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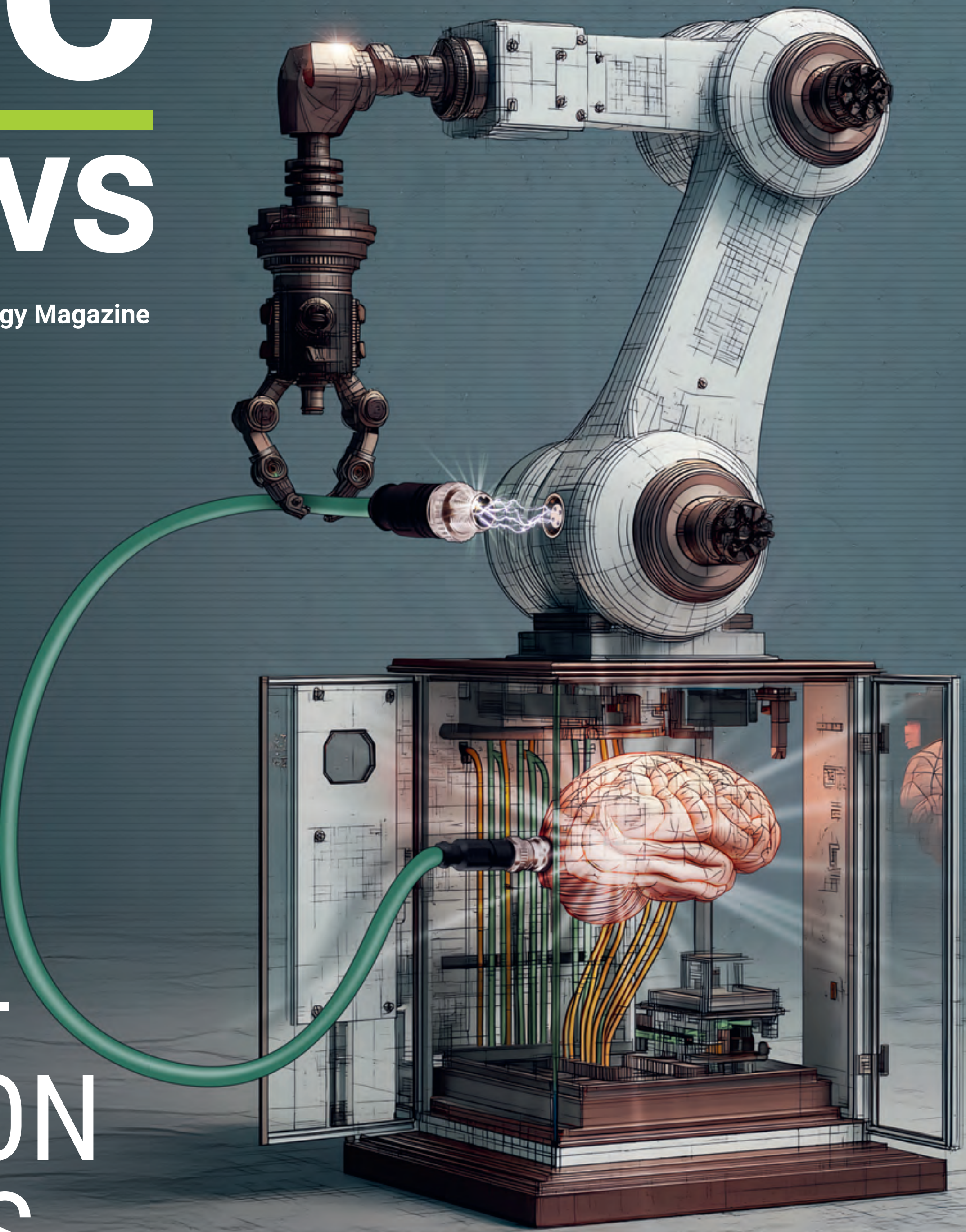
tec news

HARTING'S Technology Magazine



AUTO-MATION NEEDS INTELLI-GENCE

To drive the All Electric Society forward, 'automation' and 'autonomy' require cognitive intelligence

A LOOK INTO THE FUTURE OF INDUSTRIAL INTELLIGENCE

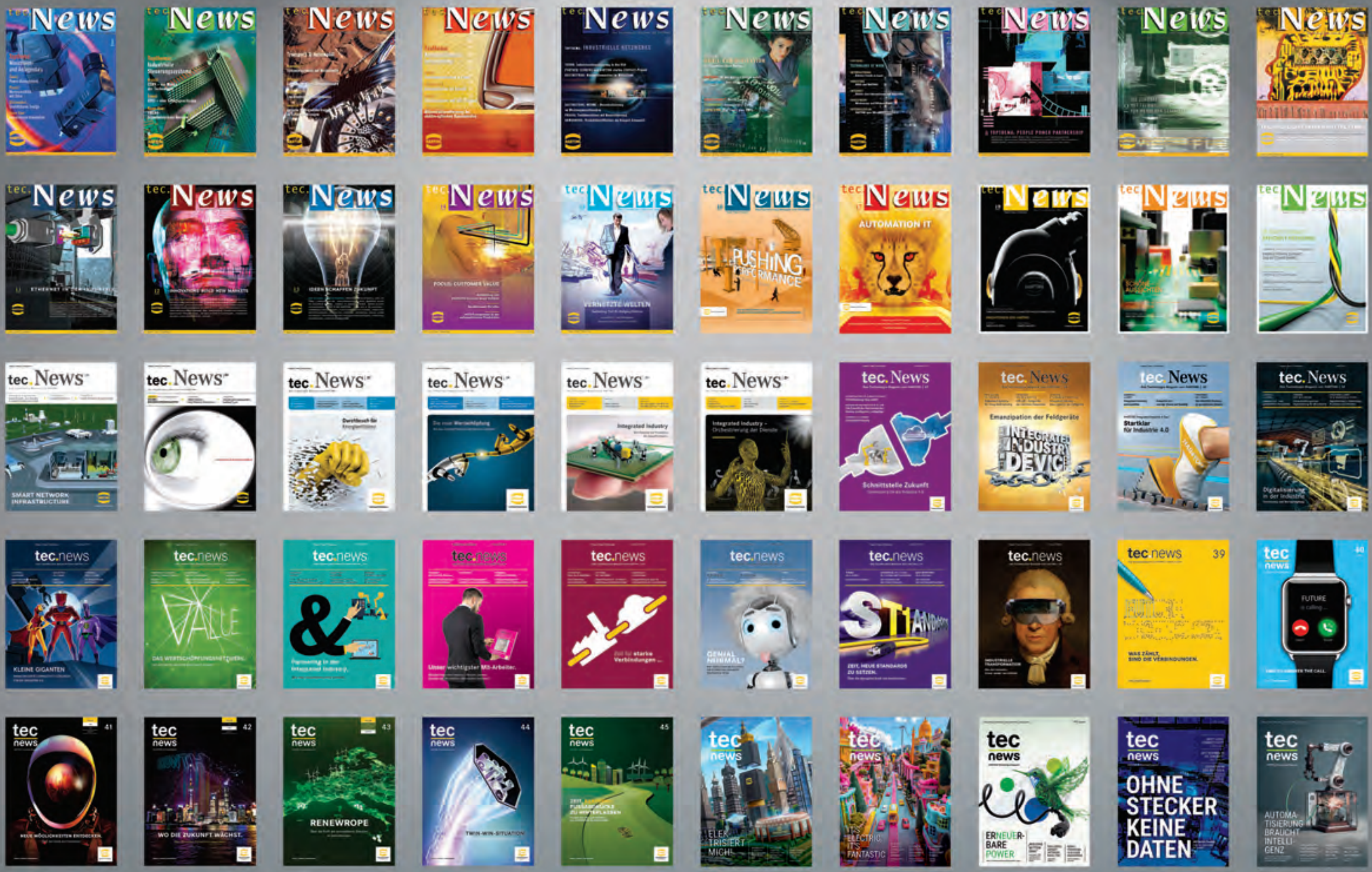
Prof. Dr. M. Ruskowski, SmartFactory-KL

AUTOMA-TION IN THE AGRI-CULTURAL SECTOR

C. M. von der Ohe, Festo

FROM REGU-LATIONS TO AUTONOMY

C. Liepert, Siemens



50 TIMES

CONNECTIONS
RELEVANCE
TECHNOLOGY TRENDS
OPINIONS
PERSPECTIVES

editorial

CONTINUITY IN CHANGE: 50 ISSUES HIGHLIGHTING THE FUTURE

Dear readers,

A grand total of 50 issues of tec.news – now that's an anniversary that is far more than just a reason to celebrate. It stands for continuity at a time when industrial value creation is undergoing far reaching and fundamental change. Our world has reinvented itself several times since the first issue: Industry 4.0, digital platforms, electrical transformation.
But one thing has remained constant – our aspiration to not only describe the future, but to actively help shape and design it.

So this anniversary is not a look back, but a 50 fold look forward. After all, the path to the All Electric Society is not a project for one issue, but a long-term course of transformation – requiring technological depth, perseverance and the ability to recognise change as part of one's own identity.

At the core are three developments that are shaping our sector like no other: electrification, digitalisation and automation. They form the triad that will determine the future of industrial value creation. In this issue, we have made the decision to specifically focus on automation – a topic that has been with us since the very first tec.news, but one that is constantly reinventing itself. Today, automation stands for much more than deterministic processes: indeed, it is all about autonomous systems, intelligent processes and new forms of industrial self-control.

In this issue, you can read about how automation is changing, what role it is playing for the All Electric Society and the opportunities it is opening up.

So here's to our next 50 looks to the future – on their way.

