The meeting of artificial intelligence and Industry 4.0

KEBA
Automation by innovation.

Index

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Prelude

Also the industrial sector is using more and more artificial intelligence in order to simplify processes, run systems with greater efficiency, and increase production flexibility. Machine manufacturers must embrace the AI trend in order to secure their future viability.

This white paper provides an overview of the key aspects of this development, presents a 7-step plan for getting started with AI, and ponders the question how solutions can be created on hardware and software that are suitable for industrial use.

Artificial intelligence is no longer the stuff of science fiction—it is making more and more inroads into our daily lives, though that is not always obvious at first glance. Voice assistants on smartphones, digital translation services, recommendations for online shopping, or browsing YouTube videos are just a few better-known examples of the AI support used daily in the consumer sector.

Image recognition in Google Lens, a health cloud that supports medical diagnoses, the automated approval of loans on online platforms, or even insurance rates based on the real-time analysis of a person's driving can also be named here. And most consumers are probably not aware of the fact that unlocking their smartphones via face recognition or the automatic text completion feature in chat applications can only work by using AI.

Automation vs. artificial intelligence

IT giants such as Amazon, Google, Microsoft and Apple have invested large amounts of money and resources in the development of AI so that today, it can be used easily for many different applications. This ultimately also benefits the industrial sector where artificial intelligence is used in control engineering to simplify and improve certain processes. This leads us to the question: Where does “classic” automation end and artificial intelligence start? Or in even more concrete terms: What exactly is artificial intelligence in the field of industrial control and automation technology?

This question can be answered from different perspectives:

// One aspect is the effect of AI.

Artificial intelligence in the context of automation means that machines are enabled to communicate, see, interpret, feel, think, and decide.

// The other aspect is the implementation.

In automation, there is a program for every problem. The problem solution is hard-coded, meaning that it is—unfortunately—not scalable. But for many industries, the days are over when manufacturing remained unchanged for 20 or 30 years. The ever shorter cycles for product and production updates add up to significant manual programming effort, and they might even require a complete replacement of the solution. By contrast, AI does not consist of fixed code; rather, it depends on data. Algorithms and neuronal networks are not programmed to follow fixed rules. Rather, they are modeled and then trained using (historical) data, allowing them to evolve and adapt and yield increasingly better results.

This ability to take current data and adapt to new environmental conditions is why artificial intelligence offers such fantastic potential for the scaling of application scenarios. Less update effort, fewer disruptions, and continuous process improvements with their ensuing positive effect on the quality and efficiency of the system—these are among the most salient benefits of AI-based solutions.

Three AI application categories

In 2019, Bitkom conducted a survey in the industrial sector about the potential reasons for using artificial intelligence. The most important reasons included the increase of productivity (47 percent), predictive maintenance (39 percent), and process optimization (33 percent). These were followed by enhanced product quality (25 percent) and better scalability (20 percent). Cost reduction by itself was only ranked 6th (19 percent).

If we examine the potential use cases of AI in automation, we can identify three basic categories:

1. Assistant systems that help the operator.
2. Local AI systems for the autonomous control of processes in real time.
3. Analytic applications in the cloud.

All three categories have a different kind of potential for using AI in industrial automation and control engineering:

// Assistant systems can simplify complex processes by providing suggestions or help, for example for operation, commissioning or programming.

// Local AI solutions, for example, can provide the machine with new communication abilities so that it can use its sensor system to think, learn, and decide. Ultimately, the goal is to increase productivity and efficiency, for example through shorter cycle times.

// Cloud applications, for example, are suited for predictive maintenance or the detection of process anomalies—tasks that do not depend on real-time responses or utmost reliability, and where a loss of connection does not lead to severe consequences.

A look at the industrial sector reveals a variety of approaches to the use of AI. The trailblazers in the area of control systems are the robot manufacturers who use AI for motion optimization. Environment detection is another major area of application, which is also significant for the logistics field. Machine manufacturers, by contrast, focus more on predictive systems for predictive maintenance and on visualization, for example through dashboards. Other sectors are still lagging behind.

Obstacles for the AI trend

But so far, the applications are not taking full advantage of the possibilities. They are frequently limited to putting the data analysis into the cloud and creating suitable dashboards intended to provide data transparency for operators. This means that the collection and smart analysis of machine data and production data and the subsequent derivation of productivity enhancements are working quite well. However, this does not provide the complete picture of the entire process.

One of the reasons is the lack of standardization:

Currently, solutions are spread over a multitude of ecosystems that are mostly not compatible with each other and that come from different automation specialists as well as from machine manufacturers. This makes it difficult to integrate all of a system's process participants into one single platform and to create a common data base that could be used to harness a broad range of productivity potentials.

