thus reducing energy and maintenance costs.

It is also possible to precisely define individual threshold values for the loss of compressed air caused by leakages. The overall effect: this does away with the need for time-consuming troubleshooting in what can be vast pneumatic networks, and helps to reduce energy costs due to leakage. The app for diagnosing leaks can be used at the same time as other apps; it can be easily combined with another app to form a kind of “multi-app”.

Self-adaptation and energy efficiency

The three examples show the areas in which a system such as the Festo Motion Terminal demonstrates its strengths. It supports energy efficiency by reducing compressed air consumption and helping to locate leakages. On the other hand, it can be used flexibly in production processes, thus saving commissioning and changeover costs – and monitors itself. This monitoring is automated and decentralised, i.e. it takes place directly on site, without the need for intervention by operating or maintenance personnel.

© Copyright 2018, Festo AG & Co. KG

Big data and the cloud: new horizons of knowledge

Storing and analysing large amounts of data in conformity with requirements is one of the additional challenges of digitalisation. While it used to be technically difficult to analyse data volumes of this size to find the answer to a single, specific question, it has now even become possible to extrapolate various features or anomalies from the collected data. Furthermore, advances in sensor technology and miniaturisation are allowing numerous components to be equipped with different sensors in order to collect the appropriate data.

Manufacturers, OEMs and system operators each take an individual perspective on the production processes of a system and are able to analyse their performance through digitally collected and processed data and improve it for the benefit of everyone.

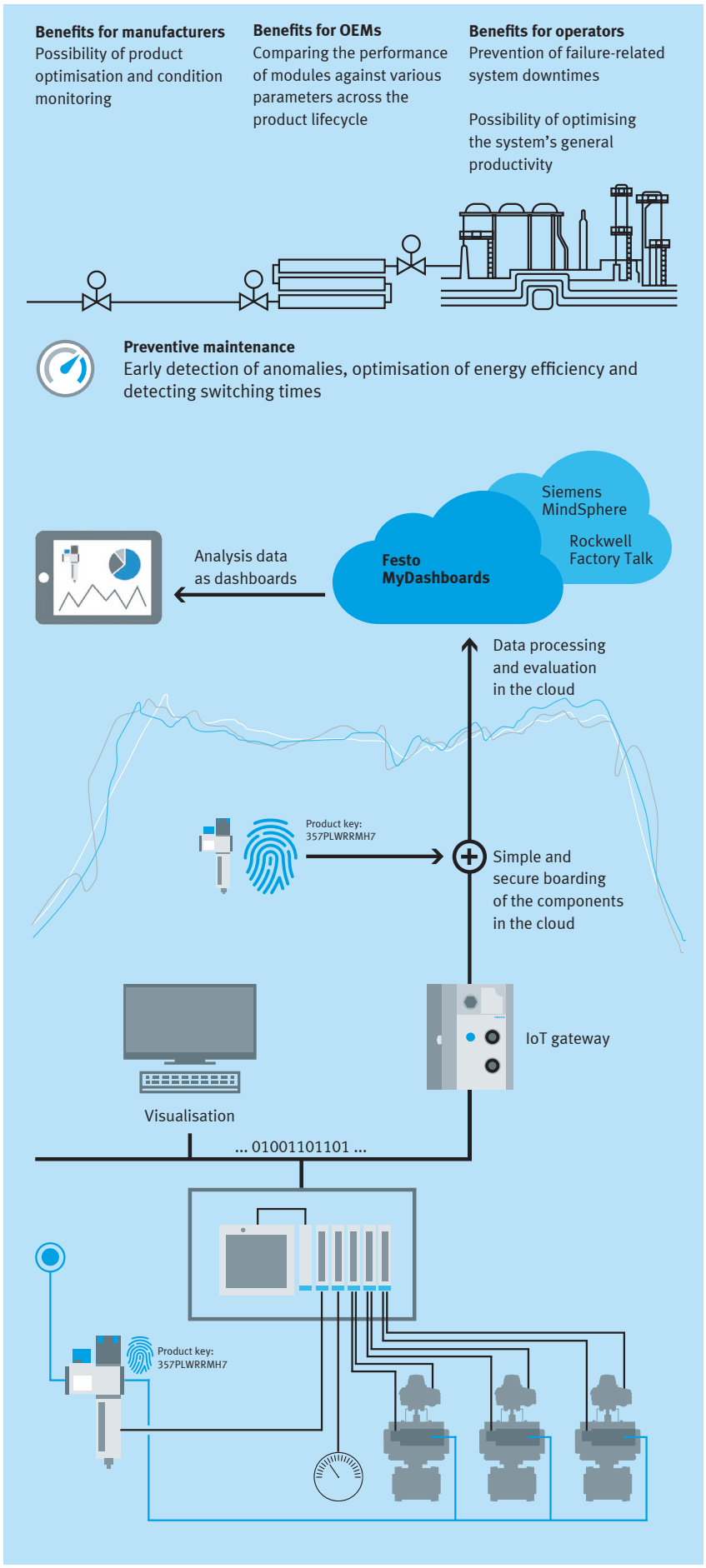
> The analysis of data in the cloud allows diagnostics and evaluations and has numerous benefits: manufacturers can optimise their products in the long term, module builders can detect anomalies in the production process early on, and operators receive important information in time about any emerging problems.

