

The meeting of artificial intelligence and Industry 4.0



White Paper

KEBA[®]
Automation by innovation.

Introduction

Artificial intelligence is no longer just a trend in industry—it is becoming a central component of modern value creation. It simplifies processes, increases the efficiency of systems and increases flexibility in production. Machine engineering is faced with the task of actively using this key technology in order to secure its competitive position and future viability in the long term.

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 industry hardware and software.

Artificial intelligence is no longer the stuff of science fiction—it has become a permanent fixture in our everyday lives, even if its presence is not always obvious at first glance. Voice assistants on smartphones, automatic translation services, personalized product recommendations when online shopping or algorithm-controlled content suggestions on platforms such as YouTube or in social media have long been part of the familiar user experience.

Today, however, AI goes far beyond these known applications: Image analysis tools such as Google Lens can identify plants, products or tourist attractions in mere seconds. AI-supported health platforms such as Microsoft Health Bot or AI-based early detection of illnesses using MRI or CT scans support medical personnel around the world. Banks use AI to check credit applications in real time, while insurance providers can make dynamic adjustments to tariffs based on data such as driving behavior or lifestyle.

In our everyday lives, AI also often works in the background: Facial recognition to unlock our smartphones, predictive text in messaging apps, or even the organization of photos by content in the Gallery app are based on learning algorithms. There are also new developments such as AI-generated content (e.g. in chatbots, text and image generators), virtual travel assistants, personalized learning platforms or AI in video games which make dynamic adjustments to the gaming experience.

The rapid development shows that AI is no gimmick—it is fundamentally changing how we communicate, consume, learn, move around, and make decisions.

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, often 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

The following categorization shows how AI can typically be used in an industrial setting—from classic image processing to process optimization, to prognostic analytical methods.

Current market development: Categorization with current data

According to the current Industry 4.0 study report from 2025 from Bitkom, 82% of the industrial companies surveyed emphasize that the use of AI will be crucial for their ability to compete in the future. [Bitkom e. V.](#) At the same time, 42% of those surveyed stated that they lack the expertise to incorporate AI into their processes in a purposeful way. [Bitkom e. V.+1](#) Only 24% of the companies believed that they have already succeeded in utilizing their AI potential—the majority (72%) sees a need to catch up. [Bitkom e. V.+1](#) These figures demonstrate: Awareness is high, but the practical implementation is still in its early stages in many places. AI adoption is also growing across Europe. According to Eurostat, the number of companies using at least one AI technology increased significantly in all EU countries compared to 2023. [European Commission](#) In a more global perspective, the Artificial Analysis AI Adoption Survey H1 2025 shows that 45% of the surveyed organizations are already using AI in production (i.e. not just in pilot schemes), meaning that the use of AI has gone beyond the exploring phase. [artificialanalysis.ai](#). In this context, three central AI application categories for industry can be derived:

1. Vision & image processing (quality inspection, object recognition, position detection)

This category covers applications in which visual data is processed directly:

- Inspection of surfaces for faults, cracks or deviations
- Localization of parts / position sensing
- Object recognition for sorting or classification

These kinds of tasks benefit greatly from Edge AI, as latency, bandwidth and real time capability are important. Many solutions run directly on the controls or on connected AI accelerators.

2. Process optimization & adaptive control

Here, the focus is on data integration from ongoing operations:

- Real-time adjustment of parameters (e.g. rotational speed, feed rate)
- Control based on historical and current sensor data
- Closed-loop optimization (systems learn to adjust themselves)

In this category, there is often added value in small, incremental improvements which add up cumulatively to significant increases in efficiency.

3. Prognosis & analytics (predictive maintenance, energy forecasts, anomaly detection)

The third category targets forecasts and more in-depth analysis:

- Prediction of breakdowns or wear (predictive maintenance)
- Pattern recognition and anomaly detection in time series
- Energy, load or stress predictions
- Simulation and scenario analysis

These applications frequently do not run in real time on the controls itself; instead, they occur on analysis or cloud components alongside operations, provided the data quality, connectivity and safety are ensured.

Integration & added value in combination

In practice, many cases show a hybrid solution which goes beyond these categories:

- An AI model for inspection (category 1) provides data which influences process optimization (category 2)
- At the same time, analysis data (category 3) can be used to derive long-term strategies

The key is not in the categorization alone, but in the integration and scaling beyond these levels. This is the only way that a consistent, intelligent system can emerge—one which can access image recognition, real-time control and forecast analytics at the same time.

Obstacles for the AI trend

In spite of rapid progress, the potential of artificial intelligence in industry goes unused, in many cases. One reason behind this is the fragmentation of systems and data landscapes—cloud, edge and on-premises solutions are often not compatible with each other, there are no standards or things are interpreted differently. In addition, many machine and systems engineering companies still lack the necessary AI competence. There is often a lack of specialist knowledge of data modules, machine learning methods or the integration of AI into existing control systems. Building up this expertise presents large organizational and cultural challenges to many companies. AI is also still too rarely understood as a fixed part of product development. Data competence, software development and classic engineering disciplines must grow closer together in order to shape the technological transition with success. But the direction is clear: With more open platforms, growing standardization and AI hardware suitable for industry, the leap from vision to broad application will become ever more tangible.