On the other hand, the situation also opens up opportunities: The fact that there are no standardization committees or industry associations who define standards for market actors to follow gives even smaller providers the opportunity to shine with their own independent solutions and secure themselves a strong market position.

Another challenge is the necessary paradigm shift in the development of machines and systems:

Here, the requirements are moving towards customization and greater variation in production. In other words, the challenge for automation is no longer to increase productivity by yet another notch, but to achieve greater flexibility without harming productivity.

This requires another development step from flexible production to skill-based programming, i. e. production based on enhanced machine capabilities. It is primarily artificial intelligence that provides the machines with such enhanced capabilities to do certain things or to re-combine existing abilities.

One look at the industrial sector shows:

This technology and application shift is already well underway. AI helps speed up the development of new applications, and the tangible progress in turn intensifies and expands this trend. But to succeed, the machine engineering sector must acquire new skills and greater AI know-how. The search for people with the right skill set and for promising development partners turns out to be difficult for many companies—otherwise, the development would be even more dramatic.

This is because the AI trend is converging with other trends that intensify each other, such as the push for greater digitization and interconnectedness as well as an extreme increase in computing capabilities. Combining these technologies will make it possible to conceive of and implement completely new solutions to problems, which creates the precondition for disruptive development leaps.

New competitors threaten machine manufacturers

The current technology shift entails complex requirements with regard to both the competence and the attitude of the providers and is opening the door for new competitors, for example from the IT and IoT industries. Providers such as IBM, HP, SAP and Microsoft have recognized that this is a pivotal point in time: They are betting on data-driven business models.

The deal for plant operators is simple: data in exchange for added value. Whoever is willing to share production data can in turn receive support for process optimization, for greater plant efficiency, and for the intelligent utilization of their machines. This means that these companies penetrate the space occupied by machine manufacturers and automation specialists and are expanding their business portfolio from information technology (IT) to operational technology (OT). They are extending their reach from the ERP level all the way to the machine, and they are suddenly providing new AI-based functions that aim to increase productivity and quality—something that in the past, only machine manufacturers were able to do.

And machine manufacturers and automation technology providers are being challenged in their core areas of expertise by yet more actors: start-ups and AI pioneers from outside the industry. While these may act as cooperation partners who can temporarily make up certain gaps in AI know-how, this creates the risk of becoming dependent on such partners. In the long term, this risk can only be countered by creating the necessary skills in-house or by hiring AI experts.

The initial experience has shown that with time, these partners simply expand their activities into the machine engineering field. For AI and digitization experts, classic control engineering is frequently just an “add-on” that they also cover.

The future belongs to data-driven business models

This means that the automation and control engineering sector is confronted with the actual risk that technology and innovation could move into other industries who will then dominate future developments. In the future, aspects such as scalability and flexibility will gain even greater importance and the question will be, who owns and drives them. What industry experts are currently observing is that automation and AI represent two different worlds that are slowly growing together but still not fully harmonizing at this point in time.

There is a lot of pressure on operators, programmers, machine manufacturers and automation specialists to take on AI and figure out how they can apply this technology in a meaningful way. And more than anything, how they can use it to generate business. Because the future belongs to data-driven business models. In the future, one of the most important innovations in the industry will be this: Which data-driven services can be offered, and how, that provide a real added value to customers so that they are willing to pay for it.

The alternative is a gloomy future where hardware turns into a commodity and the machine becomes a data source for other providers whose services are securing them the lucrative value creation. This would severely diminish the role of the machine engineering sector as a driver of innovation and would ultimately reduce its importance.

Dr. Rene Fassbender, CEO of OmegaLambdaTec, is convinced: “After a certain point in time, companies who do not use any AI solutions in the future will no longer be competitive.” As a member of the “AI for Industry 4.0” research advisory committee, he also encourages the industry to embrace AI because this endeavor will pay off in the medium term: “AI applications will yield their major pay-back in the coming five to ten years.”

Support for the machine engineering industry

KEBA recognized the trend towards the use of artificial intelligence in the industry early on, and a few years ago, created an AI center of competence.

At this center, in-house developers are programming industrial-strength AI platforms that support the installation and operation of AI solutions. In addition, the center creates proprietary AI solutions based on KEBA automation technology. Last but not least, the specialists at the AI center of competence also provide support, both in-house and externally.

KEBA covers all three areas of AI application:

1. IoT where AI runs either on the premises or in the cloud to satisfy needs around digitization, data analysis and smart factory.
2. Local AI directly in the machine or product, for example in order to make machines autonomous and more intelligent.
3. Assistant systems that use smart AI support for everything from programming to operation in order to reduce complexity and to hugely simplify machine handling through intelligent HMIs and AI support.