To the cloud via the IoT gateway

All data collected by the Festo Motion Terminal or other intelligent devices, such as the service unit E2M, can be sent to the cloud via an IoT gateway. The gateway connects components and modules at field level, for example the Festo Motion Terminal, to the Festo Cloud. The security of the transmission paths and processes has top priority here. The appropriate products and protocols to safeguard this are now available. “We find that customers now have more confidence in IT security mechanisms,” says Roos. “However, we have installed a hardware switch in our IoT gateway that allows the customer to easily vary the connection to the cloud: from uni- to bi-directional communication or simply to disconnect it completely.”

The data can then be subjected to a large number of analyses in the cloud. That is also where they are processed, monitored, calculated and diagnosed. This data can then be used to analyse trends or for comparisons with either current or earlier production data. In also helps to detect trend deviations, which in turn point to emerging defects in components in the production systems at an early stage so that, in an ideal case, defect-related failures are avoided.

© Copyright 2018, Festo AG & Co. KG



More information via the cloud: by evaluating the data collected, there are significant advantages for the various parties involved.

© Copyright 2018, Festo AG & Co. KG

A) Local and global comparison: the manufacturer

If manufacturers like Festo are able to monitor their components worldwide and evaluate the data to determine how they are used in specific applications, they gain a wealth of helpful information. This can then be used as part of an individual system as well as on the basis of globally collected data.

As part of an individual system:

- For example, the number of switching cycles of components can be precisely determined and thus a more accurate statement can be made about the service life reserve in operation.
- Possible deviations in the production process can be detected, for example when the energy requirement of a component has increased significantly.
- Any change in the opening and closing times of the actuator units can be traced, for example by looking at increasing friction or additional loads in the process.
- The torque reserves of pneumatic actuators can also be determined.

As part of a global comparison:

- The manufacturer can compare how different ambient conditions affect the performance or service life of the components and systems.
- This knowledge can be used to optimise products or develop new components.

With the data thus obtained, it would also be possible to give customers specific warnings if they were to install their components in an environment that could have a negative impact on service life or performance, or which does not comply with the product specification. “If for example the ambient temperature is too high,” says Roos, “suppliers could then inform the customer that their environment does not comply with the specification and advise them as to what should be changed”.

