# Reinventing the Manufacturing Industry With PVM

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Imagine:

1. If an operator knew when a production process was unstable and fixed it immediately.
2. If a machine automatically shut off or alerted someone when there was a setup error.
3. If an error could be predicted before it even happened.

Every so often a technological breakthrough reinvents the way manufacturing is done. We introduced the assembly line in the early 1900's, which permitted mass production of products at a fraction of the cost. The invention of robotics in the mid-20th century assured accurate and reliable performance levels at increased speeds, and now we have process monitoring systems, an advanced technology which will again reinvent this age-old industry.

Process monitoring systems, technically referred to as Process Variation Monitoring (PVM) is a true paradigm shift in technology for the manufacturing industry. PVM devices are putting the emphasis on refining and improving the manufacturing process itself, and away from inspecting the finished part, as with traditional methods. This proactive methodology focuses on preventing errors, rather than detecting them after they occur.

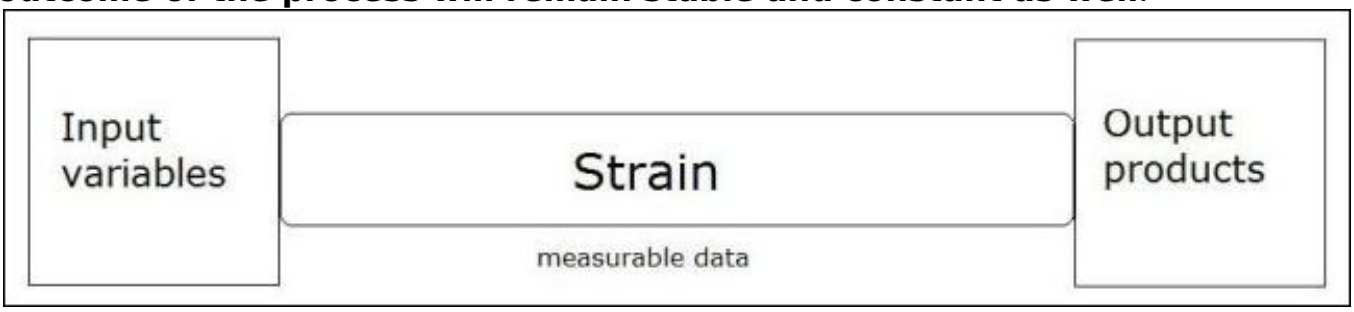
With today's zero defect tolerance, manufacturers have to pay close attention to quality and have to be sure that they do not ship even one bad product to their customer. Doing the latter can result in expensive consequences, such as being put on containment by the customer, a complete product recall, or worst of all, lost future contracts. At the very least, it results in increased costs and a diminished reputation. For these reasons, it is absolutely imperative that defective and sub-standard products do not make it out the door.

**Measuring quality:**

Until recently, companies had learned to rely solely on post-production inspection methods and devices to detect any bad products before they might be shipped. This conventional practice followed the underlying assumption that a bad part can be produced at anytime and that catching these parts before they went out to

customers was a priority. Little emphasis, if any, was put on the actual manufacturing process.

With the demand for quality hitting an all-time high, progressive companies are shifting their focus by putting less emphasis on the inspection stages and more emphasis on refining and improving the manufacturing process itself. Their conviction is that *it is impossible for a good process to produce a bad part, unless something in the process changes*.This revolutionary attitude towards 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 outcome of the process will remain stable and constant as well**.




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

In many force-form manufacturing processes (including end-forming, tube bending, and wire crimping), it is known that 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 said force. 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” states Kiet Ngo, director of Research and Development for OES Technologies and inventor behind a patent thatproves a sensitive and stable strain sensor, coupled to an intelligent analysis device, can provide an accurate and reliable indication of process quality.

