

Media Information
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Smart Data Analytics: BMW Group relies on intelligent use of production data for efficient processes and premium quality

- Data analysis creates growing added value for continuous improvement in the production system
- Tangible improvement in system availability through connected production: Every minute saved means another vehicle built
- Intelligent data management enables more accurate prediction of wear and guarantees consistently high quality – with reasonable cost and effort

Munich. Building a car generates massive amounts of data throughout the value chain. The BMW Group uses its Smart Data Analytics digitalisation cluster to analyse this data selectively and enhance its production system. Results from intelligent data analysis make an effective contribution towards improving quality in all areas of production and logistics.

Data-driven improvements to processes and systems help reduce lead times and lower costs. New solutions are being developed not only at headquarters, but at many different points in the international production network. In this way, the BMW Group is able to take advantage of a wide range of innovations that open up additional options for even more flexible production. The company uses an access-protected intranet-of-things platform to link the large quantity of sensor and process data from production and logistics quickly and easily. Smart Data Analytics therefore offers completely new opportunities that extend far beyond previous analysis possibilities. The speed with which new solutions can be implemented is increasing significantly. At the same time, new IoT sensors, combined with cloud and big data technologies, are reducing the technical complexity and implementation costs involved.

Christian Patron, head of Innovation and Digitalisation in Production System: “Smart Data Analytics is setting new standards for our production system. By combining the experience of our staff with new possibilities for efficient processing of large data volumes, we are able

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to create accurate forecasts and proactively optimise processes. This speeds up continuous improvement of our production system in line with the basic principles of lean production.”

Numerous use cases implemented in various manufacturing sections demonstrate the benefits of Smart Data Analytics.

Laser-marked body parts: fine-tuning for presses; body parts traceable at all times

Steel coils up to 40 tonnes in weight and about three kilometres long are cut into blanks in the press shop and then formed into body parts. However, sheet thickness, strength, surface texture and degree of oiling are not uniform throughout the coil. Deviations from target can lead to cracks in body parts that are subjected to particular stress during the forming process. This is where the Smart Data Analytics application at BMW Group Plant Regensburg comes in. A laser is used to mark each blank with a multi-digit code, which serves as its own ID. Going forward, this ID will allow the presses to be fine-tuned to accommodate the characteristics of the blank. If needed, the ID may contain a control command, which triggers additional oiling of the blank in the press before forming, for example.

This clear marking enables the blank to be identified at any time. Each body part is assigned information that remains available throughout all subsequent production steps. Since the blank stays in its production line for marking, the ID is assigned without any cycle downtime. The ID is designed so that it remains visible throughout car body construction. BMW Group planning specialists already take advantage of the traceability of all parts for further optimisation involving additional algorithms. For example, taking into account the characteristics measured for each individual body part, the gap dimensions of the finished body can be further optimised, or the paint application better matched to the surface of that particular body. Fine-tuning of press parameters according to the properties of the blank is already having a major impact: The number of scrapped parts is significantly lower, with better utilisation of the coil material. The system downtime required for fault analysis is also reduced.

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Predictive maintenance for body shop robots, welding tools and drives

Smart Data Analytics applications offer especially high potential for increasing the availability of production equipment and machines in highly-automated areas of manufacturing. Maximum accuracy in predicting any risk of breakdown largely helps avoid unplanned system downtime. Based on the forecast, maintenance staff can plan a targeted maintenance intervention to limit downtimes to an absolute minimum. This so-called predictive maintenance is enabled by intelligent analysis of large quantities of real production, sensor and process data: Targeted analysis of this information makes it possible to determine the ideal time to replace wearing parts used in production. If the change is made too late, there is a risk of production stoppage; made too early, valuable resources are wasted. Without the relevant data on which to base this decision, the purely preventive maintenance of the past was conducted without knowing the actual state of wear. This method required allowing safety margins for the timing of the changeover, but could not detect unexpected breakdowns.

Data-based solutions for predictive maintenance are used at various stages in car body production to predict gear and brake wear in robots. Sensors in welding tongs signal ahead of time when defects or quality problems are likely to occur. Widescale sensor monitoring also improves the reliability of the electrical drives used in a variety of systems, including lifts and turntables. Robots and control technology are fitted with the necessary sensors from the start. Maintenance staff analyse the data and then draw the right conclusions. Recent evaluations of predictive maintenance clearly demonstrate the benefits for reliable operations.

Online process controls: Even more stable processes guarantee top quality

The BMW Group received the Prix de la Technique 2017 at the prestigious Surcar Congress in Cannes for its concept for comprehensive paint shop digitalisation at the company's new plant in San Luis Potosí, which will begin series production in 2019. BMW Group paint shops already use sensors for ongoing monitoring of automated production processes. Intelligently networked systems enhance the stability of process sequences, enable predictive maintenance and ensure the highest quality for our customers. Online process control combines the strengths of algorithm-based analysis of large data volumes

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with employee experience: As a result, humans can focus more on their role as architects of the production process, since real production data is sorted and optimally pre-structured for them. Error potential can be detected in time and rework avoided.

