

How Bosch uses AI in manufacturing: examples from Bosch plants

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Bosch plant in Ansbach: This plant manufactures printed circuit boards for use in control units for ABS and ESP as well as for electronic steering systems. In the assembly of these boards, particular attention has to be paid to the solder joints: there are between 5,000 and 8,000 of them on each board. The Ansbach plant uses an AI-based measuring process to check whether all circuit-board elements are soldered correctly. If this is not the case, an image of the faulty solder joint is presented to experienced visual inspectors for evaluation. All in all, the inspectors now receive only a fraction of the images they previously had to review. The AI significantly reduces the visual inspectors' workload, improves the quality of the results, and increases productivity.

Bosch plant in Blaichach: The plant in Bavaria also uses AI for quality control. At the Immenstadt site, the screen at the test bench for ABS systems lights up red to show the assembly workers if the component being tested is defective. This information is provided by a self-learning system that uses the data it has collected to recognize error patterns and, in this way, to distinguish relevant error messages from non-relevant ones. Weekly retraining of the algorithms continuously improves the high success rate.

Bosch plant in Changsha: At this plant in China, Bosch has introduced an AI-based energy management system that it developed in-house. The system relies on AI algorithms to predict energy consumption on production lines, enable continuous production scheduling, and incorporate business and environmental factors. These factors include forecasts of customer demand, production plans, weather, temperature, and humidity. This saves energy and reduces emissions. With the help of the AI solution, the Changsha plant was able to cut its annual electricity consumption by 18 percent and carbon dioxide emissions by 14 percent. For its achievements, the plant was singled out as an Industry 4.0 lighthouse by the World Economic Forum in 2022.

Bosch plant in Charleston: At this U.S. location, Bosch manufactures mobility solutions such as ESP, electric motors, and fuel-injection valves. The plant uses a root-cause analysis to investigate causal relationships that can lead to rejects at the end of the production process. AI software lends support to this analysis by sifting through the billions of data points that a manufacturing execution system (MES) collects and records during production. From this data, the AI derives possible correlations between the measured values and quality deviations in the production line and sets them out clearly on a dashboard, where associates see a ranked list of possible causes sorted by descending probability.

Bosch plant in Dresden: In this wafer fab, which went into operation in 2021, the company employs an AI system developed by its own researchers to detect anomalies and faults in the manufacturing process at an early stage. Predictive maintenance means that work on machines and systems is carried out as necessary. Artificial intelligence guarantees high process stability in the wafer fab and increases quality continuously. This saves customers time-consuming tests and curtails month-long trials. As a result, Bosch not only manufactures faster, but can also be relied on to deliver on time.

Bosch plant in Mexicali: At this plant in Mexico, AI uses noise analysis to check the quality and functionality of the multifunctional tools manufactured on-site. Once production is complete, a microphone “listens” to the tools for three seconds before the AI software delivers its verdict: OK or not OK – and the results are much more reliable than is possible for human inspectors. Around 300,000 tools were tested during development of the AI solution. The plant aims to use this process to inspect over one million products per year.

Bosch in Reutlingen: Artificial intelligence is also used in production scheduling at highly automated wafer fabs such as the Bosch plant in Reutlingen, Germany, where it saves time and costs as it guides the wafers through up to 1,000 processing steps. The AI has an overview of all the materials available for a manufacturing step and sorts them on the assembly line so as to achieve optimum throughput. In many instances, production sequencing is determined completely by AI, thus ensuring optimum utilization of capacity.

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The company was set up in Stuttgart in 1886 by Robert Bosch (1861–1942) as "Workshop for Precision Mechanics and Electrical Engineering." The special ownership structure of Robert Bosch GmbH guarantees the entrepreneurial freedom of the Bosch Group, making it possible for the company to plan over the long term and to undertake significant upfront investments in the safeguarding of its future. Ninety-four percent of the share capital of Robert Bosch GmbH is held by Robert Bosch Stiftung GmbH, a charitable foundation. The remaining shares are held by Robert Bosch GmbH and by a corporation owned by the Bosch family. The majority of voting rights are held by Robert Bosch Industrietreuhand KG, an industrial trust. The entrepreneurial ownership functions are carried out by the trust.

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