Wishing you
enjoyable reading,

Philip Harting
CEO
HARTING Technology Group

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Since 1945

Issue 50 | Cover story:

AUTOMATION NEEDS INTELLIGENCE

future technologies

future trends

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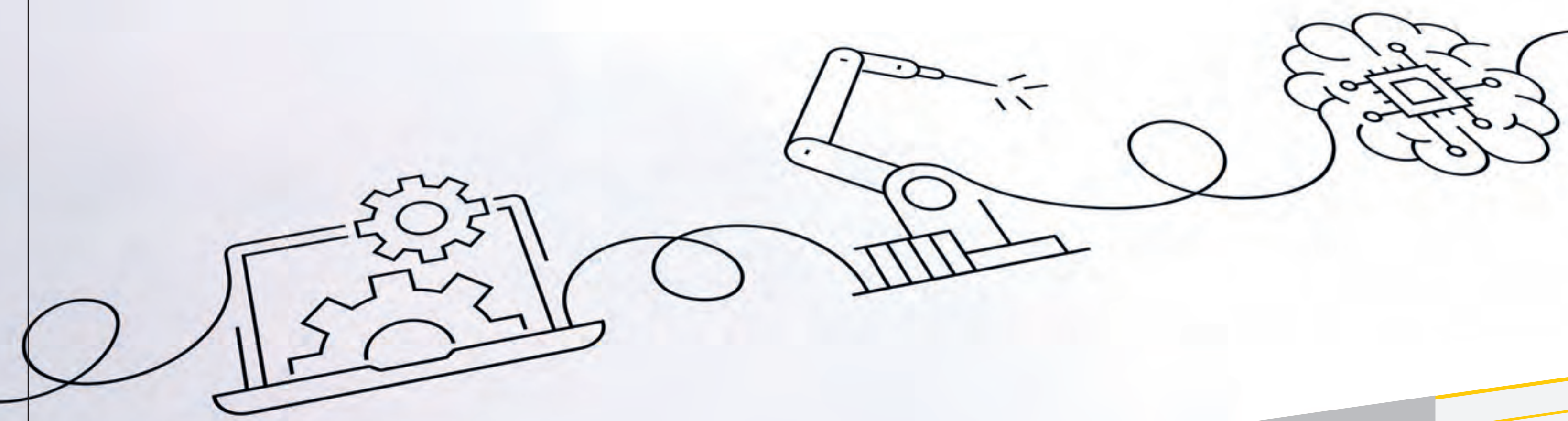
AUTOMATION IS CREATING THE FUTURE – BECAUSE IT REINVENTS ITSELF



Over decades, automation has featured as one of the cornerstones of industrial production. The success factors of classic automation are as follows: rule-based processes, rigid structures, field buses, PLC logic and precisely pre-programmed reactions – thereby enabling deterministic optimisation of the processes. When it comes to the future, this idea falls somewhat short. Because automation does not stand still – far more, it changes fundamentally.

When it comes to the future, this idea falls somewhat short. Because automation does not stand still – far more, it changes fundamentally.

Andreas Huhmann
Strategy Consultant
Connectivity & Networks,
HARTING Technology Group

Dr. Stephan Middelkamp
General Manager
Quality & Technologies,
HARTING Technology Group

The core of the debate is not whether automation is still up to date. Quite to the opposite: Automation is timeless – but rethinking its design is now topping the agenda. Modern production systems face challenges that can no longer be mastered by fixed and rigid processes alone. Autonomous functions, situational learning and adaptive decisions will shape and determine what is needed in the future. In this way, autonomy is becoming the decisive component of **automation driving its extension forward.**

Automation meeting autonomy

The integration of autonomous principles into traditional industrial processes calls for change on several levels. Rule-based principles – a basic requirement of industrial control – must be combined with technologies that are capable of making situational decisions. Digitalisation is making powerful inroads into automation: AI processes, data rooms, semantic models and digital twins form the foundation for systems that no longer just react, but act.

Research impulses – such as the architecture model developed by DFKI (German Reasearch Center for Artificial Intelligence) for future automation systems – demonstrate how autonomous software agents and digital images will be able to interact. **This makes it clearly evident that in future, automation must be understood less as a rigid construct and more as a living interaction between data, decision-making systems and flexible modules.**

AUTONOMY IS NOT REPLACING CONVENTIONAL AUTOMATION – BUT IS FAR MORE ITS LOGICAL DEVELOPMENT.

The All Electric Society as a systemic framework

The All Electric Society forms the system that is viewed holistically within the context of sustainability. Electrification, digitalisation and automation are converging to form an integrated overall system. Energy, mobility, industrial value creation – the need for autonomous, data-driven systems is emerging everywhere. Consequently, automation is becoming cross-sectoral, networked and software-driven.

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Connecting you to the All Electric Society
HARTING connects data and power – efficiently, sustainably, future-proof

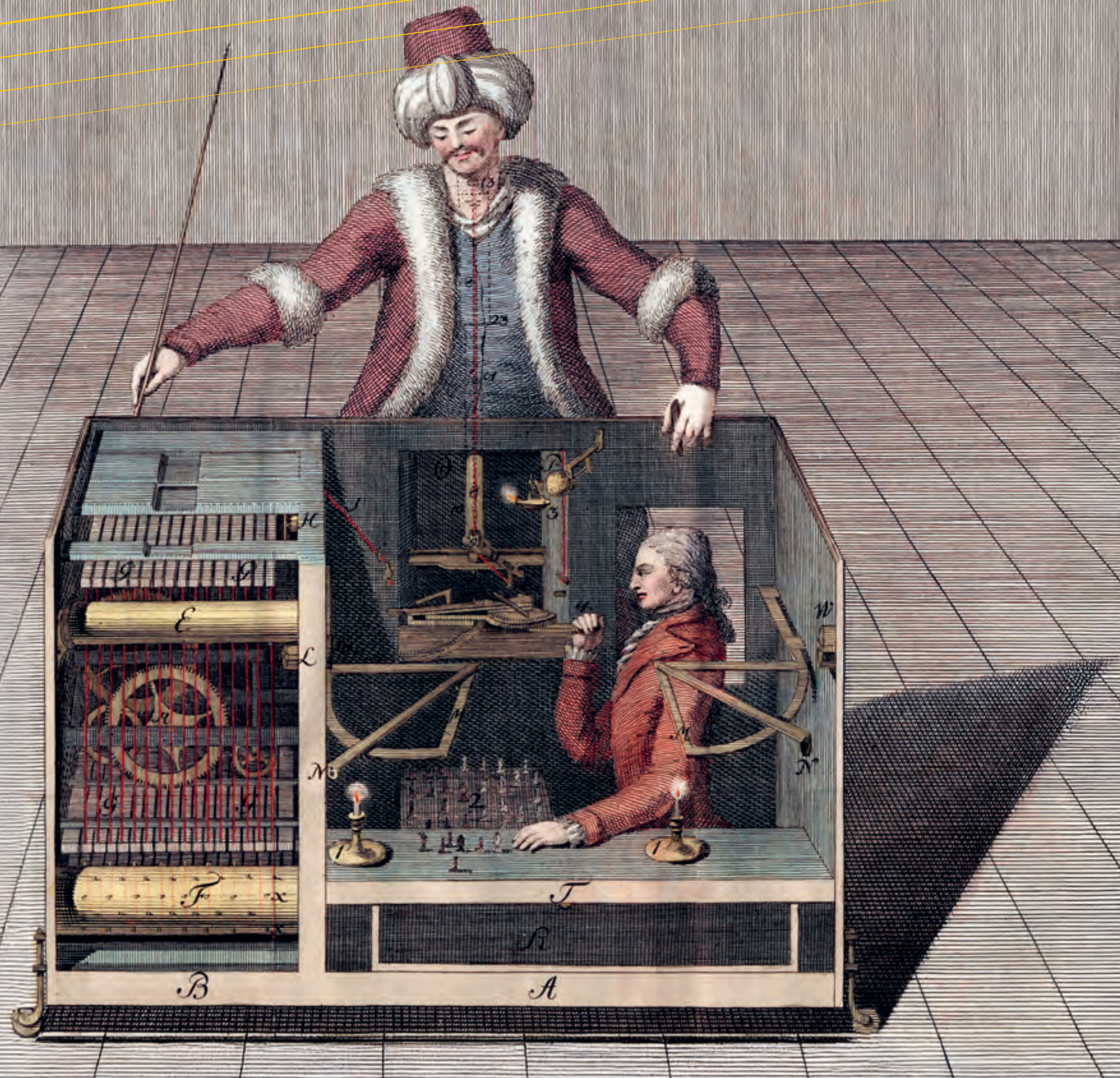
The digital twin will represent a central element, as it enables assets to be digitally mapped across their entire life cycle – and therefore to be automated and managed autonomously. In future, this will also involve components that were previously assigned a purely passive role. Connectors, for example, can draw on concepts such as HARTING's Connectivity Instant Shell to digitally record statuses and loads and integrate them into automation scenarios – thereby creating an entirely new dimension of what is considered "automatable".

Why the chess automaton from the 18th century is relevant

The discussion about autonomy in industrial automation leads surprisingly precisely to one historical example: the chess automaton from 1769 (known as The Mechanical Turk, or The Automaton Chess Player).

Automation has always been an attempt to build something that acts independently. The original developer of the chess machine also followed exactly this dream of mankind. His goal: A system that can react situationally to moves that cannot be predicted.

What was not mechanically possible back then is now possible thanks to AI and digitalisation in networked architecture models. And the parallel lies precisely therein: **Autonomy is created by introducing intelligence into architectures – previously in the form of human input and presence, today in the form of artificial intelligence.**



Copperplate engraving by Racknitz (1789)
Source: Wikipedia

to the Wikipedia entry

This makes a centuries-old idea tangible: Automation is no longer just about following rules, but about understanding context, learning and making decisions. Autonomy is therefore not a move away from automation, but represents its logical next step.

Consequently, automation is becoming the basic technology of an electrified, digitalised and sustainable future. While it remains indispensable, further thinking is called for. It is not the past of automation that determines its significance, but its ability to continuously renew itself. This issue of tec.news describes precisely this transformation: How automation is emerging from the rigid logic of the past and evolving into the dynamic, intelligent and autonomous foundation of the All Electric Society.

Connectivity Instance Shell (CIS)

The Connectivity Instance Shell (CIS) turns conventional connectors into digital, condition-based assets. It supplements the static type AAS with real utilisation and load data, by way of integrated sensors for example. This means that connectors can be integrated into digital Twin concepts and support autonomous, transparent and more robust automation architectures.

THE AUTOMATON CHESS PLAYER OF THE YEAR 1769: MORE VISIONARY THAN PREVIOUSLY THOUGHT

Today, the Automaton Chess Player of 1769 is often regarded as a technical trick or even a deception or scam of sorts. But this view distorts what was really the issue back then: It was one of the earliest serious attempts to develop an autonomous automaton.

The designer wanted to create a system that
- acts independently,
- reacts to situational moves and
- makes flexible, intelligent decisions.