In May 2017, the BMW Group began using fully-automated quality control for the first time at its Munich plant, with robots scanning the entire outer vehicle surface. The system is capable of detecting errors the human eye cannot perceive. The data obtained in this way also provides valuable feedback on the precision of upstream painting processes – allowing continuous optimisation and timely identification of defect potential.

Fastener data analysis: More reliable error prevention benefits thousands of bolted connections

Bolted connections are fundamental to automobile production, since every vehicle contains several hundreds of them. The BMW Group monitors and analyses all bolted connections that are relevant to the safety of the vehicle. Basically, bolted connections that do not, or only partly, meet the desired specifications may require rework. As part of its preventive quality strategy, the BMW Group has developed algorithms that have been analysing bolted connections in more than 3,200 assembly systems at all vehicle plants since July 2017. Recording and analysis of bolting process curves provide accurate feedback on the quality of bolted connections. The programme can recognise different types of fault and show possible sources of error in a cause-and-effect diagram. The BMW Group uses this information to train and qualify employees for preventive quality work – after all, a mistake that is not made does not need correcting. A trainer at a mobile training station or directly at the workplace can also provide tips on error avoidance.

Analysis of bolting process curves also provides important insights for systematic monitoring of bolting systems and parameters, such as tightening torque. When implemented quickly, these findings create a closed loop of continuous improvement.

In many cases, purely manual analysis of bolting process curves would only result in a finding of "acceptable" or "not acceptable", without identifying the cause of errors or highlighting potential for improvement.

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Predictive maintenance for materials handling in assembly

The BMW Group production system is characterised by the highest degree of flexibility: The company produces an especially wide range of models and variants on its assembly lines, but is nevertheless competitive – as confirmed by independent benchmarks. On the assembly line, a reliable supply of materials is particularly important. A breakdown at any point could cause the entire production area to grind to a halt.

In assembly, many conveyor systems are now equipped with a large number of sensors that monitor various factors – especially temperature, vibration and electrical power. These sensors are cost-effective enough to allow them to be widely used. Data from these sensor kits and other process data is streamed live to the BMW internet-of-things platform, where it is visualised and analysed in real-time. If the data detects a trend indicating deviation or patterns from previous breakdowns, the platform notifies maintenance staff. Staff can then decide whether the hanger should be removed for maintenance. In this way, it is possible to ensure long-term, reliable operation of the conveyor system over a number of years.

Every minute saved means another vehicle built

Christian Patron: “In automotive production, every second counts: If a part isn’t available on time or a system fails, the production process is delayed and it disrupts the value chain. Intelligent use of production data ensures a stable and efficient process. We see tremendous potential in Smart Data Analytics for incorporating feedback from our customers into development and production even faster.”

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The BMW Group production network

Strong customer demand and the launch of new models resulted in very high capacity utilisation for the BMW Group's production network in 2016. With 2,359,756 vehicles produced for the BMW, MINI and Rolls-Royce brands, production volumes reached a new all-time high. This figure included 2,002,997 BMW, 352,580 MINI and 4,179 Rolls-Royce units. The company's German plants, which produced more than one million vehicles, are responsible for roughly half of production volumes.

With its unparalleled flexibility, the leading-edge production system is in excellent shape for the future. Based on Strategy Number One NEXT, it is characterised by a high level of efficiency and robust processes. The BMW Group's production expertise represents a decisive competitive advantage and contributes to the profitability of the company and its sustainable success.

Quality and speed of reaction are key factors in the BMW production system, as well as flexibility. Digitalisation, standardised modular concepts and intelligent composite construction testify to the high level of expertise within the production network. At the same time, the production system offers a very high level of customisation and allows customer specifications to be modified up until six days before delivery.

The BMW Group

With its three brands BMW, MINI and Rolls-Royce, the BMW Group is the world's leading premium manufacturer of automobiles and motorcycles and also provides premium financial and mobility services. As a global company, the BMW Group operates 31 production and assembly facilities in 14 countries and has a global sales network in more than 140 countries.

In 2016, the BMW Group sold approximately 2.367 million cars and 145,000 motorcycles worldwide. The profit before tax for the financial year 2015 was approximately € 9.22 billion on revenues amounting to € 92.18 billion. As of 31 December 2016, the BMW Group had a workforce of 124,729 employees.

The success of the BMW Group has always been based on long-term thinking and responsible action. The company has therefore established ecological and social sustainability throughout the value chain, comprehensive product responsibility and a clear commitment to conserving resources as an integral part of its strategy.