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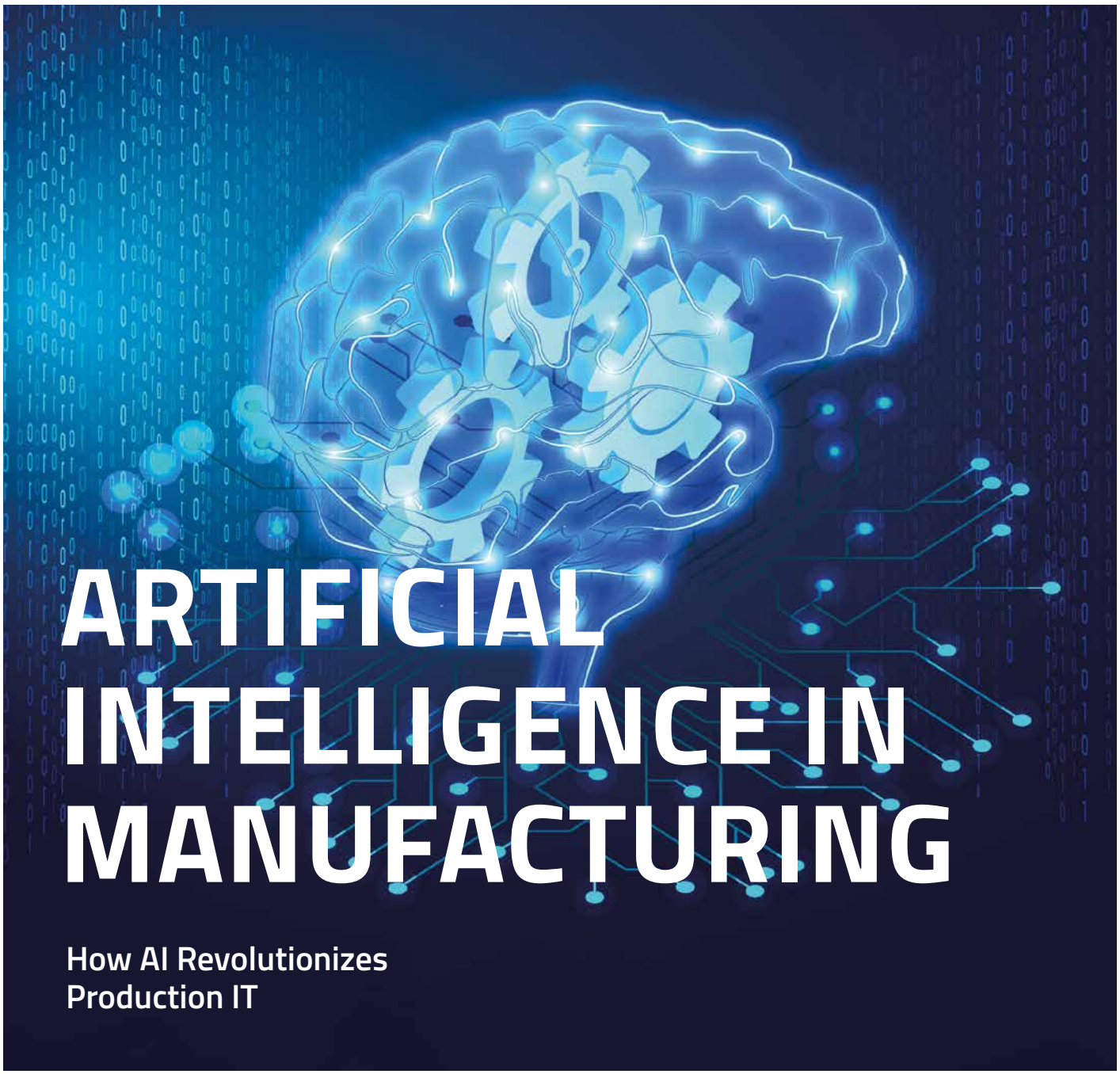
WE CREATE SMART FACTORIES

MPDV NEWS

Edition 2020



ARTIFICIAL INTELLIGENCE IN MANUFACTURING

How AI Revolutionizes Production IT

THE NETWORKED CELL
HYDRA Dynamic Manufacturing Control for your way to the Smart Factory

INTELLIGENT FACTORY
When MES and WMS directly communicate with each other

REALISTIC PLANNING
Predicting setup time with Artificial Intelligence

Snapshot

THE SMART FACTORY

Vacom has taken an innovative step on the way to the Smart Factory. MPDV's Manufacturing Execution System (MES) HYDRA communicates directly with a goods management system using a newly created interface.

The positive effects of this are shown from page 36 onwards.

EDITORIAL

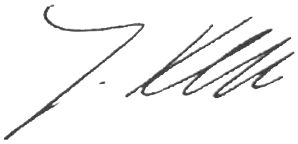
Dear Readers,

For more than 30 years, humans have been researching in the field of artificial intelligence (AI). We have already been able to make great progress with this future technology. Just think of more powerful hardware and software solutions or better data transmission. AI opens up completely new possibilities for manufacturing IT to produce even more efficiently and to manufacture complex products in small batches more cost-effectively than ever before.

The potential of AI for industry is immense. Studies by PwC show that AI can make a significant contribution to the global economy in the future, and according to Roland Berger forecasts, intelligent, digitally networked systems could generate strong growth in Western Europe.

As an innovator for IT solutions in manufacturing, we at MPDV have also set out to develop new products based on AI. We are presenting in this edition of the MPDV NEWS our AI solutions Cognitive Planning and Setup Time Prediction for the first time. Read in this NEWS how these systems release around 20 percent of new capacities in production and how setup times can be planned even more realistically.

I wish you an informative read.



Yours, Jürgen Kletti

Prof. Dr.-Ing. Jürgen Kletti, CEO MPDV

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ON THE WAY TO PERFECT PRODUCTION PLANNING WITH ARTIFICIAL INTELLIGENCE

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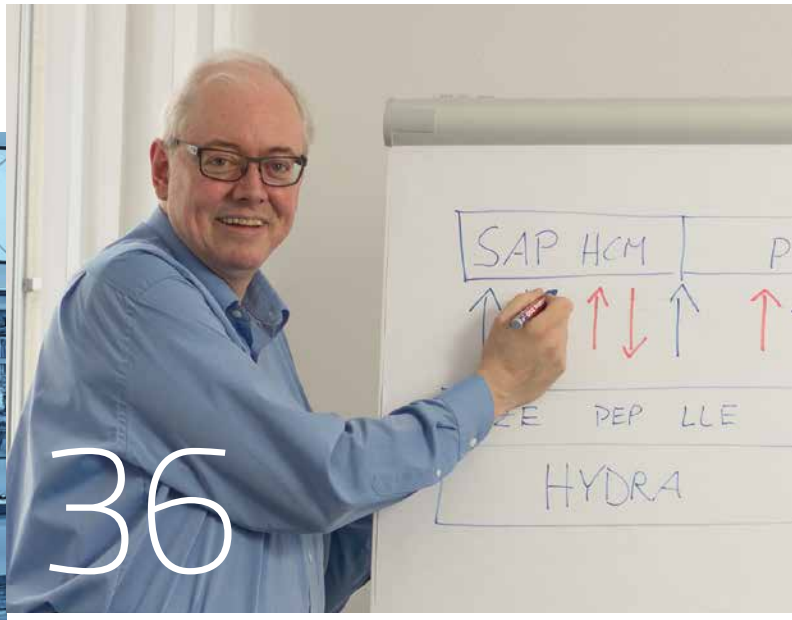
EASILY CONNECT MACHINES TO HYDRA



THE DRIVING FORCE:
MYCONSULTANT REINHARD BECKER

STRATEGY & VISION

PANORAMA

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MPDV NEWS

EdgeCS 2.0

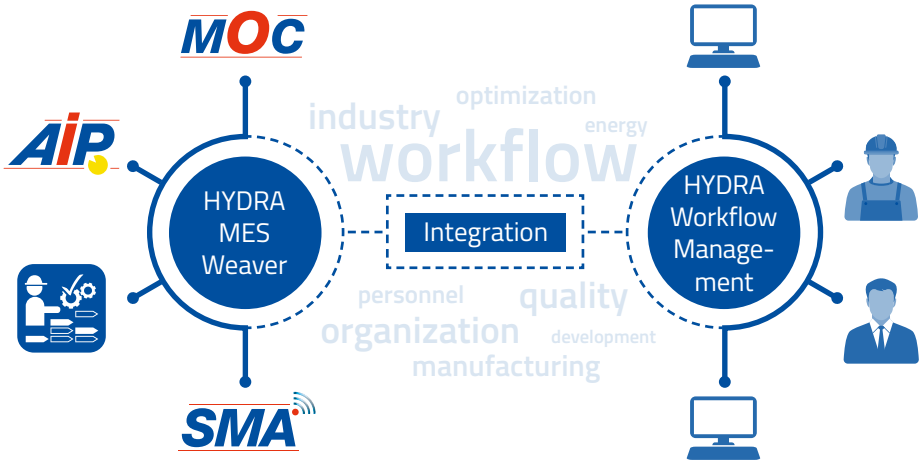
New Data Collection

With the Edge Computing Suite 2.0 (EdgeCS), MPDV offers an innovative form of data collection on the shop floor. Using this new product, you can easily integrate driver modules for modern protocols such as OPC UA, MQTT or MTConnect. The driver configuration is intuitive. Another advantage: During data collection, several signals can be combined to form a new information that cannot be recorded directly as such. An example: The system can interpret the posting "open flap" and a temperature of below 40 °C as machine status "maintenance in progress" and report this information. The EdgeCS 2.0 infrastructure is designed for large data amounts and a wide variety of signals. Therefore, the developers of MPDV have integrated monitoring functions enabling a continuous monitoring of the system status and performance.

More about EdgeCS 2.0 at mpdv.com

Workflow Management with HYDRA

The digital integration of production workflows has many advantages, such as an increase in transparency and a consistent high level of process reliability. Using the integrated workflow management of MPDV, you can map the recurring organizational workflows in production in the Manufacturing Execution System (MES) HYDRA. The workflow management is a useful tool to integrate all processes – apart from the actual orders – ensuring productivity and competitivity. The employees constantly have an overview of all processes and can immediately see if something is wrong.



With the integration of the workflow management in HYDRA, the data recorded can be saved and evaluated in the system. All HYDRA clients available can use the workflow management: the shop floor terminal, the office PC or mobile devices like tablets directly at the assembly line or elsewhere.

A good example is the recurring process of decision making when scrap has been produced: Can the item be reworked? If so, do you wait for more scrap or do you immediately start reworking? If not, what happens to the item? Is it recycled or stored for training purposes? Using the workflow management, you can add as many details as required to this decision tree. You can also use the workflow management to trigger logistics workflows after posting part quantities: removal of the posted parts, delivery of a new pallet, storage of the finished items and booking in the ERP.

First Customer Day in China

MPDV's first Customer Day in China was a complete success. In Wuxi, the beautiful city at Taihu Lakeside, more than 40 participants from 22 companies met and exchanged their experiences with the Manufacturing Execution System HYDRA. Mingfeng Li, China General Manager at MPDV, presented the service concepts as well as the operation and maintenance system as part of MPDV's service portfolio.

mpdv.com/en/fairs-events/

MPDV Supports UMATI

Interoperability is one of the key requirements for the success of Industry 4.0. Therefore, MPDV supports the standardization of machine connections and assists UMATI, the standardized protocol to communicate with tooling machines.

UMATI (Universal Machine Tool Interface) is driven by the Association of German Machine Tool Manufacturers (VDW) and is based on OPC UA, which is considered the standard for Industry 4.0. IT systems by MPDV used in the production environment – the Manufacturing Execution System (MES) and the Manufacturing Integration Platform (MIP) – have been supporting OPC UA for many years. MPDV extend their own portfolio with the native connection of machines from all sectors of industry and manufacturers with UMATI.

Advantages of the machine connection

Thanks to the connection of as many machines as possible to the production IT, users get a clear picture of the current processes in the shop floor. Also, versatile evaluations of recorded data help to promote continuous optimization and thus ensure greater efficiency and competitiveness. Tooling machine tools of different manufacturers can be connected to HYDRA in no time with UMATI. Communication is instant and without much effort.

MPDV NEWS

New Partners for the MIP

The ecosystem of MPDV's Manufacturing Integration Platform (MIP) keeps growing. Staufen AG, a leading consulting company for shop floor management, is one of MIP's newest partners. Staufen provides the manufacturing app (mApp), ValueStreamer®, which is a management, visualization and collaboration tool. Based on mainly digitally generated data and information transparency, this mApp enables structured communication and problem solving across all hierarchical levels. All this leads to considerably improved process lead times, productivity, efficiency and quality. Consequently, ValueStreamer combines the benefits of digitization and the shop floor management in a pragmatic way.

The mApp Bridge MIP to OSIsoft PI by MEGLA is also new to the MIP. Production companies using this mApp can combine order data of the MIP with process data of OSIsoft PI, which is a Plant Information System. As a result, MEGLA creates a uniform data infrastructure and provides for new opportunities to increase efficiency along the value chain.

The IIoT platform toii used by the thyssenkrupp group is also available as MIP mApp. Machines and production equipment of different manufacturers use toii to communicate with each other. This can include calipers, manual band saws and multistage production plants. The collected data is stored in the MIP and shared with other mApps.

The Russian company Alekta uses the mApp AMON CNC Data Extractor to read and evaluate detailed condition data from CNC processing machines and to make this data available via the MIP. This mApp also provides extensive analysis functions. Alekta is also one of MPDV's service partners and contributes development resources for outsourcing projects.

The new MIP marketplace provides interested parties with information about all companies that offer software, hardware or services for the MIP:

mpdv.info/mipmarktplatz

STAUFEN.

MEGLA
digital. personal. reliable.

thyssenkrupp

ALEKTA
DEVELOPMENT AND INTRODUCTION OF CORPORATE INFORMATION SYSTEMS

Young Researchers Shape the Future of Construction

Two teams with children of MPDV employees participated in the regional competition FIRST LEGO League (FLL) in Obrigheim, Germany, this year. The "MPDV Junior Developers" ranked third in the research task. "The Originals" won the jury's special prize and were praised for their excellent teamwork. Altogether 17 teams competed in the regional competition in Obrigheim.This year's main topic of the competition was "City Shaper, design construction of the future".

Focus on promoting young talents

The FLL was founded in 1998 and has established itself as a worldwide competition for children and young people. In 2018, more than 38,000 teams worldwide competed in the FLL. As part of MPDV's social commitment, the company has been supporting the research and robot competition for more than 15 years. MPDV is the main sponsor of the regional competition in Obrigheim and helps to finance the teams.

MPDV is Now a Member of the Open Industry 4.0 Alliance

If the 40 or so members of the Open Industry 4.0 Alliance have their way, then in future at least 80 percent of the machines in a Smart Factory should speak the same language. The members of the Alliance are committed to an open ecosystem and to ensuring interoperability between systems. The aim is to ensure that the solutions of the members can communicate directly with each other.

OPEN INDUSTRY 4.0 ALLIANCE

MPDV has been a member of the Open Industry 4.0 Alliance since the beginning of the year. "We are pleased to be a part of this cooperation and to contribute our expertise to the work of the Alli-ance. Together, we can continue to successfully promote Industry 4.0 and shop floor networking in the production halls," says Nathalie Kletti, Vice President Enterprise Development at MPDV.

New added values

MPDV offers an open platform in their portfolio with the Manufacturing Integration Platform (MIP). MIP is a link between shop floors, production IT applications and associated systems such as the ERP. The MIP serves as a central hub and replicates all processes in production. "Thanks to our membership in the Open Industry 4.0 Alliance, we ensure that our solutions can communicate directly with the systems of other providers. In this way, we achieve a whole new level of interoperability and create real added value for our customers. After all, processes can be optimized by standardizing interfaces," says Thorsten Strebel, Vice President Products at MPDV.

10^{1000}

several options exist to schedule 500 operations in a particular order. With MPDV's Cognitive Planning and Optimization product, users can use artificial intelligence to calculate the perfect combination and make the best use of their resources, thereby reducing costs and increasing delivery on time. The system incorporates numerous planning restrictions and only examines the options that have potential for a good overall result. On the basis of reinforcement learning, the system learns more about the available data with each decision and thus gradually finds the best possible solution.

A question to Thorsten Strebel

HOW CAN I OPTIMIZE MY PRODUCTION PLANNING WITH ARTIFICIAL INTELLIGENCE?

First of all – if you want to produce competitively, then you have to make the best use of your resources. You need a sophisticated production planning to achieve this. Methods used by artificial intelligence (AI) might be a useful tool. But before we take a look at our new product Cognitive Planning and Optimization let us take a closer look at the existing possibilities of the automatic production planning.

