36 **SPECIAL** TRENDS **Automation**

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"Intelligent Automation Brings Systems Closer to their Optimum"

Artificial Intelligence of Things: Trends and Models for the Plastics Industry

The latest trend in digitization is the Artificial Intelligence of Things. It amounts to "marrying" Artificial Intelligence with the Internet of Things. In the following interview, Martin Dimmler and Martin Rugfelt discuss how companies can profit from AIoT and what plastics manufacturers can learn from its pioneers in other industries.

For a smart factory, the Internet of Things and Artificial Intelligence are two sides of the same coin. When combined, they enable an intelligent automation of industrial processes capable of leveraging undreamed of potential for optimization. Can the plastics industry also profit from AIoT by emulating its application to the empirical values in other industries? Two experts, Martin Dimmler, the Head of Solution Strategy & Solution Engineering at Device Insight GmbH, and Martin Rugfelt, the CEO of Sentian, present an overview of the technological trends round about IoT and AI and describe the factors that make the Artificial Intelligence of Things a success.

The digital transformation of industry and what the factory of the future ought to look like have occupied us for some time now. Mr. Dimmler: Smart processes, networked products, digital business models – is that today's reality? How far have companies taken the Internet of Things in 2021?

Martin Dimmler: Some industries have gone far by now with their networked products. We are seeing suppliers of industrial vacuum cleaners, tractors, parking heaters, or coffee makers who began to digitize years ago. With their sophisticated solutions, they now stand out among their competitors on the market. Some companies are already developing the second or even third generation of their IoT solutions and establishing innovative business models. Due to the pandemic, mainly IoT-based remote services are coming back into focus. The ones who had already put a functioning solution into practice have survived the crisis well. To name an example: our customer Krones, a Bavarian supplier of filling and packaging systems, has connected over 20,000 of them worldwide, thereby enabling efficient 24/7 maintenance by 600 remote service employees.

How far along is the Industrial Internet of Things (IIoT)?

Dimmler: We're still lagging a bit behind. At the moment, we mainly see

companies and large family-owned concerns that have at some point at least developed Proofs of Concept to test the technical feasibility of an IIoT solution and have digitized certain individual machines or a production line. In doing so they have noted what potential remains dormant in their processes that can be implemented by IIoT. In principle, more and more companies are rethinking the digitization of their plant and production sites from the ground up.

What are the biggest trends currently emerging in the implementation of IoT and IIoT projects? Where is the technological development headed?

Dimmler: The first trend involves data strategy. Companies that have already gathered practical experience with IoT are concentrating on unifying their data sources. In essence, it is a matter of developing and implementing consistent data architecture. Standardized protocols and architectures are terribly important here. Fortunately, the OPC UA communication standard is becoming more and more popular in industry, since it enables manufacturer-independent data exchange between individual machines up to the cloud, in short, real interoperability. The second trend marks the convergence of Edge and Cloud computing. Both technologies have reached a high level of maturity in the meantime. Optimized hybrid solutions can utilize the strengths of both concepts.

And the third one?

Dimmler: The third and certainly most important trend we are seeing is cloud acceptance. There has been a total change of heart, from skepticism to a willingness to use it and now to the desire to have it. Companies have recognized that it is not economical to create their own infrastructure and data center. Those who wish to optimize and improve scalability and flexibility at the same time find that cloud-

native solutions offer them much more room to move. Following initial reservations, most of them have meanwhile recognized the advantages of high investments in secure technologies such as those that only hyperscalers like Microsoft Azure and AWS can provide. We at Device Insight had this trend on our screen right from the start and can therefore offer products that enable native integration in the form of solution building blocks in the large platforms.

Let's talk about another trend: Artificial Intelligence of Things, in short, AIoT. Mr. Rugfeld: What role is the combination of AI and IoT playing in digitization?

Martin Rugfelt: Artificial intelligence is ubiquitous where companies digitize. The secret of success here does not lie in the technology, but rather the consideration given to processes and products, the availability of know-how, and, above all, clearly defined company goals and business cases. Many companies forget to set the right KPIs that AIoT is supposed to operationalize. Right here it is entirely realistic to expect a ten percent reduction in the costs of a department. Of course, there are pioneers among the CEOs who set quite clear goals and wish, for instance to improve the quality of their products, increase output or reduce rejects. And they can do it, too – provided they do not see AIoT applications as separate projects, but rather as a part of their core business.

Is that the exception or the rule?

Rugfelt: I have the impression that more and more companies are beginning to understand the overall value of AIoT. We are seeing applications where it is no longer a matter of analyzing a particular problem, but of integrating AIoT in a product application, no longer just about a Proof of Concept, but of use in running operation. And this is exactly where the real business benefits come from combining AI and IoT.

AIoT is supposed to raise production automation to a new level. What does that mean? What's behind "intelligent automation"?