Based on our experience with AI projects, KEBA’s AI experts have developed a structured approach that can help machine manufacturers embrace the AI trend in order to stay relevant in the future.

Step 1: Develop the big picture

The first step is to define the initial situation. How is the market changing? What are the technology trends that will dominate the activities of machine manufacturers and automation specialists over the next two to five years? Ask your customers about their plans and strategies for the coming five to ten years in order to gain a good overview:

- // Are there changes to the business model?
- // How will production change from their point of view?
- // What (new) requirements does this entail for their machines and plants?
- // What are their actual pain points, and which of these can (only) be addressed through AI?
- // Which trends do they consider important?

Step 2: Identify the influence of AI

The next step is to figure out where in the big picture the effects of artificial intelligence will become relevant. What role does AI play in these trends? What areas are relevant for AI?

For example:

- // Machine operation: simplification through assistant systems
- // Intelligent enhancements of machine control and functionality
- // Cloud solutions for data analysis

Anyone still without in-house AI resources should use this step to acquire basic knowledge of AI, for example by attending industry events on the subject, by studying best-practice examples, or by obtaining support from more experienced partners.

Step 3: Define your own position

The next step is to consolidate this knowledge and apply it to your own situation. Use the big picture and the identified AI trends as a basis for finding answers to questions: How will the market changes affect your own business? What role can you—or do you want to—fill in the future? What are your own capabilities with regard to data availability? What data is already available, what data can be generated for applications, and what data is definitely out of reach?

Since AI is data-driven by definition, the availability of data determines your position. Data provides answers to questions such as how you can support customers through changing technologies and strategies, or how you can use more digitization and more AI to adapt your products and services better to your customers' requirements.

Step 4: Identify AI potential and action fields

The next question is inevitable: Which AI aspects are relevant to you? In what areas can you—or do you want to—become active? The answers depend, at least partially, on what in-house competencies are available. You should take into account that AI solutions need both hardware and software.

Completing this step successfully requires uncompromising focus. AI technology in its totality offers an enormous wealth of options. But individual applications will be successful only if they solve specific problems.

Step 5: Develop your business case

Becoming active in a field is one thing—achieving business success is another. And so the next step is to develop the business model and define the future business strategy.

The following questions can be helpful:

- How can AI applications be integrated into your own business model?
- Is it possible to offer new, additional data-driven services?
- What are the benefits with regard to cost?
- Which opportunities for additional revenue are there?

Sometimes, the use of AI solutions is simply unavoidable in order to remain competitive and not lose existing revenue!

Step 6: Create the right conditions

In order to turn plans into realities, the right conditions must be created. What do you need in terms of skills and resources? How can you create AI competence in-house? Data scientists in particular are needed in order to develop data-driven applications and services.

A surprise may await you at this point: Frequently, the sought-after competence does exist within the company—but nobody knew! Younger employees in particular frequently have had the necessary training, but they have been assigned other tasks because previously, there was no need for AI expertise. Another important requirement are employees with in-depth domain knowledge who can function as the liaison, supporting the work of the AI and data experts by contributing subject-matter expertise on processes and workflows. Such interface positions, too, can frequently be filled with existing in-house personnel.

However, if no such experts can be found in-house or if the ensuing gaps cannot easily be filled with new hires, another consideration could be to gain the necessary skills through partnerships and cooperative ventures. A word of warning though: Never rely on external support alone. Rather, use the cooperation as a learning opportunity; foster and train your own employees; and use joint projects to build up the practical know-how you need.

Step 7: Find a cooperation partner, if needed

Working with external partners can strengthen your company by providing additional resources. Possible cooperation partners include other companies, but also for example research institutes. When choosing a partner, think about the following questions:

- // What competencies do you need? In addition to product development, also take into account product maintenance and subsequent customer support.
- // What competencies can be integrated best?
- // What competencies does the partner contribute in terms of hardware and software?
- // Does the partner also come with application competence?
- // In addition to best-practice examples, does the partner also provide examples of projects that did not work out? What changes were made as a result?

The AI sector is brimming with newcomers and start-ups whose innovative solutions are driving the market. While they do represent interesting cooperation partners from a technical perspective, you must ascertain during the planning stage whether they are in a position to provide a competent and reliable long-term partnership with a high level of quality.

In addition, the partner must be willing to accept certain key aspects of the cooperation as defined by the machine manufacturer. The role of the latter is primarily to ensure that any solution is suitable for the industrial sector. Whenever neuronal networks and algorithms become hardware-embedded, each new generation of the solution frequently entails a change of the technical basis.

