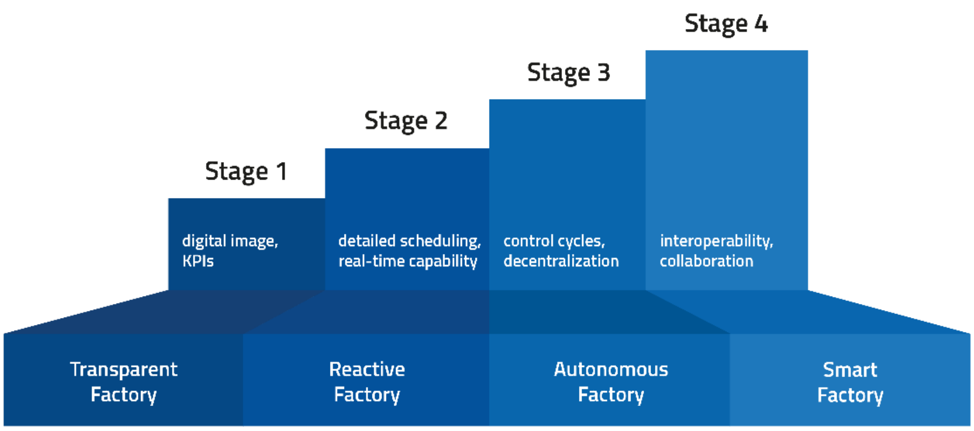
White Paper | July 2024

Four-Stage Model by MPDV

Smart Factory: Getting Started

Motivation

A lot of companies have already set out to transform their production into a Smart Factory — some with success, others with painful setbacks. This begs the question: Why did some companies fail and what can they do better? In the following, we will have a closer look at MPDV's Four-Stage Model describing a promising strategy for the transition to a Smart Factory.



The model developed by MPDV provides a practical approach focusing on the needs and requirements of a company. However, the first step is to create transparency in order to become more reactive. Transparency and responsiveness enable self-regulation, which in turn will lead to the Smart Factory if combined with interoperability. In this white paper, we will explain the distinct stages of the model and describe the steps to be taken on the way to the Smart Factory. For each stage, we will outline what the MPDV Group can offer to help manufacturing companies make progress towards the Smart Factory.

Contents

Why a stage model?

The decision to develop a model with stages describing the road to the Smart Factory was an obvious one because everyone can imagine what stages mean. Also, four is a manageable number. The road and the goal are clear and always in view. If necessary, stages can also be skipped, but you need to invest extra energy to do so.

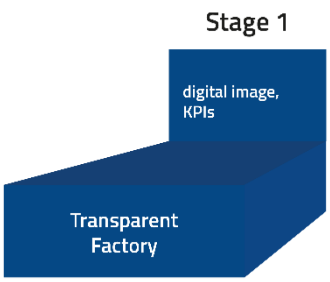
Such a model provides a structured approach that helps companies to systematically plan and evaluate their progress. Each stage stands for a clearly defined development status including specific requirements and objectives. This not only facilitates planning and implementation, but also communication within the company and with external partners. The stage model therefore provides a clear roadmap enabling companies to deploy their resources effectively and to shape the transformation process to the Smart Factory. The model creates transparency and gives orientation to managers and employees so that everyone knows exactly where they currently stand and what steps need to be taken next in order to realize the vision of a fully networked and intelligent production.

Eight reasons why a stage model is a good idea:

1. **Step-by-step implementation:** allows a gradual approach and reduces complexity and costs.
2. **Measurable progress:** enables clear evaluation and documentation of progress and success.
3. **Risk minimization:** reduces errors and bad investments to a minimum by proceeding step by step and adjusting decisions if required.
4. **Learning curve:** supports continuous learning and helps employees adjust to new requirements.
5. **Flexibility and adaptability:** offer the opportunity to react to market changes and technological advances.
6. **Strategic planning:** facilitates defining long-term goals and giving priority to investments.
7. **Resource efficiency:** allows a targeted and efficient use of resources.
8. **Best practices and benchmarking**: support the exchange of best practices and comparison with other companies.

On the way to the Smart Factory, a company needs support from IT systems. Integrated Manufacturing Execution Systems (MES) have proven to be a most suitable tool according to the VDI guideline 5600 because they centrally collect, process, and provide all relevant data. An MES serves as a central data hub for production and other business areas and acts as an interface between people and factory.

Stage 1 – Creating transparency



First of all, you need a reliable data basis, which is why **transparency** is the foundation for all other functions in the Smart Factory. The good thing about transparency is that nothing needs to be explained as it is a well-known topic. However, it is also true that many companies still know too little about their production processes – even though the required technologies and methods have been available for many years. That's why even the smallest enhancements improving consistent data collection often reveal significant opportunities for optimization.

One reason why many companies shy away from collecting data in the shop floor is the great heterogeneity of their machinery. The production halls of a typical company usually host a mix of modern, old, and almost antiquated machines. The younger the machines and production units, the easier it is to collect data electronically and in real time. Capturing data from middle-aged machines usually works by recording simple operating signals or cycles. The connection of even older machines often presents major challenges. But there is also a solution for these cases, for example with external data collection devices and digital real-time interfaces.

Variety of interfaces

Not only the older machines, but also modern production units with standardized interfaces may be challenging. OPC UA is often a lifesaver. You can use OPC UA to connect various machines to an MES system in a standardized manner, but it is only transporting the data, which means that OPC UA provides the container for the communicated data. The data itself is structured by a companion standards — and there are many! Until a machine communication standard for Industry 4.0 will have been developed, companies are faced with the challenge to transfer machine data to the MES with the least possible effort. This also applies to MQTT, which has long been the standard protocol for the (Industrial) Internet of Things.

Intuitive shop floor connectivity would make it easier for many companies to connect machines, production units, sensors, and test equipment to an MES. With this approach, it is then centrally specified why data is collected (selection of MES applications), and how to address a data source (selection of interface and assignment of data content). Whereas in the past, complex configuration and even programming were needed to define the details, modern manufacturing IT can do this intuitively with just a few clicks. Here, the system accesses an extensive database of already realized interfaces, which can easily be extended by adding new driver components. The functional scope thus increases with every new connection. Tried and tested functions like wizards in combination with an intuitive drag-and-drop operation considerably reduce the time needed to connect a machine. What used to take a whole day can now be done in just a few minutes. This efficiency is crucial as the number of machines, production units, sensors, and measuring equipment to be connected is on the increase.

Using collected data

Ultimately, data is not collected for its own sake, but to serve a higher purpose, which is transparency. All collected data together with the known relationships initially create a more or less precise image of reality. However, we must bear in mind who or what is using this image: an IT system or a human being. The two target groups need this information in a different level of detail. IT systems benefit from large volumes and detailed data, whereas people prefer meaningful key figures and evaluations. Both requirements must be considered during data collection and processing.