In this way the chess machine picked up on an idea that we encounter again today: Automation needs intelligence if it is to extend beyond rigid processes. What could not be realised mechanically was compensated for internally by human intelligence – a principle that can be translated surprisingly accurately into today's AI architectures.

TODAY, WE NO LONGER HAVE TO PUT A HUMAN BEING INTO AN AUTOMATED MACHINE. ELECTRIFICATION, DIGITALISATION AND AI MAKE IT POSSIBLE TO IMPLEMENT AUTONOMOUS FUNCTIONS ARTIFICIALLY – WHICH SHOWS JUST HOW VISIONARY THE APPROACH OF 1769 REALLY WAS.

A LOOK INTO THE FUTURE OF INDUSTRIAL INTELLIGENCE

Prof. Dr. Martin Ruskowski
CEO
SmartFactory-KL

We are at a genuine turning point in industrial evolution. While production systems are becoming more flexible and at the same time more complex, many companies continue to operate within structures that hark back to a bygone industrial era. Machines are highly reliable, but the actual intelligence of a factory – the ways in which information is created, flows and leads to decisions – is often fragmented. **It is time to rethink: What does a factory look like that would really be capable of acting independently? Not just in an automated, but autonomous way?**

From automation to autonomisation – a fundamental change of perspective

Automation has been the backbone of industrial value creation for decades.
But what does the term actually mean? I define it as follows:

Automation means replacing human behaviour with technical processes – processes that are reliable, reproducible and generally deterministic.

An automaton is a self-contained unit whose behaviour is fully described, predictable and dependent on clearly defined conditions. This form of automation was and is essential for efficiency, quality and safety. The industrial context, however, is changing faster than automation can react. Variant diversity, volatile markets, dynamic supply chains and demographic change demand systems that not only execute, but also decide, adapt and interpret.

Autonomy therefore broadens the horizon

An autonomous system is capable of operating under uncertain and variable boundary conditions, making decisions over longer periods of time and stabilising itself – without constant human intervention.

smartFactory^KL®

The SmartFactory-KL technology initiative, based in Kaiserslautern, is a leading German research and demonstration platform for future-orientated production systems. For over 20 years, the network of science and industry has been developing practical solutions for the factory of the future, focussing on modular production architectures, digital twins, interoperability and autonomous processes. The network serves as a testing ground for new technologies and standards and demonstrates how modern automation can also be implemented in the brownfield.

A new scientific discipline is currently emerging, which we are building up in Kaiserslautern in co-operation with the local research institutes: autonomics. It combines automation technology, AI, computer science, social and legal sciences and is addressing the following question: **How can we create machines, systems and factories that are capable of genuinely acting autonomously – safely, robustly and responsibly?**

Demographic pressure is accelerating technological maturity

Change is not optional – it is necessary.
In the coming years, an entire generation of experienced specialists will retire from the industrial arena. At the same time, demands and requirements are on the rise: sustainable production models, the circular economy, variable product portfolios and highly individualised supply chains.

Our future production systems will have to be able to do more because we will have fewer people to maintain and sustain them.

Consequently, autonomous systems are not a technological "add-on", but a social imperative.

Our architecture model for the autonomous factory – an open structure for a new industrial order

In order to enable the transition from today's production landscapes to autonomous factories, **SmartFactory-KL has created an architectural model that is intentionally and specifically modular, open and brownfield-capable.** It consists of three fundamental building blocks:

1. The digital backbone – the factory's memory and nervous system

Digital twins represent all relevant assets – machines, components, software modules, products or workstations. The backbone creates:

- a uniform, standardised description of all production objects
- the end of conventional data silos
- a semantic information system that provides the right knowledge for every decision-making situatio

It forms the basis for interoperability and machine understanding.

2. Automation – machine functions as modularised intelligence

Conventional automation thinks in terms of signals, cables and circuit diagrams. The factory of the future thinks in terms of functions.

Software-based encapsulation abstracts machine behaviour, resources and workstations in such a way that they can be used flexibly regardless of manufacturer or technology. This allows even decades-old systems to act as fully-fledged components of an autonomous system.

››

3. *Agent systems – the motor cortex of autonomous production*

Software agents assume active control roles:

- Products know what should happen to them next
- Machines know what they can do and when they will be available
- Logistics systems dynamically plan optimal routes

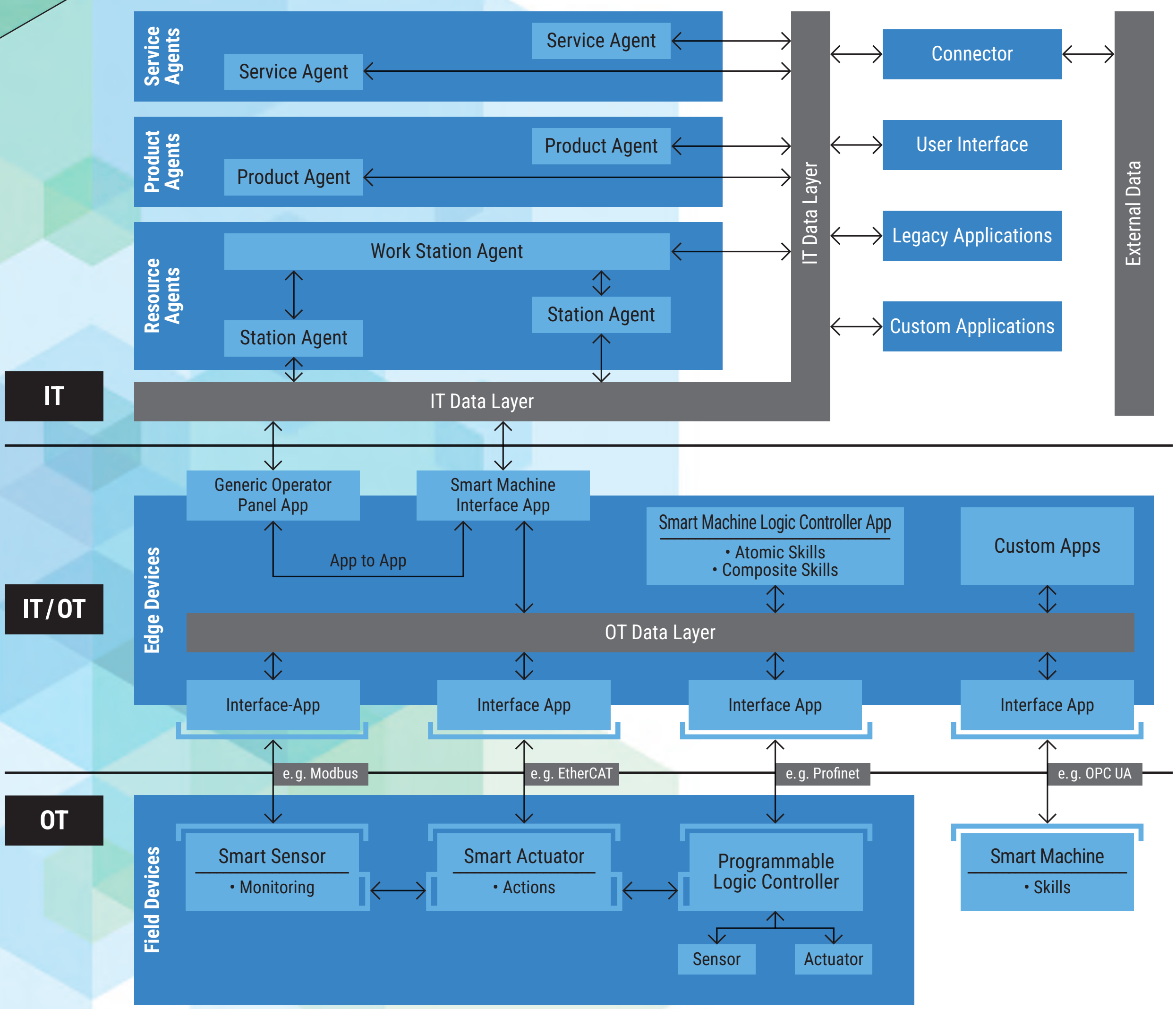
This creates production logic that is no longer "commanded" centrally, but negotiated decentrally. Systems are organising themselves – and that is the core of true autonomy.

Connectivity – the invisible fabric of autonomous systems

Autonomy needs information – comprehensive, precise and at an early stage. Digital twins enable transparency down to the depths of individual components. In future, even simple industrial connectors will provide data on mating cycles, loads or contact quality.

Many small sources of information all together create a highly intelligent overall picture – a principle borrowed from nature: Swarm intelligence.

SmartFactory-KL architecture



THE ARCHITECTURE REDEFINING AUTOMATION

In the face of shifting industrial landscapes, businesses are confronted by a number of different challenges. Companies that want to respond rapidly to shifts in the market while remaining efficient and flexible, will need automation that functions increasingly autonomously. Consequently, the future of automation will be largely characterised by systems that are capable of adapting and optimising complex production processes independently.

Simon Jungbluth
Scientific Researcher (Automation), SmartFactory-KL

You can find the full version of the article here:

Reference architectures for modern automation

Reference architectures such as the SmartFactory-KL are an important factor in this ongoing automation evolution. **This architecture provides an infrastructure that combines both traditional automation solutions and modern software and hardware components.** The interaction between the OT, IT/OT interface and IT levels is at the core of this structure. Clearly defined components, interfaces and processes ensure consistency and interoperability. In this way, technologies can be seamlessly integrated so as to enable an increasingly autonomous production environment.

Here, the architecture serves as a flexible framework facilitating the integration of self-learning systems and intelligent algorithms.

Such systems are capable of recording and analysing data in real time and learning from it independently in the process. This ability is the foundation for autonomous decision-making processes. And this ultimately enables automatic adaptation to changing production requirements and unforeseen events.

By clearly defining interfaces and processes in the reference architecture, different systems are able to interact seamlessly with each other. This, in turn, is the technical precondition for an autonomous factory in which machines and systems can actually act and cooperate independently. **This networking and modularity enables dynamic customisation and scaling without incurring significant restructuring costs.**

The integration of intelligent assistants

Intelligent agents represent a central component of the architecture. They not only automate routine tasks, but also recognise complex patterns and provide recommendations for action. During assembly routines, they provide visual support, for example by projecting instructions. Sensors and cameras minimise errors and enhance quality assurance.

These agents also support maintenance work thanks to predictive analyses that monitor the tool status. If attrition and wear is detected at an early juncture, they generate maintenance suggestions, thereby minimising downtimes and extending tool life.