Manufacturing Execution Systems (MES) such as our HYDRA provide functions for the automatic planning of production orders.

Manufacturing Execution Systems (MES) such as our HYDRA provide functions for the automatic planning of production orders. Due to the low processing power in the past, heuristic planning was for a long time the best mathematical approach for automatically scheduling orders and their operations to the workplaces and machines. An essential feature is that one operation is planned after the other in the best possible way according to fixed requirements. Decisions that have already been made are only questioned to a certain degree and operations planned later on, are disregarded.

Learning from mistakes for the future

By introducing our new product Cognitive Planning and Optimization, we have taken a decisive step towards achieving optimal production planning. In contrast to the step-by-step approach of heuristics, our Cognitive Planning and Optimization solution reviews the numerous decisions before making a final planning decision.

We use reinforcement learning, which is a form of artificial intelligence. Reinforcement learning helps training a computer program to work like the dog's reward principle. Whenever the dog does something right, it gets a reward – for example in the form of food. If not, then the dog goes away empty-handed. The dog will therefore strive to do as much right as possible to get as much extra food as it can.

Applied to our solution, this means in short: the algorithm learns with every decision made, evaluates it and uses this knowledge in future planning. The algorithm questions decisions made and does not automatically check all options, but only those with the best results. With each decision, the system collects new information on existing data, further improving the quality of the planning decision step by step.

All factors in focus

This approach to intelligent production planning has enormous advantages. The system takes all the decisive factors such as orders, workstations, transport routes, setup times, limited resources and personnel availability into account right from the decision-making stage.

Conclusion and outlook

Today's complexity and masses of data can be managed with AI. The optimization of detailed planning with AI is of particular interest. This allows resources to be planned much more effectively and real advantages to be secured in a highly competitive market.

This minimizes setup times, shortens throughput times, increases on-time delivery, minimizes personnel costs or carries out a material availability check.

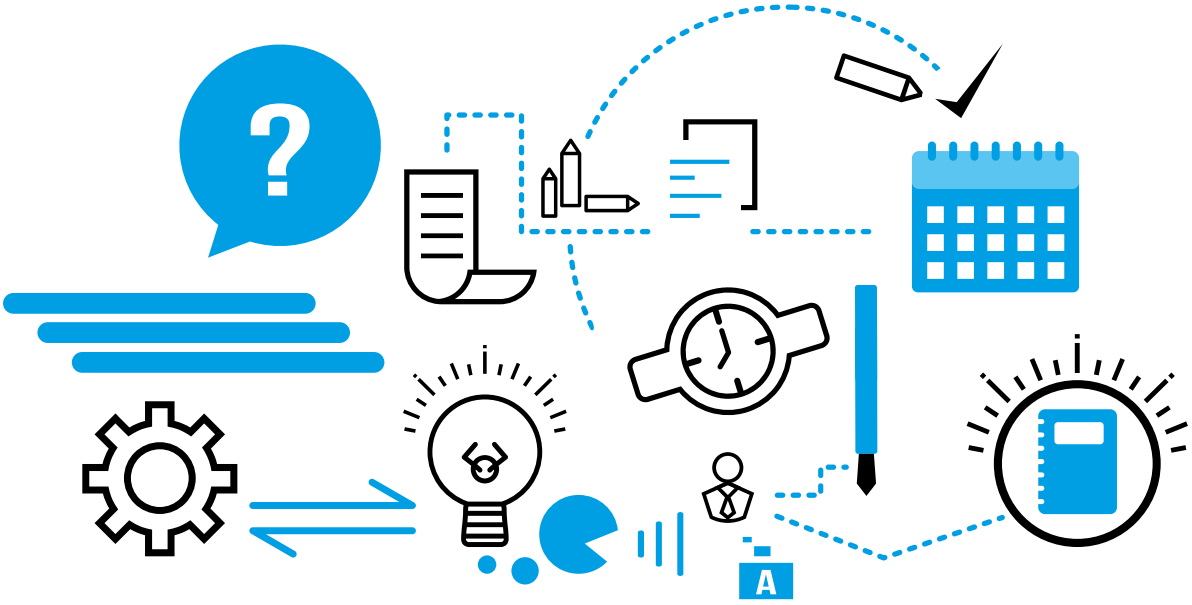
This minimizes setup times, shortens throughput times, increases on-time delivery, minimizes personnel costs or carries out a material availability check. The user can define which factors the system should consider and to what extent.

ABOUT THE PERSON

Thorsten Strebel studied Technical Informatics with a focus on production informatics at the University of Vocational Education in Mosbach. Today, he is a member of the MPDV executive board and responsible for product management and the further development of the product portfolio. As managing director of AIMES, he is also responsible for the deployment of AI-based software products and solutions.

Predicting setup time with AI

PLAN MORE REALISTICALLY



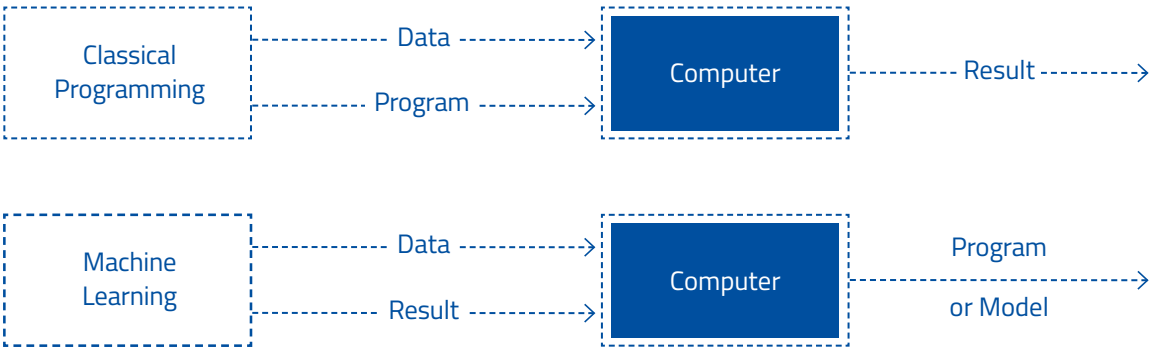
The planning of operations in production can only ever be as good as the specifications and assumptions on which it is based. Artificial intelligence (AI) can change rigid specification into dynamic projections that results in a more realistic production planning. This effect can simply be explained using the setup times.

Until now, production employees usually calculated standard values for setup times manually with a stopwatch according to REFA (Association for work structuring, company organization and business development) instructions or with a Manufacturing Execution System (MES) using recorded actual times. The problem with this method is the combination of different influence factors. The setup time for a product can vary depending on the used tool. Color changes can also delay or shorten the setup time. To date, an MES usually covers this variation with a so-called setup change matrix, where the transitions of time additions or deductions are managed manually and then put into the detailed planning. This is very costly, depending on the number of influence factors, and difficult to keep up to date, as new combinations are constantly being added. Another point is that REFA time recordings are usually only carried out every few years due to the enormous efforts involved. This is precisely where the use of AI changes the rules of the game.

The new product Setup Time Prediction by MPDV enables the user to calculate the setup times dynamically. To do so, the AI-based system analyzes historical data and calculates setup times that are much closer to reality than the specifications from a conventional setup change matrix. This also means, that wasteful buffer times are eliminated. Initial analyses show that the use of AI systems releases around 20 percent of additional production capacity. How does it work?

Paradigm shift

Machine learning is the basis for MPDV's setup time prediction and the associated paradigm shift between classical programming and machine learning. Classic programming always requires a detailed understanding of the facts to be depicted and their influence factors. The pro-



Machine learning leads to a paradigm shift.

grammer had to know what influence certain factors have on the result and store it precisely in the program. The programmer entered in the setup matrix how long the setup activities would take. For example, it takes around 30 minutes to change a tool. Color changes take on average 10 minutes and if you need to clean the tool, it takes a further 60 minutes.

Machine learning does not need this often rigid interpretation of facts and its influence factors. After all, machine learning can identify, based on the historical data from the MES, what is important and which aspect has a varying degree of influence on the result. A model is created for this purpose, which contains all identified correlations. When creating the model, the system also examines the historical data used to determine whether this is an influence factor. Then the system works out, for example, how the choice of a particular tool affects the length of the setup time. If an operation on a machine is scheduled to run at a specific time with a specific tool, this factor and possibly other data is used to predict the probable setup time based on the previously created model.

Information on how relevant an influence factor is for the expected setup time is generated as a by-product of the model creation. This means that the time of day might be less relevant as the setup process takes just as long in the early shift as it does in the night shift. On the other hand, the material used could have a significant effect – setting up with the material from supplier A takes considerably more time than with the material from supplier B. Given this complexity, a manually managed setup changeover matrix quickly reaches its limits because there are simply too many possible combinations.

Solid estimate

Since new articles or variations are constantly being made in a production facility, a procedure is also required, as in this case no historical data is available. We can use AI to calculate projections based on current data and similarities. The algorithm essentially acts in the same way as manual editing would do: a technical expert draws conclusions about the new combination from comparable articles or tools. The prediction will therefore not achieve the accuracy that would be reached if all factors were known, but it certainly does not fall short of conventional manual estimates.

Update the model

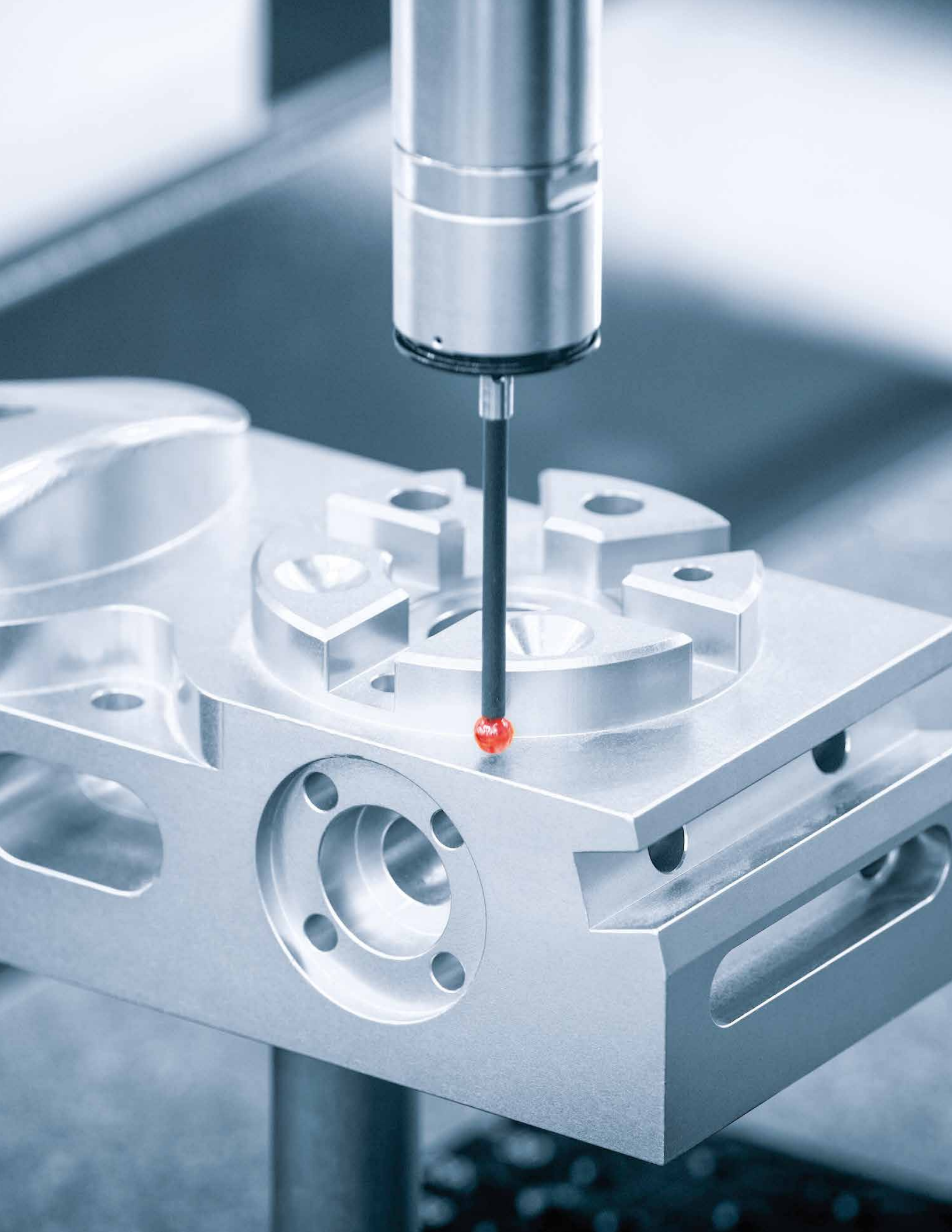
If the first historical data is available for the new article, the data can also be used to generate a model. This closed loop is another important characteristic of a powerful AI system – self-monitoring in case of conflict between model and prediction quality. The AI system should constantly monitor the prediction quality and when it falls short, trigger a new model on the basis on historical data. If this is achieved automatically, one also speaks of Automated Data Science.

AUTOMATED DATA SCIENCE – WHAT MATTERS IN AI

The power of an AI system is particularly apparent in the modelling process. Powerful AI systems like the one used by MPDV are characterized by the fact that they can independently process historical data used for modeling. This includes not only data synchronization in preparation for the actual model creation but also unsupervised anomaly detection - i.e. the automated detection of outliers and their correction. This process model, which automates the conventional and largely manual CRISP-DM approach, is also known as Automated Data Science.

The CRISP-DM concept (Cross Industry Standard Process for Data Mining) is an open standard process model that describes general principles used by data scientists. The CRIPS-DM is the most widely spread analysis model. Typically, a data scientist applies the methods from CRISP-DM manually in a number of phases, which can be quite complex depending on the volume of data. The separate phases involve, among other things, the interpretation and processing of the data. A model is then generated from the data, which is evaluated with the necessary knowledge of business and processes.

Automated Data Science can provide cost savings of up to 80 percent compared to the current CRISP-DM procedure. The reason for it is that available data does not have to be elaborately prepared.



THE NETWORKED CELL

Those who manufacture several thousand fittings every day need an efficient production that meets the highest quality requirements. A family-run company from the Sauerland, Germany, has set out on its way to becoming a Smart Factory using HYDRA Dynamic Manufacturing Control.

Full transparency: By scanning a Data Matrix code located on each component, a digital image of each part can be created in MPDV's Manufacturing Execution System (MES) HYDRA.

The internationally active fittings manufacturer* is one of the leading specialists for fluid media. The company places great importance on quality to meet the stringent safety requirements of this industry. "We have strict standards for our components. This makes it all the more imperative that every component leaving our production line is clearly identifiable and we know exactly how it was made and the areas of manufacturing it has passed through," says the Head of the Technology Competence Center.

MPDV's Manufacturing Execution System (MES) HYDRA allows you to create a digital image of the part containing the most important information by scanning a data matrix code located on each part and serving as a unique identifier. "As a result, we can exactly trace with how much pressure we checked a part for tightness or how many Newton meters we used to screw it together. We can prove during an inspection that we have executed each process step neatly," explains the Head of the Technology Competence Center.

Complex workflows flexibly modeled

A few months ago, the company was one of the first in the world to decide to model and implement a fully networked assembly cell, a so-called digital twin. The project team uses the HYDRA module Dynamic Manufacturing Control (HYDRA DMC) as a pilot in a production cell. "We decided to start somewhat out of the ordinary and introduced HYDRA DMC as a pilot before taking the next steps for the MES implementation," explains the Head of the Technology Competence Center.

Complex production processes can be modeled flexibly with HYDRA DMC. The module is used both in smaller assembly cells and in complex assembly lines for a great variety of products that typically require a fast work cycle and high information requirements. This includes systematic operator guidance, control commands for intelligent tools and peripheral devices. In addition, HYDRA DMC can improve traceability and the specified production sequence is guaranteed by intelligent networking.

"In production, we have many isolated solutions in use that do not communicate with each other. By introducing HYDRA we can replace all these stand-alone solutions. That's just great! All HYDRA modules can communicate with each other and exchange information. This has many advantages and takes us a considerable step further on our way to a networked production."

Head of the Technology Competence Center

HYDRA enables a clear view of the status of the separate process steps.

The manufacturer of fittings has been using HYDRA DMC in a U-cell where operators work in a so-called one-piece flow. In other words, each employee passes through the entire cell and assembles the component until it is finished. Recently, the operator was guided through the assembly process with the aid of networking and sensors.

Paperless cell

In the first step, the team, supported by MPDV, digitally reproduced the entire assembly process of the cell. For this purpose, a variety of sensors were connected to HYDRA DMC, thus optimizing operator guidance. The software can check precisely if a workflow was performed correctly in the cell. The operator no longer has to decide for themselves whether a seal is correctly fitted. That part is taken on by sensors together with HYDRA. If the system-supported inspection of a part is positive, the software releases the next work step and the employee continues assembly. The system uses this mechanism to ensure that work only resumes on components that meet the quality standard. The result is a fully networked cell.

