

THOUGHT LEADERSHIP

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Leveraging Quality Analytics to Optimize Process Improvement

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Manufacturers across industries are increasingly leveraging data analytics to inform important business decisions and improve product quality. This trend is driven by two major factors: 1) technological innovations that continue to fuel product complexity and 2) society's growing expectations for product quality, reliability, and safety. Analytics based on quality and warranty data can provide valuable insight to manufacturers throughout the business cycle. This article focuses on quality analytics that help manufacturers identify and resolve product issues that occur before market deployment. To learn more about addressing product failures that occur in the field, click [here] to read our colleague Patrick Murphy's article on warranty analytics.

Today's manufacturers collect significantly more data than in the past. Many organizations have implemented process monitoring tools that incorporate engineering or statistical process control methods into their manufacturing processes. Data sets are extracted from a variety of sources including equipment operating systems, specialized sensors, inspection systems, and human information entry. Ideally, these data are summarized and presented in easily accessible visual dashboards that provide operators and other plant personnel real-time feedback on the key characteristics that are important for managing a particular process. Simultaneously, manufacturers have increased their computing power with sophisticated tools to analyze, visualize, and communicate results. While these are welcome advancements, the way they are envisioned and implemented in different organizations may not be as effective as possible. A manufacturer can optimize the effectiveness of its quality analytics strategy by 1) instituting data collection and analysis processes that support both real-time identification of emerging issues and post-failure root cause analysis; 2) integrating data from the entire quality system-not just manufacturinginto the analysis process; and 3) proactively ensuring that data generated throughout the process is trustworthy and reliable.

One of the most important aspects of a manufacturer's quality data analytics strategy is capturing and monitoring process data with the capability to identify and react quickly to emerging issues and follow up with more detailed root cause analyses. This requires putting systems in place that monitor key characteristics in real time and developing methods for detecting signals in the data that indicate significant departures from target. When manufacturing teams encounter problems, analysts can use the data to identify the decisions or product and process changes that led to the issue. Over time, manufacturers can use the learning acquired in this process to implement systems that provide improved problem detection and prevention in the future. A manufacturer seeking to improve in this area should consider several questions: Are we collecting the right data, and are the data providing the right information for making operating and improvement decisions? Are we detecting issues as close as possible to the time they occur? Do we have teams that include capabilities to both conduct statistical analysis and provide subject matter expertise on the process itself? Finally, do we have a feedback loop that allows us to validate whether our system detected true signals of an issue or a false alarm that indicates the need to improve the detection mechanism?

Our team at Exponent has partnered with several manufacturers to conduct process and root cause analyses. This often involves analyzing data from measurement devices or inspection systems that are either integrated into the production process or maintained as a separate quality assessment step. Our goal is to examine the data and find the characteristics likely to correlate with a result of an item being accepted or rejected. If we can identify those characteristics, we can go back into the manufacturing process at the step when those characteristics are created and try to minimize variation or reduce mistakes that occur at that step. We can then deploy a feedback mechanism to verify that future products have reduced occurrence of the issue.

Some organizations put their data collection and analysis emphasis primarily on monitoring manufacturing operations. Others have effective efforts in different groups within the organization, but those groups don't collaborate well. Optimizing a quality analytics strategy requires integrating analysis from across the entire quality system. Data collection and analytics should include not only what is happening on the manufacturing floor but also information on the design process, the decisions about designs and specifications selected, the materials consumed and the reliability of the equipment used in the production process, and feedback from customers using the product in the field. This involves examining the supply chain to better understand and incorporate data from the production processes and materials used by suppliers. Developing analytics that cover the entire quality system can help a manufacturer more quickly and effectively arrive at correct solutions and assessments of root cause.

Finally, it is important for a manufacturer to ensure that the data it uses is trustworthy and reliable. While "big data" gets all the buzz, ensuring that teams are working with "good data" is a more important concern. We have identified five characteristics of good data:

- Integrity—Data are complete, accurate, precise, and interpretable.
- Consistency—Data are maintained over time; all changes are captured and documented; and structures are similar across organizations.
- Usability—Data are organized and accessible in a manner that facilitates analysis and discovery; key characteristics used for assessment and decision making are captured.
- Traceability—Inputs such as raw materials and influencers such as process parameters and operators can be identified and traced throughout supply chains and distribution systems.
- Currency—Data are up to date (fresh) and available when needed by plant personnel, managers, problem solvers, and senior management.

Based on our experience, organizations that have worked to achieve these five characteristics are better equipped to leverage their quality analytics processes to make timely informed decisions. For example, let's consider traceability. Manufacturers often ask our team to compare products that come from different plants or study product history over time to make predictions about future performance and generate recommendations for improvement. We are equipped to provide useful answers when a manufacturer has collected basic parts related information that allows us to trace and identify the inputs to, and experience of, those parts. Such information may include individual part IDs, descriptions, dates and locations of failures or concerns, information on when and where the part was manufactured, and the constituent elements of material and processes that went into the part.

Exponent's multidisciplinary team of statisticians, engineers, and scientists leverages the latest quality analytics tools and methods to deliver actionable process improvements to manufacturing and industrial clients.



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