Man, machine, synergy

The SFKL architecture demonstrates that people remain necessary despite automation, especially in terms of planning and monitoring. **The goal is achieving synergies between man and machine.**

AUTOMATION AS A CROSS-SECTIONAL TECHNOLOGY FOR THE ALL ELECTRIC SOCIETY

Automation means that technical systems perform tasks independently and precisely. This basic function will also continue to exist in the All Electric Society (AES) – a world in which energy and data systems are fully electrified, networked and dynamically controlled and managed.

Pascal Rübel
Project Lead Factory-X, SmartFactory-KL

Automation in the AES

Only automated processes will make it possible to control energy intelligently – for example, when machines flexibly adapt their operation to energy availability or private households automatically determine the ideal time for charging, heating or washing. Data forecasts and automated analyses represent the foundation for this.

Digital twins and skills as flexibility drivers

In modern production systems, digital twins guarantee flexible processes: if delays in processing steps are recognised, other machines can take over automatically. This is based on standardised skills that clearly describe the capabilities of a machine, thereby allowing tasks to be reallocated quickly and flexibly. **This keeps the process stable – and all without manual intervention.**

New requirements for automation

Production processes are becoming ever more variable, batch sizes smaller and adjustments all the more frequent. At the same time, technologies are changing: while PLC remains relevant for safety and real-time functions, high-level languages are increasingly taking over flexible tasks.

Standardised interfaces and skills – i.e. digitally described machine capabilities – enable automation to be used in a modular and cross-sectoral manner.

AI needs maximum reliability

While many technologies are available, AI-based decisions in particular must be extremely reliable, explainable and certifiable. Error rates that would be acceptable in the consumer sector are entirely unacceptable in industrial environments.

Outlook

Realistically speaking, the vision of universal, skill-based, AI-supported automation will not be fully established for another 10-15 years. But every step towards standardised interfaces, digital modelling and intelligent connectivity brings this future closer.

You can find the full version of the article here:

BUILDING BLOCKS OF THE FUTURE: THE POWER OF AGENT-BASED SYSTEMS

Imagine an architecture that is constantly changing – with structures that adapt flexibly as soon as requirements demand it. This adaptive design could come to symbolise the automation of the future. Agent-based systems are crucial here, as they coordinate individual production orders and resources as dynamic, AI-controlled modules.

SmartFactory-KL actively implements such agent-based systems in its own model factory.

Transparency and efficiency in matrix production

One example of the use of agent-based systems is matrix production. In contrast to traditional production lines, matrix production offers a flexible arrangement of production resources with dynamic material flows.

In such a production environment, product agents can make ad-hoc decisions on the optimum route for an individual product based on their work plan. This eliminates the need for extensive material flow control systems in which all possible routes for all product types have to be mapped by matrix production.

Industrial agent systems are based on the ability to collect environmental information via sensors, communicate with each other continuously, analyse the incoming information and make decisions based on this. They can learn independently from experience, foresee the consequences of their own actions and continuously improve their strategies. These systems also have a modular structure. They can therefore be easily adapted to different production environments.

In production, for example, this modularity makes it easy to integrate new machines and systems without the need for extensive reprogramming. They also increase transparency by providing real-time data on production processes to the other agents in the system. Other agents can thus react directly to deviations from the plan.

Dr. Henning Gösling

Senior Researcher, Agent Based Production and Logistics SmartFactory-KL

Future potential of agent systems

Successful implementation requires interdisciplinary teams and a clearly defined roadmap. Agent-based automation can then significantly increase flexibility and efficiency. This is particularly valuable in view of the shortage of skilled labour.

Agent systems optimise existing processes. The networking of systems and advancing digitalisation make this technology a key to progress and solutions for current and future challenges.

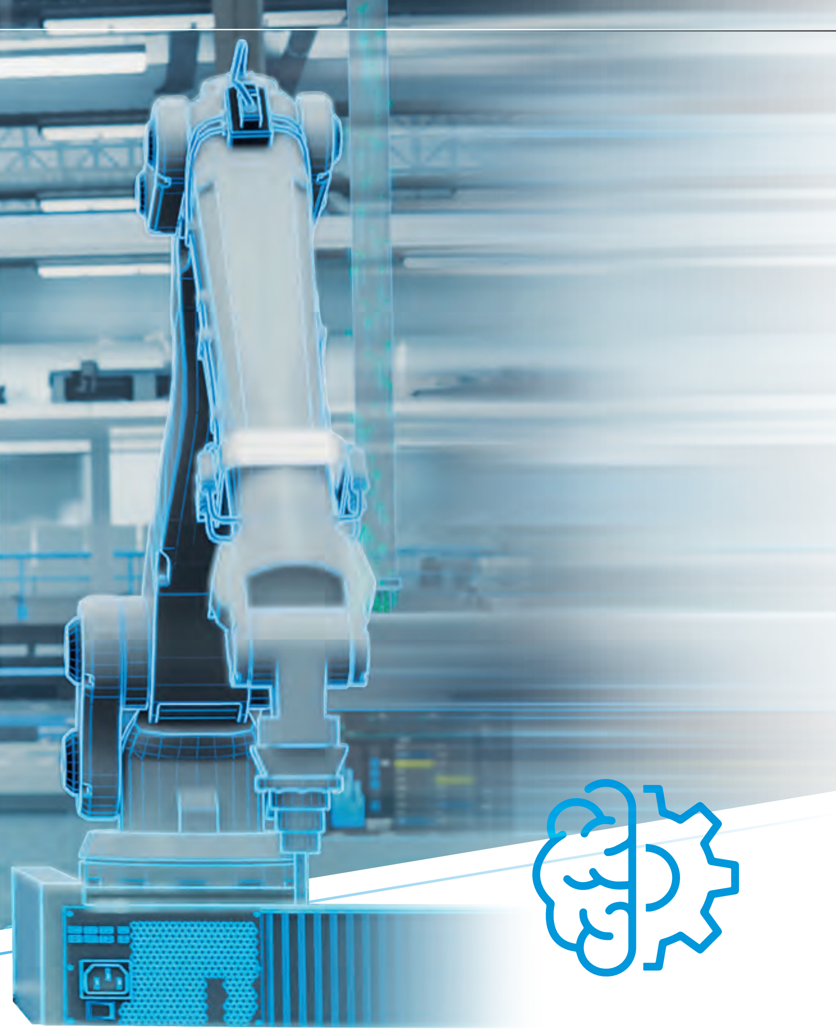
Here you can find the full version of this article

tec.news in an interview with Prof. Kasper Hallenborg, University of Southern Denmark

MORE RESPONSIBILITY DOWNWARDS: AUTONOMY BECOMES A PRINCIPLE FOR SUCCESS

Production environments are changing faster than traditional automation can respond. In an interview with tec.news, Prof. Kasper Hallenborg, Director and Head of the Faculty of Engineering at the Maersk Mc-Kinney Moller Institute, describes how software-driven robotics, digital twins and decentralised intelligence are opening up new scope for action – and why automation is currently being fundamentally rethought.

Prof. Kasper Hallenborg
University of Southern Denmark



tec.news: Mr Hallenborg, how do you define automation?
Kasper Hallenborg: Automation means that software or hardware takes over tasks that were previously performed by humans. For a long time, this was limited to deterministic, hard-wired systems. Today, digitalisation, sensor technology and AI are radically changing the possibilities.

In what way?
In the past, robots had to be programmed entirely on the hardware side – slow, inflexible and hardly capable of real-time operation. Today, we simulate entire production processes in advance, use digital twins, synthetic training data and more and more sensor technology. This allows robots to be controlled dynamically and react to situations. This opens up new opportunities, especially for countries with many SMEs: even low-volume, high-mix production can be automated.

How does this affect the all-electric society?
Electrification and digitalisation reinforce each other. The more products can be digitally recorded, the more intelligence can be added on the software side. Data-driven systems enable functions that previously had to be solved mechanically. And autonomy is becoming more important – in order to conserve resources, cushion the shortage of skilled workers and implement more sustainable production models.

What is your approach to automation in the future?
One core component is the digital twin, which connects design, simulation and operation. This enables us to automatically manufacture even very large structures – such as components for wind turbines or maritime applications. We are currently developing the world's largest robotics cell for single-item production. Another focus is automated disassembly to improve recycling processes. Many products today are not designed for this; we are researching "design for disassembly" and robot-assisted processes.

What role does AI play in this?
AI and multi-agent systems open up new degrees of freedom. Classic automation enforces rigid processes; any deviation leads to problems. Agents, on the other hand, observe their environment, make decisions locally and adapt. This is similar to the trend in organisations: greater autonomy increases flexibility and overall performance. Such decentralised architectures will be crucial in production. Part of the responsibility shifts to the production environment, and employees gain more autonomy.

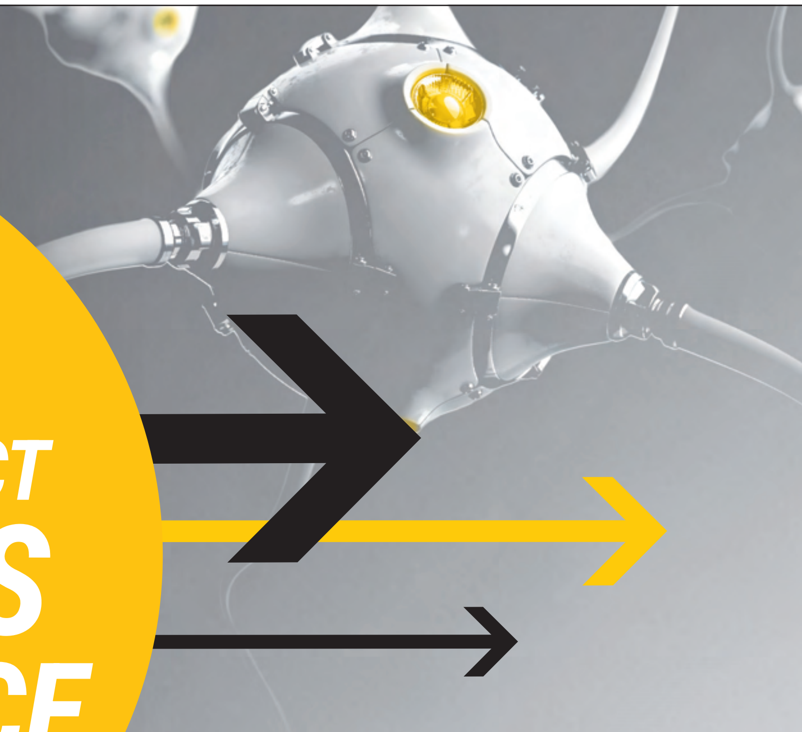
Does that mean we need a new term – away from classic automation?
You can still call it automation, but in the future, systems will become more autonomous, more dynamic, more intelligent. The decisive factor is the philosophy: away from centralised control, towards distributed, adaptive systems.