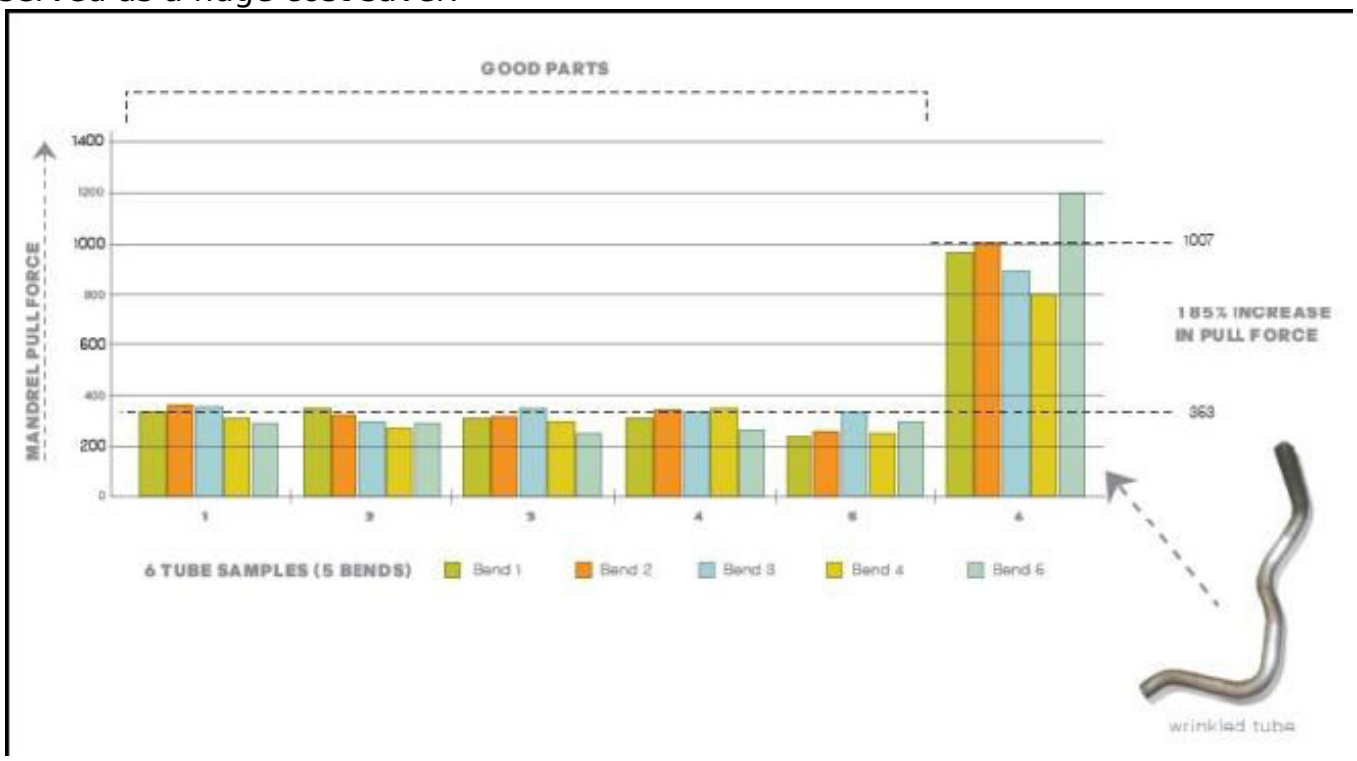
The “variables” in a process that might change and affect part quality could be the raw material, broken or worn tooling, machine deterioration, equipment failure, lack of lubrication, or even improper presentation of the raw material. If the “outcome” is altered, then a variable in the process has to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

For North American-based manufacturers, the challenge to succeed is even greater as foreign competition continues to affect the market. This innovative technology allows for continuous improvement of quality through process improvement, while reducing unnecessary costs from scrap material and/or downtime, thus helping this

market remain competitive.

Early adopters and followers, as with Centerline in welding, are realizing the significance of this technology, focusing on the opportunity, sustainability, and profitability that comes with a paradigm shift of this nature. Some OEM companies, such as Addison Mckee in tube bending, are quickly supporting this movement by offering PVM products, while others are educating themselves in preparation for the majority acceptance.

When the fluid handling division of a Tier 1 company was experiencing process problems and potentially creating defective parts that may have lead to connection leaks, they deployed an OES monitoring system as a quality solution. The bad parts were being caught, but the cost of scrap material was getting expensive and solving the problem was critical. As a data-driven organization with a strong commitment to operational excellence, finding the process problem and monitoring it thereafter served as a huge cost saver.




Consider now the example of mandrel bending. Most bends are designed to be performed with a lubricated mandrel. If the lubrication is not present (automatic lubrication system failure or omission by the operator), it is quite possible that the product produced by the faulty process continues to meet the acceptable dimensional and visual criteria — for a while. After a few, or perhaps many bends, the mandrel is likely to break, resulting in downtime for service. At that time, it is likely that the lubrication failure is discovered and only then rectified. The pipe in which the mandrel broke would (hopefully!) be identified and isolated, and the production would continue.

But what about the many pipes prior to the breakage that were bent with a non-lubricated mandrel? The material in each of those bends 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? This proves the strongest argument for process variation monitoring: even if the part looks good and passes dimensional and visual inspections, it is not 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 the operator 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, the operator is alerted to make adjustments, and the situation is rectified well before a real problem occurs.

In a force forming application, something in the process may change to the point that it is detectable but still minor and the process might still be producing good parts — but only for awhile. Sooner or later (and most likely sooner), the process will either produce a bad part or it will cause damage to the tooling or machine. With PVM technology, you now have an early warning system that alerts you of these conditions.

**The future of quality assurance:**

With stringent controls being placed on product quality in the automotive industry it is increasingly likely that production standards will require PVM technology.

Process variation monitoring is a more efficient, more reliable, more advanced, and more 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.

*Paul Hogendoorn is president and co-founder of OES Inc, recipient of the 2008 Delphi Technology Pinnacle Award, celebrating its 30th anniversary in 2010. He is the past chair of the London Region Manufacturing Council and a regular contributor to Manufacturing Automation magazine, the Tube and Pipe Journal and Quality Magazine. In recent years, he has written and spoken on the topic of process variation monitoring, drawing from his company's experience in a wide range of manufacturing applications. Paul can be reached at* phogendoorn@oes-inc.com *[1].*



**Links:**
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