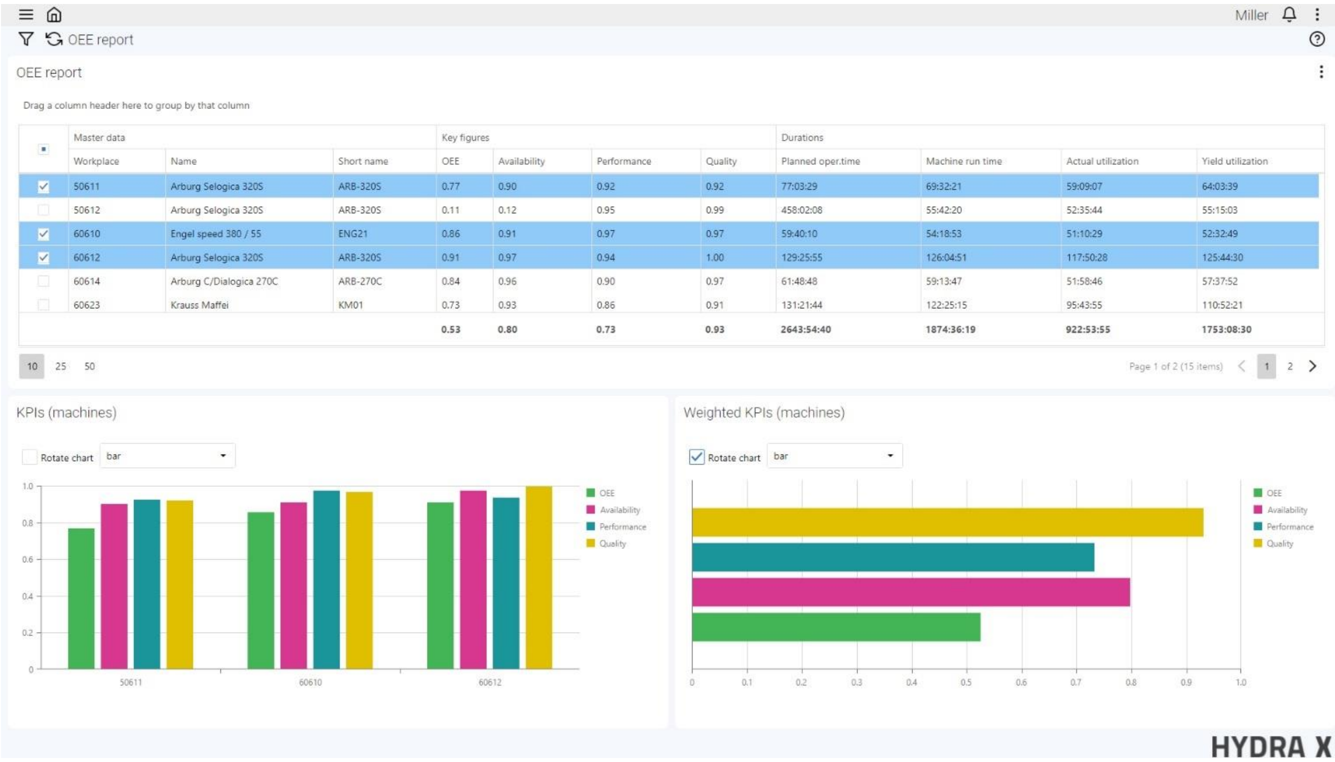
Supporting MES functions

The most important functions to increase transparency in production are the two MES applications Production and Machine Data Collection. We know them now as Order Management and Resource Management. The applications must first of all ensure an efficient utilization of machinery and secondly align automatically transferred machine data with manually recorded order postings. At the same time, tool and material data must not be neglected in the process. If everything is integrated, interrelationships can be identified, and optimization processes started. This method also supports recalculation of production orders as the system can use reliable data.

In view of the large amount of recorded data, the MES also takes on the task of compressing and aggregating data as the higher-level ERP systems can hardly process the raw data from the shop floor. In its role as central information and data hub, an MES connects the business and management level represented by the ERP system with the shop floor thus ensuring communication and finally transparency.

Evaluations & KPIs

A modern MES such as MPDV's HYDRA offers a wide range of evaluations and KPIs to increase transparency in the production environment. One of the most important key figures in the Smart Factory is the [Overall Equipment Effectiveness (OEE)](). It is a comprehensive KPI integrating three aspects: availability, performance, and quality. It visualizes each type of loss or waste in production.



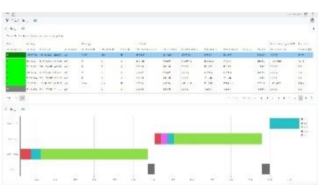
For example, if a production manager detects a decline of the OEE, three main causes might be responsible:

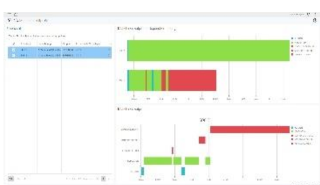
- less availability due to frequent machine downtimes and therefore less main utilization time than planned
- poor quality due to an increase in scrap
- lower performance because of longer cycle times.

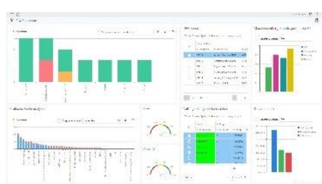
An MES shows these complex relationships in charts totaling the numbers and displaying details on the different factors. The responsible employee in production obtains an instant overview of the causes that have actually led to the current situation and can directly take countermeasures.

[Find out more about KPIs and their benefit in the white paper "Controlling Production with KPIs".]()

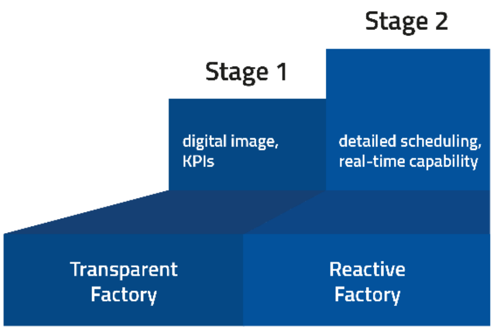
A Manufacturing Execution System not only provides KPIs, but it also scores with its evaluations and charts. The user decides about the data basis used for the relevant evaluation. A classic example is the order profile evaluating the operations of an order and visualizing unnecessary idle and wait times. Another use case is the machine time profile: it shows how productive a machine was by visualizing setup times and interruptions including their reasons.







