Industry 4.0 and lean manufacturing – what value is added by Industry 4.0?

How IIoT software facilitates and improves company-owned production systems

A white paper from Bosch Connected Industry
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5. **Summary and outlook**
An idea born at Toyota in the 1950s has become common practice in most businesses: lean production systems ensure waste is systematically avoided, ideally throughout the entire value chain. Bosch was involved in the early days of lean manufacturing and, as a supplier to Toyota, learned about this revolutionary method of manufacturing organization straight from the originator – and systematically adapted the production concept to suit its own operations. The Bosch Production System (BPS), which was established in 2002, has become the standard in all Bosch plants around the world. It adds striving for the best technical production process to Toyota’s approach.

In traditional lean manufacturing, paper sets the tone; every process is documented in writing. The ever-increasing automation in production has proven both a blessing and a curse: on the one hand, it represents a quantum leap in terms of data capture and data analysis; on the other hand, it often disrupts the flow of information through inconsistent solutions or a jungle of different IT systems. Tried-and-tested processes are increasingly undermined, while the basic principles of lean manufacturing are overridden by highly praised digitalization solutions. Selective, proprietary digitalization solutions turn out to be nothing more than blunt data collection tools that make little contribution to the general improvement of processes.
This is how, in a worst case scenario, companies come to spend years digitalizing processes only to end up with an entire menagerie of individual solutions that are incompatible with each other. By developing a holistic approach of lean and digitalization, Bosch successfully bucked this trend and transitioned the digital solutions they trialled in their own plants into a standardized Industry 4.0 portfolio designed specifically to follow the principles of the BPS.

This white paper uses practical examples to demonstrate how these Industry 4.0 solutions can work in harmony with an own production system. Software developers take the principles of lean manufacturing into account from the very outset and develop suitable functionalities. Intelligent software can uncover deviations with precision, and hence represents a powerful tool for those responsible for the implementation of lean manufacturing. This is the key to implementing IIoT (Industrial Internet of Things): digitalization should not be adopted simply for its own sake. It must add value by improving processes within the production system or, in some cases, by facilitating these processes in the first place.

Fig. 1: IIoT software and lean manufacturing optimize cooperation on the shop floor
There is nothing new about bright minds and dedicated teams developing and establishing ideas to increase efficiency. Yet industrialization transformed the general circumstances of goods production completely. Factories grew bigger and bigger, production quantities increased, and processes became more and more complex. This increasing complexity made it necessary to ensure the cause-and-effect relationships regarding productivity and profit were transparent and controllable. Consequently, recording target and actual conditions, organizing production and permanently increasing efficiency should not be left to chance; they should rather be systematic, traceable and reproducible. Emerging from Toyota in the 1950s, production systems were taking shape in companies around the world, at a time when the digital revolution was also presenting industry with increasingly extensive automation solutions. To better understand the fascinating interplay of these two developments, we must first take a closer look at the significance of production systems within industry.

The introduction of production systems and the increasing use of digital technologies are two developments that have largely run in parallel over the last few decades.
2.1 Production systems as basis for modern manufacturing

Efficient manufacturing without production systems is almost unthinkable in a modern factory. The only way to achieve a consistently good product quality at maximum efficiency is through standardized processes – a fact exemplified by Henry Ford. However, strict standards can also make production slow and inflexible, especially since we no longer see mass products being manufactured to the same design over years or even decades. Markets today are agile and unpredictable. The products themselves are also increasingly complex, which results in multi-layered production processes. Production systems must enable quick reactions and troubleshooting, while combining flexibility and efficiency. Digital support in the form of Industry 4.0 applications helps to make the relevant processes faster, more flexible and more stable.

Flexible, efficient manufacturing needs a good production system. Fusing it with Industry 4.0 software brings further advantages.

Fig. 2: Digitally supported production systems enable efficient comparison of target and actual conditions in production.
2.2 Toyota as a role model

Most modern-day production systems are based on the Toyota Production System (TPS). The fundamental idea: instead of setting standards once, the TPS is all about continuous optimization and maximum flexibility. The primary objective is to achieve a high-quality product at reduced costs or, in other words, with minimum waste. This approach proved a great success for Toyota, and to this day is viewed by many other companies as the model example – including Bosch with its own Bosch Production System.

The Toyota production system focuses on standardizing optimization processes to prevent waste.