B) Discovering irregularities: the OEM

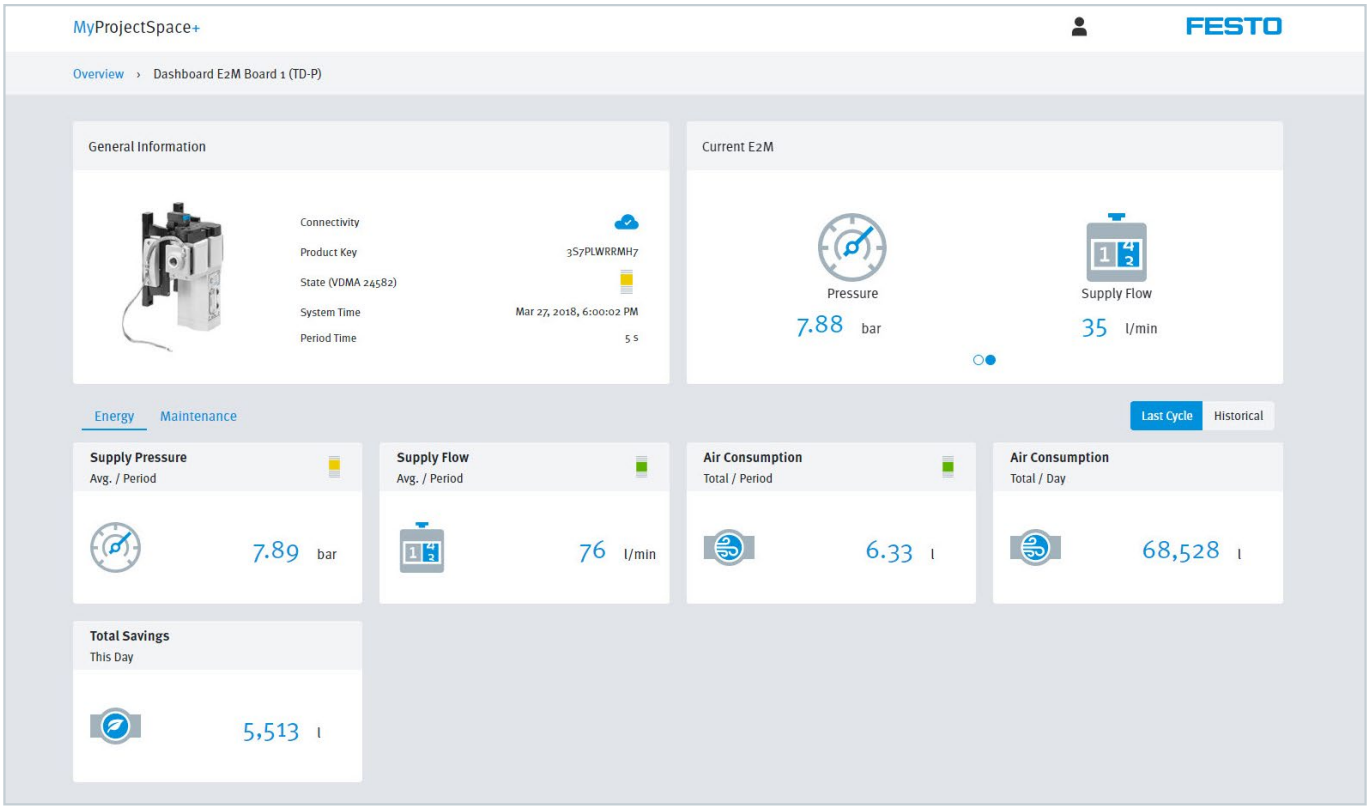
OEMs, who in turn supply their modules and systems to machine builders or even directly to end customers, also have an interest in monitoring the performance of these systems so they can draw conclusions about possible weak points or potential improvements. This enables them to detect problems in existing installations even before they lead to a failure. They are then able to inform the user accordingly and can prevent costly production downtimes. By and large, the advantages meet the needs of the component supplier. The module builder can detect deviations, compare the energy consumption of different installations or draw conclusions about the performance of the system based on different requirements such as ambient conditions, for example. If these findings are used to improve future modules, or to give the user specific support about handling the module, this is a direct benefit for the end customer.

C) Timely notification: the system operator

Theoretically, it has been possible for certain operators to collect data in the past. “But with the exception of large corporations that could afford a data analyst, hardly anyone had the capacity to use this data to their advantage,” says Roos. This is now changing. As the manufacturer can monitor and analyse the operator’s data and can compare it with the data of other operators, the module builder gains additional insights which in turn is of enormous benefit for the system operator. This could include receiving timely notifications of any necessary software updates or receiving warnings about any noticeable anomalies in the process. This helps to avoid downtimes and any necessary

© Copyright 2018, Festo AG & Co. KG

maintenance work can be more specifically targeted. They also benefit indirectly from manufacturers using the information gained to optimise and improve their future products, based on real customer needs. “In the past, many manufacturers were only made aware of specific problems customers had with the equipment when they actually reported them,” says Roos.



Pre-configured dashboards clearly show important analysis data, both in real time and in retrospect, both in the plant and also thousands of kilometres away. This benefits everyone involved.

Conclusions

Digitalisation will not only fundamentally change our everyday lives, but also the way in which production facilities are built and operated. A look at the current innovations and developments around process automation is therefore worthwhile for everyone involved. This could be to make everyday production more flexible, efficient or profitable, to be able to rely on the advantages of data-supported analyses in long-term planning or, for example, to monitor life expectancy by looking ahead. The opportunities for the industry presented by digitalisation are manifold – and the overall scope is far from being accurately estimated.

Published by:
Festo AG & Co. KG

process@festo.com
→ **www.festo.com/process**

Your personal contact:
Dr Eckhard Roos
hanseckhard.roos@festo.com

© Copyright 2018, Festo AG & Co. KG