"Thanks to HYDRA, we have managed to streamline our processes and improve communication between man and machine," explains the Head of the Technology Competence Center. "The system provides transparency and instant support for solving problems."

There are videos on the displays at each workstations in the cell showing special features of the assembly process. So employees know immediately what is important at which station. "Previously, the assembly process descriptions were displayed on paper. Now we've digitized everything and created a paperless cell.

Massive development boost

A particular challenge during the introduction of HYDRA DMC was to set up interfaces between the system and the sensors in the cell. During training sessions on site at MPDV's headquarters in Mosbach, the team of the family-run company learned how to model and configure the software in the simplest way and the options offered by the OPC UA protocol.

OPC UA stands for Open Platform Communications Unified Architecture and enables interoperability between systems from different manufacturers. The transport of data as well as interfaces and security mechanisms can then be specified. Transmitted machine data can be measured values, sensor data, controlled variables or control instructions.

"We had little experience with OPC UA but that has changed with this project and the involvement of MPDV. This has given us an enormous boost to our development. Moreover, with HYDRA we can supersede all our stand-alone solutions," adds the Head of the Technology Competence Center. "That was also the deciding argument for the MES HYDRA."

HYDRA Dynamic Manufacturing Control automatically guides the worker through the entire assembly process.

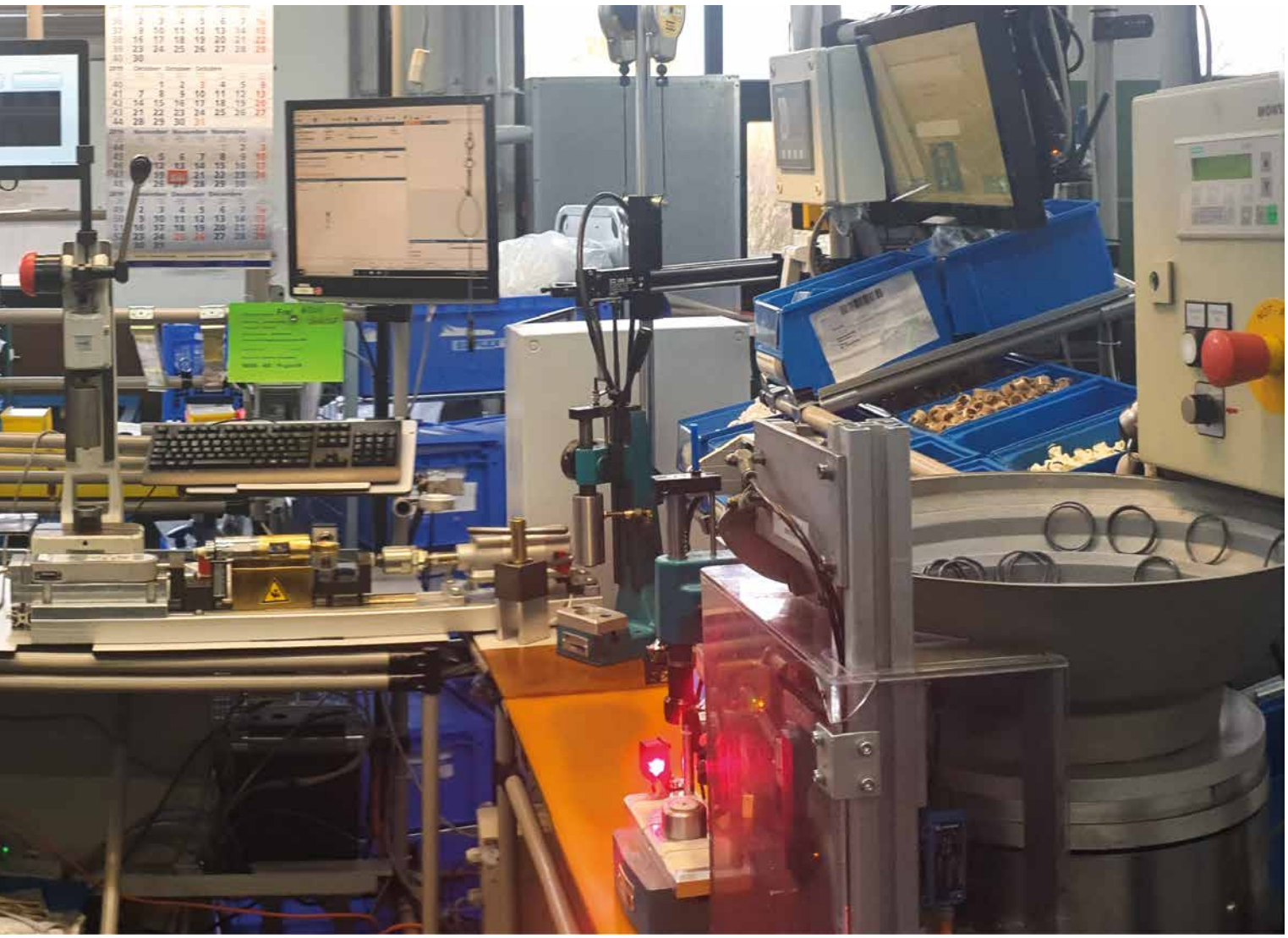
So far, the fittings manufacturer has used various software solutions in the fields of shop floor data and HR, but these do not communicate fully with each other. The modular structure of HYDRA enables the company to effectively exchange data in the future. Different HYDRA applications can be combined on a central MES database in line with requirements and without interfaces. Thus, the software provides a 360-degree view of all the resources involved in production and can also seamlessly map overlapping processes. HYDRA can be modified to industry-and company-specific requirements with tools for configuration and customizing.

In the coming months, the company plans to expand its cooperation with MPDV and fully implement the MES HYDRA. "We can't wait what the future brings", the Head of the Technology Competence Center ponders.

**At the request of the user, the names of the employees and the company are not disclosed.*

"Thanks to HYDRA DMC, we can document and prove precisely that our products only leave our premises when they have undergone all the specified processes and tests. The intelligent networking of sensors also enables us to generate even more precise information from separate process steps."

Head of the Technology Competence Center



THIS IS WHAT HYDRA DYNAMIC MANUFACTURING CONTROL CAN DO:

- Mapping of processes including separate work steps for all product variants
- Modelling of multi-level and branched production processes
- Specification of any quality checks and rework loops
- Custom configuration for ergonomic user interfaces directly at the workstations
- Easy connection of peripheral devices at the workstations
- Development environment for individual interfaces
- Collection, visualization and documentation of real-time data

More on HYDRA DMC at mpdv.info/dmcnews

Process Communication Controller

EASY CONNECTION OF MACHINES

Connecting machines to the Manufacturing Execution System (MES) HYDRA offers many benefits: increased transparency and higher efficiencies. But how can machines be easily connected to HYDRA? What are the most common ways to connect machines?

Erik Schostal, Product Manager and Shop Floor Expert at MPDV, has been connecting more than a thousand machines. Among them were old installations such as a drilling machine from the 19th century or state-of-the art injection molding machines that have standardized interfaces. Erik Schostal used the Process Communication Controller (PCC) by MPDV to connect HYDRA which is a data hub to universally connect machines and protocols like OPC UA. These protocols are used to connect machines that are not communicating consistently.

Standard protocol to connect machines with a standardized interface

"For instance, it is possible to connect machines with a standardized interface to HYDRA via our PCC in a very short time using the OPC UA protocol," explains Erik Schostal.

OPC UA stands for Open Platform Communications Unified Architecture and is a standard protocol to enable the communication between products of different manufacturers. The transport of data as well as interfaces, security mechanisms and the semantic structure of the data can be specified. Machine data such as measured values, sensor data, controlled variables or control instructions can be transmitted.

The PCC uses various communication drivers such as the OPC UA client, which enable the connection of different machine types and thus provide standardized data in HYDRA.

The communication drivers act as a kind of "translator" because they prepare data in a way that the PCC can supply these to HYDRA for further processing. HYDRA then turns the data into useful information and presents it in diagram form.

"Unlike IoT data collectors, HYDRA turns the data into information. After all, the machine data we collect, whether it is a simple signal or an error, has an affiliation to a scrap quantity in HYDRA, a defined status or process values. Many IoT data collector have data but have no idea that there is an information about piece numbers. We turn the data into useful information that tells the worker how many parts they have produced."

Erik Schostal, Product Manager at MPDV

The PCC not only uses standardized protocols such as OPC UA, MTConnect or MQTT but also industry-specific protocols like Euromap 63, a protocol used in the injection molding process.

MPDV's Development Suite also allows users to program their own communication drivers and connect them to the PCC if the machine does not support any of the standard protocols.

IIoT Connector to connect older machines without a standardized interface

With the IIoT Connector the user can connect easily older machines to HYDRA without an interface, which is a special hardware component.

To do so, the IIoT Connector is hooked up to the machine. The IIoT Connector renders the recorded signals via OPC UA and MQTT for further processing in the PCC, which makes the data available in HYDRA.

The IIoT Connector records analog and digital input signals, that means MPDV supports solutions for diverse machinery.

Detect gaps, increase efficiencies

Recently Erik Schostal visited a user on site to connect their system to HYDRA. Among them was a machine that, in the customer's perception, runs around the clock. After the machine had been connected to HYDRA for a day, it turned out that the system was stationary overnight. "This was a key event for me as the customer was totally unaware that this central machine was standing idle at night. It goes to show that it is essential to have transparency on the shop floor to produce efficiently. Connecting machines to HYDRA and collecting information can reveal crucial gaps and thus significantly increase production efficiency," says Erik Schostal.

ABOUT THE PERSON

Erik Schostal works as a Product Manager for MPDV and is responsible for shop floor integration. His job is to consult HYDRA users when they connect machines. He has been working for MPDV for 20 years. During this time he has connected thousands of machines. In his spare time, Erik Schostal is interested in Smart Home subjects, like the networking of technical devices such as lamps, televisions or mowing robots.

Three types of machine connection

The digital signal

One of the most common ways to connect a machine is the digital signal. We differentiate only between Yes and No. Yes, the machine is producing or No, the light is off and the machine is not producing. The IIoT Connector records the digital signal. A special signal mapping sends the signal to HYDRA which turns the signal into information. This type of machine connection is mainly used for the machine data recording or for older systems.

OPC UA for more information

OPC UA is an open data interface that can transport significantly more information than a digital signal. The user can record all types of information with an OPC UA. For example, counter values or process data, setting data of machines or order data can be transmitted. With the OPC UA the user can transmit information like the production rate of a machine. For example: The machine has produced 40,000 in 30 minutes.

This form of machine connection is one of the most common types. OPC UA has established itself as the data exchange standard. Associations such as Bitkom and the German Central Association of the Electrical Industry (ZVEI) recommend OPC UA as the communication protocol for Industry 4.0.

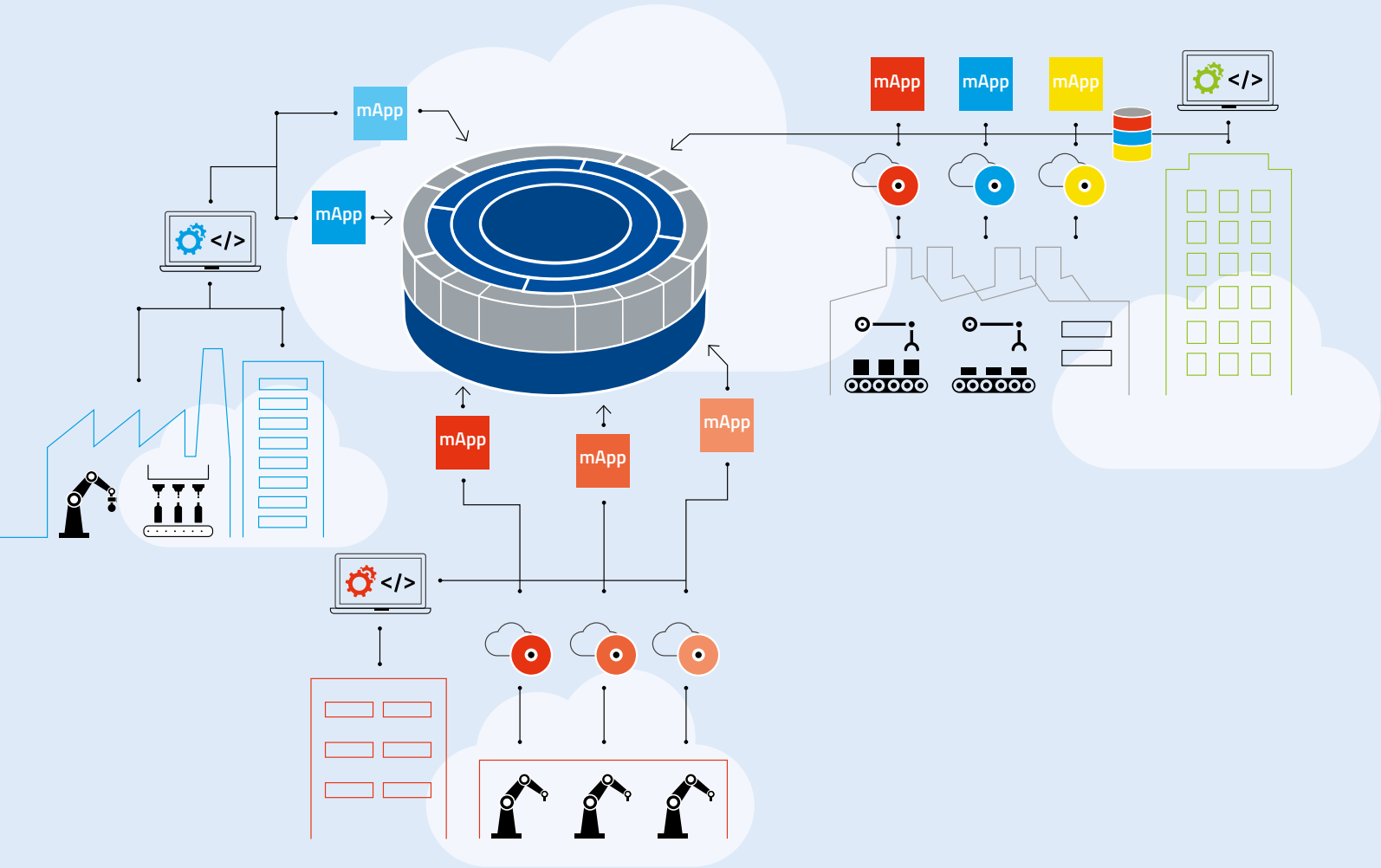
Euromap 63 for injection molding machines

Euromap 63 is an interface specifically for the molding process. Here, machine manufacturers from the injection molding sector have agreed on a standard. In this way, all kinds of injection molding machines can be easily connected to HYDRA via Euromap 63. Exactly as with OPC UA it is possible to transfer a wide range of information using Euromap 63.

MIP in use

AN ECOSYSTEM THAT BENEFITS MANY

Processes in manufacturing are becoming increasingly complex. This is the reason why today's companies are asking for flexible platform solutions allowing to program applications according to the specific requirements. Using this platform, they can also combine applications from different providers. The Manufacturing Integration Platform (MIP) of MPDV is the first representative of manufacturing IT offering these features.



The MIP is an open platform for manufacturing. It is used as a central information and data platform in production and for all connected processes. All applications communicate using a common information model guaranteeing a global interoperability. The MIP user selects from a multitude of so-called Manufacturing Apps (mApps) of different manufacturers with different functions. These mApps can be combined flexibly. Companies can develop their own mApps and offer them on the market. System integrators can create customized solutions from available applications for their customers. The MIP thus becomes an ecosystem of users, providers and system integrators providing completely new business models.

The advantages of this are the focus of the following three application scenarios.

Develop efficiently in-house

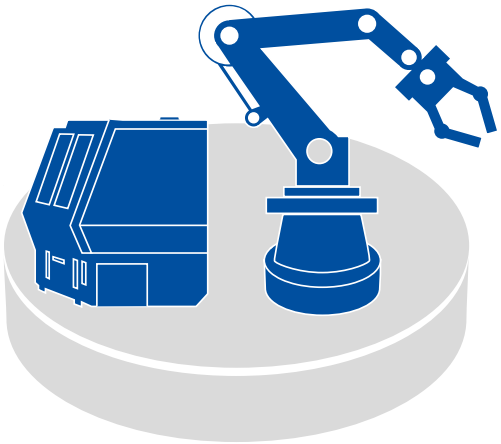
The MIP helps companies and app developers to create their own applications in no time. If companies and app developers use the MIP, they save the timeconsuming task of setting up a data storage structure, as the platform includes its own data model and predefined object structures for important production elements like order, machine and staff. Most remarkable: the applications can be created in different programming languages and still be flexibly combined thanks to the open platform architecture.