The history of lean production
The Toyota Production System is the brainchild of Taiichi Ohno, who joined Toyota as head of production in the 1950s. In order to optimize production, Ohno closely studied Henry Ford’s production system. However, he soon realized that this principle was difficult to apply to the economic conditions of post-war Japan. Raw materials and capital were hard to come by. It was important to avoid waste and overproduction. The model from the Ford plants in the USA was designed for mass production and did not have the flexibility to also produce small volumes of a specific product. At the same time, Taiichi Ohno was fascinated by the idea of the supermarket – a place where everybody could get hold of what they needed when they needed it. A factory that could achieve precisely that was, to his mind, the pinnacle of efficiency.

The path to production at the customer’s pace
In addition to process standardization, the TPS allows processes to synchronize and to coordinate more effectively with one another in order to avoid errors and to continuously optimize entire production processes and machines. The TPS sets out to achieve the ultimate objective – avoiding waste and overproduction – with the help of two underlying principles:

The Jidoka principle is based on the belief that quality should be achieved during production. Post-production repairs or downstream quality checks increase workload and costs. Consequently, production faults are identified and rectified during the actual production process, which in turn avoids unnecessary rejects. For Toyota, this principle centers around the people at the machines. The machines at Toyota signal the errors themselves, but it is

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down to the employees to immediately stop the faulty machine and, if necessary, the entire production line. If there is an underlying problem, the employees get to the bottom of it and propose improvement suggestions for the future.

Every single employee is the expert in their own workstation. Continuously optimizing this workstation is part of the job at Toyota, and is actively encouraged by means of a dedicated bonus system. In 2010, Akio Toyoda, President of Toyota Motors summed it up as follows: “At Toyota, we believe the key to making quality products is to develop quality people. Each employee thinks about what he or she should do, continuously making improvements, and by doing so makes even better cars.” This gives employees more responsibility and it is also in the employer’s interest to make every employee an expert, who is motivated to actively contribute toward continuous improvement.

Toyota views overproduction as the worst type of waste. That’s why the company applies the **just-in-time principle** to produce only what is truly needed. Apart from customer demand, this principle is also based on the specific requirements of the individual lines within the value stream. This is where the Kanban system comes into play. Kanban is an information system, originally operated via small cards that are exchanged between successive production lines. For example, line A, which produces parts for line B, always knows exactly what is needed on line B. Overproduction or a shortage of the necessary parts can be effectively avoided.

**The just-in-time principle is designed to prevent overproduction.**

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2.3 The Bosch Production System

In the 1990s, Toyota’s production philosophy gained more and more attention in the west where it became known as “lean production”. The BPS also builds on the foundations of the TPS, tailoring the objectives and principles and adapting them to the circumstances of the digital age. All the while, the BPS remains scalable, meaning it works for both small-scale and mass-scale production. It is essential that the BPS fulfills this underlying principle so it can be adopted across the hugely varied Bosch plants.

**Scalability is a central principle to the BPS.**

**Point of orientation instead of a fixed target: True North**

The BPS is also primarily focused on maximizing value creation and minimizing waste. However, the BPS does not define a fixed target, but rather points in a direction to provide orientation – known as True North. Much like a ship must keep adjusting its course to align the compass needle, True North is viewed as a waymark that the production team must constantly keep in sight despite ever-changing external conditions. This ideal is defined by four core targets: 100% value creation, 100% delivery fulfillment, zero-defect production, and one-piece flow, whereby a workpiece goes from one process step to the next without any waiting time or any buffer volumes and is ultimately delivered directly to the end customer without the need for any interim storage.

**The so-called True North leads the way in the BPS.**

**True North**

- 100% value creation
- 100% delivery fulfillment
- Zero-defect production
- One-piece-flow

**Eight principles for sustainable and efficient production**

Within the BPS, the metaphorical compass check is a matter of permanently repeating target/actual comparisons. The True North ideal is in fact unattainable, but these eight principles should get production ever closer to the relevant targets.

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Eight principles help to take production closer to perfection

01 Pull principle: according to the BPS, only what is needed by the next production stage or by the customer is actually produced.

02 Process orientation: process steps are always considered holistically in view of the entire process.

03 Fault prevention: preventive measures make sure that errors do not occur in the first place. This saves costs and ensures the highest product quality.

04 Flexibility: adapting products and services to customer requirements in the shortest time frame possible prevents overproduction and safeguards success in the event of unforeseen market changes.

05 Standardization: in the BPS, standards are used to define the current best solution for the overall process. Employees evaluate all standards at regular intervals.

