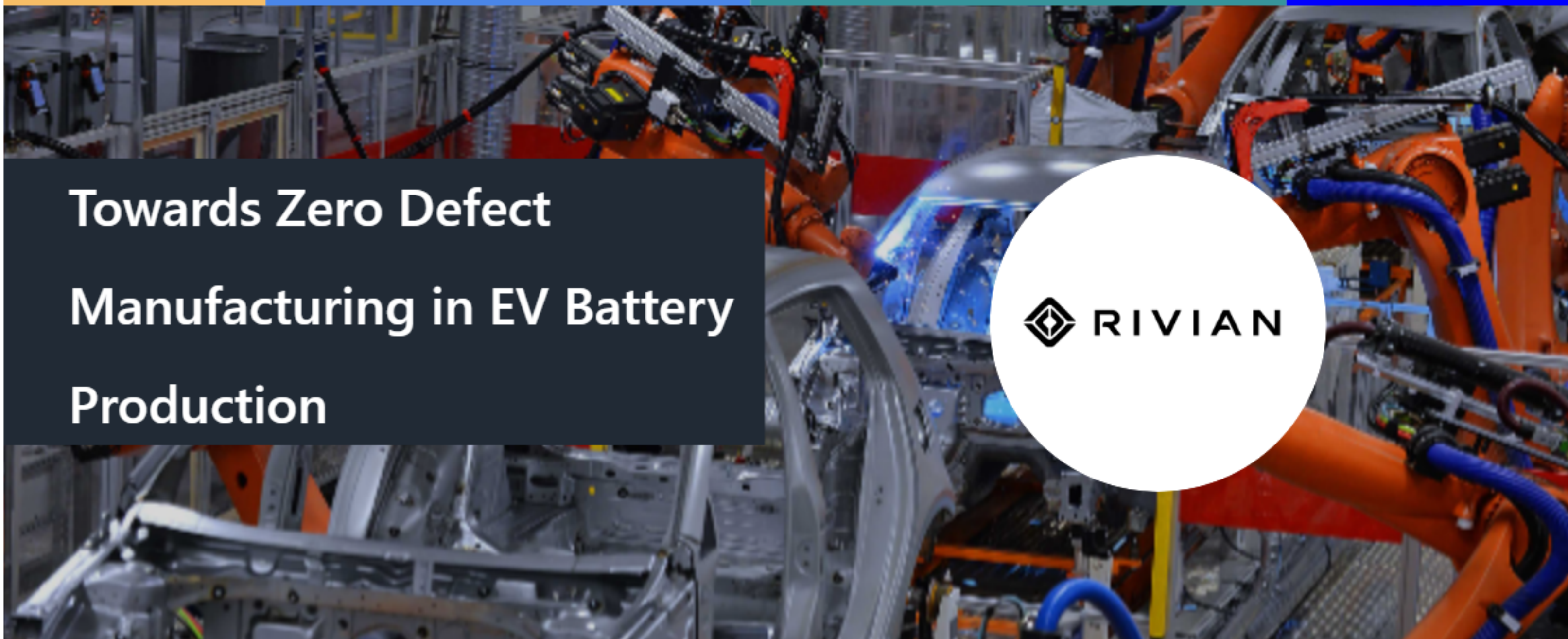
Quality | Automobile manufacturing | Improved process performance | Classifiers



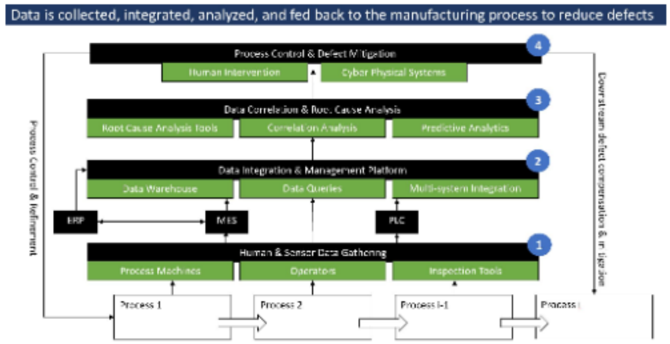
Towards Zero Defect Manufacturing in EV Battery Production

BUSINESS PROBLEM

In June of 2022, Rivian's battery module production lines were generating defect rates above stated targets, with much of the nonconforming material being nonrepairable and ultimately scrapped. The battery shop did not have sufficient tools and processes in place to systematically measure and analyze the root cause of defects. Therefore, management was unable to efficiently allocate resources to resolve quality issues. The primary objective of my project was to improve the quality measurement system and reduce the scrap rate of work-in-process and built battery modules in order to ultimately improve throughput of vehicles.