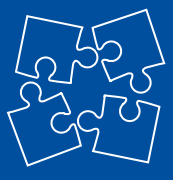
Quicker production start thanks to mApps of the machine manufacturer

Manufacturing companies that buy a new machine expect the machine manufacturer to deliver a software, which easily integrates the machine into the existing IT environment. Here, the MIP offers new opportunities. Machine manufacturers can develop their own mApps for the MIP to collect and visualize machine data. The buyers of machines install these mApps in the MIP and can directly communicate with the new machines. The time-consuming integration of new systems becomes obsolete and costs and resources are saved.

More flexibility for system integrators

System integrators can flexibly combine different MIP applications thereby creating customized solutions. The task of system integrators is to turn applications of different manufacturers into a complete solution for customers that contains all required elements. They can use the universal MIP interface to quickly and easily integrate solutions of different providers. It is then possible to combine for example the planning tool of one software company with the time and attendance program of another external IT provider.





Open **platform architecture** allowing a flexible combination of applications of different providers

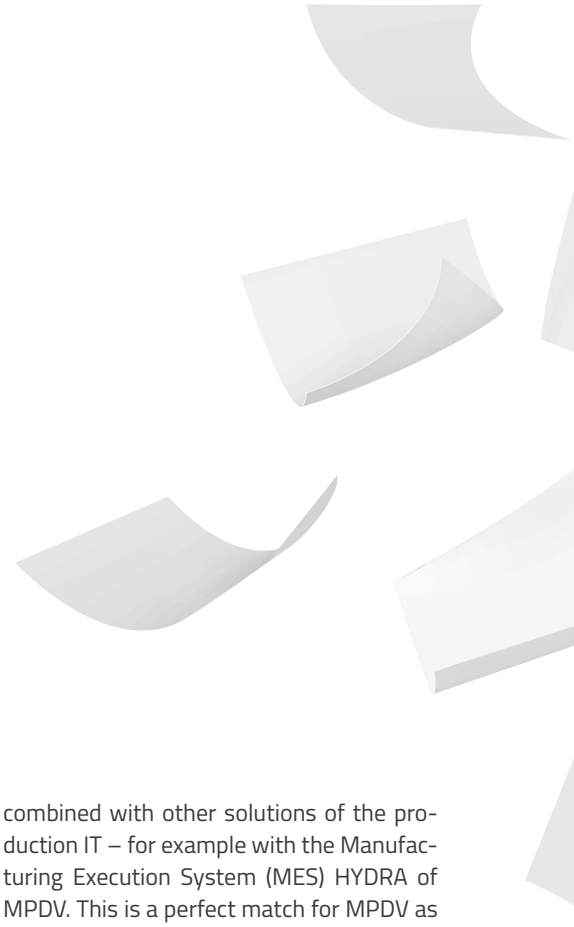
Interoperability promoting the data exchange between different systems

Standard functions providing targeted data analysis and production control

Increased **transparency** and productivity

Product presentation

DIGITAL CHECKLISTS



Checklists on paper are still widely used and not only in the production environment. However, the advantages of a digital solution are obvious. Here, the product Digital Checklists is a perfect example to demonstrate how products from the Felten company can work together with products from MPDV.

Who does not know the classic checklist? If something is done, it is checked and the next item is addressed. In the production environment, such checklists are often used. Checklists are handy for recurring activities like order change, regular inspections or security checks. A checklist is especially useful if the activities performed or checked have a major effect on the further course of the process. It is then important to work carefully and document the results. Many employees in production used to have paper-based checklists for these purposes.

Digital is more efficient

If you use the product Digital Checklists from Felten, you can save a lot of paper and the documented results are available both promptly and transparently. Costs are reduced, not only when filling in the checklists, but also when searching for the documented results. Transparency is especially important when legal requirements must be met.

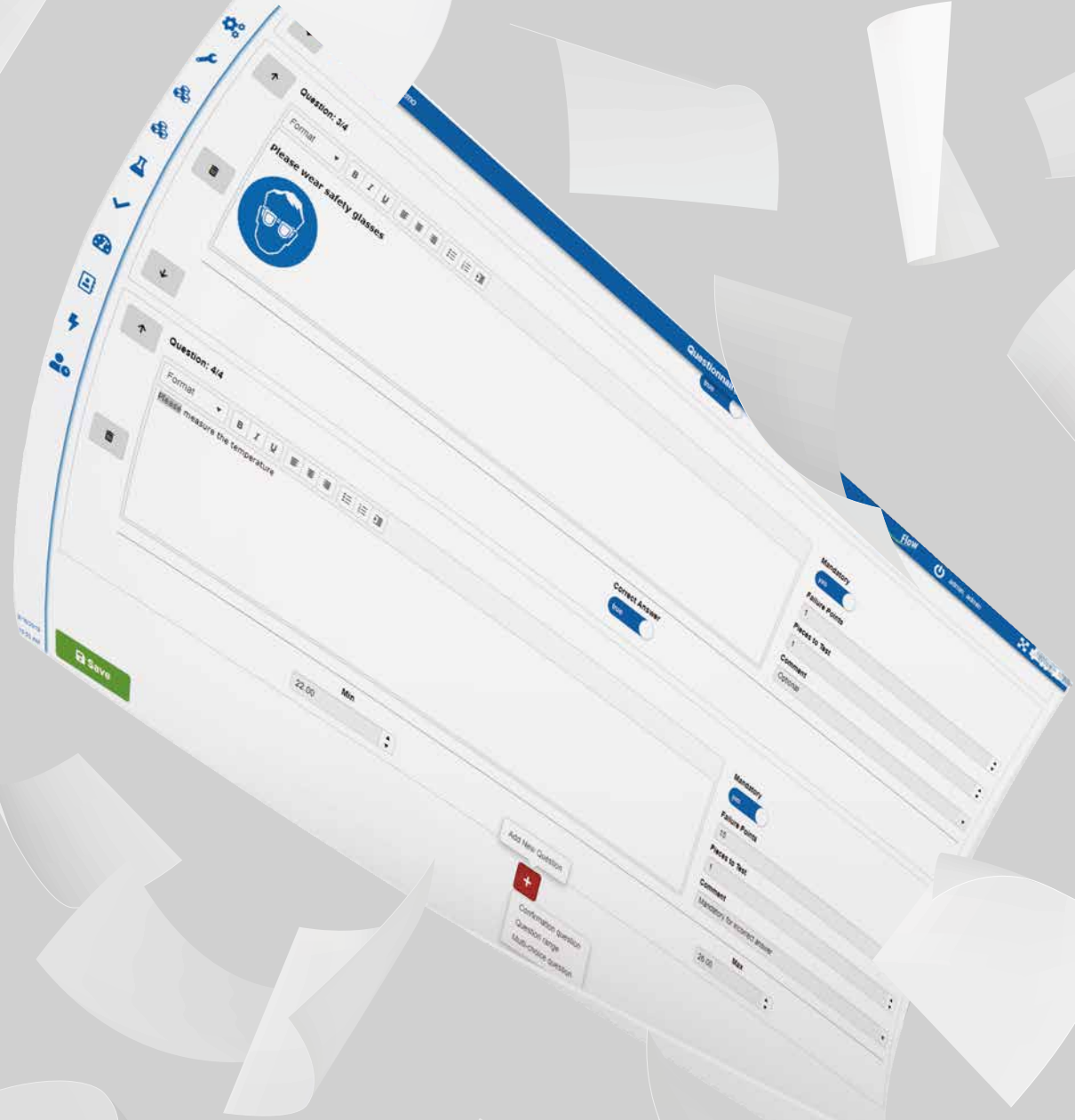
The Digital Checklists application helps to manage any number of questionnaires that are displayed for operators on special occasions. This could be, for example, a check of a filling unit of a mixing system that is due every 60 minutes. You can also link a specific material to a questionnaire. In this case, the operator is reminded to wear gloves, protective goggles and an apron each time this material is used. Here, the operator must confirm the prompt each time. Any number of questions or actions can be included in a questionnaire. The application can not only ask for confirmation, but also for numerical values that should be within a specified range. The application can also provide a selection of predefined answers similar to multiple choice questions. The system documents the events and also the time required for processing. Questionnaires can be saved in versions and integrated in release processes. This might be necessary to fulfill the legal documentation requirements.

Integration via MIP

Felten also provides the Digital Checklists as an mApp for the Manufacturing Integration Platform (MIP). The product then becomes part of a larger overall solution, which is very flexible and can be changed according to the user's requirements. Thanks to the integration in the MIP ecosystem, the events used to set up a questionnaire can derive from other applications and vice versa the results of the checklists can be used and visualized in other applications.

Acting in unison to fulfill requirements

As a stand-alone solution, the product Digital Checklist can solve many problems of the daily routines in production. The benefit of this product is even greater if combined with other solutions of the production IT – for example with the Manufacturing Execution System (MES) HYDRA of MPDV. This is a perfect match for MPDV as this precise issue was discussed in a working group of the HYDRA Users Group (HUG) on quality some time ago. According to the requirements of their daily production routines, the members of the working group set up a specification for an application that should digitally integrate today's paper-based checklists in HYDRA. MPDV checked the requirements listed and decided not to develop their own product, but to use an existing product of the Felten subsidiary adding it as a new module to HYDRA.


Question: 3/4
Format
Please wear safety glasses
Question: 4/4
Format
Please measure the temperature
Save
Correct Answer
Mandatory
Failure Points
Pieces to Test
Comment
Min
Max
Add New Question

HYDRA for Electronics

AN INDUSTRY SOLUTION FOR THE ELECTRONICS MANUFACTURING

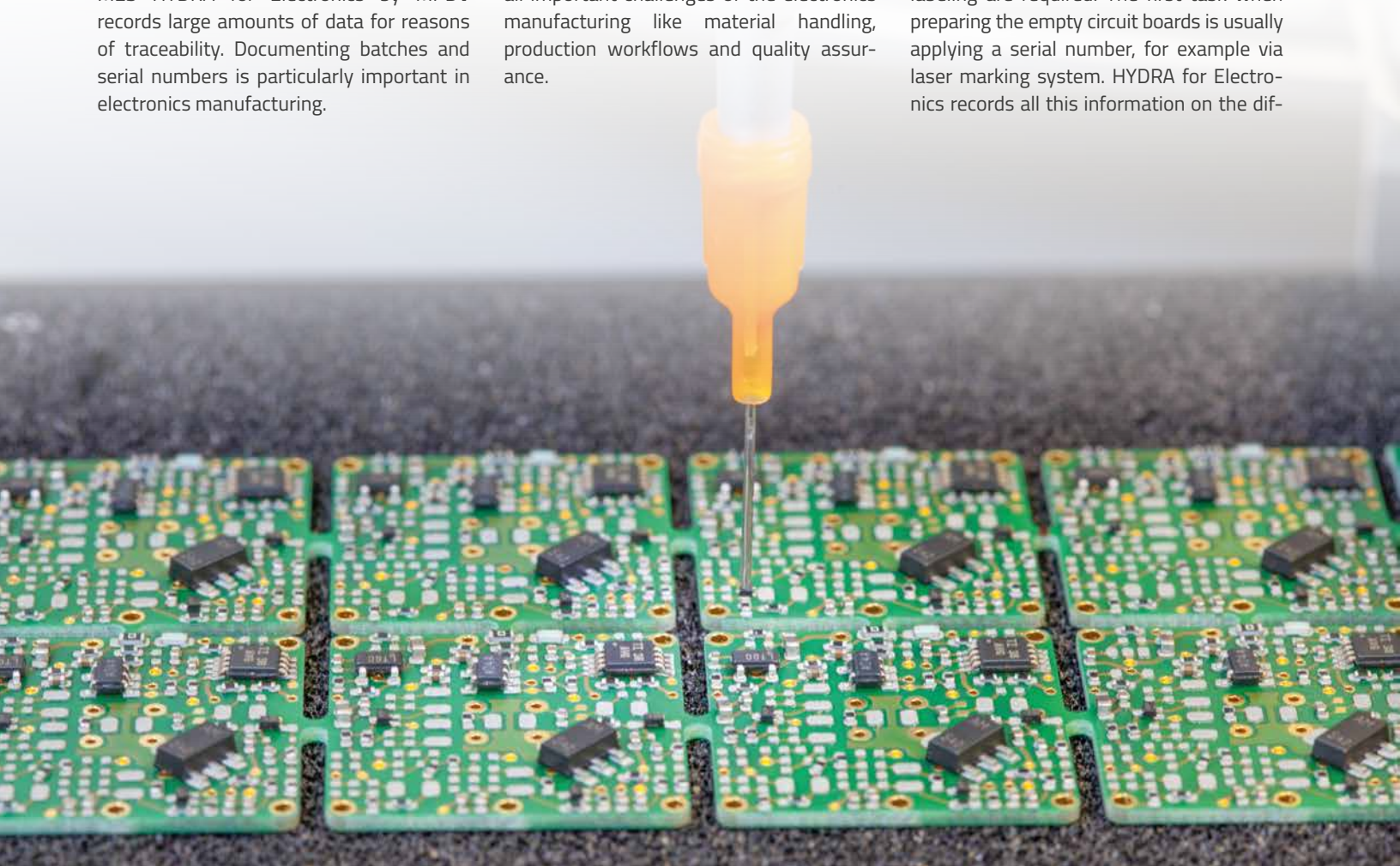
The electronics industry places special demands on production IT. With HYDRA for Electronics, MPDV offers a solution that perfectly meets these demands.

Machines in the electronics industry mount more than 100,000 components per hour when assembling printed circuit boards (PCB). The components are of different manufacturers and are processed at an incredibly high speed. This is where the MES HYDRA for Electronics by MPDV records large amounts of data for reasons of traceability. Documenting batches and serial numbers is particularly important in electronics manufacturing.

Beyond the standard

The industry solution combines the standard functions of an MES with the requirements of the electronics industry and thereby supports the workflows in the PCB assembly perfectly. The system considers all important challenges of the electronics manufacturing like material handling, production workflows and quality assurance.

Looking at a typical production process in the electronics industry, it quickly becomes evident that material handling is a major factor in this process. When the components are stored after receipt, a clear identification of component containers and correct labeling are required. The first task when preparing the empty circuit boards is usually applying a serial number, for example via laser marking system. HYDRA for Electronics records all this information on the dif-



ferent components. Tracking is then no problem. You know exactly when the package of components has been opened, how long the open material package was stored and where the component was installed.

Process data for products in the solder bath or oven, such as temperature and throughput speed, are essential. After soldering, different inspection processes are performed. The circuit boards and other components are then run through an assembly process and finally packed and labeled.

This is what HYDRA for Electronics can do

Easy connection of placement machines

An MES in the electronics assembly must be able to connect placement machines. HYDRA for Electronics can do this and directly handles all relevant data from the machines' subsystems. So far, placement machines of ASM SIPLACE, Mycronic and Fuji were successfully connected.

Calculating First Pass Yield made easy

The most important KPI in electronics production is probably the First Pass Yield (FPY). This KPI informs about the pass rate of assembled units after the first production run – without repair or rework. HYDRA for Electronics calculates this KPI and provides the relevant evaluations. The users can see at a glance how well the production of the current article is running.

Increased efficiency thanks to setup lists

In the electronics industry, the material availability is a crucial factor. So-called picking trolleys bring a great number of components to the placement machine. This kind of setup is variable, contrary to the fixed setup where the components are permanently stored at the machine. HYDRA for Electronics provides setup lists for variable setups and thus increases efficiency in work scheduling.

Keeping an eye on all materials

The use of electronic components is time-limited as they are highly sensitive to moisture. HYDRA for Electronics can integrate the moisture sensitivity level (MSL) as an indicator when planning and using a material. The moisture sensitivity level specifies the moisture sensitivity of semiconductor components during packing, storage and assembly. The MSL specifies the maximum time between opening the special packaging of a component and the last soldering process of the finished assembly. The advantage for the electronics manufacturer is that a careful monitoring of material storage times has two benefits: less material must be disposed of and there are less faulty products.

Which progress has been made in the production process? A production employee informs himself via a tablet, where HYDRA runs about the current status.

Unique identification via UID

In goods receipt, a unique ID (UID) is assigned to each package in order to ensure that the correct component is used. HYDRA for Electronics can generate this UID or it can be passed from the ERP system.

Connecting test equipment

The electronics manufacturing is characterized by highly complex processes and automated inspections are common. Among these are the automatic optical inspection (AOI) or the in-circuit-test (ICT). You can directly connect these inspection devices to HYDRA for Electronics. This means, the inspection results are automatically available for further processing and smooth workflows are guaranteed.