06 Transparency: communication is clearly managed in the BPS and is kept as simple as possible. The production processes themselves also require no further explanation. The simpler a process is, the quicker deviations can be identified.

07 Continuous improvement: even well-established and effective processes are not intended to last forever in the BPS. Instead they are subject to constant re-evaluation.

08 Autonomy: it is important to recognize skills, give freedom and motivation if you want employees to instigate change. Employees are also involved in the development of processes from an early stage.
2.4 The value creation of Industry 4.0 in production systems

Toyota already implemented various tools, such as Kanban. The BPS also has its own portfolio of methods that makes it easier to follow the principles in the long term. Of course, continually improving processes also means making the most of new technologies. This is where the digital revolution comes into play. Digitalization helps to implement the eight defining principles of the BPS in everyday production. However, this can only work if lean managers and developers work together. This allows a system such as the BPS to visibly evolve from a lean production system to a smart production system.

The objective of more value creation and less waste can be achieved even more effectively by integrating Industry 4.0 technologies.

![Diagram](image-url)

**Fig. 4:** Process of value creation in production systems using Industry 4.0, based on Wigand et al. (1997, p. 159)
What makes a smart production system so intelligent is the way it handles data. This new understanding of the production system is characterized by the smallest possible control circuits, maximized value creation and minimized administrative efforts. To achieve this, relevant data must be collected automatically to make it available wherever and whenever needed. This increases quality and reliability without generating too much non-value-creating work for the employees. The ever-growing complexity of manufacturing exposes the limits of human capacity. The number of target/actual comparisons required is sometimes so large that it is practically impossible for employees to keep an overview of everything. What’s more, the time-consuming tasks of conventional documentation methods would reduce the efficiency of the entire production process.

Industry 4.0 technologies make process parameters easier to access. Processes can be recorded in minute detail; deviations are made clearly visible. Adaptive software helps to identify opportunities for improvement sooner. Maximum transparency of entire production processes is attainable – without any Kanban cards or other labor-intensive paper-based methods. For the digital BPS to succeed, however, it is essential that the new technologies and the new software applications are also “lean” and are focused on the value chain. This is often prevented by generations of mismatched IT equipment amassed over the past years.

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Many older software solutions in the industrial sector are proprietary systems and offer only selective support to specific machines or processes. They form islands of knowledge along the value stream with very limited reach. Often only the employees on one individual machine benefit from the information they provide; a comparison is rarely available or very time-consuming. Often there are no superordinate systems that provide a uniform database for everyone involved in the process. When developing innovations for digital manufacturing and logistics, it is essential to ensure an optimum interplay between the software and the production system at an early stage. The vision of working in single steps to contribute toward an overarching goal is the guiding compass for the software structure. The eight principles form a basis for every action and for the cooperation between different functions when creating a long-term, agile zero-waste order processing procedure. They broadly split into three levels that should be reflected in the design of an optimum IIoT system.

**A uniform database** lays the foundation for optimum interaction between software solutions and the production system.
3.1 A three-level approach

Standardization and transparency form the foundation of a software that spans multiple processes and act as the common denominator for all related components. They help to avoid redundancies, make production data available and ready to use. This solid basis of standardized data, in turn, forms the basis for the second level: intelligent data processing, which is vital for optimizing both IT-assisted and manual processes. The focus here is on the BPS principles of process orientation, fault prevention, continuous improvement and the pull principle. The third level addresses the user as an individual: the software must provide a user experience that allows ample room for flexibility and autonomy. This spans from adaptive dashboards to intuitive rule creation.

A uniform database lays the foundation for optimum interaction between software solutions and the production system.

Fig. 6: Based on three levels, different software functionalities can be developed to ensure an efficient implementation of the BPS
3.2 Building the foundations: standardization and transparency

Standardization and transparency are crucial principles within the BPS. **Standardization** means making all processes uniform and implementing best-in-class solutions. A standard in this sense defines the current best course of a procedure that takes place regularly in the same format. While this is already being implemented for production procedures in many companies, it is not yet the case with diverse IT solutions. There are no standardized processes for the creation of master data or access rights across all IT applications, which leads to redundancies, errors and communication difficulties. A possible solution is to create an IIoT system with a foundation designed to serve all applications, thereby taking account of the system’s future growth due to changing needs. This simplifies how master data and user rights are updated, which becomes a standard procedure for the IT administrators. The uniform basis also facilitates connectivity and interoperability across all production lines and even between different plants.