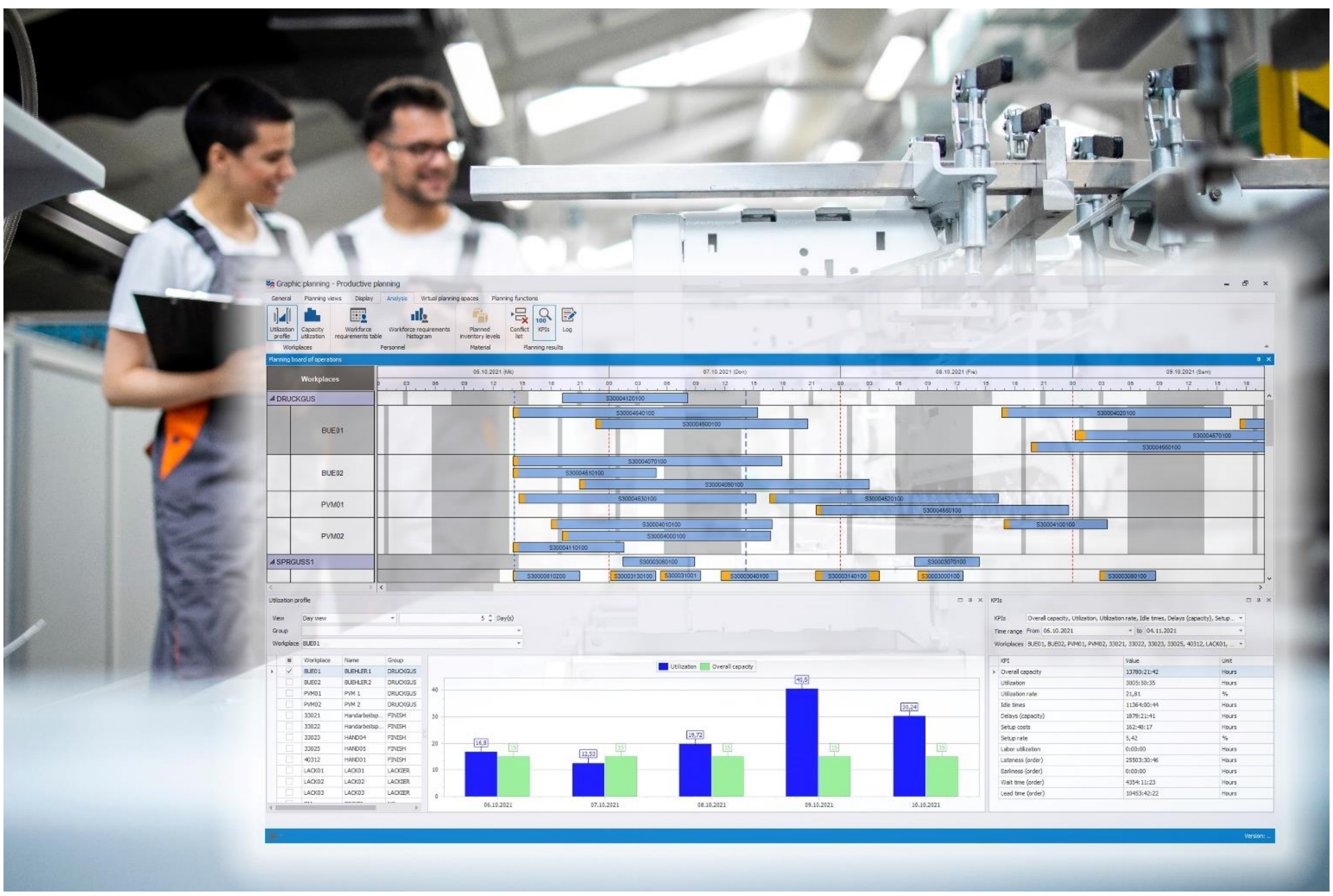
Stage 2 – Becoming reactive



The second stage, the "reactive factory", has two major challenges: reacting to unforeseeable events in production and adapting to customer requests requiring rapid response. Typical disruptions are tool problems, lack of employees due to illness, or incorrectly delivered material. Customers increase the pressure with last-minute changes. If a company can react promptly, losses and wastes are minimized. Manufacturing IT has some advantages over other IT tools or an ERP system by providing an overview of the entire production. Malfunctions can be detected at an early stage and the system can also show alternative options. Without an integrated MES, a malfunction or a change request of a customer often result in a lot of phone calls, e-mails, and meetings at short notice. To remain competitive, manufacturing companies need a flexible manufacturing IT offering all functions of an MES including planning. The latter can also be outsourced to an Advanced Planning and Scheduling System (APS), which interacts with the MES.

Planning and control

If you are well informed about the current status of production, orders transferred from an ERP system to an MES or APS can be scheduled optimally. Contrary to a rough planning in the ERP system with unlimited capacities, the production controller will precisely specify the machine used to produce the order in the planning tool and also schedule the order for an exact time. It is important for a precise planning to know which orders have already been scheduled or are currently running and be up to date about production progress. This is also referred to as capacity planning.

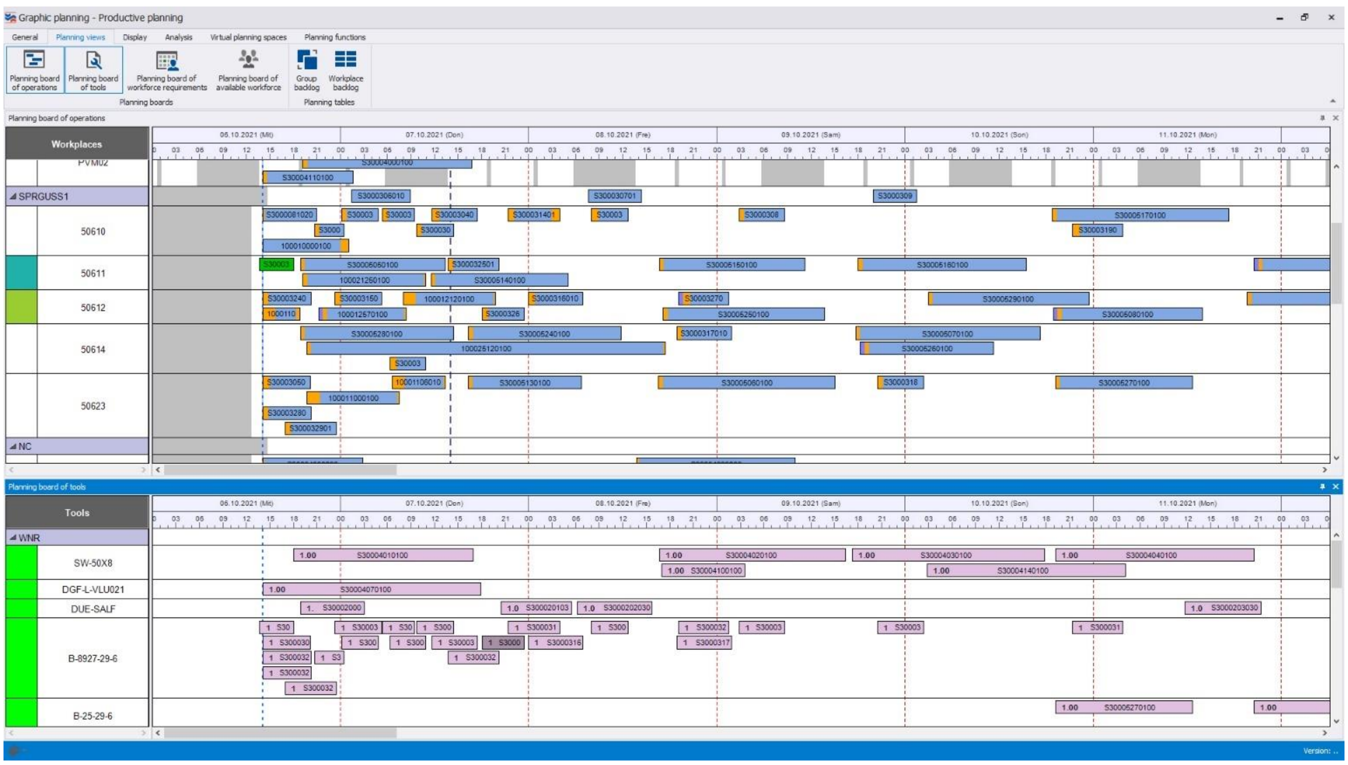


Operations are planned for a specific time, and this also implies a perfect sequence planning, which is important when it comes to optimizing setup times. Modern planning systems help finding the optimal scheduling of an order. MPDV's APS FEDRA, for example, suggests changing the setup time transferred from the ERP if the mean value measured in the past, results in a different time requirement.

The closer the default times to the actual times required later on, the less time buffer needs to be integrated in planning. Closing gaps in planning increases efficiency and productivity. If real-time data from production is additionally integrated in planning, then planning becomes a control system that can quickly react to current events. A tool breakage or other machine malfunction is directly detected. The detailed planning then reacts by shifting the succeeding orders. The planner is notified and can take targeted action. Time-critical or important orders can be replanned or split, and additional capacities can be created by working extra shifts.

Machines, tools, and other resources

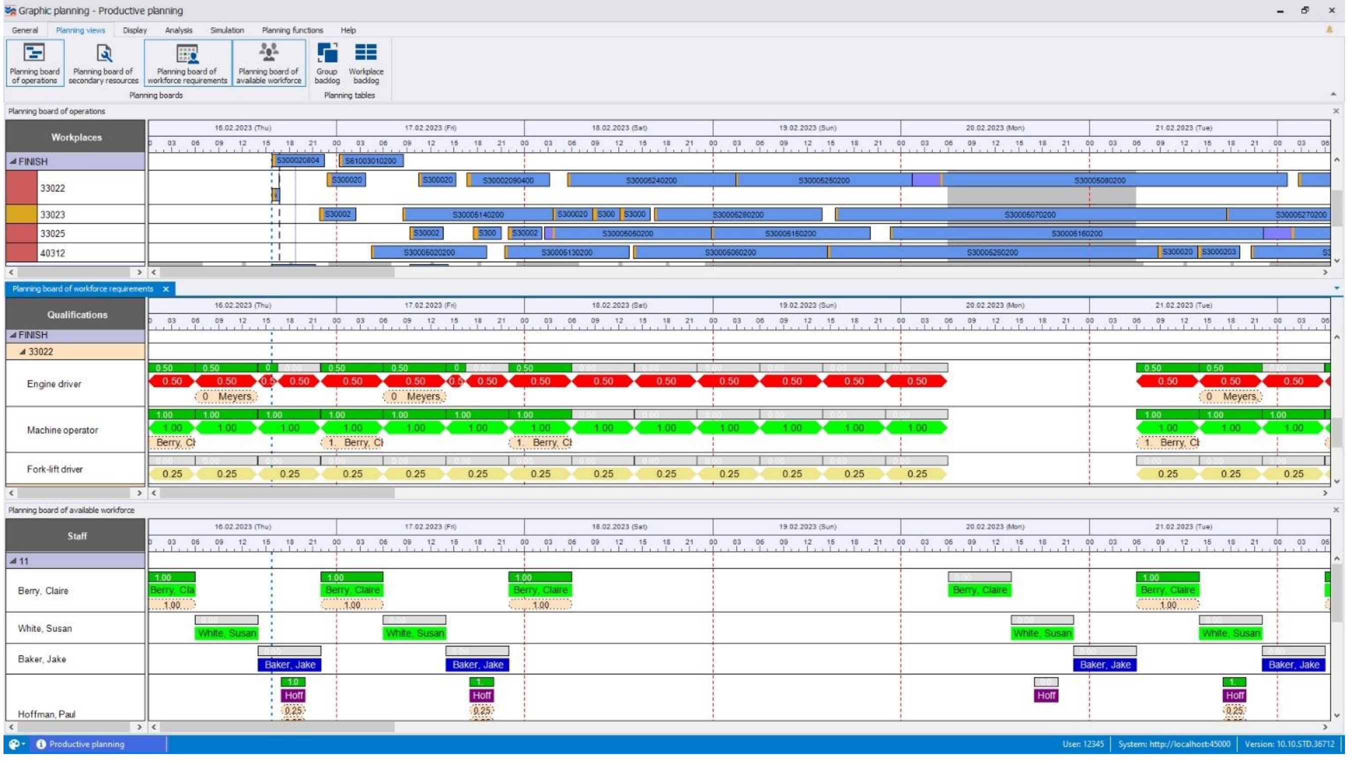
Whereas in the past, it was usually sufficient to reserve the capacity of a machine for an order, it is becoming increasingly important to include all resources in the planning. Classic planning boards and self-developed Excel spreadsheets often cannot handle the complex relationships between machines, tools, devices, and other peripherals anymore. The graphic planning integrated in an MES or an APS can support companies by managing all required resources in one system and displaying their availability in a multi-dimensional Gantt chart.



