On the road to the Smart Factory

INDUSTRIAL EVOLUTION | Industry 4.0 and the Smart Factory address major challenges – the securing of competitiveness, resources and energy efficiency, the quick change of sales markets and ever-stronger individualization. The introduction of cyber-physical systems as well as flexible and intelligent software solutions is necessary to create completely networked, self-organizing production systems and thus secure the sustainability of industrial manufacturing.

MANUFACTURING COMPANIES – which also includes the brewing industry – are now facing the fourth industrial revolution: Cyber-physical systems (CPS) that network the machines and components to one another, as well as flexible and intelligent software systems will pave the way to the Smart Factory. In doing so, cyber-physical systems are created by linking embedded systems to the digital networks of machines or product components. They can log and process data from their environment independently – and, in turn, influence their environment with the results. If cyber-physical systems have IP addresses, they can be controlled online. With their sensors, actuators and small embedded computers, cyber-physical systems organize production autonomously and can thereby overcome barriers between companies such as between suppliers and producers.

Manufacture with more flexibility

In smart factories, many of the companies' processes will be controlled and coordinated in real-time depending on the requirements, even over long distances. This means that individual process steps must be standardized as modules and made addressable. Robust networks ensure the necessary continuous exchange of data that is needed for the automatic adaptation of the processes. Process control is now no longer necessarily central; it can also be taken over directly by components in some cases, thanks to CPS. Embedded systems can be used to interpret ambient data and deduce control commands based on this. Production as a whole becomes more flexible. Machines also contribute to this new flexibility because they are designed to be open for different applications. They are in a position to complete different tasks in an impressive sequence and to employ various tools. The software for process control and visualization must also be designed open and flexible in order to meet these requirements.

In practice, this means that flexible production also allows small batch sizes without conversion costs. If components require processing, the machine selects the appropriate tool. Maintenance is organized by the machine itself. The ordering of materials and consumables is also automated. Because industrial robots are becoming increasingly lighter and more adaptable, they

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Process control via tablet

can go beyond their limits and take on many other tasks. Energy management can also supply such flexibility: Machines can organize themselves independently and automate energy consumption.

Closer intermeshing of corporate areas

Superordinate modules for planning and control will be cloud-based in part and will change the familiar automation pyramid. The automation level will increasingly carry out administration and analytical tasks; the planning of manufacturing will already start in the ERP system. In order to be able to act as flexibly as this, complex computing tasks must be feasible at the different control levels in a company, starting with the processing of the order, through planning and manufacturing, to logistics and resource management. The process of connecting different levels in the company will further establish itself and continue to accelerate. It will push beyond company limits. However, all processes will have to be permanently coordinated with one another.

The challenge of the Smart Factory

The implementation of the Smart Factory requires increased harmonization of the interfaces and languages, as well as joint data pools and equal access for the parties involved. In doing so, programs must increasingly work independent of hardware and obtain data from different sources, then process this and be able to deliver it in different formats. Only this way can companies exploit the potential that the Smart Factory offers and benefit from growing flexibility with reduced production costs at the same time.

Use new possibilities effectively

The prerequisites for a Smart Factory have, in part, already been implemented – or are being created now. This means: The procurement of new machines and new software, the forging of new alliances and the purchase of professional services must already focus on future ways of working. It is not a matter of being the first to produce goods in a Smart Factory. It is a matter of using new possibilities effectively. This includes, among other things:

SCADA system with Batch Control

A prerequisite: an ergonomic software for planning, control, visualization or analysis

- Targeted preparation for flexible production – in extreme cases down to a batch size of 1;
- readiness to incorporate suppliers and consumers more closely in the company's own processes and to also share information with them in an automated manner;
- the preparation of new machines for IPv6 and communication with components;
- the use of individually-amendable and ergonomic software for planning, control, visualization or analysis;
- secure networking of communication beyond company limits.