**Transparency** in the BPS is defined as the self-explanatory and uncomplicated process design and documentation, which make all information available and clearly visualized. One way of fulfilling these requirements is, for example, a customizable web portal. By logging in just once, every user can instantly access the available basic default functions, as well as individually selected software elements – and then adapt them to suit their individual needs. Dashboards make all the important information available to the users at a glance, providing maximum transparency across all relevant processes – and enabling them to spot any deviations from the standard as soon as they arise.

Fig. 7: Building the foundations – the first level for merging BPS with IIoT software
3.3 Optimizing processes: process orientation, flexibility, fault prevention, pull principle

**Process orientation** in the BPS consists of the holistic design and optimization of production processes. The idea is to achieve an overall optimum across all departments and functions, rather than just improving individual functions on a one-by-one basis. However, proprietary or individual software solutions only ever permit a blinkered view of a machine. Those who wish to make the entire value chain transparent must also incorporate storage and intralogistics, for instance. Thanks to a shared data basis, consistent use cases will then be easy to achieve.

To retain a competitive edge, products and services must adapt to customers’ ever-changing requirements even faster and more effectively. The BPS therefore stipulates that production should be able to accommodate new processes at any time – no matter what size the system has reached. The Industry 4.0 software must support this flexibility, which sometimes presents highly complex challenges at many levels: from the fast integration of new machines to ad hoc production changes that affect entire lines. A fully scalable IIoT system helps to keep investment low, while remaining as flexible as possible to enable a gradual introduction and expansion of the relevant solutions. Open interfaces and lean communication protocols make an IIoT software well prepared for any eventuality.

The entire value stream – including storage and intralogistics – is taken into account in the BPS. Hence, holistic Industry 4.0 solutions must also include these areas.

A freely scalable IIoT system provides the required flexibility for manufacturing operations.
The principle of **fault prevention** makes it mandatory to have preventive measures in place to reduce rejects and downtimes. The overall target of this vision is “zero defects”. The idea is to get closer and closer to this ideal state. This can only happen if the software ensures maximum transparency across all processes and provides the requisite tools to create rules quickly. Real-time process analysis allows complex procedures to be monitored live at any time. Systematic faults are identified earlier thanks to this clear overview; the causes can be isolated quickly by comparing different data. If the system also sends warning notifications directly to an appropriately qualified and, most importantly, available person, rejects are avoided efficiently before it is too late. A further step toward the “zero defects” vision consists in incorporating fast and targeted external assistance. A system that fully supports external access and remote maintenance gives every opportunity to make full use of innovative digital services – such as connecting to experts in the event of unexplained deviations.

The **pull principle**, i.e. the needs-based production process strictly governed by order requirements, is also easier to implement when using the right software: every product has its own unique, optimum ratio between stock and ad hoc production at the time the order is received. Special applications designed to facilitate the intelligent logging of circulated and stored materials, as well as the dynamic allocation of production lines, represent a major advantage.

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**Fig. 9:** Optimizing processes part 2 – the second level for merging BPS with IIoT software

Software tools such as real-time process analysis minimize rejects and machine downtime effectively.

The pull principle can be implemented with low effort with software designed for stock optimization.
3.4 Focus on individuals: continuous improvement and autonomy

In the BPS, **continuous improvement** means always seeking to develop further and hit more targets, always questioning established standards and systematically working to avoid waste. Combined with the principle of autonomy, which is intended to actively promote improvements, employees should always be thinking independently and creatively, seeking opportunities for potential optimization. Of course, the employees need the motivation to do so, which is unfortunately hampered by software-related barriers and stumbling blocks in many companies. If an employee has only limited access to data, or none at all, and no chance to make independent adjustments to processes, they are not equipped to act autonomously.

An optimum IIoT system grants every employee in the organization, from machine operator to director, the potential for maximum **autonomy**. This begins at the decision-making stage when a new Industry 4.0 solution is chosen. The employees’ pain points and their experience with the equipment play an integral role in choosing the right software functionalities. Furthermore, if eventual users are actively involved at this stage, they are more likely to accept the digital solution. An intuitive operating system, clearly designed user interfaces and easy-to-use optimization tools all help users to familiarize with the software quickly. A simple rule creation, for example, gives them the chance to take an active part in minimizing rejects and reducing downtimes. By adjusting limit values for error messages, they can spot wear and tear earlier and intervene before the machine malfunctions.

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**Fig. 10:** Focus on individuals – the third level for merging BPS with IIoT software

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**Continuous improvement**

Equipped with the right information, employees will proactively drive improvements forward.