Integration of assembly and supporting processes

You use HYDRA for Electronics to integrate not only typical production processes like placement; at the same time you can map all kinds of supporting processes or upstream and downstream steps. HYDRA supports the connection of injection molding machines producing housing parts and assists in mounting PCBs into a housing. In particular during assembly, flexible operator instructions by HYDRA prove to be very useful. The functions developed as part of the Dynamic Manufacturing Control (DMC) provide precise instructions for the employee in production and support an immediate control of the work steps performed. After a short induction phase, the employees are able to perform complex assembly processes.

Guaranteeing traceability

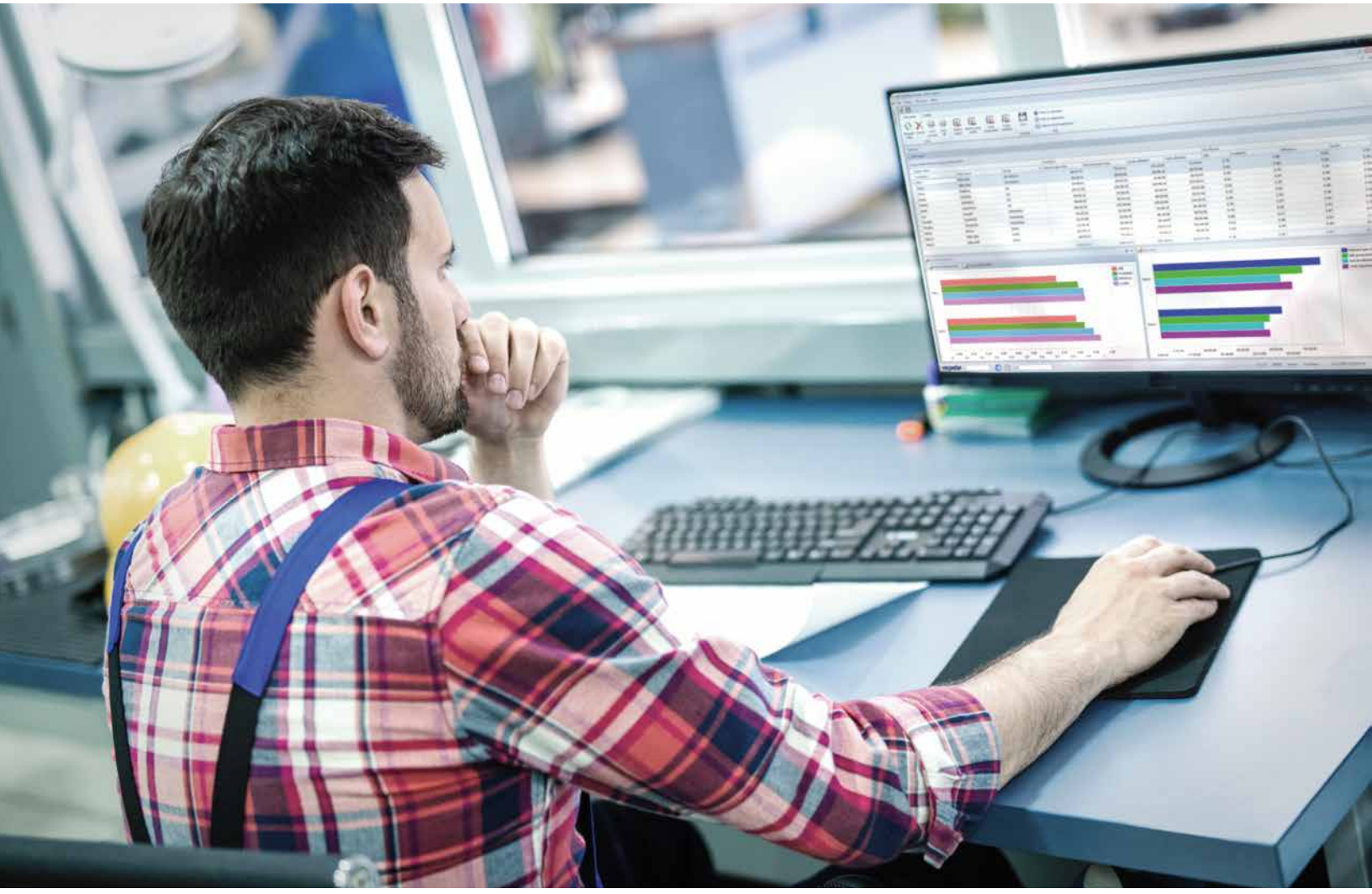
Last but not least, the traceability of components and assemblies plays a major role in the electronics manufacturing. The reason for it are both, the requirements of the customers in the electronics industry and the high costs of single components. Among the customers of electronic products is the automotive industry, which is known for the requirements imposed on suppliers. Sometimes the use of an MES is explicitly required. If electronics manufacturers use HYDRA for Electronics, they meet two goals: increasing their productivity and fulfilling the customer's requirements.

mpdv.info/hydraelectronics

KPIs in production

CORRECT EVALUATION OF COMPLICATED FACTS

KPIs and evaluations are of great importance in production as they serve as a basis for decision-making for managers, supervisors and operators. But what are the most important KPIs in production?



You can easily and quickly collect KPIs with the Manufacturing Execution System (MES) HYDRA by MPDV.

1. Overall Equipment Effectiveness (OEE)

The OEE represents the overall equipment effectiveness and is a measure for the availability and effectiveness of plants and machines in the company. This KPI helps to identify production losses, promotes the improvement of product quality and is important when comparing machines and production lines.

A reduced OEE can basically have three causes: one is less availability, which is due to frequent machine downtimes and results in less production time than planned. Worse quality, i.e. an increase in scrap is another reason. Finally, there can also be a reduced performance which means that cycle times are longer than planned. MES systems like HYDRA by MPDV use diagrams to illustrate such complex correlations, generate total values and highlight certain factors. As a result, production employees obtain an instant overview of the causes that led to the current situation and can respond quickly and appropriately.

To achieve consistent communication across all company levels, the used KPIs must rest on a common database. The data collected by an MES are consolidated and combined with other data and displayed as KPIs for specific target groups. The operator can directly check the produced quantity and the supervisor obtains the OEE calculated from this quantity and other relating data. Evaluated information must be up-to-date. Some KPIs represent a current status while others refer to a defined space of time. KPIs relating to a specific period are usually only significant after the respective interval has expired (availability), whereas real-time KPIs can be evaluated at any time (quality).

2. Lead time

The lead time shows how efficiently a company produces. It is the time between the initiation and completion of a production process to manufacture a part. The lead time includes all production stages from processing and transport to waiting times. You can use HYDRA BDE (Shop Floor Data Collection) to collect and evaluate all order-related data. The application Order Profile shows all processing, transport, idle and waiting times. The application Lean Performance Analysis provides all order-related KPIs broken down by operations.

3. Work in progress (WIP)

Experts refer to WIPs as material in process, material waiting in queues or in buffer stocks. The task of production planning is to keep WIPs to a minimum because they tie up capital and can cause high storage costs. You can use HYDRA MPL (Material and Production Logistics) to identify the quantity and type of material included in production buffers. Using upper and lower tolerance limits, you can monitor the buffers and generate escalation messages once these limit values have been violated.

Today and in future, sustainable management decisions require sound evaluations and KPI systems (Smart Data). To this end, you need integrated MES solutions with standardized interfaces. Then data can be collected locally and processed by different systems. This also shows how important MES systems are as a central information and data hub, today and in future. The concentrated information of an MES bestows the production manager and the team with the power to directly influence productivity. No matter how intelligent and self-sufficient production facilities are becoming – in the end responsibility for the right decision lies in human hands but they need reliable information. Knowledge is power!

HYDRA Basics

COLLECTING SHOP FLOOR DATA WITH HYDRA

Transparency is a crucial success factor in manufacturing.
HYDRA Shop Floor Data (BDE) is making a substantial contribution to this.

If you want to make your production fit for the future, you should record shop floor data. Besides classic data such as order times, quantities and status messages, this also includes simple quality data such as yield or scrap as well as personal time recording. HYDRA BDE by MPDV clearly offers more functions and benefits than a classic stand-alone BDE system.

For example, HYDRA can be used to collect order-related information. The aim is to support the production process with digital information and to monitor actual data such as order progress in real time. At the same time, HYDRA BDE with its diverse evaluations and KPIs provides the basis for the entire production control system. HYDRA also supports an improved cost accounting and post-calculation process in the ERP based on actual data. Furthermore, controlling teams benefit from the increased transparency and the fact that KPIs are calculated in a reproducible manner.

Addition to the ERP system

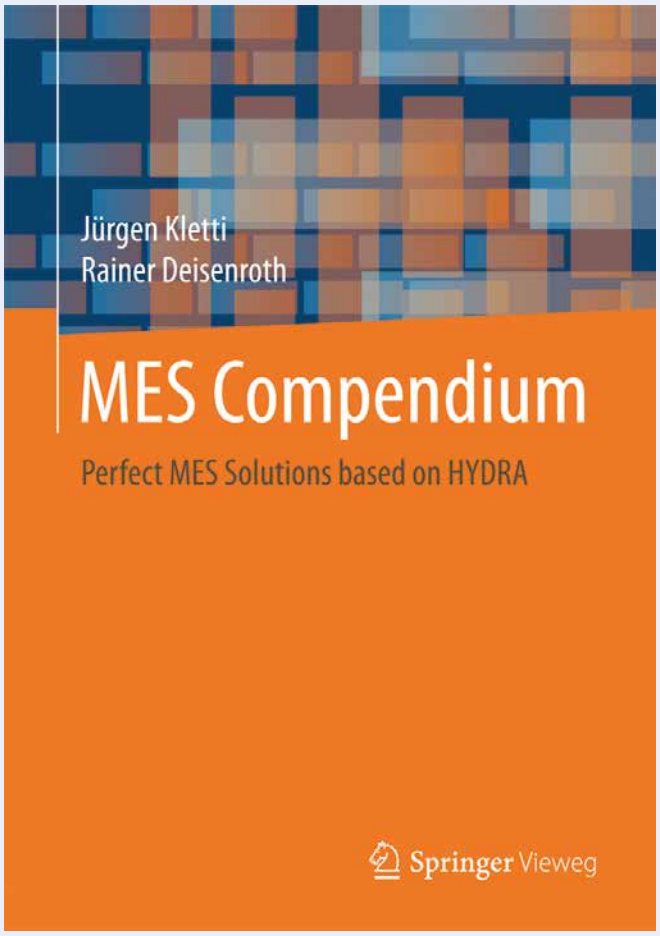
HYDRA BDE adds to the functions of an ERP system that manages all customer orders. A modern BDE system such as HYDRA BDE supports departments close to production to collect order and article-related data according to their own specifications and to plan and organize production processes. HYDRA BDE collects data, evaluates the data and then creates statistics with the supplied information. This allows problems in the production process to be identified and eliminated earlier.

HYDRA BDE supports the production control using simple functions for sequence planning and the resulting reports for connected areas. HYDRA BDE allows supervisors and shift managers to keep track of current orders and work processes and to view and evaluate the progress of past shifts. Users can call different evaluations at all times. As is customary with modern software systems, HYDRA BDE also has flexible administration and editing functions to create or import master data and to correct collected data if necessary.

OVERVIEW OF FUNCTIONS AND BENEFITS OF SHOP FLOOR DATA COLLECTION WITH HYDRA BDE

- Total transparency of all workflows in production
- Transfer of production orders from the ERP
- Paperless, precise recording of times and quantities
- Improved on-time deliveries
- Shorter throughput times due to the reduction of idle times
- Improved data quality that also benefits the ERP system
- Order monitoring in real time
- Order controlling, evaluations and target and actual comparisons

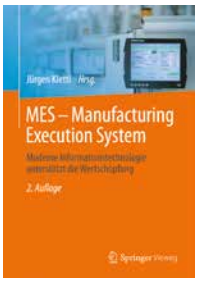
KNOWLEDGE IS POWER!



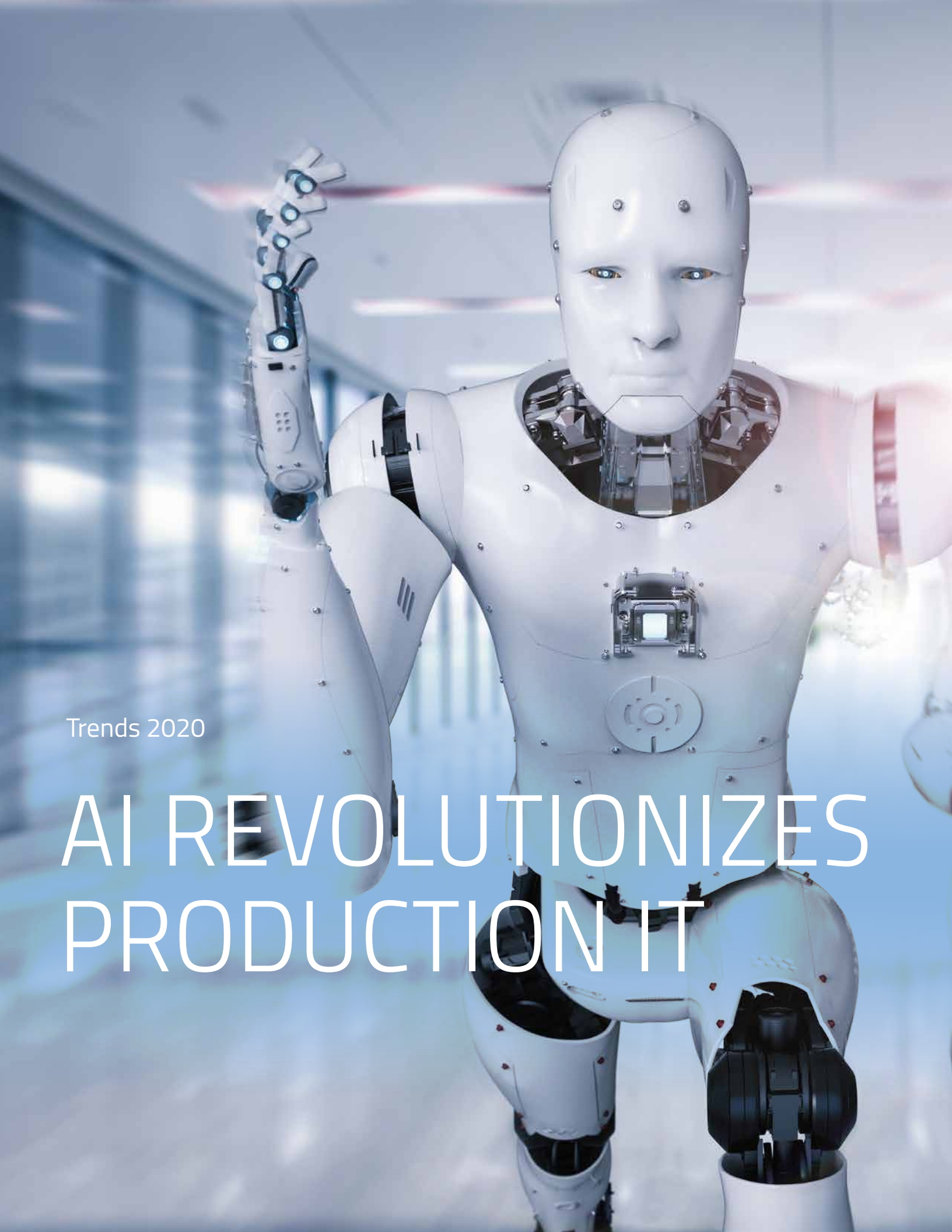
MPDV is regarded as a pioneer in spreading the MES idea and contributes with extensive know-how to the development of market trends. In addition to numerous publications in the trade press and the generation of its own white papers, MPDV publishes its own text books on MES and efficient production.

mpdv.info/publications

More publications



Also available as eBook



Trends 2020

AI REVOLUTIONIZES PRODUCTION IT

Even if actual applications will remain the focus of the manufacturing industry for a long time to come, the technological influence on IT solutions for the Smart Factory can hardly be dismissed, especially when it comes to artificial intelligence (AI). However, it is not only science that tackles this matter. Many innovative AI solutions have also arrived in industry – and there is still no end in sight.

In principle, little has changed in the tasks assigned to the production IT – it should still support the production company and facilitate optimization. What has changed is the complexity. Lot sizes are now considerably smaller, which means that the number of variants increases tremendously. That entails in turn that humans and software must be able to handle an ever increasing flood of data. In order to handle mass data efficiently, we need new methods – AI can help.

Methods of AI are highly versatile and can be used in almost every application field of production IT. The following examples are intended to show the potential of different applications when they are enriched with AI.