Automation means making processes independent through technology. The key is to no longer view it as a rigid, purely deterministic system. In the context of digitalisation, we need to rethink automation – with more autonomy, adaptability and more intelligent, flexible systems.

Are there any links to connectivity?
Absolutely. Digital twins only work if physical components also provide data. Intelligent, sensor-equipped connectors would be a logical step. They could record states decentrally, abstract them and process them in edge logic. This increases robustness and supports precisely the distributed autonomy we are talking about.

Design for Disassembly

Automated disassembly is becoming the key to reuse, repair and recycling. What is currently limited by high manual costs will become scalable and economical in the future thanks to robotics. This requires modular product design: components connected via plug connectors can be efficiently assembled and separated in a targeted manner. Defined interfaces enable robot-assisted disassembly, sorting and reuse. Plug connectors connect during operation – and enable efficient separation during repair and recycling.



HOW HARTING APPLIED TECHNOLOGIES IS SHAPING AND DESIGNING CHANGE IN AUTOMATION

FROM PRODUCT TO PROCESS INTELLIGENCE

In the past year 2025, HARTING Applied Technologies was honoured with the prestigious "Batch Size 1+ Innovation Award" bestowed by the ife network on make-to-order manufacturers. And this success is no coincidence, but far more the result of a consistent reorientation in automation technology. The fundamental shift from a product-orientated to a process-orientated design of machines is the pivotal factor here. The modularisation and standardisation of mechanics, electrical engineering and control technology enables the efficient and flexible manufacturing of products involving many variants in smaller quantities – a decisive advantage in a globalised industry with increasingly individual customer requirements. The positive effects are clearly evident given optimised cost structures and shorter delivery times.

Dr. Volker Franke
Managing Director
HARTING Applied Technologies

Systems engineering as the key

Engineering is undergoing fundamental changes in HARTING's special machine construction activities.

Pursuing a holistic approach, systems engineering is combining and merging mechanics, electrical engineering and software. The motto here is: "Intelligence before steel".

Where mechanical precision used to take centre stage, software is now increasingly handling and managing flexible tasks – such as camera-based inspections and corrections replacing mechanical solutions. Development work takes place in a team and is simulated in advance. The additional work involved in programming and commissioning is compensated for by virtual processes running parallel to mechanical engineering. Digital tools are indispensable here, for example to precisely describe the capabilities of individual process modules. The Asset Administration Shell (AAS) plays a central role in this context by reducing configuration and integration costs, overcoming translation difficulties between mechanical, electrical and control engineering and creating a complete digital image.

Development sets in already at the sales stage: Customer requirements are defined at an early juncture and seamlessly transferred to implementation. Process modules facilitate this process, as sales-relevant data is available right from the outset. The significance of software development is rapidly on the rise – shifting away from conventional PLC programming and towards complex IT tasks that enable deep integration into higher-level systems. This allows the orchestration of machines and systems, the digital support of maintenance and servicing, as well as the continuous data-based optimisation of production – **which is understood as an overall system in which value-adding processes and intralogistics are automated and digitally integrated.**

Challenges and solutions for the future

Despite all the progress that has been achieved, obstacles do remain. Efficient simulation tools and integrated engineering tools are just as much in demand as is engineering support for electrical and control technology commissioning. **Artificial intelligence and machine learning must be integrated as easy-to-use tools in engineering, documentation and adaptive control tasks.**

The AAS should be supported across the board, as well as editor software enabling seamless collaboration. Cooperation platforms are necessary in order to overcome divergences in terminology and labelling between specialist areas – for example between electrical planning and PLC programming.

An example from actual practice: HARTING's assembly systems are designed along the lines of injection moulding machines. A basic system is flexibly customised with product-specific grippers and devices. The combination of hardware and software is the special feature here, which significantly elevates the degree of automation – also for low-volume products. The processes – such as feeding, assembly, labelling and packaging – are viewed as "skills" that can be easily adapted in a skills-based environment.

The future of manufacturing is flexible, intelligent and digital – and HARTING is playing an active role in shaping and designing this future.

HARTING Applied Technologies

HARTING Applied Technologies specialises in innovative solutions in the fields of toolmaking, special machine construction and automation technology areas. Drawing on many years of in-depth experience and high levels of engineering expertise, this business area of the HARTING Technology Group develops and manufactures customised production systems, precision tools and automation solutions for demanding industrial applications.

AUTONOMOUS PRODUCTION

HARTING WELL ON THE WAY TO THE NETWORKED, FLEXIBLE FACTORY

Autonomous production kicks off with the customer order: At HARTING, Enterprise Resource Planning (ERP), Manufacturing Operations Management (MOM), Product Lifecycle Management (PLM) and Autonomous Mobile Robots (AMR) all combine to create an integrated system that controls all steps from order entry to delivery.

Dr. Stephan Middelkamp
General Manager Quality & Technologies, HARTING Technology Group

Thomas Kämper
Head of Digital Prod. Systems Hub EMEA, HARTING Technology Group

Florian Raabe
Expert Product Owner Manuf. Operations M, HARTING Technology Group

Martin Wischmeyer
Project Engineer Operations, HARTING Technology Group

Mareike Knost
Sr. Oper. Techn. Data Scientist, HARTING Technology Group

The ERP creates and prioritises customer and production orders. Subsequently, MOM takes over operational control on the shop floor: the platform translates planning data into executable work processes, automatically provides all the relevant technical documents from the PLM system and guides employees through the production and testing steps.

AMRs ensure efficient material flows, bring material to the machines, transport semi-finished goods and store finished products. All the feedback – order status, material movements, quality data – converges live in ERP and MOM. When it comes to the delivery, the ERP takes over the logistics processes, from picking through to despatch.

The integrated workflow enables:

- **transparent order management**
- **automated, consistent data flow**
- **Live progress monitoring**
- **efficient material handling by AMR**
- **reliable delivery to customers**

This creates a fully synchronised value chain – the foundation for autonomous production.

More than the sum of individual steps

Autonomous automation boosts efficiency considerably. The focus is no longer on optimising individual processes, but on the networked control of machines, as well as on planning and logistics extending across the entire value chain. In view of dynamic customer requirements, flexibly interlinked systems and software-supported control systems are becoming indispensable.

The basics of autonomous manufacturing processes

In this context, HARTING relies on three pillars:

- **MOM as a central platform for production planning and process management,**
- **AMR for autonomous material flows,**
- **an end-to-end digital machine connection.**

Standardised OT infrastructures create efficiency, reduce errors and enable scalability.

MOM as a data hub

The MOM platform networks systems and machines, creates consistent data flows, ensures transparent processes and provides live process monitoring. In this way, it forms the centrepiece for higher automation levels.

Autonomous material flows thanks to AMR

AMR handles material transport, loading and unloading as well as storage. These flows reduce waiting times and avoid bottlenecks, while enhancing production flexibility.

Transparency increases efficiency

Real-time data renders process statuses visible, allows bottlenecks to be recognised at an early stage and supports dynamic resource planning. This improves quality and efficiency in a continuous manner.

Standards and qualification are key factors

Technology is only one component. Employees must be able to play an active role in shaping change. At the same time, global standards are required so as to ensure that transparency, collaboration and scalability function sustainably.

Although the systems have already been implemented and are ready for operation, the complete rollout in all global plants will still take up to three years. The expansion is intentionally taking place incrementally, in a site-specific, stable and sustainable manner.

In this way, HARTING is consistently pursuing the course towards autonomous, fully networked production and creating the foundation for globally harmonised production operations.

Read the full article here:

FROM REGULATIONS TO AUTONOMY

Constantin Liepert
Siemens Digital Industries Software

Automation has ranked as a central component of industrial value creation for decades. But roles are changing fundamentally. Instead of purely rule-based processes, the focus today is on integrated, data-driven processes – a development that Siemens is consistently driving forward with the "Siemens Xcelerator" approach.

Traditionally, automation has been understood to be rule-based logic. But modern industrial processes are far more complex: Efficiency, quality and speed can only be increased if IT and OT interact and operate seamlessly. It is precisely this connection that forms the core of the Siemens Xcelerator, combining automation and software solutions in a comprehensive portfolio, open ecosystem as well as a marketplace. In this way, automation is defined more broadly – all the way to autonomisation, i.e. processes that support data-based decisions or make decisions themselves assisted by artificial intelligence (AI).

Process and data consistency are playing key roles here.
With the "Digital Thread", Siemens is creating a consistent database along the entire product life cycle. Requirements, CAD models, simulations, parts lists, production data and service information are interlinked at this point and form an integrated system landscape. Media discontinuities are avoided, changes are evaluated more quickly and parts lists are synchronised automatically. Consistent workflows make it possible for adjustments in engineering to have an immediate impact on planning, production or service. This data consistency is crucial for AI supported applications, as only fully networked engineering and production data will enable robust analyses and genuine process optimisation.

In the Siemens Xcelerator, End to End processes become reality.

Weblink:
Siemens Xcelerator – Software for Industry

Modern industrial processes are far more complex: Efficiency, quality and speed can only be increased if IT and OT interact and operate seamlessly.

In the Siemens Xcelerator, End to End processes become reality. The Siemens Xcelerator portfolio covers all phases of the value chain – from early requirements and system design through to production and subsequent operation. Supplemented by industrial edge devices and IoT solutions, a seamless connection is created between the field level and the cloud. New control systems are edge capable, and brownfield systems can be integrated via gateways and open interfaces. **This means that IoT does not become a parallel world, but far more an integral part of industrial automation.**

The emerging "Industrial Foundation Model" from Siemens is another pioneering step, which understands the language of industry and is capable of processing industrial data such as CAD geometries, simulation results or parts lists. **This enables AI models to factor in and understand complex technical relationships for the first time – an important building block on the way to autonomous engineering and production processes.**

A first example from the electromechanical industry shows just to what extent this approach is capable of changing industry: When developing connectors, users can now enter requirements based on text or voice. AI automatically checks whether an existing product is suitable or whether a new design needs to be generated. In combination with Rulestream and Designcenter NX, complete CAD models are automatically created to suit the respective application. Further simulations using the Siemens Simcenter simulation portfolio, take materials, ambient temperatures and other factors into account in order to ensure the functionality of the design. This significantly speeds up a process that used to require a great deal of manual coordination. Here, it is readily evident **how automation, data consistency and industrial AI merge and work together: from demands and requirements, the call up and on to the finished product.**

This closes the circle in terms of conventional connection technology: end-to-end data, integrated workflows and AI supported automation also result in significant efficiency gains in the development and production of connectors. The technologies of the Siemens Xcelerator not only accelerate digital processes, but also specifically support the further development of electromechanical components – and show how autonomisation creates genuine added value – also in established areas of industry.