**Autonomy**

An intuitive operator guidance is a fundamental requirement to enable every employee to work autonomously with the IIoT software.
BPS and Industry 4.0 in practice

The theory of production systems interacting with lean-oriented Industry 4.0 software became a reality quite some time ago. The following three examples reflect the three-level approach and demonstrate how the right software solution is already contributing to an efficient implementation of the BPS principles.

**Fig. 11 and 12:** Employees are ideally supported in their daily work thanks to BPS methods and Industry 4.0 software solutions
4.1 BSH Hausgeräte GmbH: cross-plant transparency thanks to user-friendliness and standardized roll-out

In the context of complex manufacturing operations, transparency means keeping an eye on even the smallest machine parameters. BSH Hausgeräte GmbH uses the Condition Monitoring module from the Nexeed Industrial Application System. The module has already been set as the standard for Industry 4.0 use cases at 16 plants operated by the household appliance manufacturer, with more to follow suit. For specific use cases, the software collects the data from the machines, harmonizes it and makes it accessible for the employees. This means production can be monitored easily and optimized for the long term.

During the initial introductory phase of the module, simple use cases are implemented, such as monitoring the temperature and pressure values of machines. To allow for a fast response in the event of an emergency, employees initially determine the rules themselves. For example, the temperature at a particular point in a press should not exceed 65 °C. At the same time, the employees determine how the software ought to respond in an emergency, for instance by sending an email to the responsible maintenance engineers. The engineers will see a graphic representation on their tablet, showing the temperature and pressure curves, enabling them to draw conclusions as to the cause of the problem and take appropriate remedial action. This effectively prevents machine downtime, production outages and consequential damages.

Introducing the software is made especially easy by the standardized process. The responsible employees use a specific roll-out package to check whether all the necessary micro-services of the BSH MES platform are set up in the plant. If they discover they are not set up, a couple of clicks is all it takes. The set-up is the same for every plant. The employees on site can then apply machines and rules to the system themselves in order to create further use cases autonomously. Various guides are available to help; no prior programming knowledge is required.
When it comes to intralogistics, efficiency and flexibility naturally go hand in hand. The Bosch plants at Feuerbach and Homburg (Germany) already had ingenious systems and initial digitalization methods in place. Still, efficiency was being hampered by static milk run routes, accounting errors and high inventory costs. These problems should soon be a thing of the past thanks to the Nexeed Industrial Application System.

The Stock Management module now allows the Feuerbach plant to see real-time bookings, providing maximum transparency regarding the current stock of materials in the supermarket. An automated ordering system makes the employees’ work easier and helps to keep material stocks lower, since, in line with the pull principle, the software only orders what is required. The module also identifies the optimum use of the available aisles to ensure additional space gains. If an employee accidentally sorts materials into the wrong aisle, a “put-to-light” signal notifies them of the error and directs them to the correct aisle. This effectively prevents errors, thereby avoiding time-consuming searches for misplaced stock.
In the Homburg plant, the internal material transport system was also optimized by a module from the Nexeed Industrial Application System. Despite carefully considered processes and digitalization methods in the form of RFID Kanban, the milk runs were still falling notably short in terms of efficiency. As is often the case in production plants, Homburg had fixed routes that were followed without fail – irrespective of the actual requirements. Higher transport costs at peak times, particularly through the additional use of AGVs, resulted in greater complexity on the shop floor. The Transport Management module increased flexibility and efficiency. The software begins by providing the necessary transparency, which in turn facilitates a dynamic route planner for all the plant’s transport operations. It collates all orders in real time, coordinates them with the data from the milk runs and sends the optimum route straight to the drivers’ tablets. They then only drive where they are actually needed. This mitigates the spikes and ensures a more even utilization of the milk run capacity.

Fig. 15: Dynamic milk run route planning at the Homburg plant improves efficiency in intralogistics
4.3 Permanent and autonomous process optimization at the Bamberg plant

The Bamberg plant produces components for gasoline and diesel engines, as well as for fuel cells in over 40 value streams. As a startup and lead plant, it is responsible for 20 plants in 13 countries. The fully automated lines are currently the flagships in terms of digitalization and Industry 4.0 for the latest generation of high-pressure injection valves – and not only in Bamberg, but also in the International Production Network (IPN). In retrospect, considering digitalization during the product creation phase was a key success factor. The line availability (OEE) of the first series production line in Bamberg was sustainably increased to a top level, followed by the lines that were later installed in the IPN. This outstanding performance is possible thanks to Industry 4.0 and digitalization solutions.