Rugfelt: At bottom, intelligent automation is mainly a matter of insuring that machines and systems work closer to their optimum – that is to say: no matter who is operating them and where they happen to be standing. This is where the shortage of skilled workers comes in, because we know that modern machines keep getting more and more complex. The main thing is that traditional control systems have been programmed for particular tasks for people. They are incapable of learning or adapting. AI algorithms, on the other hand, can examine innumerous combinations until the best solution is found and the production step is optimized. Take the example of Advanced Process Control, APC, for short: where model-based control is replaced by AI, companies can expect significant improvements and cost savings. It is those grad-

Where Artificial Intelligence of Things (AIoT) is used, value-adding opportunities for more efficiency, quality, and thus higher sales can be realized in every industry © Device Insight/Sentian

ual improvements, of which several examples can surely be found in production, that can give a company a competitive advantage.

Can you give us some figures?

Rugfelt: McKinsey speaks of potential efficiency increases of from three to 30 percent, IBM of up to a 25 percent increase in productivity. And from our own projects we also know that just a fine tuning with AI can appreciably affect company earnings. That is how our customer, Jumo, increased the proportion of their "highest quality" sensors by eight percent – the equivalent of a 20 percent quality improvement.

Many are familiar with the term predictive maintenance where the combination of AI and IoT comes into play. Why is predictive maintenance no longer enough?

Dimmler: Predictive maintenance and intelligent automation don't exclude one other. The former is and remains a case for applying AIoT where you work more with domain know-how and with classic data analysis. At the same time, we have realized that we can leverage very much greater potentials with AIoT that go far beyond predictive maintenance. Take a look at the machine tool industry: today's machines are highly developed and characterized by very high availability. In order for AI to optimize here, you would have to have a truly high number of documented failures to train the AI algorithm. Failures of this kind are relatively rare. Moreover, real business value accrues less from increasing availability than it does from optimizing the process.

25%

process and quality improvements through AI led to 25 % higher productivity at a European auto manufacturer

Source: Künstliche Intelligenz in der Fertigung, IBM 2018, URL: www.ibm.com/downloads/cas/VWD75RJA; graphic: © Hanser

into company production follows in the fifth and final step. All relevant systems can then be integrated.

Where do you see the biggest stumbling blocks for the implementation AIoT solutions?

Rugfelt: It is important to approach an AIoT project with your goals in mind. That means considering in advance what optimization strategy you would like to realize with AIoT. Ambitious

> " *Thanks to AIoT, many companies are finally taking their data seriously.*"
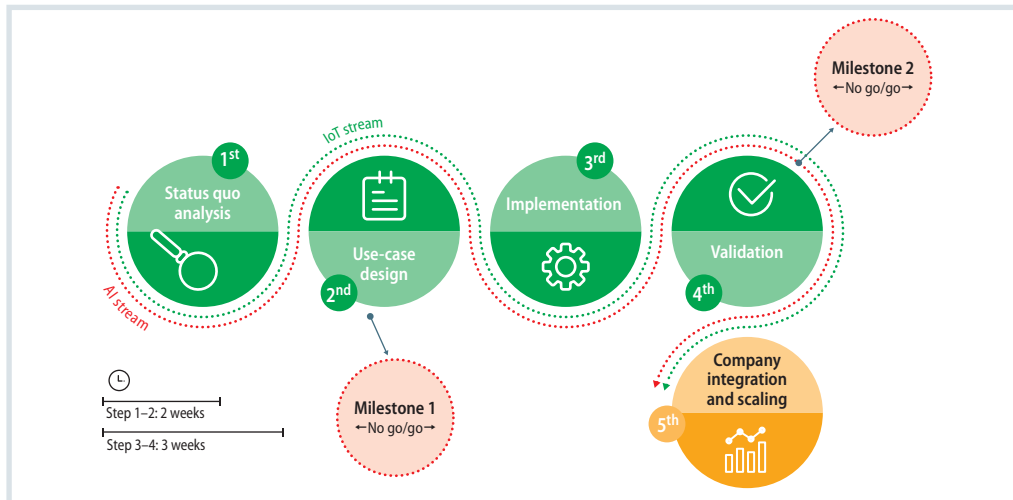
Martin Dimmler

company goals and the necessary attention from top management help to avoid getting bogged down in individual solutions, instead of thinking big. Both AI and IoT technologies are really powerful and have the potential to be transferred and scaled to any number of application cases, machines and – take new business models for instance – to users, too. Many people don't realize that. Of course, it isn't advisable to go into an AIoT project with great expectations for perfection. It's a better idea to proceed iteratively and try things out. Fail fast, learn fast is the right motto. Don't produce anything to be thrown out, but don't plan too long, either – that gets you no further and is expensive in the end.

Dimmler: You have to think of IoT as the nervous system of any production, while AI serves as the brain. That means that the more signals, i.e., the more data AI receives, the better it functions. To have a high-quality, well-maintained database, I have to observe the production process as extensively as possible. That, too, is an essential prerequisite for a successful AIoT project.

