A case study on innovations in automation in the automobile industry

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Abstract — *The automotive sector has always been at the forefront of automation & robotics, since it is heavily dependent on precision in all it's tasks. Constant innovations in the sector make it a viable opportunity for deriving observations for the future of automation. This paper aims to put some light on a few of the automation applications that have secured their place in the industry.*
Keywords *— automotive, automation, robotics*

I. Introduction

The global automotive finance market size was USD 248.10 billion dollars in 2020 and is projected to grow to 385.42 billion dollars in 2028[1]. The birth of industrial robotics was done by the automotive sector; Unimate was the first industrial robot,[2] which worked on a General Motors assembly line at the Inland Fisher Guide Plant in Ewing Township, New Jersey, in 1961. From there, automation has found its place in every part of the automotive supply chain, from manufacturing to the end-user experience.

II. Discussion

Ducati's Desmodromic engines

The most important stage of the Ducati Desmodromic camshaft production process is carried out on two Stama machining centres. The machines work non-stop throughout the year producing camshafts for all the different Ducati engines. Great precision is required when making the shaft, with the rather elaborate machining process carried out entirely within the factory.

It is a very expensive component, made of a special steel alloy, and a tool breakage during the camshaft production process would be particularly serious and could result in scrap, costly re-machining and wasted time. There could also be damage to the machine spindle which, when added to the cost of the specialist tools themselves, would total thousands of Euros.

Non-contact tool setter systems were installed on two work centres: immediately after a tool is loaded in the spindle ready for machining, it crosses the device's beam at a set height. If the cutting tip is broken, for example instead of being 100mm long it is 97mm, the laser system triggers an alarm. E each tool has its own length, diameter, etc. and the system takes this into account when the tool passes through the checking beam.

The system also allows us to check for breakages of small tools used to make keys and other reference points on the cam, which are vital if the engine is to operate properly. If it wasn't for the system, the machine could, for example, operate with a broken cutting tip, with disastrous results. Furthermore, since tools are checked for breakage automatically, one operator can easily manage both machines: all he needs to do is load the pieces and ensure that everything is running smoothly

Toyota reduces energy emissions

Toyota aims to eliminate CO2 emissions from its global production plants by 2050. To meet these goals, Toyota is taking steps to both reduce its energy usage and move to reusable energy. These efforts are helping Toyota not only shrink its environmental footprint – they're benefitting the bottom line.

Workers at Toyota's Huntsville plant receive engine components that have been cast at other facilities to machine and assemble them into the engines that will go into vehicles at yet other facilities.

The plant's air compression system is crucial to the production process. Comprised primarily of five large centrifugal air compressors, the system provides air across the 1.2 million-square-foot plant for various machine processes, automation, and drying engine components.

Compressed air (CA) systems are energy-intensive by nature. The system at the Huntsville plant is no exception; it accounts for 25% of the plant's annual energy costs. The plant's electrical contract created more challenges. The contract charges more for energy consumed during peak usage hours. When team members needed to start one of the large compressors during these times to keep the plant at capacity, a single machine start-up could increase the plant's electricity bill by 100% of one day's energy charges.

For the job, they turned to IZ Systems and Case Engineering. The company delivered a two-part solution that included local and plantwide controls.

Locally, Case migrated the controllers on the five large compressors to its AirLogix control solution. The solution is based on the CompactLogix control platform and includes a PanelView Plus 7 operator interface to give workers performance and diagnostics data at each compressor.

At the plant level, Case used its AirMaster load-sharing solution to create a master air control system. This solution is based on the ControlLogix platform and uses the FactoryTalk View SE software for data collection and visualization. Case worked with IZ Systems who also installed a 5,000-gallon storage tank for boosted CA of 500 PSI to allow the system recovery time without faulting. A modulating valve delivers air during high air demand periods. This stored air provides a smooth transition when an additional centrifugal machine is required to meet the plant's air demand.

The new, more efficient air compressor controls have helped the Huntsville plant reduce annual energy usage by nearly 1 million kilowatt-hours per year. This doesn't include the savings realized by avoiding start-ups during peak-usage hours.

As a result, the plant recovered its investment in the new controls faster than its goal of two years.

Tata migrates to a new manufacturing execution system

The Tata Motors passenger vehicle plant in Pune, India, manufactures the Zest, Bolt, Indica, and a variety of other models in multiple variants. Since the existing system was beginning to show early symptoms of aging, so the plant managers and engineers recognized that their 6-year-old Manufacturing Execution System needed an upgrade. The plant was facing system availability issues stemming from sporadic server failures, which if continued or became worse, it would prove difficult to meet the high availability expectations of users. The company also wanted an MES system with automated, real-time, information-sharing capabilities through quality gates.

To improve the speed of interlinked quality-related communication, system-based feedback and feed forward mechanisms were implemented. This would help faster actions to support achievements of quality benchmarks. Tata decided to go forward with Rockwell automation's FactoryTalk ProductionCentre (FTPC) software, which is software built for supporting an ecosystem of advanced industrial applications.

Since the company wanted to transition from the old system to new system with minimal downtime, the team built data bridges between the old and the new system that could run parallel during the migration process.

The data captured by one system was transferred via a data bridge to the other system. The progressive migration approach meant that if any failure occurred during transition, the development team could switch back and forth between the two systems without affecting production.

The Tata Motors team managed the migration with a downtime of just 0.1 percent and no loss in production. As soon as a defect is detected at a quality gate, an alarm is issued through the gate, and depending on the defect category, messages are sent to the supervisors and managers through the system. Prompt corrective and preventive actions are taken.

By transitioning to the FactoryTalk system, the team strengthened operational consistencies and provided visibility for decision support within the Pune plant. Plus, they could also help enable a Connected Enterprise by integrating with Tata's other two plants and standardizing communications, applications, processes and technology.

III. Conclusion

The automotive industry is rapidly exploring places where they could automate their processes in order to reduce their cost. This continuous innovation will likely transfer to newer subsets of the industry, like electric vehicles. Undoubtedly, the automobile industry has made tremendous advances in process automation, and considerable progress in data automation.

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