INDUSTRIAL DIGITALISATION: FROM STATIC AUTOMATION TO ADAPTIVE, LEARNING SERVICES

Whereas in the 1980s systems operated with fixed logic and delivered the same results for decades, today we expect significantly more from digital services: they should be flexible, adaptive and customer-orientated.

Conventional automation followed rigid processes. Once set up, machines repeated their tasks deterministically – even in cases in which they reproduced errors millions of times over. Modern services, on the other hand, must be capable of continuous learning and adapt to changing requirements based on artificial intelligence (AI) and digital twins.

Within the HARTING Technology Group, the Centre of Excellence Digital Transformation is responsible, among other things, for developing digital services that enable this new type of automation. These services include AI supported assistance systems, the Han® configurator, automated engineering processes, digital knowledge services and the Group-wide use of digital twins. The aim is to bridge the gap between conventional machine logic and data-driven, intelligent solutions.

Digital Twin as a key technology

At the core is the digital twin, consistently implemented at HARTING based on the Asset Administration Shell (AAS). It provides a comprehensive virtual representation of products, processes and applications and interlinks data from development, production and application. This creates a data-based foundation for automating decisions, deriving variants and intelligently controlling services. The days of pure I/O signals are past and gone – modern automation calls for complete, structured data models.

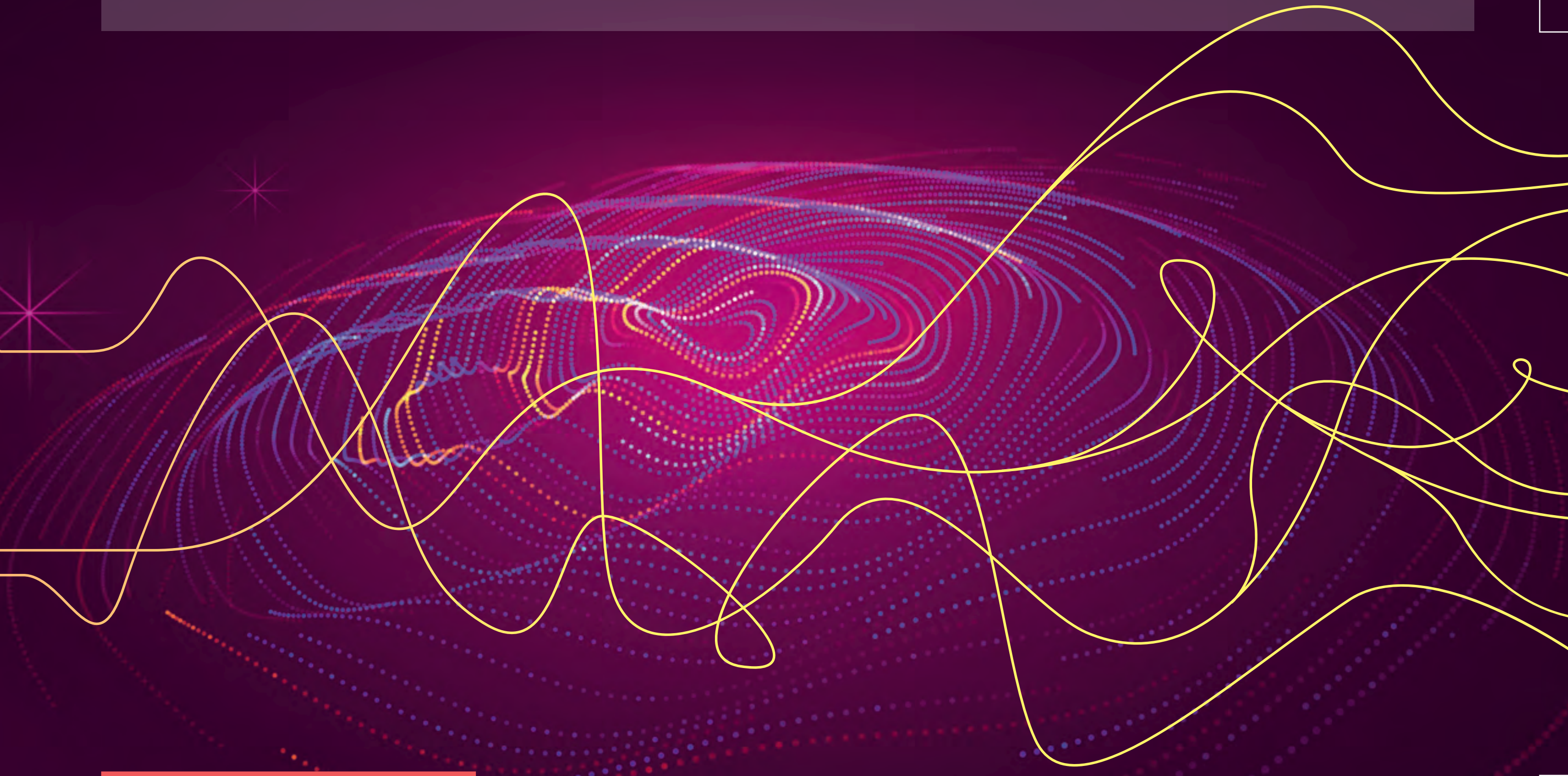
Andreas Wedel
Director Digital Transformation,
HARTING Technology Group

Digital services at HARTING

1. Automated knowledge
AI supported systems provide product and application knowledge directly and consistently.

2. Automated engineering
Repetitive tasks such as data derivation, documents or variant logic are automated with software support.

3. Automated customer journey
AI supported recommendations, automatic data packages and digital Twin information accelerate processes and improve decisions.



The focus is on customer needs

Digitalisation is shifting the focus from merely raising efficiency to actively supporting users. Engineers are not being replaced, but their workload is being reduced in a targeted manner: tasks such as the manual transfer of technical attributes or the remodelling of 3D data can be increasingly automated. The less time is tied up in routine activities, the more time will be available for creative and value-adding development work.

Markets stand at the outset

In spite of tremendous potential, the widespread implementation of adaptive services is still in its infancy. HARTING is developing the first market-ready applications – such as AI supported configuration aids, automated data packages or Digital Twin based engineering processes. In future, fully integrated, self-learning service chains will emerge. The industry is now in an exciting transition phase in which companies like HARTING are establishing new solutions, step by step.

Outlook: The future of automation

The transition towards adaptive, digital services is irreversible. AI models, time series analyses and digital twins will fundamentally change industrial automation. In future, services will not only automate tasks, but also recognise customer needs at an early juncture and suggest suitable solutions. Performance gains will trend upwards with every interaction – systems will become more context-sensitive, more precise and more flexible.

Data quality remains the greatest challenge. Only when the available data is complete, structured and consistent will digital systems be able to make well-founded decisions independently. But the trend is clear: the industrial automation of the future is digital, adaptive and consistently customer-orientated.

HOW IT IS MAKING ITS WAY INTO SENSOR TECHNOLOGY

To date, there were the clearly separate worlds of the field level and higher-level IT. In the meantime, the two areas are now merging in terms of data technology. At the core of this development is the question as to how information can be transferred from the machine level to digital systems efficiently, comprehensibly and without media gaps. This is precisely where Perinet comes in with a novel approach that is dissolving traditional boundaries.

Dr. Karsten Walther
Managing Director
Perinet GmbH

Perinet

German technology company

that directly interconnects sensors, actuators and IT systems. The solutions enable secure, end-to-end data communication from field devices to higher-level software and cloud systems. In this way, Perinet is creating the foundation for advanced, data-driven production environments while facilitating the use of AI in industry.

Barrier-free communication between IT and sensor technology

Traditional systems are based on proprietary bus systems and gateways that utilise data at field level and only translate it to IT when required. This process causes delays, media gaps and complex integration efforts. Perinet enables direct Ethernet-based communication from sensors through to the IT level.

This consistency is based on Single Pair Ethernet (SPE), a technology that brings Ethernet communication to the most compact devices. Today, modern microcontrollers enable computing power in sensor format; SPE complements these capabilities by providing a suitable, compact network interface.

Intelligence moving into sensors

As computing power trends upwards, the tasks and role of sensor technology are changing. Information is no longer provided as raw data, but as relevant information. A sensor that previously only output voltage is now supplying information directly that is relevant to decision-making – such as the fill level of a tank, for example.

This is creating an intelligent data flow that relieves burdens on IT and reduces network loads. Sensor technology is developing into the first processing level and forms the cornerstone as IT technology penetrates increasingly deeper into the field level.

The future of automation

The automation of the future will be holistic, with automation at field level and IT complementing each other.

Field level:

Networked, intelligent sensors that pre-process, interpret and securely communicate data and automate the production process.

IT level:

AI, machine learning and the data-based optimisation of processes.

While machine control used to form the sole core of automation, the innovative power is increasingly shifting to the IT level, where information can be evaluated across systems and processes can be optimised dynamically.

Practical example:

Brownfields the easy way

The approach impresses with its strength demonstrated especially in brownfield systems. Instead of integrating different machine control systems which involves considerable input and effort, Perinet accesses the information directly at sensors – parallel to the existing PLC, without impacting on the ongoing operations.

In complex systems such as bottling lines, it is sufficient to read out a few specific data points to visualise throughput and rejects. **Operators benefit from a minimum of installation input and effort, standardised infrastructures and risk-free retrofitting, even of decades old machines.**

Connectors as enablers

The merging of IT and sensor technology also places new demands on connection technology. Hybrid connectors that combine power and data in one interface are becoming the foundation for modern automation. **Just as USB brought about standardisation in IT, compact hybrid solutions – for example in the Single Pair Ethernet environment – are facing similar developments in the industrial area.**

DRONES: THE NEW DIMENSION IN AUTOMATION

Unmanned aerial vehicles (UAVs) are becoming increasingly important in today's rapidly evolving digital landscape. Companies are striving to digitally transform their industrial processes in order to reduce costs and improve working environments. Whether for mapping of large fields, intelligent obstacle detection or fully automated operations for the precise application of water, fertilisers and more. Commercial drones and quadcopters are helping to enable industrial self-control and take automation processes in various market segments to the next level.