Ideally, not only production equipment, but also the resources consumed are included in the planning. This can be material (raw material, semi-finished products, or finished products) and in many industries also energy. It is easy to understand why material needs to be included in the planning because only available material can be processed. Negative stocks are possible in theory but lead to unnecessary interruptions of the production workflow. If energy is integrated as resource, then it is all about avoiding peak loads that would result in higher costs. Even the use of temporary energy quotas can be included in the planning. To this end, it is useful if the required information such as material availability and energy budgets are stored and managed in the planning tool.

Qualification-based personnel scheduling

Operators and employees in production must be deployed efficiently in the shop floor according to their qualification. Today, simple shift planning on a pegboard or with an Excel spreadsheet is still widespread. However, an MES or APS can support companies effectively and achieve a modern HR management by digitalizing workflows, eliminating media disruptions, and simplifying processes. Leave requests can then be paperless, and digitalization in production also results in reliable data for the supervisor when planning the shifts. They benefit from the transparency implemented in stage 1 on the way to the Smart Factory. Clear charts and integrated calculations of the required number of employees in a shift turn shift planning into a routine task.

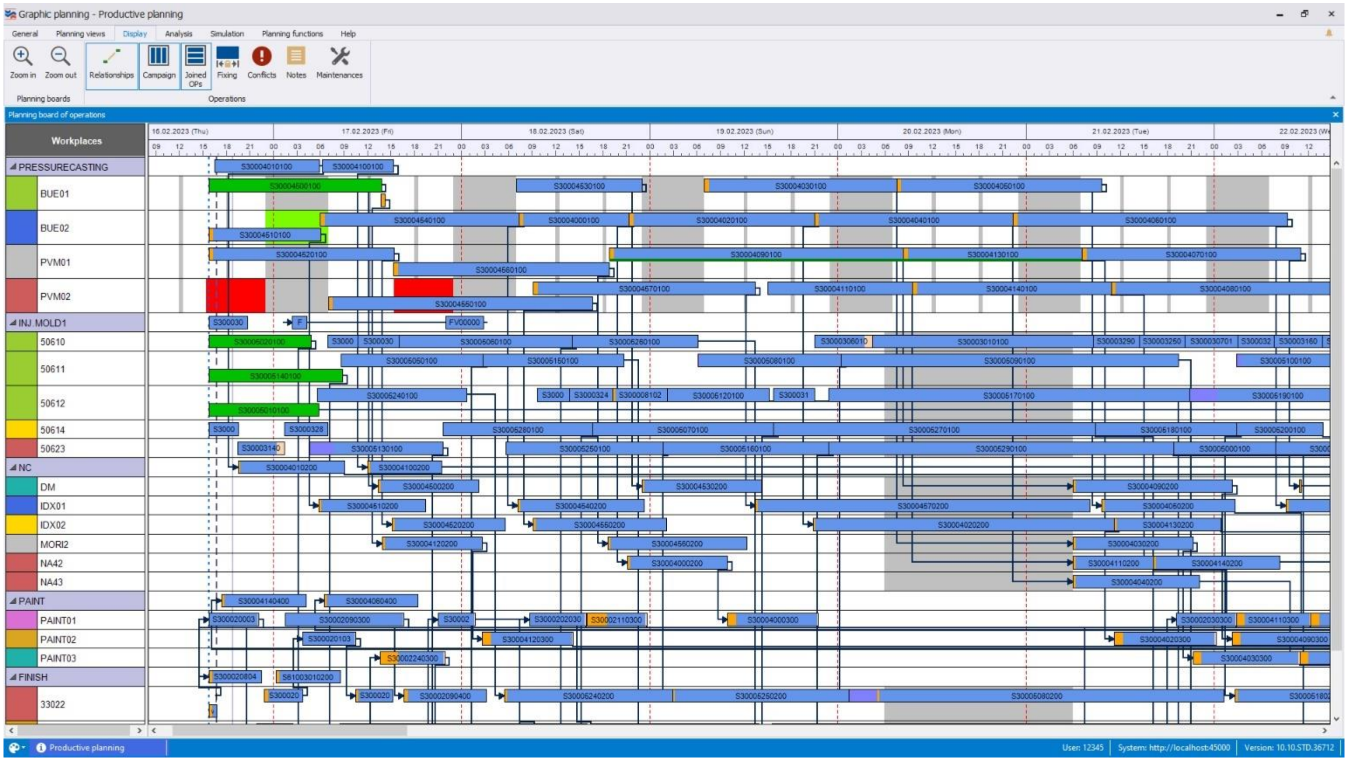


The more complex the tasks of the employees in production, the more important it is to deploy them according to their qualifications. Employees often have more than one qualification. A modern planning tool can store qualifications and temporary permits such as a forklift driver's license or a welding permit in a qualification matrix where they can be edited and prioritized. This matrix is then the basis for personnel scheduling.

In the simplest form, the workforce requirement is directly stored for a workplace, which is managed in the manufacturing IT. The assignment of employees to specific machines and workplaces is then performed in a Gantt chart. Automatic assignment supports the supervisor in planning. You can even include the order backlog into workforce planning, which is particularly recommended in markets with fluctuating demand or seasonal products. Overcapacities can then be identified early on and working times adjusted accordingly. Available employees are deployed more efficiently this way, which also ensures higher employee satisfaction.

Manual or automatic planning?

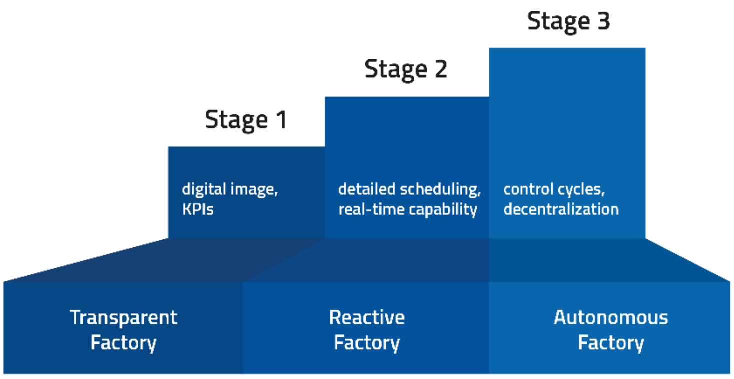
Production controllers are still arguing about what is better: automatic assignment or manual allocation of orders to specific machines. It is possible that the fear for one's own job is often subconsciously present as automatic planning algorithms are constantly improving. But ultimately, competent specialists will always be needed. They are needed to edit extensive master data and use their experience to put finishing touches to the planning or intervene if the automatisms do not provide a useful result. And taking over responsibility is and will be a human domain. In the end, a company plans and controls production most efficiently if they use intelligent automatisms and employ competent planners who intervene manually when necessary and profitable. People are therefore not only important players in the value creation, but they are the ones conducting the planning.