Humans as the success factor

New thinking is also required. The people involved must look at the new concepts in detail. In order for comprehensive networking to work, supervisors and other employees must recognize and accept its benefits. Initially, cross-company and interdisciplinary cooperation will enable the Smart Factory to be a successful concept. The change will not be a revolution, but an evolution. Machines have long lifecycles; companies don't want to change concepts that work and and engineers and operators like to use what has been tried and tested. However, the increasing complexity is one of the biggest hindrances in industrial environments. If the Internet of Things and Smart Factories are to be successful, companies will not just have to think about their technical requirements and implementations, but must prepare their employees for this – particularly engineers, people involved in automation, managers and IT experts – and improve their tools accordingly. Therefore what will be required in the future, more than ever before, is software that can analyze quickly, provide data in an intelligible format and, above all, can be operated easily and safely. This is because, despite all the progress in mechanical engineering, humans remain the decisive factor. They must interpret events correctly, and react and make decisions quickly, but also correctly. Therefore we also require people who adapt to the quicker pace of change, continuously update their knowledge, and are open to new technology.

Seven steps to the Smart Factory

Act across disciplines

One of the biggest challenges at the moment is not technological, but organizational. Companies must gather their employees to one table – those who are responsible for implementing the corporate objectives with those who know what is technologically feasible. This requires cross-discipline teams from areas such as production (including automation), IT, marketing and sales, as well as supply chain management.

Find a common language

The Internet of Things, cyber-physical systems, PLCs, information flows, ergonomics, business processes, total cost of ownership, return on investment, investment cycles… There is a danger that companies can already lose themselves in Babylonic linguistic confusion before the discussion has even started. They should therefore concentrate on the actual problems that they want to solve and attempt to leave out the technical or business jargon.

Defining business objectives

People who are technology enthusiasts are often subject to the temptation of concentrating on what is technologically feasible or what is not yet feasible but could become feasible. Companies should only consider technology as a lever to be used to implement business objectives. The following questions can help to shape the discussion: Can we gain additional customer groups if we produce more flexibly? What costs (for energy, raw materials etc.) present a risk for our business model? What should our production be able to do in order to make our customers happier and more loyal? What can differentiate us from the competition in the future?

Determine the ideal status

If the business objectives that a company wants to pursue have been defined, it is possible to work out what the ideal status quo would be: An energy-autonomous factory? Product customization down to a “batch size of 1”? Shorter cycles from product design to delivery?

Cost benefit evaluation/investment plan

If the business objectives have been established, it is also possible to estimate which investments – taking the risk into account – can be made and what additional profit a company can expect.

Technology matching regarding the cost-benefit structure

Using the definition of the business objectives and the investment framework, companies can evaluate how close they can get to the ideal status quo with the technology that is available today. It also becomes clear which technological solutions are still missing in order to take the next steps.

Implementation and continuous improvement

At this stage, companies can return to familiar routines and look at implementation, integration and continuous improvement of the previously-defined technical measures – and then start again with stage 1 if they so require.

Status quo – what is possible?

There is certainly a great deal of research and development ahead of us until companies have reached the objective of fully-digital manufacturing. The networking of sensors and actuators via the Internet means that with our current level of technology, they still face unanswered questions such as real-time compatibility and security, which are needed in an industrial context. However, the concepts of the Internet of Things (IoT) are not just visions for the future. Nowadays, with hybrid architectures, companies can already exploit potential in their manufacturing – in resource efficiency, effectiveness and flexibility. As long as network infrastructures and protocols do not allow real-time-capable processes via the Internet, companies will work with architectures that combine both decentralized and centralized intelligence. ■

Technologies for the Smart Factory

zenon is a versatile software for industrial automation solutions. It consists of zenon Analyzer – offering evaluations and Big Data analyses; zenon Supervisor – an independent SCADA system; zenon Operator – an HMI system; and zenon Logic – an integrated, IEC 61131-3-based PLC system. zenon offers numerous functions and technologies that allow networked production systems and consistent vertical integration, thus creating transparency in value-added chains:

- Connectivity: Vendor-independent connectivity for the networking of heterogeneous production landscapes.
- Intelligence of “embedded device” via the PC to the cloud: With straton and zenon Logic, the IEC 61131-3 development environment and Runtime. Can run on microcontrollers, PCs and in the cloud.
- M2M communication: With “straton binding”, we offer a powerful protocol for horizontal communication at machine level.
- Flexible architectures: With the components straton, zenon Logic, zenon and Batch Control, flexible architectures can be implemented as required.
- Cloud integration: For data used across sites and computationally-intensive applications.
- Security/Safety: Integrated security and safety technologies, and design concepts, in order to meet networked production requirements.