Predicting quality

MPDV has developed a tangible product with Predictive Quality: The basic assumption for Predicting quality is that fail or rework can also occur if all process parameters are kept within the applicable tolerances. This is caused by complex correlations and interactions, which are often attributed to the actual production technology. Predictive Quality addresses these correlations and gives employees in production the opportunity to see immediately whether the article currently being produced is fail or pass. Predictive Quality also indicates the probability of occurrence. This means that the quality of an engine block can be predicted while it is still just cooling down. Employees can therefore quickly decide whether it is worthwhile to continue investing in a part or whether to remelt it directly. This saves time and reduces costs, as potentially defective parts can be rejected at an early stage. Predictive Quality rests on the execution of a model that is created using machine learning, which processes recorded process data in real time.

Predicting setup time

In production planning, a number of standard values are used to predict the processing time of an operation and also for the interim times between two operations of an order. The setup time is one of these values, which is usually measured manually with the stopwatch. AI can support setup time predictions to cope with the growing number of possible combinations of tools, material, personnel and other factors. For this purpose, a model is created based on historical data from an MES that takes all factors into account, such as the length of the setup time in relation to the combinations of article, machine and tool. The historical data used can also be examined for its attribute as an influencing factor in the course of a model development. A conventional setup change matrix quickly reaches its limits, as there are simply too many possible combinations.

MACHINE LEARNING

Machine Learning is a generic term for the artificial generation of knowledge from experience: An artificial system learns from examples and can generalize these once the learning phase is complete. Algorithms build in machine learning a statistical model that is based on training data.

Studies with real customer data confirm the superiority of AI-based setup time prediction over conventional standard values.

However, the real highlight is the use of the generated model and as a result the prediction of the setup time. For instance, if an operation on a machine is scheduled to run at a specific time with a specific tool, this factor and possibly other data is used to predict the probable setup time based on the previously created model. Setup times can also be estimated for new combinations based on similarities. AI primarily operates in the same way as a manual maintenance would: A technical expert draws conclusions about the new combination from comparable articles, tools, etc. The prediction will therefore not achieve the accuracy that would be reached if all factors were known, but it certainly does not fall short of conventional manual estimates.

What the setup time prediction can achieve in comparison with the conventional method was investigated using several real production scenarios. It turns out that an AI-based prediction is clearly superior to conventional prediction mechanisms. This also means, that wasteful buffer time are eliminated. Initial analyses show that the use of AI systems releases around 20 percent of new production capacity.

Analysis of influence factors

The mere identification of the actual influencing factors using historical data would represent for many companies an added value. Usually, there is a lack of information on how relevant an influencing factor is which is in this case the expected setup time. For example, the time of day might be less relevant as the setup process takes just as long in the early shift as it does in the night shift. Then again, the material used could have a significant effect. For example, setup with the material from vendor A takes significantly longer than with the material from vendor B. The analysis of the influencing factors to determine their relevance is virtually a useful by-product of the model created for the setup time prediction. However, the methodology can be easily adapted for any other field of application where predictions are of interest.

Holistic production planning

Industry also benefits in the actual production planning process thanks to the fact that much more powerful computers are available today than in the past. This enables to process large data quantities and develop much better algorithms. Compared to the previously heuristic approach to automatic production planning, artificial intelligence can be used to take a decisive step towards perfect production planning. In contrast to the step-by-step approach of heuristics, reinforcement learning is used to examine numerous decision options before a final planning decision is made. Reinforcement learning evaluates the decisions, challenges these and learns from them. The algorithm learns with every decision made, evaluates it and uses this knowledge in future planning. The algorithm questions decisions made and does not automatically check all options, but only those with the best results. With each decision, the system collects new information on existing data to further improve the quality of the planning decision step by step.

This approach to intelligent production planning has enormous advantages. The system takes all the decisive factors such as orders, workstations, transport routes, setup times, limited resources and personnel availability into account right from the decision-making stage. This minimizes setup times, shortens throughput times, increases on-time delivery, minimizes per-

sonnel costs and carries out a material availability check. When using a solution such as Cognitive Planning and Optimization of MPDV, the user can also control which factors the system should consider and to what extent.

Supreme discipline: Automated Data Science

The performance of the AI system is particularly used in modelling. Powerful AI systems like the one used by MPDV are characterized by the fact that they can independently process historical data used for modelling. As part of the preparation for the actual model creation, this includes not only data synchronization but also unsupervised anomaly detection, i.e. the automated detection of outliers and their correction. This process model, which automates the conventional and largely manual CRISP-DM approach, is also known as Automated Data Science.

If you also combine the methodical know-how of an AI specialist such as Perfect-Pattern with the hands-on experience of an MES provider such as MPDV, you can quickly create usable standard products and flexible solutions. The main advantage of these standard products is that available data that the available data does not have to be elaborately prepared. As a result, cost savings of up to 80 percent are possible compared to the current CRISP-DM procedure. The reason for it is that available data does not have to be elaborately prepared.

Conclusion and outlook

The use of AI in production is a fundamental step into the future and can offer companies the decisive competitive advantage. With the help of an MES, this huge advantage can be exploited and help companies to achieve their goal of Industry 4.0 compliance and the Smart Factory. Nevertheless, it all depends on the use of the application and only then on the technology used – even in 2020.

REINFORCEMENT LEARNING

According to Wikipedia, Reinforcement learning is a set of machine learning methods whereby an agent independently learns a strategy to maximize rewards. The agent is not told what is to be done in which situation, but receives a reward at certain times. This can also be negative. Using these rewards, the agent estimates a benefit that describes the value of a particular state or action. This procedure is comparable with the training of a dog by rewarding it with extra food.

Interview

LOGISTICS AND PRODUCTION – A PERFECT MATCH

It is an innovative step towards the Smart Factory: For the first time, the Manufacturing Execution System (MES) HYDRA of MPDV directly communicates with a warehouse management system (WMS). The company Vacom with headquarters near Jena in Germany uses HYDRA in combination with the WMS viadat of Viastore. Kevin Möser, COO at Vacom, explains what new opportunities opened and what experiences they made.

Mr. Möser, the systems are going live these days. Looking back at the past weeks, what do you think?

I would say that it was a very exciting time. We have been using MES HYDRA and the WMS viadat in our production for several years. But now, the two systems can directly communicate via a new interface and need no longer communicate via the ERP of SAP. At first, I was curious whether we could realize all our plans. We could, and I am very proud of this success!

What are the advantages of a direct communication between MES and WMS?

Today I can say that we now have full transparency in the warehouse and on the shop floor. We know exactly where each item is located. Up to now, the parts in production disappeared somewhere in a black hole. We knew what was going in and got a finished product in the end. But we never knew where a part was in between and how long it remained at a workplace. Today, we know this. We can analyze work in process, develop new workflows and increase efficiency in our production. I would therefore say that the direct exchange between the systems was a big step forward on our way to the Smart Factory.

We can ensure that the required material is available in the correct quantity for the on-time processing of our orders by reserving stocks for production. To this end, HYDRA exchanges information with our WMS and ERP system, automatically triggers operations or escalates if the goods are not available. We are constantly kept informed and can concentrate on the main activity – the production of our components. This is another big advantage.

"The cool thing is that our MES HYDRA and WMS viadat communicate directly. The systems trigger actions automatically and we humans need not interfere. That's fascinating. This is a basic form of specific intelligences and logics."

Kevin Möser, COO at Vacom

THE FOUR-STAGE MODEL

The first stage on your way to the Smart Factory is the "transparent factory". That means, that the responsible production employees know at all times what is happening on the shop floor. That is where the "reactive factory" (stage 2) sets in: Collected data is compressed and properly visualized in order to quickly see the repercussion if changes are introduced to the shop floor. This is essential in order to react quickly with targeted measures to interruptions on the shop floor. Then, we arrive at the third stage, the "self-regulating factory", where you can develop local standards for production processes based on achieved reactivity. And finally, you arrive at the fourth stage, "the functionally networked factory". This final step considers associated processes and systems like PLM, energy and site management.

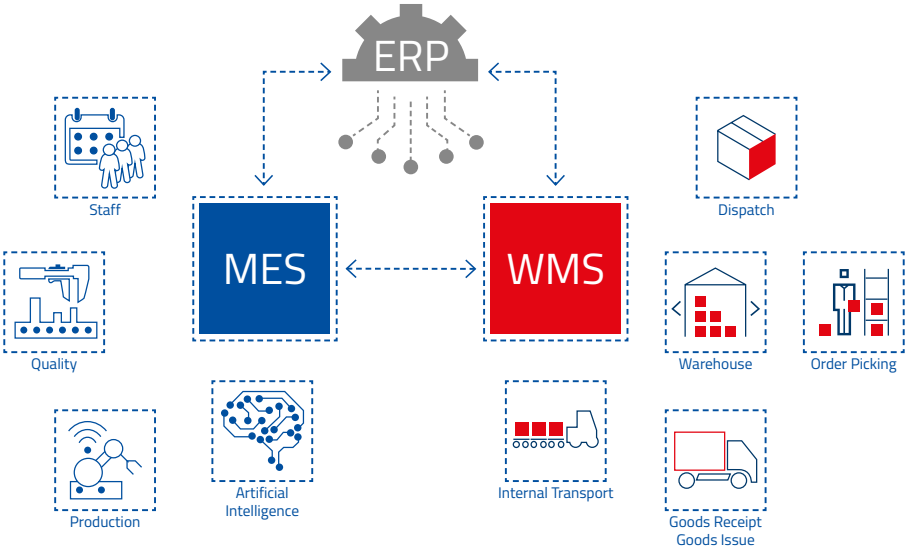
The first two stages, the "transparent and the reactive factory" can be achieved almost completely with an MES solution. When introducing or extending an MES, we highly recommend to not only digitize the existing processes but also to take a critical look at these processes. Often, you can optimize processes and avoid unnecessary waste.

The third and fourth stages partly exceed the performance scope of today's MES systems. Cutting-edge Manufacturing Execution Systems like HYDRA already offer valuable support, e.g. in the design of decentralized loops like eKanban or when connecting PLM systems to production.

And what about the implementation? How did you proceed?

Our workflows in production are very complex. We manufacture vacuum and mechanical parts for the semiconductor industry and chip production, for coating processes in the optics industry and for research and development centers. No part is like the other as we develop custom solutions for our customers. The first thing we had to do was to precisely analyze our production processes. We do not have typical assembly line operations. A part can go from milling to welding and back to milling and welding again. We had to take all this into account during planning. Our aim was to synchronize all systems involved in the production process and obtain a smooth interplay of production and logistics. We soon realized that all systems must communicate directly and be able to trigger actions. After all, we wanted a fully automated production logistics system.

In order to guarantee a perfect interoperability, we precisely defined what information the MES, WMS or ERP passes to which system. Here, it was necessary to assign a role to each system.



Very interesting. What are the roles of the different systems? How do the systems interact?

We use our ERP system to generate the different orders. Once the production order is released, it is transmitted to HYDRA. HYDRA knows the components of the part and knows the workplace where the components are used. We book the demands in HYDRA and reserve the stocks or the demands in the WMS up to three months in advance. If the materials are available, they are firmly booked and cannot be used for another order. This is how we can guarantee that all components are available and we can finish our articles on schedule.

Two days before the planned production of the part, the ERP sends a signal to the WMS asking to supply the components to a specific machine at a specific time. The

Kevin Möser is COO at Vacom and in this role he is responsible for the operational business. As project leader, the 32-year-old is involved in the implementation of HYDRA and viadat.

"Some tasks like searching for material used to take a lot of time. Our systems now do this autonomously. Our employees can concentrate on the main thing: the production process."

Kevin Möser, COO at Vacom

Does the diameter of the hole meet the specifications? A Vacom operator during a quality inspection.

WMS then automatically generates a picking order. Our logistics staff then pack the components into a box with a unique ID number and our driverless transport systems take the components directly to the machine, where an operator receives them for processing and logs on the order. All the operator has to do, is scan the boxes. As soon as the components have been processed, the operator at the machine allocates the intermediate parts to a box. This action generates a new transport order in the WMS and the box is sent to the next station via driverless transport system. The transport system picks up the parts and brings them to the next workplace or to our buffer stock.

The systems perfectly match and it is amazing to see how smoothly it all works. Another benefit is that the WMS reports the consumption to the ERP. We are always informed about the stocks in the warehouse and are able to make a realistic planning.

The use of driverless transport systems was certainly a change for the employees in production. How did you involve your employees in the process?

We involved all persons at an early stage and demonstrated the advantages. For example, we had the robots serve drinks at a company event to take away the employees' anxiety about the transport system. This was received very well.

What are your hopes for the future?

We expect to greatly optimize our setup times and considerably improve our production times. This must be possible because all components needed are available at the machine when the operation starts. We can reduce search times and optimize wait times. Besides, our administration costs have decreased. Combining the WMS directly to the MES has many advantages. We are curious to see what other effects might result. Let us come back to it in six months.

What do you think, how far did you get on your way to the Smart Factory?

Now, looking at MPDV's four-stage model, we are at stage three. I would speak of our factory as a self-regulating factory where our employees act as problem solvers. A major element of stage four, the functionally networked factory, has additionally been implemented with the network between production and logistics. So I think we are on track. Let us carry on like this! I am looking forward to other exciting new projects.

ABOUT VACOM

Vacom is one of the leading European suppliers for vacuum technology and operates worldwide. The family business was founded in 1992 and employs more than 250 people. As a business partner of companies from the high-tech sector such as analytics, optics, semiconductor and accelerator technology, Vacom has specialized on products ranging from vacuum components to complex chambers and has innovative cleaning processes with defined purity classes and reproducible cleanliness measurements. At their premises near Jena, Germany, Vacom has used a self-developed system for the collection of shop floor data and labor times for a long time. This system had to be replaced by a flexible standard software in order to be ready for the future. Vacom also wanted to complement the framework of SAP and production-oriented IT by a detailed order planning. To this end, Vacom implemented step by step the Manufacturing Execution System (MES) HYDRA in 2015.

Interview

REVEALING WEAKNESSES IN THE PRODUCTION MANAGEMENT

Companies wishing to produce efficiently should put their processes to the test. In an interview Stefan Molitor, Senior Consultant at Felten, and Werner Felten, Managing Director of the Felten Group, explain how to identify typical weaknesses in the production management.

If you had to prepare a manufacturing company for the future, where would you start?

Molitor: First of all, I would consider and evaluate the processes in production as a whole. It is essential to evaluate all standard processes in order to optimize them directly and to improve profitability. Looking at the process industry, I would examine all the processes from incoming materials, weighing the raw materials, filling and packaging the finished product to the dispatch.

Felten: According to our experience, this will lead to further steps such as the consolidation of isolated applications, the introduction of system-supported detailed planning, the reduction of paper in production and the optimization of process-specific tasks such as maintenance or formulation management. The potentials are enormous.

Sounds very complex and elaborate. Where should managers ideally start? Have you got any tips for us?

Molitor: After the process evaluation, you should specifically involve employees in order to find out which processes are running well from their perspective. Ask specifically for things that work well and for areas of friction. For example, you could ask how long it takes employees to record process data during mixing or how much material is spilled during weighing.

Felten: You should analyze the results precisely and evaluate the potential for improvement monetary. By this I mean that you add up the time that employees spend documenting processes on paper and multiply it by their hourly wage.

Stefan Molitor has worked for Felten for 22 years and is a senior consultant for customers in the process industry.

Material excess consumption can also be valued monetary. You will be amazed at the considerable sums of money involved. If paper-based data entry processes are replaced by digital data entry with an MES, a major share of these costs can be saved. Material losses must be balanced across all process steps. This can only be achieved by digitalizing these processes in the weighing and mixing areas.

What role do standardized key figures play?

Molitor: In the process industry, we work with key figures that are specific to this industry sector, such as material scrap, but also with non-industry specific figures such as the OEE. It stands for overall equipment effectiveness. If you calculate key figures like the OEE you make transparent what works and what not.

Felten: That's right, in many cases this already leads to improvements. However, you should also discuss the findings from the questionnaires and the calculated key figures with your controlling department. Find out what effect an optimization at one point or another could have on the overall result or the profitability of the production site in question. This helps you to assess the importance of investments. After all, more machines always result in higher depreciation costs. This allows you to determine, especially with expensive filling and packaging machines, whether a new system really needs to be invested in, or whether a specific improvement in effectiveness is sufficient to produce the required output.

In your experience, are there any areas that are best suited for the start of an optimization phase?

Molitor: I can answer this question quite clearly with yes. Detailed planning is an issue that hurts many companies – especially manufacturers of consumer goods. Directly approach employees in the detailed planning department and try to get their know-

FELTEN
Member of the MPDV Group

how on optimum segmentation and efficient use of equipment out of their heads and into suitable IT systems.

Felten: I've often heard that planning is dependent on a few long-standing employees in the company and that everything collapses when they're not around. Nowadays, no company can afford that. So, let's do it.

What can you do in order not to lose sight of the target during the optimization phase?