Once 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.

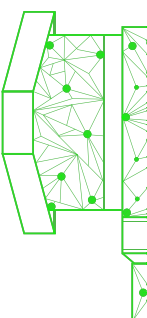
On the other hand, the situation also opens up opportunities: The fact that there are no standardization committees or industry associations who define standards for market actors to follow gives even smaller providers the opportunity to shine with their own independent solutions and secure themselves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

The AI Act may not promote technical standardization directly, but it does create a clear legal framework for handling data and the use of AI systems. It ensures more transparency and legal certainty, which helps smaller providers in particular develop trustworthy solutions and gain a foothold in the market.

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 detriment to 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.



New competitors pose a threat to machine engineers

The ongoing technological transition presents high requirements—especially for machine manufacturing companies. Data-driven business models are gaining ever more importance and changing industrial value creation. New competitors from the IT and cloud sectors are penetrating the market and increasingly occupying key positions. In this way, Amazon Web Services (AWS) offers platform services for IoT, data analysis and predictive maintenance today which are specially tailored to suit industrial applications. With its Azure platform, Microsoft supports the integration of cloud and edge solutions in production processes and enables quick scaling of digital services. Google Cloud is also pushing its way into production with AI-supported applications such as visual quality control and anomaly detection. With WatsonX, IBM is utilizing industrial AI solutions for process monitoring and data-based decision-making support. In turn, SAP supplements its ERP systems with AI-supported analytics, process optimization and integrated asset management.

These tech companies are increasingly shaping the digital infrastructure—and challenging the machine manufacturing field to develop its own data-based business models. If you do not establish your own data-driven value creation, there is a risk of becoming a mere hardware supplier in third-party platform ecosystems.

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 are pushing directly into 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.

Machine manufacturers and automation technology providers also face competition from another direction—from start-ups and artificial intelligence pioneers from outside the industry. These new companies often bring innovative approaches, dynamism and in-depth AI expertise which machine manufacturers often lack. As cooperation partners, they can provide valuable impetus or close technological gaps at short notice, for example, in developing intelligent assistance systems, predictive maintenance solutions or AI-supported data analysis.

” AI has the potential of changing the way in which the industry approaches its processes.”

Michael May

Head of Data Analytics & Artificial Intelligence at Siemens

Collaboration with start-ups also brings challenges, however: Many of these businesses are under a great deal of investment pressure and operate with unstable business models. Quite a lot of them disappear from the market again once the initial AI euphoria climate cools off or when they fail to secure further financing. Cases such as Builder.ai or Rain AI show that overly high expectations, a lack of product maturity or operative weaknesses can lead to insolvencies—even with prominent support.

For machine manufacturing companies, this means: Start-ups can be key pacesetters and technology partners, but a long-term strategy requires the purposeful development of competences in-house. If you rely exclusively on external partners, you risk dependencies—especially if AI expertise is increasingly becoming the key requirement for your differentiation and ability to compete.

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 artificial intelligence represent two different worlds that are slowly coalescing 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 the 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.

Michael May, Head of Data Analytics & Artificial Intelligence at Siemens, emphasizes the point in this context: “AI has the potential of changing the way in which the industry approaches its processes.” The decisive factor will be who scales data-driven models, makes industrial intelligence productive—and shapes marketable business models from it. AI is therefore becoming the key technology for the future of the industry.



Go to report:

AI – The key to the world of tomorrow

KEBA covers all three areas of AI use:

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 more autonomous and intelligent,** and
3. **Assistance systems** that use smart AI support for everything from programming to operation in order to reduce complexity and to vastly simplify machine handling through intelligent HMIs and AI support.



Support for the machine 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. They have been developing AI applications purposefully for several years now. This center allowed further colleagues in the organization to be trained, which means that AI solutions have now been developed in various departments. The specific developments include, for example, an AI assistant for supporting software developers in KeStudio and the KEBA AI module for industry control systems which serves as an industry hardware platform for AI applications.

Based on our experience with AI projects, KEBA's AI experts have also 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 mis-steps and potentials

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.

