Enhancing plant maintenance with real-time predictions of robotic arm failure

"INDUSTRY 4.0 connects embedded system production technologies and smart production processes to pave the way to a new technological age which will radically transform industry and production value chains and business models."
Germany Trade and Invest

Foreword

The aim of Industry 4.0 is to advance smart factories, cyber-physical system consisting of smart machines, hybrid storage locations, and production facilities capable of autonomously exchanging information, triggering actions, and controlling each other independently. However, with great vision come great challenges. The manufacturing industry is looking for improved productivity, better quality products, and shorter lead time to market but faces a significant shortage of skilled labor. Deloitte[1] predicts that by 2025 there will be over two million unfilled manufacturing jobs. Amidst a declining workforce, manufacturers need solutions that allow them to operate plants efficiently and effectively without major unplanned shutdowns.

According to the US National Response Center[2], it costs approximately 50% more to repair a failed asset than it does to preempt the problem. Cost, together with safety, availability, and reliability, is therefore a primary reason why key industrial players are investing in predictive maintenance of plant assets.

In an automotive manufacturing unit, for example, robotic arms are a regular feature in assembly lines. They perform various tasks, such as welding, gluing, and cabling of the automotive parts. Scheduled maintenance of these robots is a given in this industry, especially since any malfunction brings the entire assembly line to a halt. According to Nielsen[3], downtime costs the auto industry $22k/minute, thus automotive manufacturers look for any possible means to avoid it.

Solution

One of our clients, a German automotive multinational operating in the premium and commercial vehicle manufacturing space, faced couple of problems with their robotic arms.

Chassis welding programs have different time, power, heat, and energy requirements. Frequent changes to these robot-driven welding programs were causing recurrent failure in chassis welding. Every Welding out parameter (WOP) would disqualify vehicle chassis to move to next process. Movement of faulty chassis to assembly line were leading to further cost escalation and delays.

Capgemini designed a scalable yet dynamic predictive maintenance solution that reduced human intervention and cost of sudden breakdown of the robotic arms by predicting genuine failure at least 1 to 2 days prior.

The solution created a model which identified failure and triggered preemptive action along with a malfunction score based on Machine Learning's (ML) decision-tree and random forest algorithms. With the help of profiling and clustering techniques, WOP could be identified for recognizing pockets of failure that resulted in chassis disqualification.
This innovative model thus tracked resistance spot welding (RSW) also.

This point solution was built on MS Azure platform with power BI reporting. Exploration of robot failure prologue, correlation between failures during the program, identification of probable program sequences that lead to failure and a couple of other features helped the customer with a much-needed holistic view of the robotic arm malfunction. Power users were thus equipped with actionable insights.

Benefit

Thanks to its predictive model and prior alerts feature, the business benefit achieved by the customer was huge – with savings of up to 350 hours of operational downtime saving per year, for over 600 assembly line robots.

Figure 1: **Malfunction Score by Date and Malfunction Type**

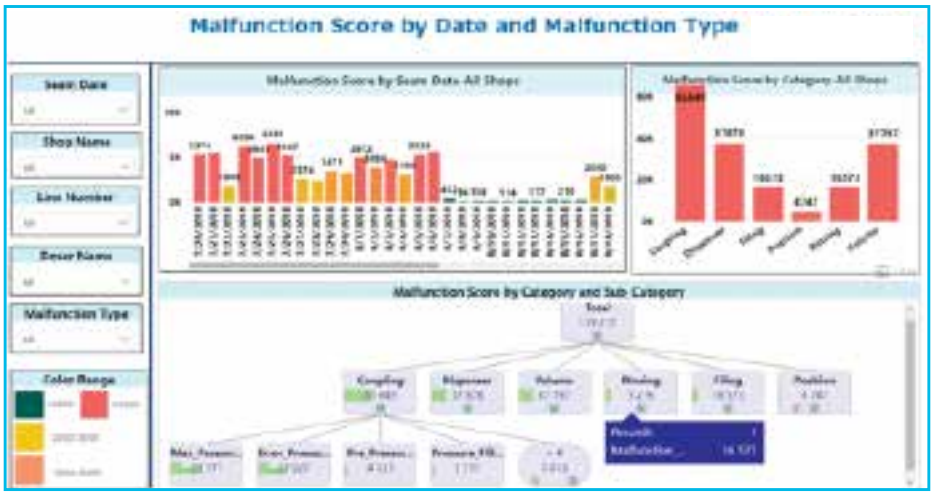
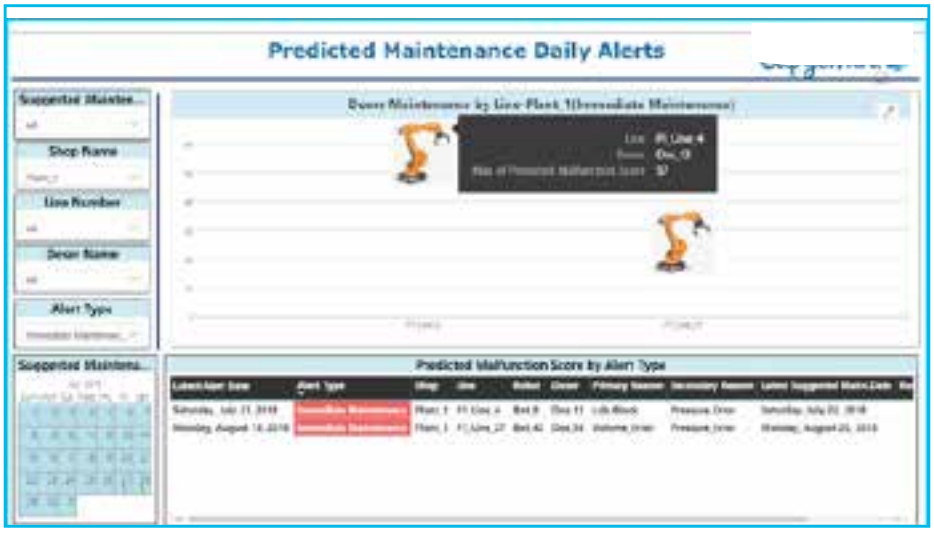


Figure 2: **Predicted Maintenance Daily Alerts**



Citations:

1 https://www2.deloitte.com/us/en/pages/manufacturing/articles/future-of-manufacturing-skills-gap-study.html
2 https://www.emerson.com/documents/automation/prediction-protection-for-production-assets-en-50282.pdf
3 https://news.thomasnet.com/companystory/downtime-costs-auto-industry-22k-minute-survey-481017

About Capgemini

A global leader in consulting, technology services and digital transformation, Capgemini is at the forefront of innovation to address the entire breadth of clients' opportunities in the evolving world of cloud, digital and platforms. Building on its strong 50-year heritage and deep industry-specific expertise, Capgemini enables organizations to realize their business ambitions through an array of services from strategy to operations. Capgemini is driven by the conviction that the business value of technology comes from and through people. It is a multicultural company of 200,000 team members in over 40 countries. The Group reported 2017 global revenues of EUR 12.8 billion.

Learn more about us at
www.capgemini.com
www.capgemini.com/insights-data
www.linkedin.com/company/bi-big-data-&-analytics

or follow us on Twitter **@capgemini.com**

or contact us at **insights@capgemini.com**

To get a demo of the solution, contact us:

Rajesh Ozarkar
rajesh.ozarkar@capgemini.com

Kumkum Datta
kumkum.datta@capgemini.com

MACS CS AP 20190109

Capgemini

People matter, results count.