Felten: Prepare a plan. This will help you see what you have already achieved and what is yet to come. Always focus on the identified potentials. Structure the plan and mark which area is next and when, so you involve employees on all levels. Every minute saved, every document not printed and every gram raw material less spilled saves money. You should also keep an eye on the return on investment (ROI) to keep track of the progress of your measures. As a result, you can see what expenditure already made and what you were able to save. Fully in line with a holistic process evaluation, ROI is a global measure of success and improvement in profitability.

What would you like to give to managers to take home at the end of the day?

Felten: Quite simple, analyze the current situation, identify potentials and then address the issues step-by-step. Only those who begin can succeed at the end.

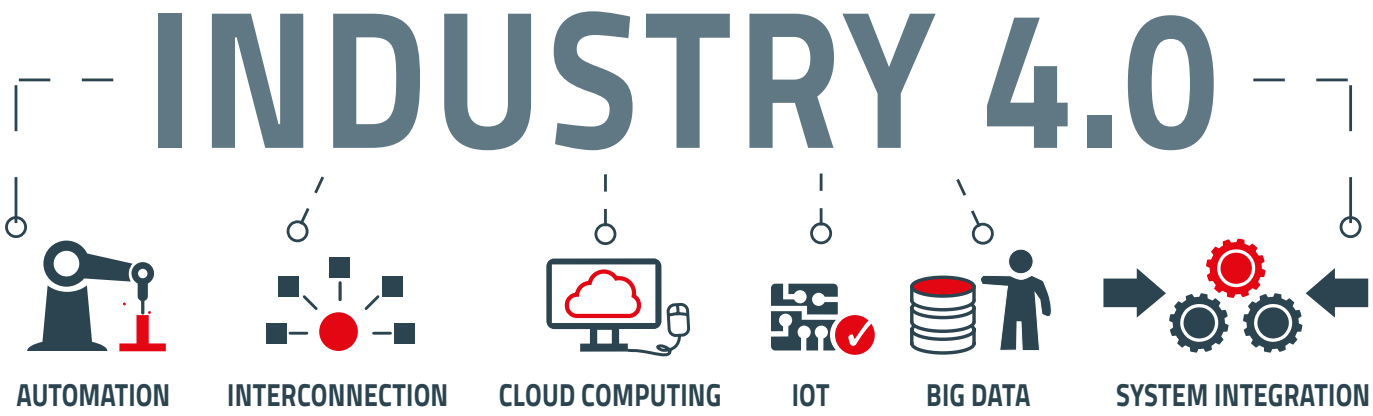
Werner Felten founded the software and consulting company of the same name 30 years ago, which has focused on the development of groundbreaking software solutions for production management ever since.

ABOUT FELTEN

The Felten Group has been a 100 percent subsidiary of MPDV since 2019. The software solutions by Felten are mainly used in the process industry for weighing and mixing processes. With 50 employees and locations in Germany and Luxembourg, Felten has implemented production management projects in over 30 countries around the world. The customers of the Felten Group include well-known companies such as Henkel, Beiersdorf, Boehringer Ingelheim, Symrise and Döhler.

www.felten-group.com

FAQs on digitalization of production
mpdv.info/faqfelten



IT landscape

LESS COMPLEXITY, BUT MORE STANDARDS

Costs involved in introducing a new ERP system can be significantly reduced if the complexity of processes and the IT landscape is reduced. The Manufacturing Execution System (MES) HYDRA can make a substantial contribution to reduce it.

Changing an ERP system presents companies with major challenges. Frequently, the previous system was heavily changed by programming company-specific modifications. In addition, the complexity of the processes and the IT landscape below the ERP system has grown over the years. Thus, numerous IT subsystems, Excel sheets and databases are often connected to the previous system. If there are several locations, the IT landscapes of each plant are often very heterogeneous. When changing the ERP system, there is a considerable risk that either the project costs get out of hand or operational processes are jeopardized.

These risks can be cut considerably if the complexity between ERP system and production is already reduced before the ERP is changed by introducing suitable modules of MES HYDRA. At the same time, processes can be optimized and the waste of IT resources avoided. The first step is to consolidate isolated IT systems in production that have grown over the years. Using MES HYDRA, it is possible to integrate machine connections, the collection of order data or the detailed planning in a modular system. In doing so, there is no need for interfaces between the individual systems. A standardized connection to the ERP system allows an exchange of all relevant data and thereby avoiding a redundant data repository and simultaneously increasing current data.

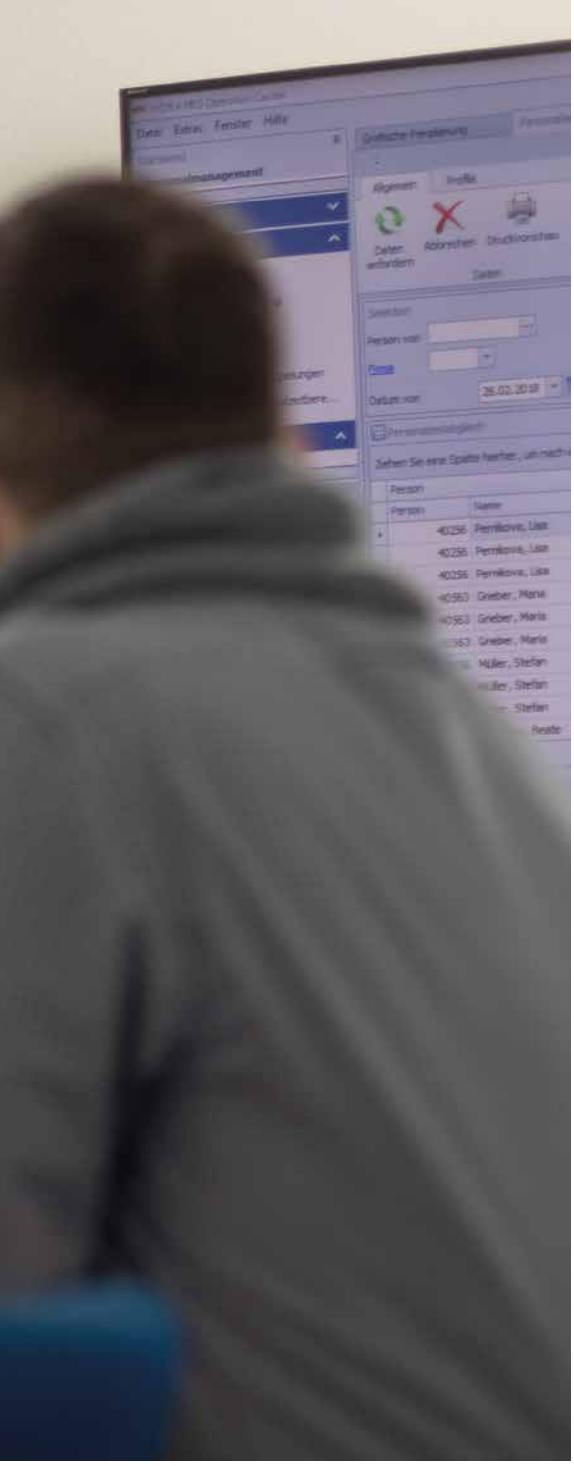
Especially when IT systems are used in the shop floor that were programmed by an employee many years ago. Replacing this system with an MES such as HYDRA means a big step towards standardization and also towards reducing complexity in the IT landscape. "Who knows, maybe the employee in question is no longer with the company. Then someone else would have to get familiarized with the proprietary system in order to implement a connection to a new ERP. HYDRA and a standardized ERP connection simplify many things," says Jochen Schumacher, Managing Director of Perfect Production, a subsidiary of MPDV, which supports manufacturing companies in developing a suitable IT target architecture.

Perfect Production
People, Lean & IT

The lean and IT experts of Perfect Production support manufacturing companies in the development of a suitable IT target architecture and provide orientation and decision-making reliability to the management before the ERP system is changed.

GIVING IMPETUS

Having new ideas of how to use the Manufacturing Execution System (MES) HYDRA in your own production is pretty fine. But only if the ideas can actually be realized. This is where the MPDV service myConsultant plays an important role. With this service, users can appoint a long-term consultant who regularly supports them when questions regarding the technical implementation arise.



Reinhard Becker puts pens, labels and pins in his briefcase, lets the lock snap shut and nods, satisfied. "Today, we have discussed interesting approaches and found ways to integrate the new requirements in our MES HYDRA," says Becker who works as Senior Consultant for MPDV and has just held a workshop at the customer DEHN SE in Neumarkt, Germany.

For one year now, Becker has been working as myConsultant for DEHN. Using this service, users can appoint a long-term consultant who regularly provides technical support. Advantage: The consultant has an overview of the complete installation and being regularly on site he knows the specific details of the customer's production processes.

"My job as myConsultant is to find ways to integrate the new requirements of the project team using our MES HYDRA standard functions."

Reinhard Becker, Senior Consultant at MPDV

Today's workshop was about the question of how to log on and off several workplaces, which are connected in an assembly line, in one go. Becker demonstrated the different possibilities and showed how they can be implemented under the specific circumstances of DEHN's HYDRA installation. "Together we discussed how the standard functionalities can be combined. The advantages and disadvantages of the different solutions were compared. The result is remarkable," says Becker. Also Thorsten Gugg, the MES project manager at DEHN is pleased with the result: "It is our objective to find solutions for upcoming requirements, to integrate them using standard functions and to keep an eye on data quality at the same time. We have achieved all this today."

Thinking outside the box

For Gugg, Becker is some kind of lead consultant. The DEHN team informs Becker when they make configurations and relies on his advice and experience when implementing new requirements in the system. They benefit from Becker's solid know-how. "You quickly focus on one thing only and concentrate on this one objective. The regular meetings with Mr. Becker help us to think outside the box. He gives impetus from the outside, which is very precious," points out Gugg and adds: "Mr. Becker has a broad expertise and is an expert for the complete standard. We greatly benefit from his skills."

Focusing on the overall solution

For almost eight years, Becker has been working as consultant for MPDV. He has had numerous customers from different industries during this time. After studying physics at the university of Tübingen, he worked as a developer and consultant. Later he was development manager. He now benefits from his experience in his work as myConsultant. Becker always focuses on the overall solution and helps the customer to take decisions. If specific problems arise, he knows exactly which expert of the MPDV development or consulting department would be the right person to have answers. "Exchange is crucial in such moments. My job as myConsultant for DEHN is then to always remember their MES environment and the specific conditions of processes and production workflows and to develop a solution for the customer together with the team. After all, it is our job to support our users on their way to the Smart Factory in the best possible way."

"You quickly focus on one thing only and concentrate on this one objective. The regular meetings with our myConsultant help us to think outside the box. He gives impetus from the outside while knowing our installation in detail. This is most valuable."

Thorsten Gugg, MES project manager at DEHN

TAKE OFF BEING CERTIFIED

MPDV's new Certification Day offers users the opportunity to test their knowledge on the Manufacturing Execution System (MES) HYDRA and at the end of the day each attendee receives a certificate. Denny Offenborn of Eppendorf reports from his experience as one of the first attendees.

"I think the Certification Day is great! Now I have official proof that I know my way around MES HYDRA. It is important to demonstrate to our customers in future that we are qualified to operate the system".

Denny Offenborn, Production Engineer Production Planning at Eppendorf

Finally, Mirijam March (left), Senior Consultant, and Eric Egenberger (right), Consultant at MPDV, presented Denny Offenborn with a certificate including a potential analysis as proof of his HYDRA knowledge.

What HYDRA function can be used to reactivate operations? What do you need to check if an operation cannot be logged? How can you plan several operations on one resource without any conflicts? These are only three of a total of 100 questions that Denny Offenborn had to answer on MPDV's Certification Day at the company headquarter in Mosbach, Germany.

Mr. Offenborn could test his MES HYDRA knowledge for a whole day. Finally, he received a certificate and a potential assessment, which shows the areas where he can further develop his knowledge. "The Certification Day offered a great opportunity to refresh and further deepen the specialist knowledge acquired in the training sessions," says Denny Offenborn.

Customers require proof

The 30-year-old has completed eight training courses in the last two years at MPDV in preparation for the Certification Day. The test itself focused on the topic of manufacturing. "The multiple choice questions were quite hard but during the 90 minutes I was able to deal in depth with all the HYDRA modules. "That was really good," says Denny Offenborn, who is a production engineer working for Eppendorf in the production planning.

Eppendorf have been using the MES HYDRA for more than 10 years. Eppendorf manufactures pipettes, automatic pipetting machines, dispensers, centrifuges and mixers. Since the regulatory requirements in the medical industry are enormous, many customers demand proof that Eppendorf's shop floor employees are qualified to operate the MES. "That's why the Certification Day is so important for me, because now I have official proof that I am fully trained," says Denny Offenborn and looks proudly at his certificate.

Valuable knowledge for the working day

Especially in his daily work Denny Offenborn benefits from the knowledge gained in the training. For example, in the training session for the Machine Data module, he learned how to set up systems in the simplest way and which basic data he has to change in HYDRA to get the information he needs for his reporting. The knowledge he gained makes it also easier for him to introduce the module Material and Production Logistics.

„It was an exciting day. I especially liked the tour around the different departments at MPDV. Now I know who to contact in case I have any questions."

HERE IS AN OVERVIEW OF THE NEXT DATES FOR THE MPDV CERTIFICATION DAY.

April, 30 2020
June, 9 2020
October, 6 2020

For more information about MPDV's training program for HYDRA users go to mpdv.info/trainingsnews

Visiting Apostolos Mitsios

WHEN NO DAY IS LIKE THE OTHER

In his role as Executive Manager of the Customer Service Center, Apostolos Mitsios and his team at MPDV are responsible for a smooth processing of customer inquiries. In his spare time, the Greek enjoys fishing and exploring new places.

When Apostolos Mitsios started working for MPDV more than nine years ago, he was the 184th employee and assistant to the management. In the meantime, a lot has changed. MPDV has now almost 500 employees and Mitsios is Executive Manager of the Customer Service Center. "My job is to ensure a smooth processing of our customer orders. Together with my team, I take care of the distribution of licenses for our software. We deal with all commercial aspects of orders and advise customers to choose the appropriate training courses," says the 37-year-old.

Sometimes, a customer needs a license within a few hours. Then Mitsios and his team are in charge of checking whether all technical requirements are fulfilled. A fast workflow and solid technical know-how are essential then.

Keeping an eye on the processes

Ten employees work at the Customer Service Center. Since 2018, Mitsios has been leading the department that he helped to build in his former role as assistant to the management. "I have been involved in many projects at MPDV. As a project manager, I was involved in the introduction of our business units and managed several customer and research projects. One thing has always been important to me: to further develop processes according to our customers' requirements."

In his role as head of the Customer Service Center, he has the opportunity to do just this, because the team is the central contact for customer inquiries. The CSC informs about the status of orders, takes care of the delivery of hardware and software components or checks orders. And everybody always focuses on the customer and his concerns.

> "For several years, we have been growing considerably, but we never lose sight of our roots as a family business. This is good and important to me."
>
> Apostolos Mitsios, Executive Manager of the Customer Service Center

What does Mitsios like most about his job? That no day is like the other. He likes variety in his job. "Today I develop new processes according to our customers' needs and further optimize our workflows, tomorrow I act as an interface between the customers and our specialist departments." And he likes the family atmosphere at MPDV. "For some years now, we have been growing considerably, but we never lose sight of our roots as a family business. This is good and important to me."

A Greek in Ireland

His favorite pastime is his one-year-old daughter. But if some time is left, he goes fishing with friends. Catching fish is not important. "What I enjoy is spending time with others and having wonderful summer evenings together. Casting the fishing pole is more or less an accessory", he says and laughs.