Through the use of artificial intelligence (AI), production planning is taken to a whole new level. AI helps to further optimize the results of automatic planning and provides for an even more efficient use of resources. A medium-sized manufacturing company can use it to shorten throughput times, improve on-time delivery, and significantly reduce planning costs.

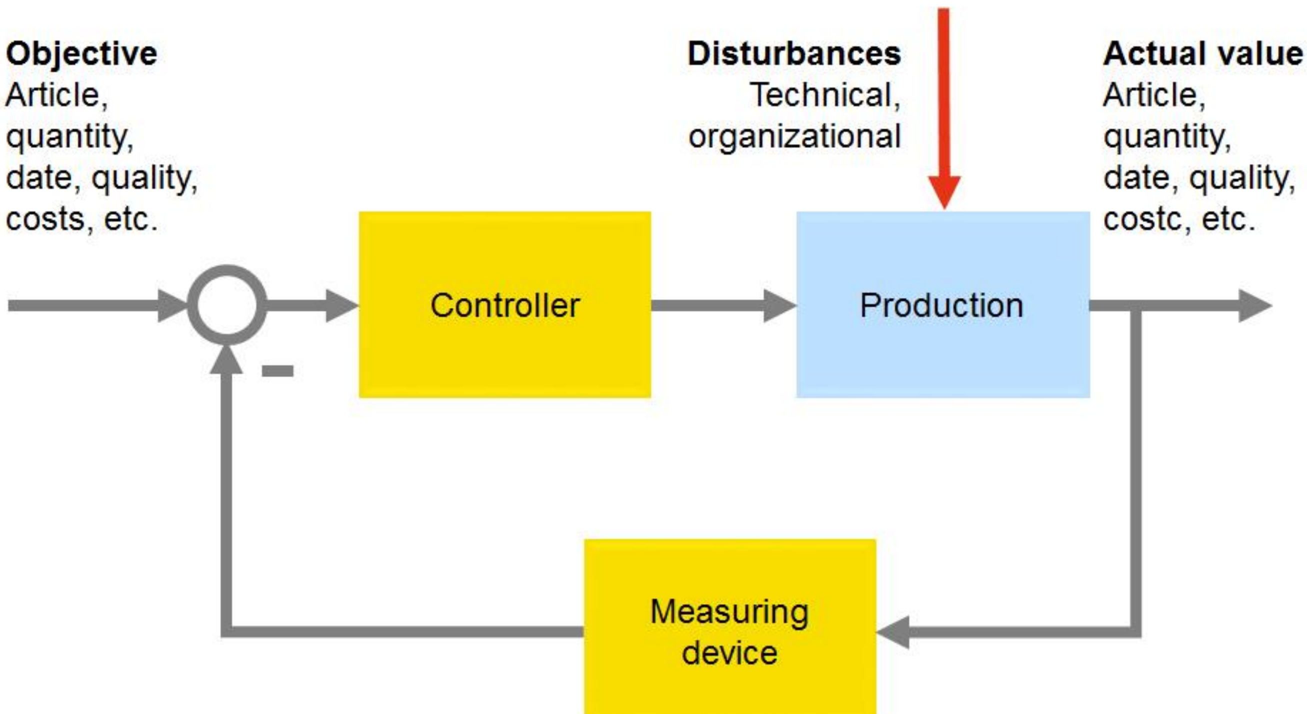
Watch the video to find out how satisfied users of automatic AI-based detailed planning are: [Video: Best Practice at VACOM]

Stage 3 – Defining control loops



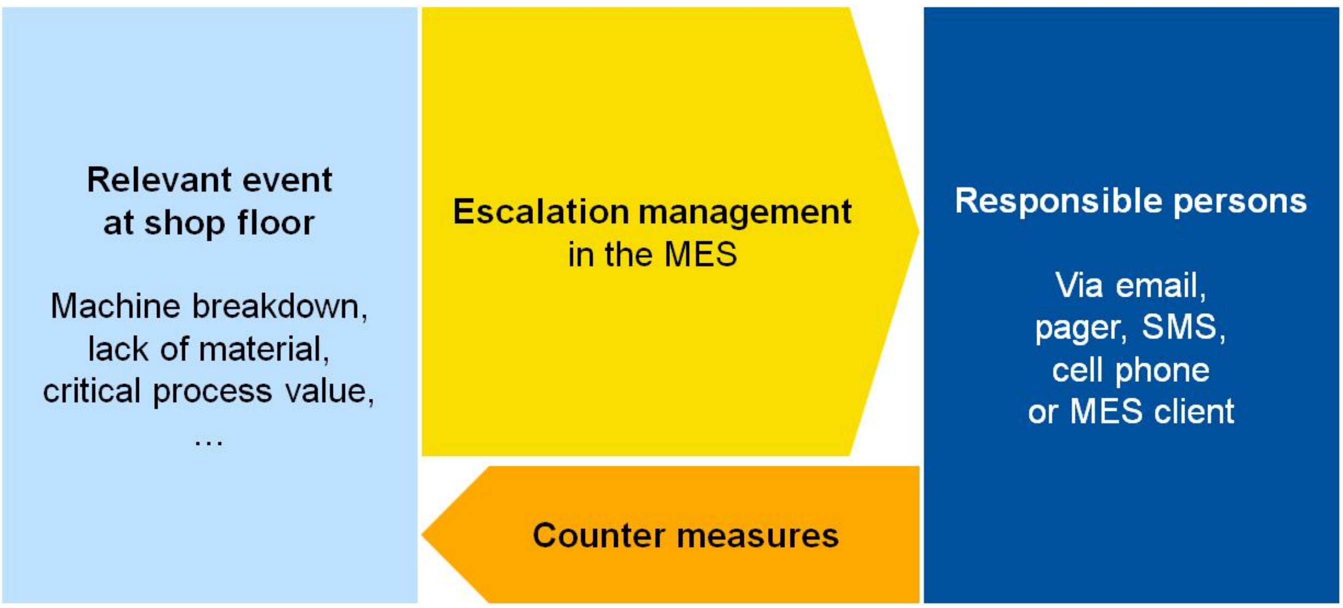
Admirer of Industry 4.0 are still dreaming of a self-regulating production site without human intervention. In order to master the pre-programmed complexity, one would have to transfer the entire experience and intelligence of humanity into an IT system. As this scenario is a long way off and deserted factories are not the aim of Industry 4.0, this article focuses on self-regulation as a relatively straight-forward discipline. When defining self-regulation, it should be noted that this is a modern concept derived from control technology. A new feature is the increased transparency, which makes it possible to respond to deviations from the target earlier, or to ideally anticipate a deviation and to counteract beforehand. Simply put, self-regulation means that a certain workflow or process regulates itself in such a way that given parameters are adhered to.

In production these parameters are about optimal utilization of machines, ensuring quality, adhering to guidelines, or increasing productivity. The number of possible variables and specified target parameters is unlimited. Also, some parameters can only be changed by manual intervention. Nevertheless, the approaches of self-regulation lead to success — provided that specified control loops are defined and equipped with the necessary responsibilities and authorizations. Self-regulation requires a certain degree of decentralization often based on decentralized targets that should, however, be synchronized centrally. Self-regulation is about enhancing the use of collected data and field-tested control mechanisms.



Examples of self-regulation

- The simplest form of self-regulation is to monitor one or more parameters and to send notification or give signal when the set thresholds are exceeded. People will then see to the issue. These functions might be called "Escalation Management" or "Messaging & Alerting" in today's MES systems.
- Enhanced functionalities can be obtained with MES modules referred to as "Workflow Management". These functions not only show a deviation from the target, but also suggest or take countermeasures. For example, the application would trigger an inspection, if the machine temperature exceeds 60°C. This process ensures that external factors do not influence the produced quality.
- If we go one step further, we arrive at self-regulating systems like Kanban or the digitally supported equivalent eKanban. Kanban is a system where material is in constant supply. However, a built-in control avoids piling up warehouse stocks.
- The premium class of self-regulation is process interlocking. Process interlocking ensures that only material is used, which is specifically provided or released for the relevant work step, and only flawless parts are further processed. Process interlocking is particularly important if multiple variants are produced as this kind of production must aim at zero-defects, which is also demanded by the customer.



