Measurement Technology: Exploiting the Potential of Industry 4.0

It was 10 years ago that the research advisory committee to the German government used the term "Industry 4.0" for the first time in public at the Hannover Trade Fair. Numerous solution approaches for the process industry have been developed since then. With its Industry 4.0 program, Endress+Hauser is working together as a technology pioneer with customers and partners to unleash this potential in the area of process instrumentation. What is already possible today in the food and beverage industry and where is this sector headed?

Attributing the potential of a fourth industrial revolution to process informatics and the concept of cyber-physical systems in advance was a bold step. If we analyze the history of the previous "revolutions", what really stands out with the utilization of steam power for mechanization is that the efficiency of the technology determines its success. From the time it was invented (1698, steam pump, T. Savery), steam power required roughly 160 years to fully establish itself in industry and unlock its potential. Let's take a closer look at the state of digitalization 10 years after the rise of the term Industry 4.0.

97 percent of the data from the field remains unused

Depending on the size and the industry, a modern production operation has between 50 and 2,000 measuring points for measuring, controlling and automating its production processes and making them reliable. Apart from the actual measurement values, today these instruments can supply additional data and information, although analyses by Endress+Hauser show that up to 97 percent is still unused. This is where Endress+Hauser's Industry 4.0 program comes into play, combining harmonized intelligent process sensors, cloud apps, interfaces and connectivity components and translating them into practical solutions. Especially relevant for the food and beverage industry are solutions for the plant overview, plant monitoring and mobile asset management.

Smart sensors are the key to Industry 4.0

The Endress+Hauser Industry 4.0 program makes this data from the smart field instruments available. This begs the question, what makes a field instrument a "smart sensor 4.0"? Communication concepts play an important role here. Integrated web servers already enable direct operation and data exchange with a laptop. The OPC UA communication standard permits the manufacturer-independent integration of measurement and status information in downstream business processes. The product portfolio of instruments with Ethernet-based field buses is steadily growing as well. The cloud-based Micropilot FWR30 level measurement instrument even makes wireless level measurements for mobile tanks possible.

Sensors with internal testing functions Other criteria that make a sensor a smart sensor are internal instrument

Smart sensors are the key to digitalization: flow sensors from the Proline 300/500 family feature an integrated web server, WiFi and a self-diagnostics system. Photo: Endress+Hauser

test functions. Instruments featuring the Heartbeat technology offer diagnostic, verification and monitoring functions that create value through data-based notifications and warnings and enable predictive maintenance. Additional information regarding entrained gas, foam or deposit buildup is especially helpful for ensuring stable processes in the food and beverage industry. For example, the Levelflex and Micropilot radar level instruments are capable of reliably detecting foam buildup and utilize internal data for permanent self-monitoring. This makes it possible to verify the operation of the instrument without interrupting the process. The verification can also be used as a documented test to trigger processes where the exact dosing of the recipe ingredients is essential for product safety. Production does not continue until the instrument has verified itself. Another example of a smart sensor is the iTHERM TrustSens self-calibrating thermometer, which automatically calibrates itself when the temperature falls below a certain level, thus permanently ensuring the safety of critical production processes. As a result, plant operators in the food and beverage industry enjoy numerous options for integrating smart sensor technology into their production systems for all measurement parameters, gaining access to the data in the field instruments and directly benefiting from the digital technology through various solution packages

Plant overview solution: maintain a complete overview, decide with confidence

Until now, monitoring the installed base of instruments in food or beverage production systems has required extensive research and a high degree of manual effort, an extremely costly and error-prone process. Added to that was the tedious maintenance of the installed base documentation. The combination of the individual, digital tools from the Endress+Hauser Netilion IIoT ecosystem enables efficient management of the installed assets. The Netilion Scanner app, which is available at no charge, makes manual monitoring of the installed base child's play. The key data stored in the field instrument can be scanned with a QR code or an RFID chip. Additional information, such as the localization of the measurement point, can be determined quickly and easily. The measurement instruments are even automatically monitored with the help of the edge device. The easy-to-install plug-and-play solution establishes a secure data connection to the Netilion hub. Changes to the