Norbert Weiß
Teamleader Marketing Service, HARTING Electric

Industry standards developed in Europe ensure optimised SWaP

Technological breakthroughs, such as **improved battery efficiency, advanced image sensors and AI-driven autonomous functions,** have significantly expanded the potential applications of drones in various industries. This development has led to certain applications, such as drones, evolving significantly from hobbyist devices to regulated, mission-critical platforms in agriculture, logistics, inspection, public safety and many other segments.

Size, **w**eight **a**nd **p**ower are crucial for enhancing the optimal performance, manoeuvrability and range of commercial drones. Industry experts refer to this as **SWaP**. As the market leader for industrial connectors, HARTING has recognised the demand of industrial-proof connectivity and cabling solutions. The new HARTING Han® MPC and the ICC 20 Drone Arm Connector (DAC) have been developed in accordance with these important requirements. HARTING's existing range of device connectivity solutions and future production based on 3D-MID technology are also helping to unlock new potential for automated flight operations.

Connection between power distribution board, electronic speed controller and battery

UAVs and other mobile robots, including humanoid robots, share a common topology of connection points. The widely used **LiPo batteries**, either regular or future-proof smart units with signal integrity, supply power to **the power distribution board (PDB)**. The PDB is the central interface between the battery and **the electronic speed controller (ESC)**. The ESC ensures efficient and reliable power management. It effectively regulates the speed and direction of rotation of the electric motor to ensure smooth operation of the device. In industry, 3-phase brushless DC motors (BLDC) are often used to ensure low maintenance and long-lasting performance.

The Han® MPC30 and MPC60 are the ideal solution for the connections between these critical units to ensure high signal integrity. Additional variants such as different housing types or straight and angled PCB variants enable even greater flexibility. The connection between PCB's can be established with extreme flexibility using the **har-modular® PCB** connector system.

Pluggable drone arms allow scalability to transport heavier loads

Modular architectures and platform concepts are state of the art for ensuring high machine flexibility. This also applies to UAVs. Adding additional drone arms for transporting heavier loads and changing tools are common procedures for responding to different tasks. Plug-in interfaces are essential for enabling the necessary modularity.

Hard-wired drone arms can also quickly become a bottleneck in the maintenance of commercial drones. Troubleshooting is time-consuming and often requires specialists to disconnect the connections. The ICC 20 DAC offers many advantages over hard-wired solutions. Drone arms can be easily plugged in and pulled out again to replace defective arms or switch between different variants.

Interference-free and stable video and signal transmission

Commercial drones need reliable connections for camera and payload sensors. HARTING offers shock- and vibration-proof solutions with data rates up to Cat. 8.2 (40 Gbit/s) and interference- free fibre optic solutions. Robust camera connections can be established with the HARTING ix Industrial® or the future-proof Single Pair Ethernet (SPE) solution T1 Industrial.

Compact antennas enable additional space and weight savings

With 3D-MID technology, antennas can be designed in three dimensions and integrated directly into device structures. This allows antennas to fit precisely into compact or complex housings, making efficient use of available space. The ability to place antennas exactly where needed supports high-frequency applications and helps maintain reliable wireless connectivity, even in challenging environments. 3D-MID offers design flexibility and weight savings, addressing both performance and integration requirements.

AUTOMATION IN THE AGRICULTURAL SECTOR – THE UNIVERSAL FIELD LEVEL OF THE ALL ELECTRIC SOCIETY

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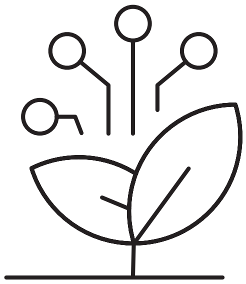
Agriculture is experiencing major and massive technology leaps forward. Electrification, digitalisation and automation are moving into the field at full force and combining efficiency with sustainability. What has matured in factory halls and consequently at the industrial field level is becoming the foundation for autonomous, selective and precisely timed processes in arable farming.



The transfer of proven applications is a central pattern here: from milking robotics where industrial motion components have been standard for years, hacking , spraying and sowing robots through to solutions for selective harvesting are now being developed. Small, networked units are performing tasks independently – controlled by higher-level systems that combine sensor technology, satellite data, weather, soil conditions and digital cultivation plans.

This places the field level at the very centre of data rooms. Classic deterministic control systems are no longer sufficient: autonomy requires a tight coupling of actuators and sensors with cloud and edge intelligence, as well as end-to-end digital twin concepts right down to the component level. Industrial designs deliver speed and scale here, while agricultural-specific adaptations make them suitable for the field.

Today, many of the scenarios outlined still represent a visionary perspective and are not state-of-the-art across the board – but do clearly indicate the course that the industry is currently taking.

The convergence of the sectors is visible: fieldbus worlds are converging and growing together with Ethernet based standards and companion specifications. In the place of proprietary islands, the idea of using industrial components with targeted adaptations is gaining ground – economically fuelled by quantities and technically supported by robust, tried-and-tested assemblies and components. **Meanwhile, start ups are accelerating this development:** new agricultural robots are often developed based on industrial drives,

Digital Twin at Festo – data rooms right down to components

Festo consistently makes its components Digital Twin capable and actively promotes these developments within the context of the Industrial Digital Twin Association (IDTA). Standardised digital images are created for actuators, valves and sensors, which bundle technical data, functions and diagnostic information. They enable simulation, virtual commissioning and seamless integration into administration shells in accordance with the 4.0 Industry Standard.

In agricultural technology in particular, this is accelerating the integration into autonomous machines: field-ready components can be parameterised, monitored and adapted to changing conditions more rapidly. In this way, the Digital Twin is creating the foundation for precise, networked and scalable agricultural systems.

Christine Marie von der Ohe
Business Development,
Agricultural Technology at Festo

The future of agricultural technology is where industrial field levels and agricultural practice meld and merge.

controllers and valves – adapted accordingly to vibration, humidity, dust and chemicals.

For example, precision spraying applications are being realised with modified valves and the appropriate connectors; pneumatic automation technology from Festo, familiar from industry, is assuming switching tasks for crop protection agents. **Connectivity is the key factor here.** Connectors are potentially the weakest link in the field – and at the same time the cornerstone for availability. Unlike in the factory, repairs often have to be executed directly in the field by untrained personnel. Consequently, interfaces should be designed in such a way to enable rapid, safe and intuitive replacement and installation. Suitable haptics, clear coding and robust housings are not a minor matter, but form the core of operating and spare parts concepts.

The overarching framework here is a positive technology narrative: Progress is expedient and serving, if it is put to consistent use. Agriculture that combines biodiversity and productivity is hardly conceivable without comprehensive electrification, digitalisation and automation. Festo, drawing on its in-depth industrial automation expertise – from motion and sensor technology to technical education – is able to support this transformation in a pragmatic manner: through components that are digitally connectable and through cooperation with OEMs that implement AI functions such as detection and decision-making.

The future of agricultural technology is where industrial field levels and agricultural practice meld and merge.
Innovative automation components, reliable connectivity and a continuous data flow through to the cloud are paving the way for autonomous systems in the field. Making the most of this convergence will result in more resilient agriculture – in economic terms, and, not least with regard to ecological considerations and factors.

HOW ARABLE FIELDS ARE BECOMING HIGH-TECH ENVIRONMENTS

What used to consist of clearly defined If-Then processes is now being replaced by systems that recognise, evaluate and react to situations. This upheaval is particularly evident in agriculture – an environment characterised by variability, weather conditions, biology and unpredictable dynamics.

Today, progress in agricultural technology is taking place where selective, cognitive and autonomous functions are converging. New technologies enable the automation of tasks that were previously exclusively assigned to humans: whether apple harvesting, vineyard care or weed control – wherever individual decisions are required, AI supported systems are opening up new potential.

The motivation is clear:

The sector needs greater precision in order to operate even more sustainably, while at the same time compensating for labour shortages.

Automation is becoming a prerequisite for producing food in a resource-efficient manner – and in a specifically targeted manner rather than across the board. The basis for this is provided by technologies that are available today at prices that were inconceivable only ten or twenty years ago: powerful edge computer units, adaptive image processing or precision satellite receivers.

The change of perspective is remarkable:

The agricultural sector, which is often regarded as conservative, is making the highest demands on automation – and every plant is unique.

Arable farming requires systems that can deal with living, heterogeneous organisms.

In this context, a new generation of multifunctional carrier platforms that serve as autonomous base vehicles is one salient example. Precise satellite navigation is ensuring tracking accuracy, while sensors record the machine status and surroundings. Building on this, camera-based AI modules work to analyse plant conditions, detect weeds or recognise growth parameters in real time. The evaluation is entirely decentralised on the machine – without cloud dependency.

The combination results in selective action: Mechanical tools remove weeds to pinpoint accuracy, while attached devices react differently to each plant.

This makes autonomy a practical tool for resource-efficient management.

Electromechanics is one aspect that is often underestimated. In the field, however, most failures are not mechanical by nature, but electrical: corroded connectors, poor quality of crimp contacts, lack of strain relief. The electrical system is the central nervous system of the machine, and its quality directly determines availability and productivity.

Watertightness, media resistance, mechanical locking and robust strain relief are key requirements in this context. Connectors have to withstand high forces, vibrations and soiling, as well as high-pressure cleaning. **Properly routed, relieved and protected cables reduce failures significantly.**

These details are crucial for transferring automation from theory to stable, cost-efficient field operation. Accordingly, agriculture is demonstrating just how sophisticated and pioneering automation can be operating away from the factory: It combines ecological responsibility, economic necessity and technological innovation.

digital-workbench.de

About digital workbench:

digital workbench is an engineering company bringing high-tech-automation to the off highway and agricultural sectors. The combination of agronomic expertise and modern sensor technology, navigation and AI positions the team as a specialist in selective, autonomous field processes.