All these self-regulation tasks can be mapped by an integrated MES since the required information is already available in the system, and the persons involved interact with the MES.

Interaction of human and technology

How communication between the connected machines or the MES and employees in production or management is to be organized is still unclear. It should be paramount that technology supports people and not vice versa. The operator becomes an "Augmented Operator" with the help of the MES. Behind this concept is the idea that the operator has direct access to further details critical to a particular situation and is thus able to make informed decisions. Thanks to a suitable human-technology interface, the operator becomes part of self-regulation in an ergonomic manner. In order to increase the effectiveness of this integration process, the employee should be equipped with the necessary responsibilities in order to decide autonomously, if necessary.

Ways to decentralization

The transformation to self-regulation and, thus, also to decentralization, takes more than just an MES or other IT support. It is rather about a paradigm shift in the manufacturing work culture, which is often reflected in entrenched structures. Therefore, we recommend a comprehensive as-is analysis of the actual situation at the outset: processes and workflows, responsibilities, documented and non-documented rules, as well as existing experiences that are pivotal for decisions in the respective area. On this occasion, the actual situation should at least be questioned, and the underlying processes should be, at best, streamlined. Here, lean manufacturing methods have proven to be effective. In a next step, companies must integrate the recorded and optimized overall situation in control loops. Simple IF-THEN relationships and complex, possibly mathematical, dependencies are suitable for this purpose. These control loops can then be integrated into a qualified IT system in a third step. Most of the manufacturing control loops can be implemented with a modern MES.

Examples

Multiple smart applications, which have been successfully implemented in manufacturing companies of any size and industry, are proof that control loops and therefore self-regulation are not an invention of Industry 4.0:

Smart intralogistics

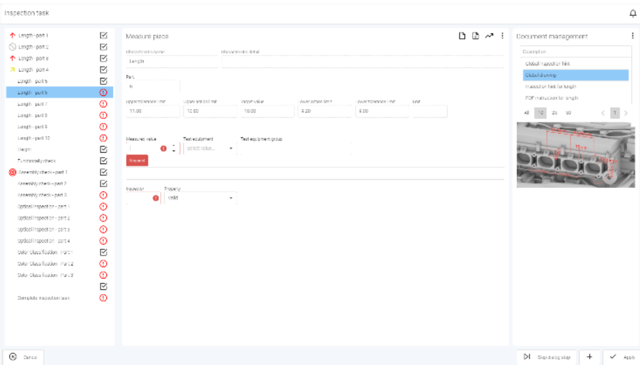
A medium-sized metal producer uses the status change of machines in production to inform employees in the warehouse of material shortages. Warehouse staff can, in turn, use the machine and order number to identify instantly in the MES which material is required at the machine. This process requires only a very small range of functions. With some additional functions, warehouse staff could be informed before an acute material shortage occurs, for example if an MES-based range estimation is integrated for certain materials. The control loop would then look as follows: If the input material falls under a defined stock level at the machine and the current order cannot be finished with the available material, then the system requests a fixed amount of material from the warehouse. Material supply would work even smoother with an eKanban system. In this case, the system itself ensures that sufficient material is available at the machine.

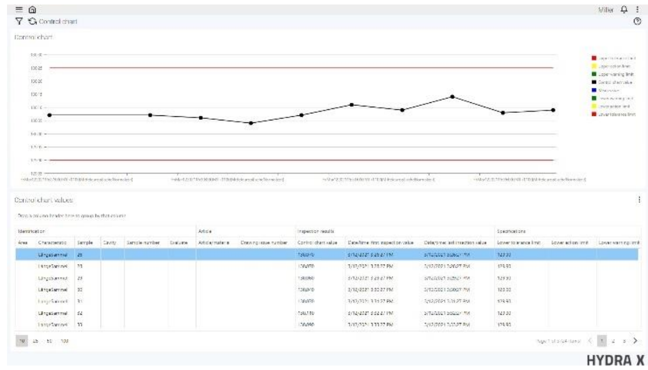
Smart maintenance

A plastic processor uses the recorded energy consumption of the machines and correlates it with the logged on orders to determine when the next maintenance is due for the production unit. For this purpose, the MES compares the target consumption with the actual consumption, which is defined by the following control loop: If the recorded consumption exceeds the default value by more than 30%, an unscheduled maintenance must be performed. The corresponding maintenance order is automatically scheduled via order backlog. When the unplanned maintenance has been completed, the regular maintenance interval is reset, resulting in a much more efficient use of equipment.

Smart quality inspection

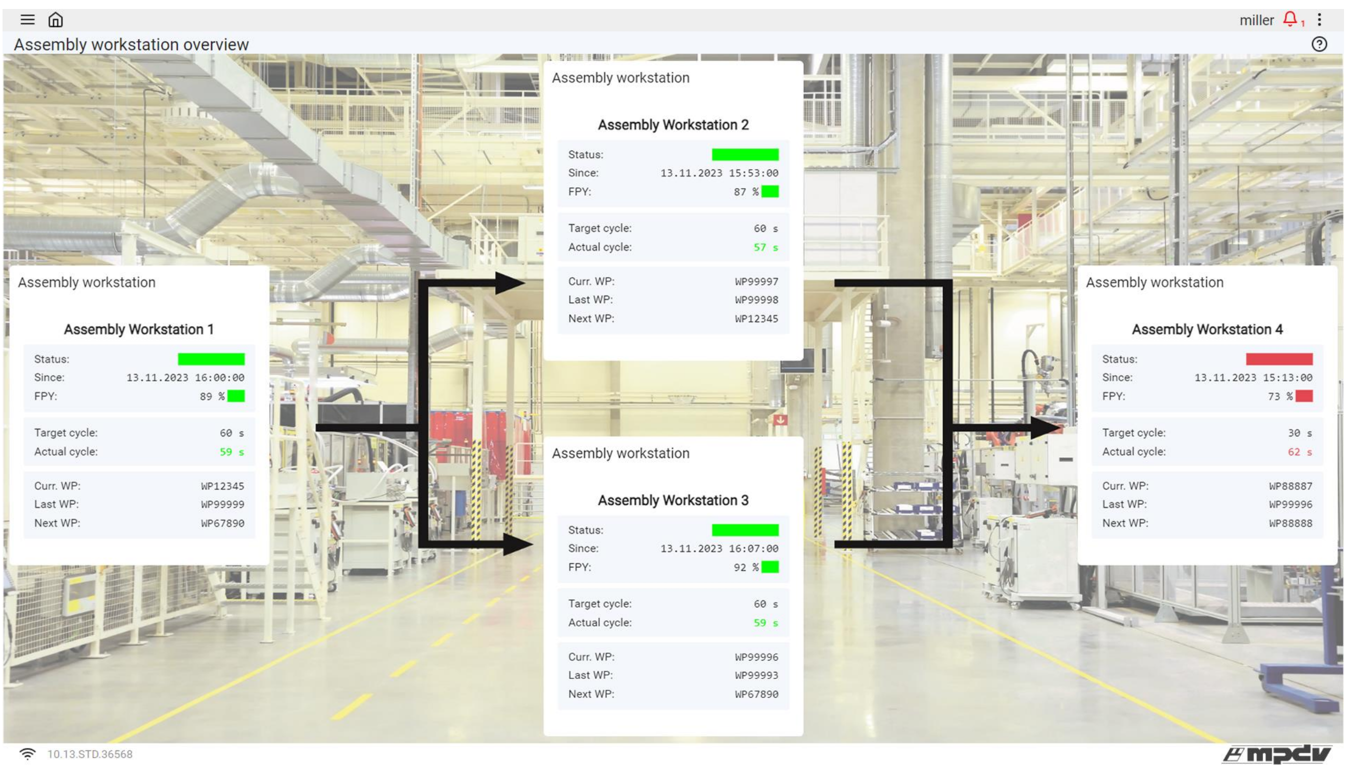
As a rule, the interval for quality inspections of samples is time-controlled or based on produced quantities. If an MES is used, a machine status change can also trigger an inspection. This makes it possible to react to events such as malfunctions or material changes, thus ensuring the required quality without additional efforts. In combination with a sampling, inspection points in the quality lab can be added. As soon as material samples reach the quality lab, the relevant inspections points can be processed away from production. It is also possible to automatically generate a transport order for the sample if the quality lab is some distance away.