The Bamberg line and the lines in the international sister plants are equipped with the uniform Nexeed Manufacturing Execution System and the downstream Information Factory. This makes it possible to compare the data of the lines and to incorporate improvements in a timely manner. Thanks to the installed sensors, the Condition Monitoring module from the Nexeed Production Performance Manager (Nexeed PPM) also records valuable information about the condition and functionality of all components. The process engineers and production planners autonomously store tolerances in the Nexeed PPM and adjust them as required. If a value exceeds or falls below a defined limit, the software sounds an alarm – via notification on the Andon board, visualization of the production key figures from the Nexeed MES accompanied by the simultaneous flashing of a signal light. The employees on the line assess the situation on the basis of the data and initiate the appropriate measures.

However, the digitalization measures for process optimization are not yet complete. They will be further developed in cooperation between the Bosch Industry 4.0 and IT units and the Bamberg plant. Additional solution suggestions for troubleshooting will be available in the Condition Monitoring module in order to maintain and improve the high availability of the lines. To do so, the individual Nexeed solutions will be transferred to the Nexeed Industrial Application System and developed further.
If, for example, a similar problem has already occurred, employees will be able to understand how their colleagues from the other shift solved the problem, which will save them valuable time. Specific problem areas from day-to-day work with the system and the experience of the maintenance technicians will be the focus of the Condition Monitoring module and will serve as a source of information for the entire network. The aim is to use the potential of the employees even more efficiently. Employee motivation is also strengthened: the software solutions enable them to solve problems independently and without time-consuming troubleshooting, and thus actively contribute to maintaining machine performance. The production planner or process engineer can use the extensive database and the information derived from it to define key topics. The team can discuss complex relationships on a solid fact base. Thanks to the extensive amount of available data, the future focus will be on error prevention and process optimization.

Fig. 16: Continuous and autonomous improvement of the production lines at the Bamberg plant thanks to detailed software-supported data
As much as the examples vary, the superordinate software that provides the foundation for the systematic implementation of the BPS is the same: with the Nexeed Industrial Application System, Bosch Connected Industry has developed a tool that can systematize all Industry 4.0 solutions. Whether at BSH, in the intralogistics departments of the Homburg and Feuerbach plants or on the fully automated production lines in Bamberg, the software acts as “enabler” for the implementation of the BPS principles. In an interactive process, it can adapt continuously to meet the company’s needs, while focusing on the human users. The target: True North; i.e. no rejects, no downtime, maximum efficiency. This is only possible when lean manufacturing and IIoT software interact seamlessly with each other. At the same time, the BPS serves as a compass and a guideline for future developments and software upgrades.

It is the very essence of the BPS to improve not only its own process, but also its own optimization tools. This means the development of the smart production system fusing lean manufacturing with Industry 4.0 is far from over. Carrying on from the current optimization tools, Artificial Intelligence (AI) is already being used in test applications for the factory of the future. The process data that is already being gathered and processed forms the basis for intelligent algorithms, which continuously analyze and evaluate process curves to learn from them. The continuous improvement of processes will no longer be down solely to the employees who use the software both as tool and as source of information. Instead, the software itself is also responsible for developing an increasingly precise algorithm. It will no longer simply record irregularities based on limit values for experts to then manually define. Instead, the software independently recognizes correlations and can suggest new rules to the experts. Well-trained AI will in future be able to collaborate with the employees in a close team relationship. Both human and machine will then contribute their valuable expertise to the continuous improvement of even highly complex processes.
About Bosch Connected Industry

Bosch Connected Industry offers software and services for Industry 4.0 in a comprehensive portfolio under the name NEXEED. Based on the needs of its own Bosch plants and warehouses, NEXEED optimizes manufacturing and logistics processes in terms of transparency, agility, costs, quality and time and supports employees in their daily work. With NEXEED, Bosch Connected Industry enables the digitalization of the entire value chain. Employees at locations in Germany, Hungary and China are continuously developing the portfolio. In addition to the interoperable Nexeed Industrial Application System for connected manufacturing, customers also receive individual solutions for specific applications, retrofit solutions for existing plants, as well as a wide range of services such as consulting, technical support, employee qualification, and implementation assistance.

For further information: www.bosch-connected-industry.com

Robert Bosch Manufacturing Solutions GmbH

PO Box 30 02 20
70442 Stuttgart
Germany
+49 (711) 811 10 900

Industry4.0.bci@de.bosch.com
www.bosch-connected-industry.com

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