
How process variation monitoring helps manufacturers to prevent errors, instead of detecting them after they happen.

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Imagine what it would be like if an operator knew when a production process was unstable and fixed it immediately. Imagine if a machine automatically shut off or alerted someone when a setup error existed. Imagine if an error could be predicted before it even happened.

Every so often, a technological breakthrough reinvents the way manufacturers operate. The assembly line was introduced in the early 1900s, permitting mass production of products at a fraction of the cost. The invention of robotics in the mid-20th century provided accurate and reliable performance levels at increased speeds. Now, we have process monitoring systems.

Process monitoring, referred to as Process Variation Monitoring (PVM), is a paradigm shift in manufacturing technology. PVM devices are putting emphasis on improving the manufacturing process, and moving emphasis away from inspecting the finished part. This proactive approach focuses on preventing errors, rather than detecting them after they occur.

With today's zero defect tolerance, manufacturers must pay close attention to quality, and they must ensure that they don't ship even one bad product to their customers. Doing the latter can result in expensive consequences such as being put on containment by the customer, a complete product recall or lost future contracts. At the very least, it results in increased costs and a diminished reputation.

For these reasons, it's imperative to keep defective and substandard products from going out the door.

## Post-Production Inspection is No Longer Good Enough

Until recently, companies were relying solely on post-production inspection methods and devices to detect bad products before they're shipped. This conventional practice was based on the underlying assumption that a bad part can be produced at any time, and that catching these parts before they went out to customers was a priority.

With the demand for quality hitting an all-time high, progressive companies are shifting their focus to improving the manufacturing process itself. Their conviction is that it's impossible for a good process to produce a bad part, unless something in the process changes.

This revolutionary attitude toward quality assurance is simple: monitor the process. This paradigm shift derives from a basic scientific principle: If all variables in a process are stable and constant, the process's outcome also will remain stable and constant.

Monitoring the process and fixing the problem at the source, before additional costs are incurred, is the most progressive way to ensure quality assurance.

In many force-form processes, including end-forming, tube bending and wire crimping, anytime a constant or predicted force is used to modify a part, the strain the machine experiences during that process is directly related to the resistance to that force. Resistance to that force is then any variable in the process, and the strain is a measurable outcome of the process.

"When the strain is no longer stable and constant, we know that a variable has changed and that the process is now capable of producing a faulty product," says Kiet Ngo, director of research and development for Rockwell Automation Encompass™ Product Partner OES Technologies.

The variables that might change and affect part quality could be raw material, broken or worn tooling, machine deterioration, equipment failure, lack of lubrication or even improper presentation of the raw material. If the outcome is altered, a variable in the process must have changed. The task then becomes effectively monitoring the process to detect the critical changes, or variations, in that process.

## Applications for Automotive Manufacturers

For North American-based Tier 1 manufacturers, the challenge to succeed is even greater as global competition continues to affect the automotive market. PVM technology allows continuous improvement of quality through process improvement, while reducing unnecessary costs from scrap material or downtime.

Early adopters and followers are realizing the significance of this technology, focusing on opportunity, sustainability and profitability that come with a paradigm shift of this nature. Some machine builders (OEMs) are supporting this movement by offering PVM products, while others are educating themselves in preparation for the majority acceptance.

For example, a fluid-handling division of a Tier 1 company was experiencing process problems and potentially creating defective parts that might have lead to connection leaks. Bad parts were being caught, but scrap metal costs were rising. After the company installed a PVM monitoring system, the Tier 1 manufacturer saw significant savings and increased uptime.

Consider another example, this time of mandrel bending. Most bends are performed with a lubricated mandrel. If the lubrication isn't present because of factors such as automatic lubrication system failure or omission by the operator, it's still possible for the product to meet acceptable dimensional and visual criteria — for a while. After a few, or perhaps many, bends, the mandrel is likely to break and cause downtime. That's when the lubrication failure will be discovered, and only then rectified.

But what about the many pipes that were bent with a nonlubricated mandrel? The material was exposed to a far greater amount of strain than the process was designed to exert. Was the material stressed to near the breaking point? Will the affected exhaust pipes last one month, one year or through the warranty period?

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This is an example of the need for PVM. Even if the part looks good and passes dimensional and visual inspections, it isn't necessarily a good part. Wouldn't it be more effective to monitor the process and control the variables at the source of production?

PVM products allow operators to set parameters, or tolerance levels, for deviation from the learned signature. This works to catch bad processes, but gives manufacturers control over their own quality standards. When a part has been made outside the tolerances of a known good process, operators are alerted to make adjustments, and the situation is rectified well before a real problem occurs.

## Future of Quality Assurance:

With stringent controls being placed on product quality in the automotive industry, it's increasingly likely that production standards will require PVM technology. PVM is a more efficient, reliable and practical solution. The manufacturing industry shouldn't settle for mediocrity and chance unexpected costs anymore, because every so often, a technological innovation reinvents the way we do business. □

*Rockwell Automation Encompass™ Product Partner OES Technologies manufactures signal conditioning and signature analysis solutions for process variation monitoring. Based in London, Ontario, Canada, the company received the 2008 Delphi Technology Pinnacle Award.*

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