This is an absolute no-no for industrial customers. They are looking for solutions that can be supplied for at least five to ten years, that will be maintained and further developed during this period, and that are based on the original hardware installed in the field.

Artificial intelligence for Industry 4.0

As we have seen, the question regarding hardware and development platforms suitable for industrial uses leaves little room for compromise. It is certainly not enough to place powerful standard IT equipment into protective housings in order to win points with the enormous computing capacity in data-heavy Industry 4.0 applications.

It is not only that the individual components are not designed for the rough ambient conditions or the high degree of fail-safe stability required in industrial manufacturing. This approach also fails to fulfill one of the central demands of industrial customers—the guaranteed availability of the same product over many years.

For this reason, KEBA has developed its own universal AI solution that meets all the requirements of industrial customers: long-term availability, on-site support, and updates for a long period of time.

AI accelerator for the industrial sector: AI Control

AI Control encompasses both hardware and software. The hardware, which meets the standard requirements for industrial settings, includes an AI module whose outer appearance with its many interfaces resembles a programmable logic controller (PLC).

There are interfaces for Gigabit Ethernet, EtherCat and CAN field buses, USB and audio ports, as well as an SD slot for adding more memory. Inside, there are various ARM processors as well as a data processing unit (DPU) that provides the AI acceleration and handles the communication with the entire sensor system. The solution also includes an open software platform that supports developing and running the AI applications.

In addition, KEBA supports its partners in the digital transformation and the development of their own AI applications. Experience has shown that industrial customers who are currently working on the utilization of AI in production typically have well-trained data scientists and programmers in-house who are experienced with popular AI programming languages such as Python or frameworks such as TensorFlow. They do not find it difficult to model a neuronal network or an algorithm and to put it on a CPU, GPU or DPU (data processing unit). The challenge, however, is to implement the AI algorithms smoothly in a machine context.

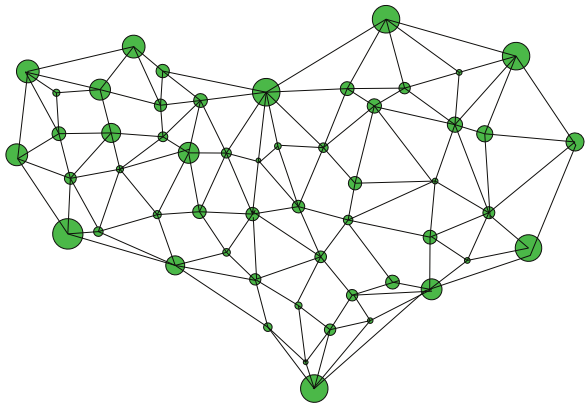
One important aspect is to establish reliable communication with the control system and make sure that the capabilities and the added value provided by AI are recognized and exploited. The experts at KEBA's AI center of competence have developed advanced know-how in this area over the past few years, and today, machine manufacturers can enjoy the benefits of this know-how.

Machine manufacturers and automation specialists must embrace this trend in order to stay competitive in the future; otherwise, they run the risk of being sidelined by new technology providers entering the market—IT companies, IoT experts, hyperscalers with cloud tools, or AI start-ups.

The 7-step plan outlined above offers practical help on how to getting started with artificial intelligence in order to stay in the game. Comprehensive solutions such as KEBA AI Control help implementing AI projects on industrial-strength hardware using suitable software tools.

In addition, the automation specialist provides extensive AI services to machine manufacturers. Industry associations such as VDMA or Plattform Industrie 4.0 provide further assistance in the form of use cases and best-practice examples that promote the use of artificial intelligence in the industrial sector.

This is how artificial intelligence and Industry 4.0 come together



The automation and digitization of industrial production is in the midst of a transformation that affects both the world of control engineering and the world of programming. The early stages were all about growing interconnectedness and the analysis of more and more data; today, this development continues with AI applications such as predictive maintenance and new trends such as skill-based programming.

About KEBA AG

KEBA, founded in 1968, with headquarters in Linz (Austria) and subsidiaries worldwide, operates in three business areas: Industrial Automation, Handover Automation and Energy Automation. The product portfolio of the automation expert, which has a workforce of around 1,800, includes control and safety technology as well as drive technology for machines and robots, ATMs, parcel and transfer machines, power charging stations for electric cars and heating control systems.

In the area of industrial automation, KEBA develops and produces innovative and high-quality automation solutions for general machine and tool construction as well as for intralogistics, robotics, plastics, wind energy, turbo systems and sheet metal processing in accordance with the guiding principle „Automation by innovation“. Whether hardware or software, individual components or complete solutions - the Austrian technology expert offers powerful, modular and safe solutions for all industrial requirements.

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