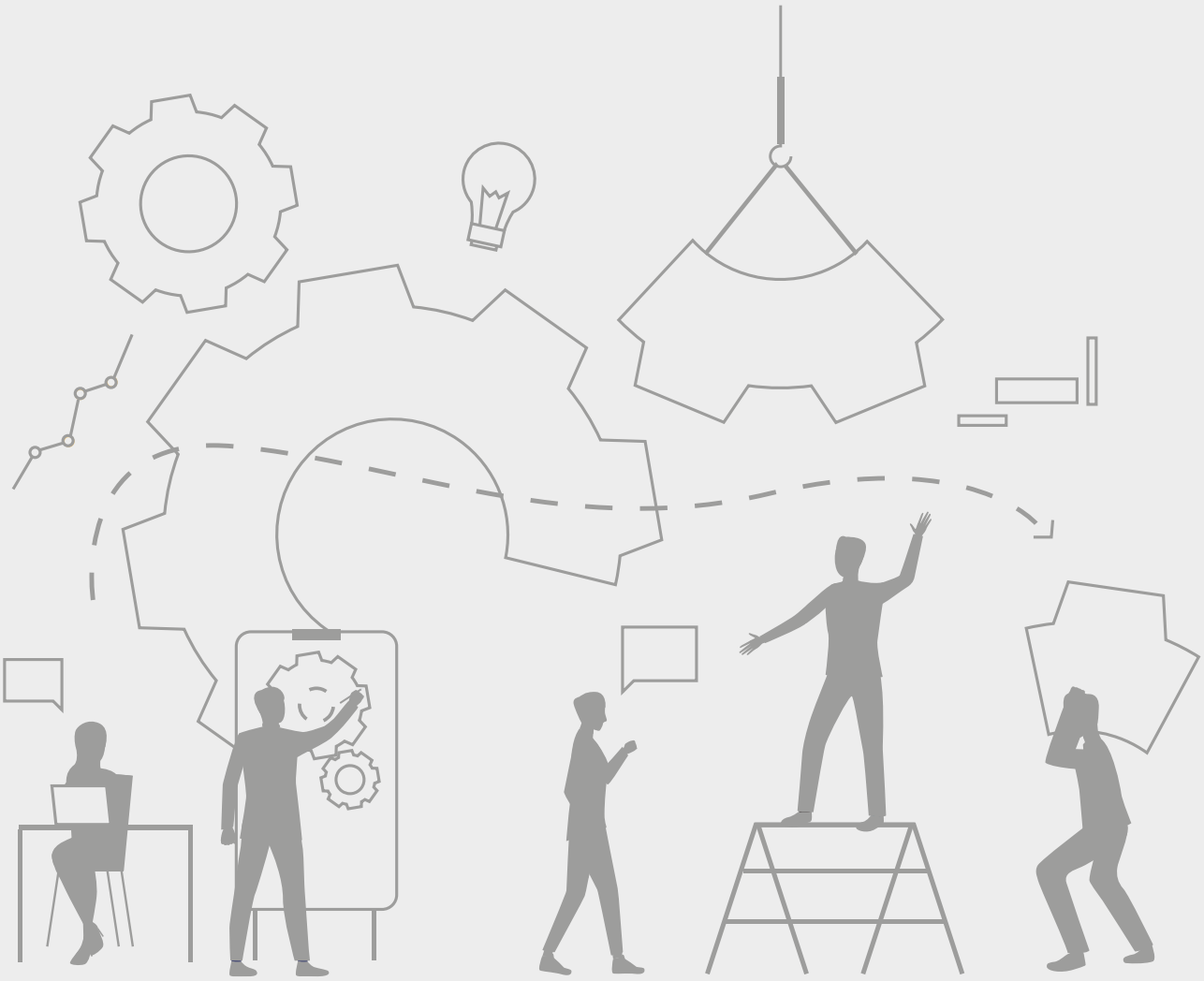
After his training as industrial clerk, Mitsios passed his A-levels and studied business administration in Heilbronn, Germany, and Ireland. If you ask him about his time in Ireland as a native Greek, he starts laughing. "In Ireland, you have all four seasons in one day. It was a real special experience."

Mitsios cannot hide his Greek roots. His name is revealing. Every summer, he visits his grandparents in Greece. This is where he unwinds and explores new places.

Column

COLLABORATION IN PRODUCTION

New technologies such as AI, IoT and platforms are not the only ones that pave the way to a powerful Industry 4.0, but also new forms of collaboration between all players in a "Social Networked Industry"!



The Times They Are A Changin' (Bob Dylan)

"Innovative spirit, flexibility and the ability to react quickly to individual market requirements are today crucial criteria when it comes to the competitiveness of a company in global markets," says Dr. Bernhard Valnion in a contribution to Collaboration as the core concept of the 21st century. The world has been transformed, and therefore collaboration and not just the technological foundation must change as well.

Collaboration –what does it mean in production?

What does collaboration actually mean in production? First of all, there are definitions of terms that are so comprehensive that they are meaningless. Following a definition of Manufacturing in Focus, a Canadian trade magazine, collaboration is the buzzword in production circles today. Collaboration takes place anywhere a group of people work together for a common goal, from formal settings in the boardroom to the factory floor, on job sites, or at off-site meetings. People have been working together since the beginning of human history, therefore such a definition is not very helpful.

Moreover, collaboration is understood more precisely as "anti-Taylorism", a partial reversal of the former division of labor of an efficient economy, which no longer meets the requirements of our economy focusing on the customer and dynamics. Welcome to the new We!

Industry 4.0 and Collaboration 4.0

In this sense, collaboration represents a major aspect or even a separate paradigm of Industry 4.0 and affects both companies and industries. I have previously criticized the original dominant technical paradigm of Industry 4.0 in my contribution to the Huffington Post, which equated Industry 4.0 = Technology 4.0 in the context of the so-called Wahlster Stairway.

Dr. Winfried Felser

In contrast, at the FIR institute of the RWTH Aachen University the ROI and productivity were emphasized early on, which results from better collaboration through networking and integration of decentralized intelligence as part of new partnerships. The Aachen team led by Professor Schuh and Professor ten Hompel working at the Fraunhofer Institute in Dortmund formulated an overall vision for a future economy in the form of a "Social Networked Industry" that rethought people and machines as partners. Here Industry 4.0 = Collaboration 4.0 is the general basis for success.

Collaboration 4.0 concrete: Hubs, platforms and ecosystems

Such a claim is technologically substantiated by hubs or platforms, which support a new form of collaboration through networking and integration, as well as by the collaborative empowerment of the participants, as is the case of collaborative robots. In addition, Collaboration 4.0 also transforms markets and organizations structurally in the direction of ecosystems.

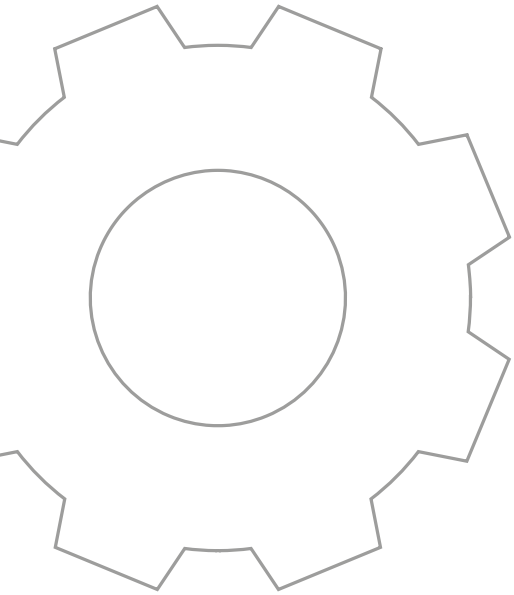
The Factory Collaboration Hub as well as the Manufacturing Integration Platform (MIP) or new forms of cooperation in companies between people, machines and systems based on new technological concepts are representatives of such a new collaboration.

Global importance of collaboration

Since collaboration stands for a whole set of technologies and concepts, it is difficult to quantify the relevance in figures. However, the rapid market growth of collaborative robots (in some studies very high double-digit growth rates) or the increase of collaborative platforms illustrates the relevance of this transformation. However, not all industries change in the same way according to a new collaboration logic. Consequently, despite the rapid growth, the old bliss remains in rigid, highly collaborative and efficient-oriented value chains and where the general conditions also remain stable.

ABOUT DR. WINFRIED FELSER

Since 2000, Dr. Winfried Felser has operated the Competence Site, a network of several thousand experts from science and industry who focus on the digital transformation for management, IT and technology sectors. He is editor of the Competence Report and Books and author for the Huffington Post, LinkedIn Pulse, The European, Absatzwirtschaft and other specialist media.

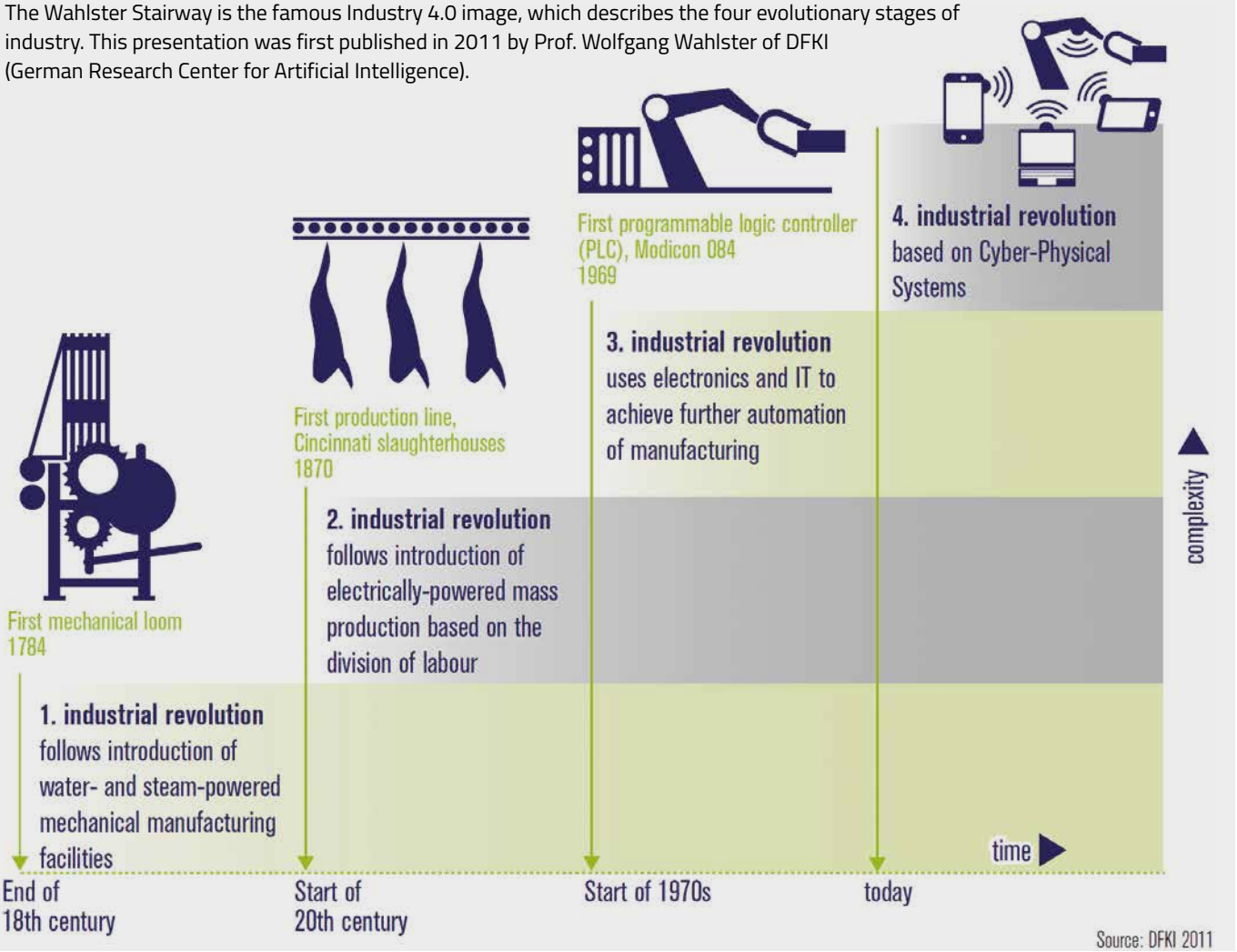


Opportunities for a new Collaboration versus Dystopian Confusions

In the long term, however, the potential of a new collaboration towards the customer (better personalization and conceptualization, more integrated product and service concepts) and in the direction of organization (flexibility, employee satisfaction) will continue to drive the triumphal march of collaboration. Collaboration does not necessarily mean "brave new world" in the best sense. Technologies can also create a new "digital Taylorism". A transparent factory as the basis of the new economy then becomes an instrument of oppression rather than liberation.

WAHLSTER STAIRWAY

The Wahlster Stairway is the famous Industry 4.0 image, which describes the four evolutionary stages of industry. This presentation was first published in 2011 by Prof. Wolfgang Wahlster of DFKI (German Research Center for Artificial Intelligence).



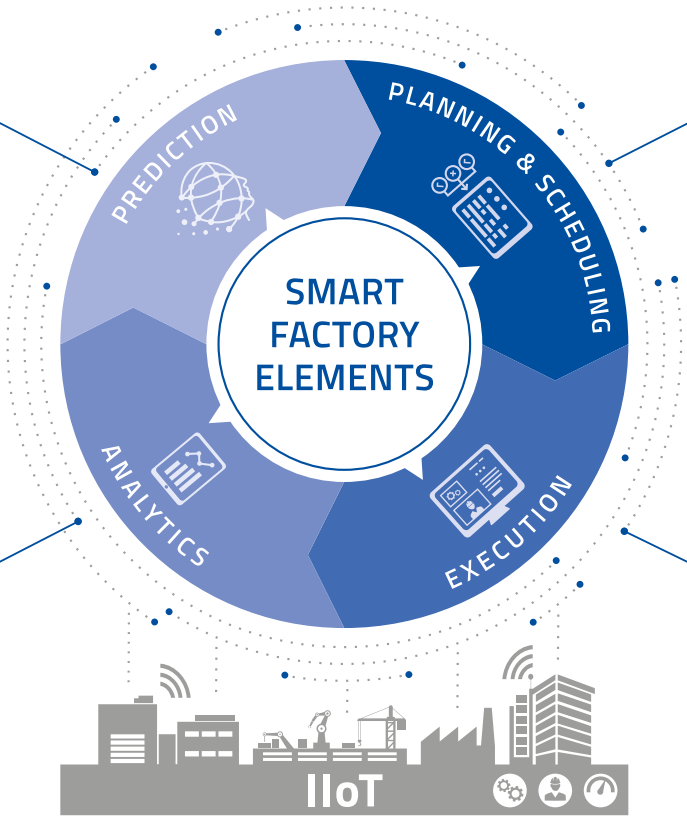
SMART FACTORY ELEMENTS

PREDICTION

enables the prediction of events based on executable models and artificial intelligence.

PLANNING & SCHEDULING

includes standard tasks of work preparation.



uses statistical methods and innovative algorithms to prepare collected data.

ANALYTICS

ensures that specifications are implemented and documented efficiently and correctly.

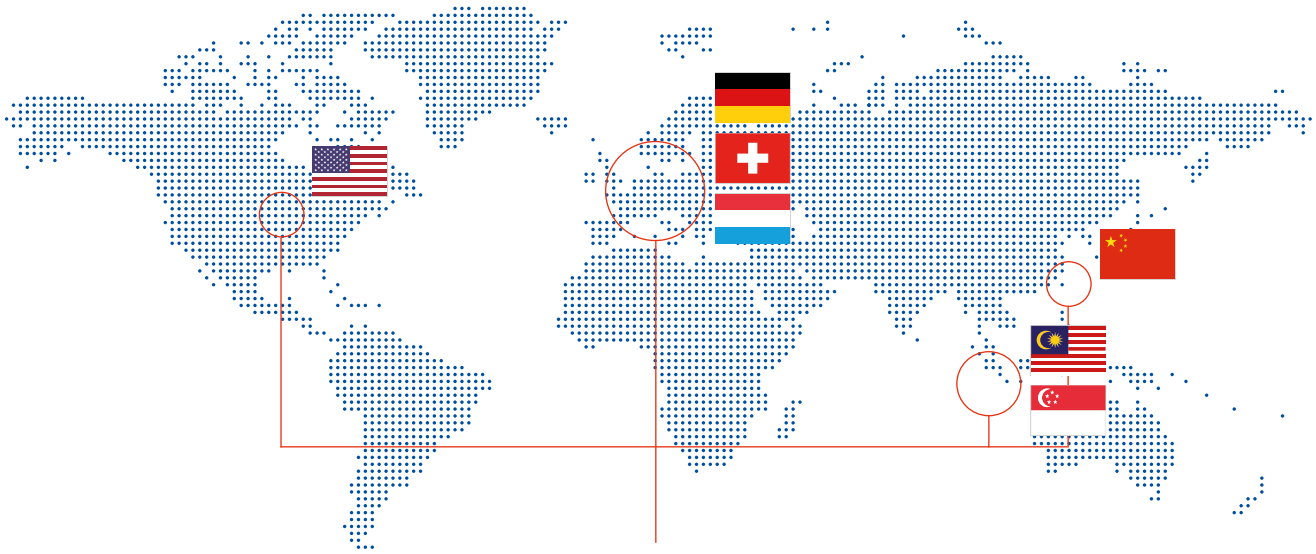
EXECUTION

INDUSTRIAL INTERNET OF THINGS (IIoT)
connects the operator and the real world of production with the digital image of the Smart Factory by means of networking and edge computing.

Requirements such as a large variety of product versions and smaller lot sizes up to lot size 1 considerably increase the complexity of production processes. In times of Industry 4.0, this is truly a case for the Smart Factory, which in turn needs certain processes and functions to meet these increasing demands: the Smart Factory Elements.

Make use of the Smart Factory Elements model and expediently formulate your requirements for the manufacturing IT. Combine applications of all elements and make your production a Smart Factory!

mpdv.info/sfe



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