What is your experience in plastics processing?

Dimmler: We are currently holding talks with the manufacturers of injection molding machines and plastics processors who wish to make their production more flexible and are seeking AIoT concepts to do so. Such flexibility is known from 3D printing, for example, and is being fueled by trends such as "mass customization". With the help of IIoT, we want to combine such flexibility with the strengths of injection molding while keeping an eye on profitability.

Rugfelt: Faced by competition from 3D printing, most plastics processers are dealing with the question how they can optimize their injection molding processes. Due to fluctuations in temperature, filling speed, and pressure, quality defects occur repeatedly during injection molding cycles. For the most part, engineers monitor and adjust processing conditions by trial and error. With our approach to AIoT, we can automate this control step and ensure that processes, materials, and machines interact optimally.

The second main issue in the plastics industry is the need to lower energy consumption. For instance, we are currently advising a South American manufacturer of PET bottles to reduce gas consumption. Not just to save costs, but to reduce environment-

About the Interviewees

Martin Dimmler (right) is the Head of Solution Strategy & Solution Engineering at Device-Insight GmbH of Munich, Germany. The company is an IoT specialist with 100 employees. Since being founded in 2003, it has accompanied customers from industry and machine tool construction in the field of the internet of things and industry 4.0.

↘ **www.device-insight.com**

Martin Rugfelt (left) is the CEO of Sentian.ai. The company headquarters are located in Malmö, Sweden. AI products and solutions in industry and machine tool construction constitute their core business. The strengths of Sentian lie in machine learning as well as in mathematical optimization.

↘ **www.sentian.ai**

How do you actually proceed with an AIoT project?

Rugfelt: Our joint AIoT approach comprises five steps. First, we carry out an AI and IoT Readiness Check based on the company's requirements. That means we examine the scope, quality, and availability of IoT data to be integrated into the AI solution. Often there is little data available because it has not been systematically stored. Or else the networked devices produce vast quantities of data that first have to be filtered and structured. There often are data gaps from manual sequences in particular that our models can still fill based on available values. In a second step, we create a use-case design supplemented by a proof-of-value plan with which we forecast how our solution will affect operational business. Implementation follows in Step 3, that means, we network the machines and systems with the cloud, accompany the collection and aggregation of data, and provide for their visualization. In this way we obtain an in-depth understanding of the processes and lay the foundation for integrating our AI solution. Finally, we check whether the proof-of-value has been furnished. If this be the case, the roll-out of our AI solution

In five steps to an AIoT solution: by linking AI and IoT, companies can track down hidden production problems, optimize processes, and improve product quality

Source: Device Insight/Sentian; graphic: © Hanser

Use case #1

**The paper industry**

Challenge: Due to process fluctuations in paper manufacture, paper thickness – quality feature number 1 – often falls below the specification limit. Production losses result. Of course, the machines can be "overfed" with wood fibers, but that also increases costs.

Solution: Quality tests at time intervals are the standard solution. However, since adaptations take time to take effect, the production variables may have changed again in the meantime. AI thus produces a sustainable solution with a dynamic reduction of process variables.

Use case #2
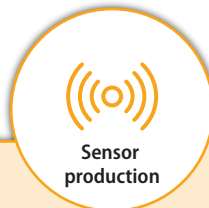
Sensor production

Challenge: The goal at sensor manufacturer Jumo of Fulda, Germany, was to increase the proportion of their highest quality class of sensors and, thereby, the overall yield of production. To do so, small but significant fluctuations within the production process had to be minimized.

Solution: An AI system assumes the adaptation of production settings per batch. The results turn out much better than was possible with manual setting by process engineers. Following each batch, this approach automatically incorporates new information, thereby optimizing the predictive model. The software thus evolves dynamically with the production system.

Quelle: Device Insight/Sentian; graphic: © Hanser

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al impact, as well. To this end we are working out a use-case design to optimize boiler heating with AIoT-based control.

Speaking of sustainability: How can AIoT contribute to it?
Dimmler: Ecological aspects go hand in hand with economic advantages. We see, for instance, that AIoT solutions demonstrably contribute to industrial energy consumption, deal with fluctuations in production, and reduce wastes and reject rates – across all industries. Many AIoT projects we are currently conceiving for the automotive branch or the print industry deal explicitly with energy efficiency issues. That is an important signal.

" *Europe has to hear this wake-up call.*"

Martin Rugfelt

What is your conclusion? Are the opportunities in the Artificial Intelligence of Things being recognized and realized?
Rugfelt: The topic is still in its infancy, but first studies are coming out, and first projects for its implementation are already under way. To be sure, Chinese and US companies are already further along with the use of AI. Europe has to hear this wake-up call. Particularly in Germany, they are still strongly focused on predictive maintenance. At the same time, there are signs of a paradigm shift. There is an increasing awareness of the strength of AI when it is combined with IoT data. ∎