When choosing a partner, think about the following questions:

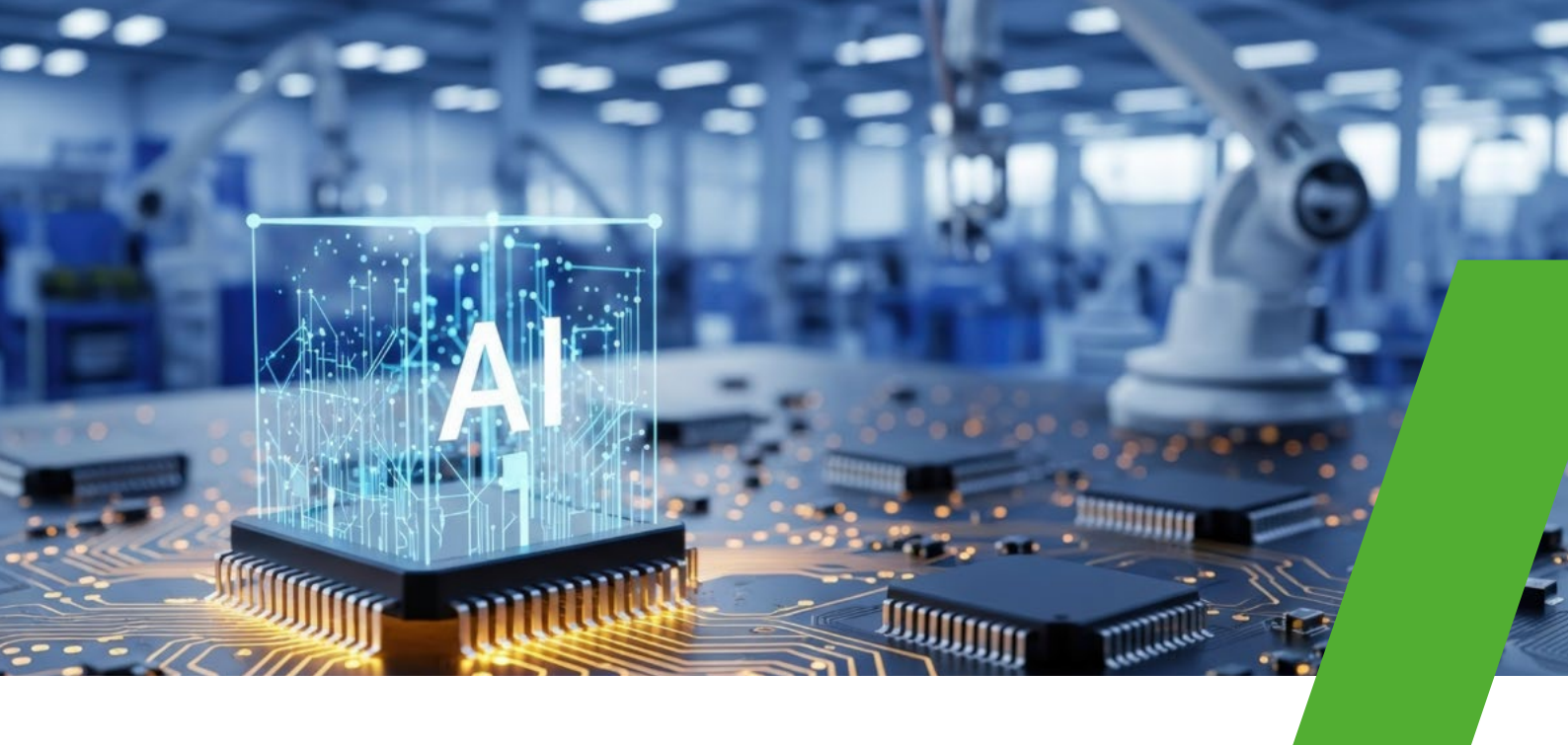
- How can AI applications be integrated into your own business model?
- Is it possible to offer new, additional data-driven services?
- What are the benefits with regard to cost?
- Where are there opportunities for additional revenue?

The use of AI solutions may simply be 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 AI 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 industry. Whenever neuronal networks and algorithms become hardware-embedded, each new generation of the solution frequently entails a change of the technical basis.

In most cases, 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 the 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: KeControl AE 550

KEBA presents the next generation of industry AI hardware: the KeControl AE550. The module combines a vast computing capacity with robust suitability for the industrial sector, and enables the seamless integration of AI and machine learning applications directly into the control environment.

The AE550 is specially designed for vision and AI tasks requiring immense computing power—for example, for object recognition, quality assessment or position sensing. Simpler AI models such as anomaly detection or time series analyses can be executed directly on the controls (PLC) without additional hardware.

Thanks to the open, Linux-based architecture of the Kemro X control system, the AE550 is fully integrated and uses the same development environment. A powerful AI accelerator, the AE550 is connected to the control system directly and integrated into the control application—a separate industry PC or additional programming efforts are not required. This results in a compact, consistent and scalable platform for industrial AI applications.

The AE550 is therefore the answer to the growing demand for integrated industrial AI, which efficiently combines vision-based inspections, data-driven process optimization and intelligent control tasks on a single platform. 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.



KeControl AE 550

They 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.

The meeting of artificial intelligence and Industry 4.0

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.

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 their cloud tools or AI start-ups.

The [7-step plan](#) outlined above offers practical help on how to get started with artificial intelligence in order to stay in the game. Comprehensive solutions such as KEBA help with implementing AI projects on industry 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.

Any questions? 

Simply make an appointment. Our experts are guaranteed to work with you to find the perfect individual solution for your company.

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