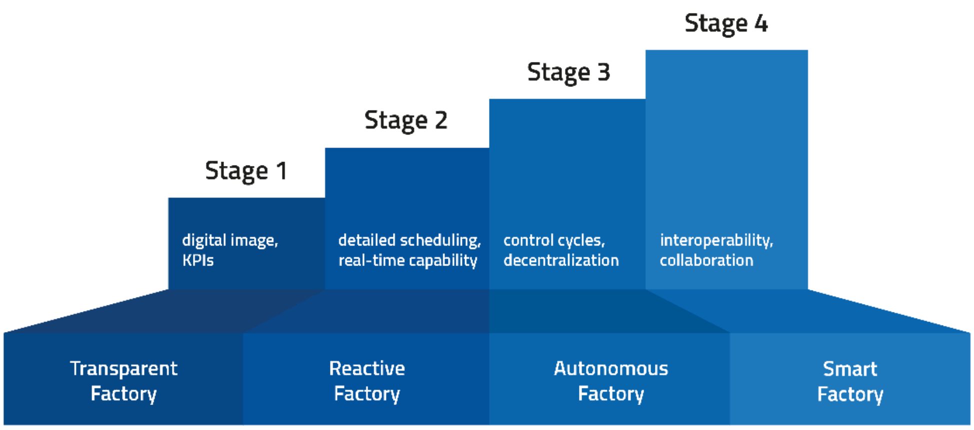


Smart assembly lines

If businesses produce a wide range of parts for the automotive industry, the complete manufacturing process must be documented ensuring that only flawless parts are processed and delivered — usually in a predefined sequence. If a process interlocking is implemented in this way, the system checks every part at every work step to approve the item and check whether the previous processing has been performed without faults. Based on a continuous documentation of all parameters, the above check can be easily performed by an MES where actual and default values are compared.



Stage 4 – Getting even smarter



Smart networking is becoming more and more important. It is about combining applications, functions, and data that were previously not considered or used together. As a result, smart networking also leads to a whole new level of complexity, both technically and organizationally. It is thus essential that manufacturing staff and management understand and live the hallmarks of the Smart Factory, which are transparency and responsiveness. This is the only way to ensure that smart networking creates new potentials for optimization or even new business opportunities, and that digitalization does not end in chaos.

Horizontal integration – correlation – interoperability

Horizontal integration means that data is correlated, which results in new and valuable insights. But the horizontal integration is restricted to the application within a system. When things go beyond system limits, we speak of interoperability. Here, other issues like security mechanisms and encryption must be observed, but most of all a common understanding of data and its meaning is key — a common language so to speak. We often hear the term semantics in this context. Common semantics guarantee, among other things, that the transmitted data is generally understood and not interpreted differently by the receiving system. All systems involved should also have an understanding of the difference between orders and operations and how they are connected.

Purposeful networking

To ensure that smart networking leads to the desired optimizations, the requirements should first be specified, the necessary structure defined, and selected interfaces implemented. Depending on the size and industry of a manufacturing company, the examples of smart networking in the following might be more or less important to them.

Networking production and logistics

Many MES systems offer solutions to digitally integrate in-house logistics. By networking with a Warehouse Management System (WMS), the existing functions can be extended and thus become even more powerful. For example, MPDV's MES HYDRA monitors defined stocks of material and intermediate products – or work in progress (WiP) material – as part of the Material Management application. HYDRA can use current stocks in production and has much more detailed information than an ERP system, which usually only knows stocks that are booked at the end of the order. HYDRA can also project the expected range of coverage of selected materials. If HYDRA is networked with a WMS, the improvements can be significant. You can then not only monitor stocks of specific material buffers, but merge information about storage locations in production with data from other warehouse locations managed in the WMS. This means that you can detect material shortages and delays at an early stage with minimal efforts or even avoid them completely. By means of smart networking, the MES knows the exact material location and can display it on the shop floor client.

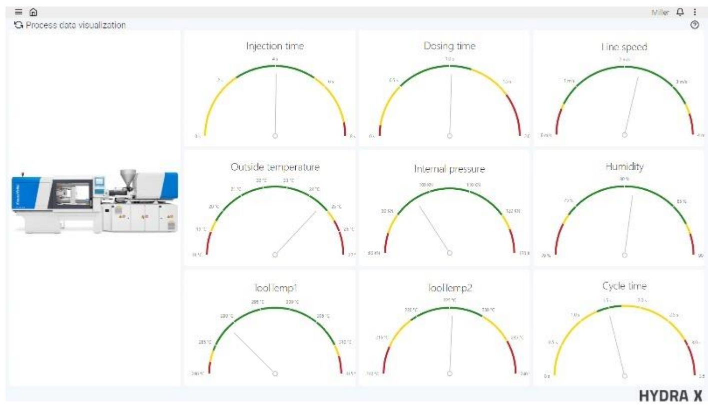
Another example: HYDRA offers an integrated transport management system for the shop floor. You can use this system to automatically generate transport orders if material is required at a machine or finished material needs to be removed. Transport management can also support during setup of a machine by automatically requesting required resources such as tools via transport order. If HYDRA were combined to a WMS, the system would allow the automatic control of means of transport such as a driverless transport system including automatic route planning. By transferring transport orders from HYDRA, important supply processes could be mapped completely automatically.

MPDV's MES experts are currently analyzing further opportunities with the experts of the viastore software, the leading provider of software for logistics processes.

Networking production planning and facility management

The existing environmental conditions are relevant or even critical for specific production processes. In this context, the networking of production planning and control with a facility management system would be an obvious solution. Temperature-critical processes, for example, can be scheduled for times when the facility management can safely control the temperature. Or alternatively, the air conditioning of the factory hall can be changed in good time before such process steps begin. Dynamic restrictions during planning can also be controlled by using information from the facility management: for example, limiting the number of simultaneously running furnaces on hot days at lunchtime or blocking certain doors on cold days while temperature-critical processes are running.

It can also be advantageous to network the energy supply with production, especially for energy-guzzling production processes. For example, operations with particularly high energy consumption can be carried out at times when energy procurement costs are low or for which low-cost energy quotas can be procured. Avoiding peak loads and thus reducing unnecessary costs is another ever more important issue.

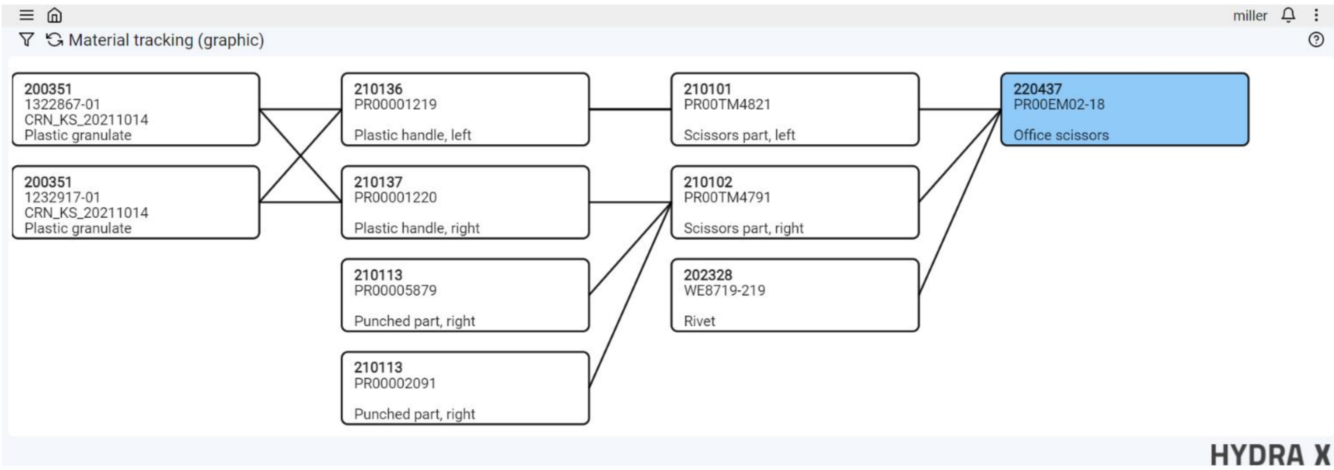


MPDV participates in different research projects in the field of networking production planning and energy management. The findings will be successively incorporated into the MES HYDRA.