The Ostwestfalen-Lippe Technical University is testing a flash pasteurizer for beverages as a cyber-physical system. Graphic: Endress+Hauser
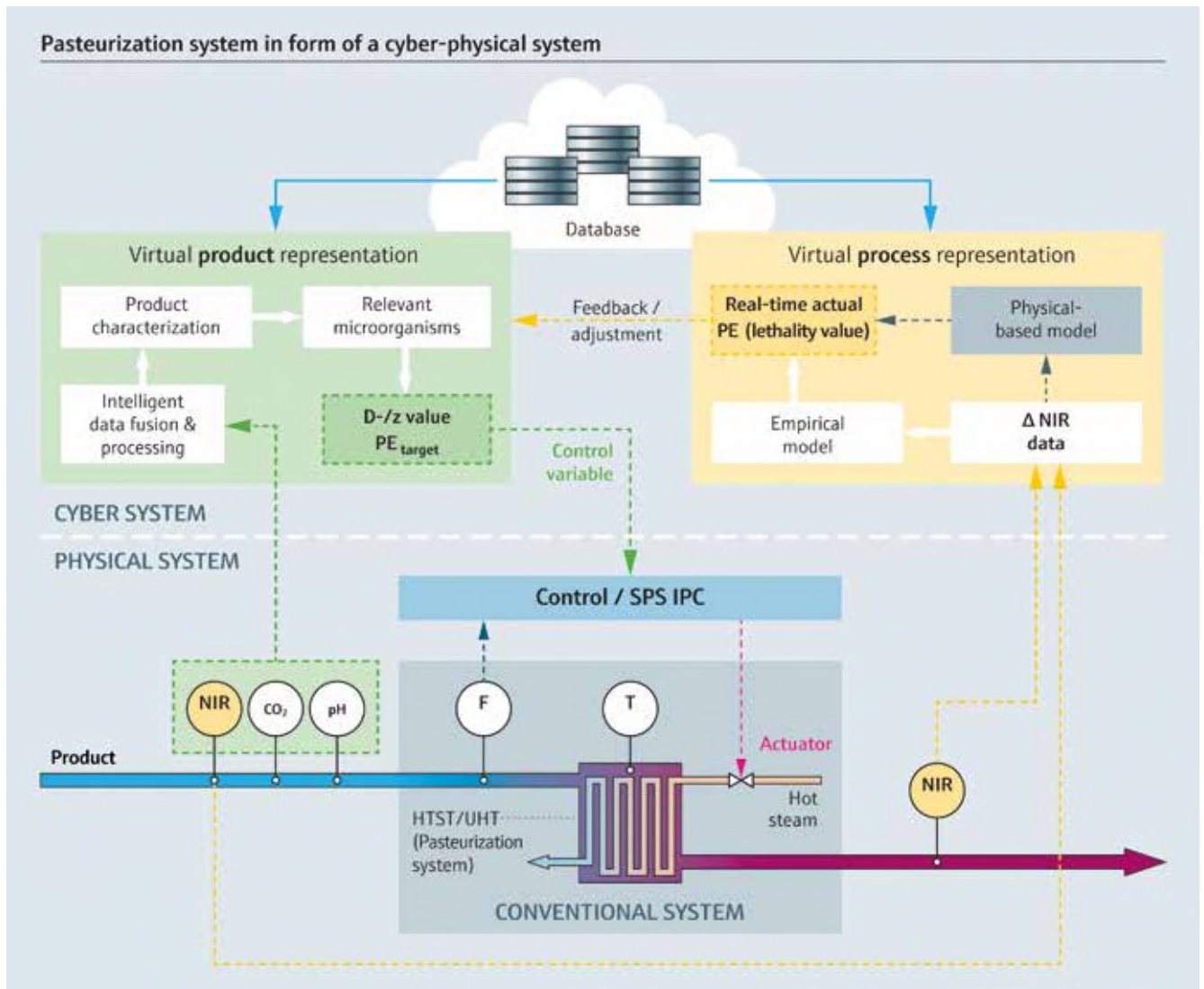
installed base are automatically recorded on an on-going basis. Practical dashboards in the Netilion Analytics module simplify fast analysis of the installed base of field instruments, thus allowing an unprecedented level of transparency. Valid data leads to faster and more reliable decision-making. Information regarding availability is also displayed here. In case of a discontinued instrument, a suitable replacement product is automatically recommended. Documentation for the monitored instruments is available around-the-clock in the Netilion Library, where a digital twin of the measurement point containing the historical life cycle data, plus documentation such as the operations guide or the calibration report from the development and manufacturing process, resides.

Plant monitoring solution package: respond faster, intervene in a targeted manner
Short response times are crucial when critical outages occur in the food and beverage industry. The time-consuming interpretation of error messages and annoying searches for the relevant resolution measures are costly. In contrast, automatic interpretation of the instrument diagnostics information simplifies maintenance in Industry 4.0 environments. Instrument maintenance is highly efficient thanks to integrated solutions and explicit resolution recommendations. Determination of the device and its classification according to NE107 is precise thanks to the Heartbeat technology. The edge device forwards the status and error diagnostics information to the Netilion Health online service via a secure data highway, thus making all of the information centrally available. The Netilion Health online service supports the user with more than 25,000 instrument diagnostics. Apart from the individual status notifications, Netilion Health also displays the diagnostics code, the cause and the recommended actions. That means the tedious interpretation of errors is a thing of the past. Each error message can be handled quickly and in a targeted manner. Thanks to continuous status monitoring and an overview in line with NE 107, the maintenance measures can be analyzed and optimized.