Drawing on modular platforms and intelligent image processing systems, digital workbench develops practical solutions that work efficiently, robustly and in a resource-saving manner – thereby supporting machine manufacturers in implementing autonomy in everyday field work.

The future of automation will not only take place in the industrial park, but also on arable fields – where technology and nature meet and interact directly.

Josef Schmidt
Managing Director
digital workbench

AUTONOMY ACTIVE ON OUR FIELDS

Sensor technology, automation and data-based processes are fundamentally changing agricultural work in fields. Automation has already been finding its way into agricultural technology since the 1990s.

The automatic boom guidance on crop protection sprayers, is an early example, which automatically regulates the working height thanks to ultrasound. This was followed in the 2000s by automatic section control, which avoids overlaps and is now the standard in many regions. These systems noticeably reduce the driver's workload and ensure precise, reproducible work results.

Stefan Kiefer
Head of Plant Production Innovation at Amazone

About Amazone:
The Amazone Group ranks as one of the leading manufacturers of modern agricultural technology for soil cultivation, sowing, fertilisation and crop protection. Founded in 1883 and headquartered in Hasbergen-Gaste, the family-owned company develops machines and digital solutions for efficient, sustainable and high-precision agriculture. Amazone stands for innovation worldwide – from smart assistance systems through to networked, autonomous machines.

With today's digitalisation advances, entire work processes are now coming into focus.

Systems such as EasyTram plan tramlines in advance using geodata. The machines themselves continue to work completely autonomously – a must, given that agricultural land often does not offer a stable grid. Consequently, all the algorithms must run on the device, which only sends status data when required.

Amazone's latest generation of fertiliser spreaders represents a technology milestone. A total of 16 radar sensors monitor the application: seven sensors on each side detect the discharge angle in the ArgusTwin and ensure precise lateral distribution. Two additional sensors also measure the actual throwing distance and compare the trajectory of the grains with reference data in real time. This means that the lateral and longitudinal distribution can be precisely controlled and permanently monitored for the first time. If values deviate, the system prompts the driver to carry out a spreading test. **All the data flows into the cloud and enables optimisations over the entire life cycle – a paradigm shift compared to previous static setting tables.**

This permanent feedback opens up new potentials: Amazone can improve algorithms, dealers receive precise diagnostic data, while even fertiliser producers benefit from feedback on the quality of their batches.

In this way, the machine improves over the course of actual use –

a decisive difference over conventional industrial automation, in which hardware is usually only configured once.

The direction is clear: the more closely processes are monitored and safeguarded, the closer we are approaching full autonomy. Autonomous operations are already a reality in soil cultivation. According to Stefan Kiefer, Amazone is now achieving around 99 per cent process monitoring for fertiliser spreaders. The main unanswered questions concern the safety of the surrounding area at large scattering distances of up to 72 metres. As agricultural machinery works on private land, however, different conditions apply as in road traffic.

Artificial intelligence currently plays a role above all in areas where image data is processed –

for example in weed detection operating with cameras or drones. Cloud computing and to an increasing extent edge computing processes are at work here. With regard to other functions, deterministic control technology continues to dominate, with AI supported further development running primarily in the background.

Agricultural technology features as one of the most dynamic innovation areas in the world of automation today. Amazone shows how mechanics, sensors and software merge – and how machines are being created that work more precisely, monitor themselves and learn with every passing season.

MODULAR CONNECTORS FOR FLEXIBLE AUTOMATION

HAN-ECO® AND HAN-MODULAR® ENABLE COMPACT INTERFACES IN THE NEW YAMAHA MOTOR COBOT

Toru Shiozaki
Regional Sales Manager,
HARTING K.K.

Yamaha Motor and HARTING look back on a long-standing partnership. In the recent development project, the Han-Eco® connector is being used in conjunction with the Han-Modular® system to reliably connect its first collaborative robot ("cobot") “YAMAHA Motor Cobot” to the control system. The new cobot features a 48 V DC power supply, seven axes and a high-precision torque sensor for exact force control.

For Yamaha Motor, design and usability are key aspects in the development of cobots. The demands placed on collaborative robots are increasing as they increasingly interact with humans and therefore need to be not only functional, but also easy to use and safe. The interface between the robot and the control system plays a crucial role here: it must be compact, clear and fail-safe.

Various challenges had to be overcome in the development process for the new cobot, including compliance with safety standards and electromagnetic compatibility (EMC). The original solution with a Han-Modular® 8-pin power module was not sufficient, as additional grounding was required. Since the interface size was fixed, the project was in danger of failing.

The introduction of the Han-Modular® Domino system provided the necessary flexibility with the half size of the conventional module: it allowed an additional contact for grounding to be integrated by dividing the connection for power and signals without enlarging the interface.

Modular connectors such as the Han-Eco® and the Han-Modular® system are central components of this development and meet the requirements of modern automation solutions for strong lifelines for power and data in an All Electric Society. The All Electric Societys describes a future in which the entire energy requirements of society and industry are met sustainably and efficiently by renewable, electrically generated power.

Han-Eco® and Han-Modular® enable energy and data flows to be integrated securely and compactly – a basic prerequisite for the implementation of intelligent, networked automation solutions. The ability to combine

Yamaha Motor Co., Ltd's new 7-axis collaborative robot "Yamaha Motor Cobot" and compact, dedicated DC 48 V controller with plastic housing Han-Eco® and modular insert Han-Modular® and Han-Modular® Domino for their connectivity.

powerful energy supply and fast data communication in a single system not only supports the technical implementation of the All Electric Society, but also promotes the development of new business models and production concepts.

The transformation of automation is also evident in the increasing collaboration between humans and machines. **Cobots, such as those developed by Yamaha Motor, are a prime example of this development: they are no longer just tools, but intelligent partners that respond flexibly to changing requirements and relieve employees of demanding or monotonous tasks.** The integration of modular interfaces helps to ensure that these systems remain easy to use, safe and future-proof. In addition, automation makes an important contribution to overcoming the shortage of skilled workers and promoting innovation.

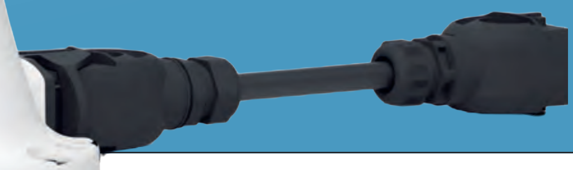
Yamaha Motor takes the lead to invest specifically in training the next generation of robotics engineers and supporting educational initiatives to secure the skills needed for the industry of the future.

About Yamaha Motor Co., Ltd.

Yamaha Motor Co., Ltd. is a global company that offers drive technologies as well as solutions for control and manufacturing technology. The company is engaged in a multitude of businesses: the Land Mobility business encompasses our trademark motorcycles, all-terrain vehicles, electrically power-assisted bicycles, and other vehicles; the Marine Products business offers boats, outboard motors, and more; the Robotics business handles compact industrial robots launched in 1976, surface mounters, drones, and other industrial machinery; and the Financial Services business provides product financing and other similar services.

What is a cobot?

A cobot (short for "collaborative robot") is an industrial robot that has been specially developed to work directly with humans. Unlike traditional industrial robots, which usually work in shielded areas, cobots are designed to be used safely and flexibly alongside humans. They are equipped with intelligent controls that detect collisions, enabling them to work together without protective fencing. Cobots take on monotonous, dangerous or physically demanding tasks, thereby supporting employees.



TIME SERIES: THE FOUNDATION FOR AI IN MANUFACTURING

Artificial intelligence and machine learning are the next logical step in industrial automation. While classic automation solutions are becoming increasingly interchangeable, companies are on the lookout for new differentiating features. The following holds true: Many AI applications are already working cost efficiently today. Progress does not require autonomous agents.

Robert Weber

is a technology journalist specialising in robotics, AI and automation. Together with Peter Seeberg, he runs the "Industrial AI Podcast", which makes industrial AI and machine learning understandable for users. Weber has been working independently since 2019 and reports on trends and developments in industrial digitalisation.

Robert Weber
The Industrial AI Podcast

Currently, there are four fields that hold great potential: Engineering, simulation, vision and, above all, time series. In the engineering area, AI systems support design, parameterisation and documentation. In the field of simulation, AI-based models are created that map complex physical processes faster and more easily than conventional tools. Vision remains a cornerstone of industrial AI, while the next technological leap is on the horizon in the area of time series.

Vision systems are already demonstrating just how well AI can function in an industrial environment: Quality testing, object recognition and inspections are production ready. The analysis of time series is the next major field on the agenda. Machines communicate via sensor data, process values and energy consumption – and modern AI models are able to analyse this information to a high level of precision. Consequently, predictive maintenance, predictive quality, energy efficiency or demand forecasting can be realised cost efficiently, often without new hardware and even on existing CPUs.

While we hear a lot of talk about autonomous agent systems or self-optimising machines, these approaches are still around 10 to 15 years in the distance. A lack of standards, safety requirements and business models are putting the brakes on the direct coupling of AI models to control systems. Today, optimisations are usually carried out in the digital twin of the system before they are transferred to real production.

Humans remain in the control loop – for now.

AI-based assistance systems, such as large language models (LLMs), could facilitate the operation and configuration of machines in the future and thereby help to offset the shortage of skilled labour. But the same applies here: : **The costs for applications and operation must pay off**. Not every innovation is immediately commercially viable – while there are many proofs of concept, actual, genuine scaling remains rare.

Especially in the time series area, large foundation models are currently being developed, which – similar to text data – are trained on a broad data basis.

Industry is sitting on a treasure trove of data that should not be relinquished lightly.

Those who control this data can not only optimise their own products, but also develop new business models – including the optimisation of competitor products.

Change will come, but not overnight. Although automation cycles are shortening, fully autonomous production chains are still years away. **One thing is certain: AI will not replace automation, but rather expand it.** – and gradually lead the industry from traditional control systems on to data-driven, learning systems.

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Phone: +49 5772 47-0, Fax +49 5772 47-400,
Internet: www.HARTING.com

Responsible for the content:
Dr. rer. nat. Stephan Middelkamp,
Andreas Huhmann

Editor Vogel: Sebastian Human
Editorial team HARTING: Norbert Weiß, Dr. Volker Franke, Andreas Wedel, Thomas Kämper, Florian Raabe, Martin Wischmeyer, Mareike Knost, Toru Shiozaki

Responsible in the sense of the Press Law:
Magdalena Okopska

Overall coordination: Lars Kühme, +49 5772 47-9982

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Pictures

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