Traceability and networking across the supply chain

In some industrial sectors, the manufacturing processes of each article must be fully documented. In view of growing individualization of products, this requirement is gaining in importance in many companies, who are striving to provide targeted service and support for their products later on. Whereas it was previously sufficient to document the raw materials used, manufacturing companies will need additional parameters in future. Not all the information required can be directly captured by the MES. Therefore, networking with other IT systems providing this data is crucial. For example, values of room air conditioning (facility management), transport routes or means of transport (logistics), data from upstream suppliers (supply chain management), or other data from the Industrial Internet of Things (IIoT) can be consolidated in the MES.

A real-life example for the networking of IT systems across the supply chain is the connection of BALLUF Mold-ID to applications of the HYDRA Resource Management. It allows to monitor injection molding tools even if they are used by sub-suppliers. The system monitors if specified maintenance intervals are adhered to and documents tool usage. The local collection of relevant data is performed via Mold-ID on an RFID chip located on the tool. As soon as the tool is back, this data is transferred to the MES and centrally available. This closes the information gap between the two companies. By correlating the tool data to the batch-related information about articles from the sub-supplier, the locally collected data can also be used for traceability purposes.



Networking of design, production, and quality assurance
A particularly illustrative example of smart networking is the use of model data from the design department (e.g. CAD model) to define characteristics that are checked and recorded during quality inspection in production. This approach facilitates manual inspection planning significantly as the characteristics to be inspected such as target value and tolerance can be read and transferred directly and automatically from the CAD model. Planning efforts are reduced, and the probability of typos are eliminated. The recorded inspection results are not only used for quality assurance in production but are also fed back to the design engineer. In turn, the designer can use this information to improve the product design, enhance product quality in the conception phase, and lessen the strain on production by reducing rework.

The Manufacturing Execution System HYDRA can be used to transfer inspection characteristics from CAD models or other systems (e.g. FMEA). Another application, which we have developed some time ago, is the transfer of NC programs from a Product Lifecycle System (PLM). With HYDRA, this data can then be used directly on the machine for the pending order. The HYDRA application DNC & Setup Data is already widely used by numerous manufacturing companies.

From smart networking to digital twin

All aforementioned examples of smart networking are about integrating data from different systems. In particular, the connection of the design area to the MES expands the overall perspective on the complete life cycle of a specific product. The digital twin of production or specific products is thus given a time axis. This benefits manufacturers and future product users. Especially in times of ever shorter life cycles and a constantly increasing number of variants, such feedback is important in order to learn quickly and sustainably from the experience gained. Thanks to smart networking, everyone involved can benefit from shared knowledge and learn from failures that have occurred.

Where to start?

"Where to start?" — A difficult question with a simple answer: at the beginning! Manufacturing companies should start by analyzing their current state. The company might already have reached stage 1 or 2. Then it is necessary to check if the stages reached are sufficiently consolidated to move on to the next stage. This as-is analysis must also factor in that different requirements apply for each company at the specific stage. What is good enough for one company at stage 2, is not enough for another company at stage 1.

It is also essential to think not only in terms of technology, but also in terms of organization. Ultimately, the way to the Smart Factory will only lead to success if suitable IT solutions and lean methods are implemented. Focusing on value creation, or in other words what the customer is willing to pay for, is crucial for this endeavor. Because only what creates added value for your customer, is truly "lean"!

The experts of the MPDV Group help to pave the way to the Smart Factory and implement it successfully. MPDV's Four-Stage Model is thought to be a guide for all manufacturing companies wishing to implement the Smart Factory. Unfortunately, there are hardly any shortcuts on the way.

Finally, some tips drawn from the experience of many digitalization projects

Think big, start smart
Have vision, but start with the so-called low-hanging fruit, i.e. what generates maximum benefit with minimum effort. Make sure that digitalization is fun for you and your employees. You may even manage to have the savings from one project to largely fund the next one. Loosely based on words by the French writer Antoine de Saint-Exupéry: "If you want to build a ship, don't summon people to procure wood, prepare tools, distribute jobs, and organize the work; teach people the yearning for the wide, boundless ocean." Only once people have understood that a ship is needed on the sea, clear tasks should be distributed, but not before.

Think about the role of people
Despite all the digitalization and innovative technologies, people still play a central role. That's why, alongside technological change, there is always a need for measures that embrace people. Even if the term change management sets alarm bells ringing off in many companies, you should get to grips with the idea of preparing your employees for the digital transformation in good time. Ultimately, the goal of the Smart Factory is to relieve people of monotonous routine tasks while giving them control over value creation. Modern manufacturing IT is intended to be a valuable tool for people to master ever-increasing complexities.

The ball is in your court - take it!
Just start! If you don't start, you will never reach your goal. Have courage and do not forget to involve your employees. Never underestimate the expert knowledge of your operators, logistics specialists, planners, and quality team.

Once again and most importantly: Get started now!

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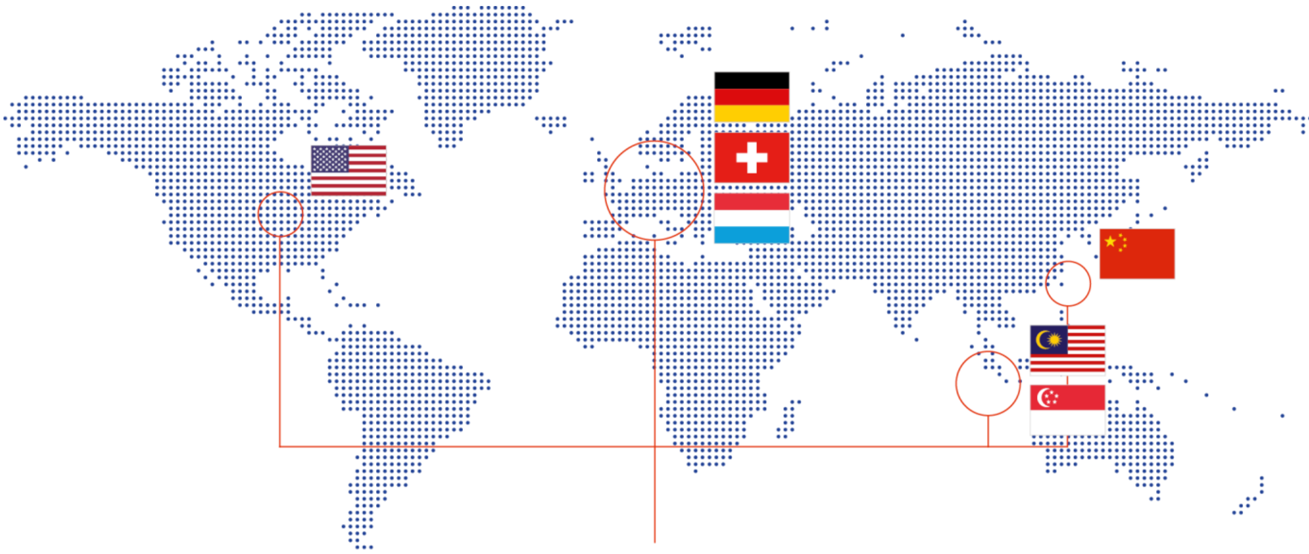
About us

MPDV Mikrolab GmbH

headquartered in Mosbach/Germany, is the market leader for IT solutions in the manufacturing sector. With more than 45 years of project experience in the manufacturing environment, MPDV has extensive expertise and supports companies of all sizes on their way to the Smart Factory.

MPDV products such as the Manufacturing Execution System (MES) HYDRA, the Advanced Planning and Scheduling System (APS) FEDRA or the Manufacturing Integration Platform (MIP) enable manufacturing companies to streamline their production processes and stay one step ahead of the competition. The systems can be used to collect and evaluate production-related data along the entire value chain in real time. If the production process is delayed, employees detect it immediately and can initiate targeted measures.

More than 1,100,000 people in over 1,750 manufacturing companies worldwide use MPDV's innovative software solutions every day. This includes well-known companies from all sectors. The MPDV group employs around 520 people at 13 locations in China, Germany, Luxembourg, Malaysia, Singapore, Switzerland and the USA.



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