Mobile asset management solution package: paperless maintenance, with or without a network connection
Who isn't familiar with this situation? While standing in front of an instrument in the middle of the plant, you need the operations guide, which is unfortunately lying on your desk at the office. The days when documentation had to be searched for and manually stored are now over thanks to Netilion Library. In addition, combining Netilion Library with the Field Xpert SMT7x tablet PC simplifies not only the documentation of the maintenance activities, but the actual maintenance activities.
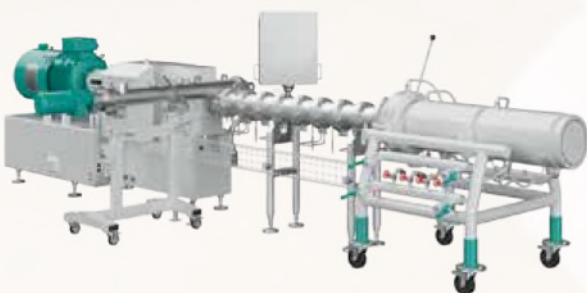
Field Xpert and Netilion Library achieve paperless maintenance across the entire life cycle. The Field Xpert industrial tablet, an outright "Swiss army knife" for maintenance and service activities, can be used to configure instruments from various manufacturers via different interfaces, including WiFi or Bluetooth® instrument interfaces – even in ex-zones of course. A digital twin is automatically created by connecting the Field Xpert with the Netilion Library online service.

The field instruments monitored in the Netilion system are linked to specific documents such as operations guides or technical information from the manufacturers' databases. Endress+Hauser furthermore provides the datasets from more than 40 million installed field instruments. By linking the Field Xpert with the Netilion system, it's possible to seamlessly switch to and from the configuration menu and the instrument documentation. The tablet maintains an overview the maintenance activities and documentation across the entire life cycle of the instruments. Reports and images of the measurement instruments are automatically stored in the Netilion Library. Maintenance activities are recorded in offline mode in a traceable manner even without an Internet connection.

Excursus: cyber-physical systems in research and practice

Measurement technology in cyber-physical systems (CPS) is making an additional contribution to digitalization. With the support of Endress+Hauser and others, the Ostwestfalen-Lippe Technical University is working on a project involving the operation of a flash pasteurizer for beverages as a cyber-physical system. In the current environment, the heating process is run with a highly idealized control model and high safety margins, which occurs at the expense of resources (time, energy) and product quality. As an approach for optimized flash pasteurizer control, during production the product is characterized before and after heating and the heat retention temperature and duration is individually adapted to the product by means of a cloud-based data to account for potentially harmful microorganisms. This ensures the product has the maximum microbiological safety under the minimum thermal load. Endress+Hauser is supporting this project which is being funded by the German Federal Ministry of Education and Research. A practical example of this type of CPS can be found at a dairy in southern Germany for monitoring the process water discharge into the neighboring river. The system monitors the volume and temperature of the discharged water and documents the water level and flow using information from the internet. The reports are automatically sent to the responsible water management office.

Data security is the top priority

Information security plays a key role in determining the success or failure of digitalization in the food and beverage industry. With this in mind, Endress+Hauser had the Netilion IIoT ecosystem certified in line with the highest possible cloud computing security standards. The Bluetooth® communication employed between the field and mobile instruments also exhibits a significantly higher level of security than Wireless HART or a WiFi router with WPA2, as was confirmed by the Fraunhofer Institute for Applied and Integrated Security (AISEC).

Summary

Smart sensors are indispensable for the realization of Industry 4.0 in process automation environments. If we draw a comparison to the previously mentioned development of steam power, then numerous hardware and software innovations have already led to a significant increase in the "efficiency" of field instruments in the area of informatization. While it's evident that Industry 4.0 is far from being implemented on a wide basis in the food and beverage industry, there are nonetheless many interesting solution approaches in place, pilot projects are being successfully implemented and individual plants have already arrived in terms of Industry 4.0.

In the food and beverage sector, the Industry 4.0 project will grow together like a mosaic. Although many individual elements are not new and are already in place, a lot of bright minds and innovation drivers will be required to bring the potential to maturity. For this reason, major training and education efforts, as well as broadening the level of knowledge regarding the requirements and benefits of digital communication in the food and beverage industry, is just as important as technical innovations. fmt

Informatization of production systems: Endress+Hauser offers edge devices for automatic monitoring of the installed base. Netilion Services provide online help for the management and maintenance of the instruments. Graphic: Endress+Hauser