APPROACH

The first step of the project was to perform data analysis and establish a process that reliably captures key information on nonconforming materials generated by the battery shop's production lines. The second step was focused on testing and evaluating which quality improvement methodologies were most effective in reducing the occurrence of defects leading to rework or scrap.



DATA SOURCES

Rivian houses data related to scrap in several different locations. Data includes information on scrapped orders, part names, serial numbers, costs, and scrap reasons. One gap that originally limited reporting capabilities from the Manufacturing Execution System was reliable, real-time information regarding potential scrap from the production line.

Data Types and Format

Data was primarily tabular. Imaging and video data was also available when targeted root cause analysis was required. Sources included ERP, manufacturing execution, and document storage systems.

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IMPACT

1. Data Quality • Achieved stronger alignment across multiple data sources, such as the daily scrap count records in MES, ERP, and outbound shipping manifests. • Defined mutually exclusive and collectively exhaustive categories for key data attributes, resulting in a more streamlined data management process. 2. Real-Time Defect Detection • Introduced control charts to detect assignable cause variation in output parameters. • Coordinated implementation of logic and alarms to stop the line or alert an operator live when a defect was detected, preventing downstream propagation. 3. Standard Process Adherence • Documented process maps and step-by-step guides to clarify process ownership and to train team members on standard processes. • Developed metrics and dashboards to measure process adherence for use by management to address gaps in a targeted fashion. 4. Data Analysis Repeatability • Shifted the team's time investments from data generation and analysis to data interpretation and action planning. • Leveraged the data integration platform to automatically refresh and update analysis output. 5. Scrap & Defect Rates • Active project management and communication across teams allowed the battery shop to recognize and prioritize solutions to address quality issues. • Despite a rapidly increasing production rate and increasing material prices, scrap costs decreased from the project start date to the project end date as a result of the quality improvement program.

DRIVERS

The project kicked off at an inflection point during the production ramp period. The rate of nonconforming material generation was no longer sustainable from both a cost and physical material handling perspective. All levels of the organization became fixated on reducing rework and scrap costs, therefore leading to more time and resources being shifted towards quality improvement activities.

BARRIERS

1. Technical Capabilities: Improvements to data collection and defect detection systems required IT and contractor involvement. Proposed solutions could not always be immediately implemented given limited resource bandwidth. 2. Communication: This project required cross-collaboration from management, engineering, and operating teams. There were not initially channels set up for these groups to communicate in an organized manner.

ENABLERS

1. Agility: Given that Rivian was still ramping production of battery modules and building new lines, the organization was used to frequent changes and therefore open to implementing new ideas without unnecessary red tape. 2. Engineering Talent: Once quality data become more easily visible and interpretable, qualified engineering resources were available to effectively brainstorm and implement solutions.

ACTIONS

1. Process Changes: Made changes to both the digital systems and the physical flow of materials to improve data collection efficiency and accuracy. 2. Dashboard Development: Visualized defect and scrap data for repeatable consumption by both management and operators. Project Management: Drove action by assigning clear ownership and deadlines for specific defect mitigation tasks.

INNOVATION

This project was innovative in the identification of defect mitigation methods. While some defects were easily resolved by tuning machine parameters, others were not as easily controlled. Sometimes eliminating defects required upstream process alterations, equipment re-engineering, or changes to product design. For example, altering the size of the buffer upstream from adhesive press had the potential to reduce adhesive cure timeout defects.

IMPROVEMENT

Despite a rapidly increasing production rate and increasing material prices, total monthly battery module scrap costs decreased from the project start date to the project end date as a result of the quality improvement program. Additionally, this project identified a single source of truth for battery shop scrap data to perform both defect root cause and financial costs analyses.

BEST PRACTICES

1. Designate quality champions outside of the quality team. 2. Create a cadence that gathers cross-functional teams to develop solutions that consider upstream and downstream effects. 3. Clearly define and prioritize the set of technical requirements that must be met to implement solutions. 4. Consider cost, urgency, and in-house capabilities to build a realistic road map of technology implementation.

OTHER APPLICATIONS

This quality improvement framework can be applied in any manufacturing environment. It is particularly applicable when running recently implemented production lines in order to rapidly identify any negative unintended consequences of both product and production line design choices. The framework provides a step by step process for management to develop quality improvement processes that match the capabilities of their organization.