Miles Free III
Director of Industry Affairs

Process Parsimony — Automation's Secret Key for Scale and Quality

Automation is thought to be the secret to improving quality in manufacturing. What if I told you, it was something else?

The volume of messages in my email inbox extolling some kind of automation solution to improve my quality continues to grow. These emails all tend to make the same claims: "(fill in the blank) automation solution will ensure that you 1) avoid operator error; 2) Ensure more repeatable and reproducible results; 3) Speed performer time to complete tasks; 4) Reduce cost of failures." These claims are logical consequences of an automation solution. But are the consequences actually the result of the automation? Or are they the result of process simplification and engineered error proofing?

Our contract precision machining shops are tasked with producing no-fail quality for many human safety critical applications and other capital applications — regardless of batch size/ order quantity/release quantity. And while inspection is known to not be foolproof, in small batch production, often it is the only economically feasible way of taking steps to ensure that the product the customer receives meets their specified requirements and functions as designed. But as lot sizes increase, so too do the opportunities for systemic, as well as random causes to trigger a nonconformance in our work product. As well as exceed the ability for humans to inspect reliably.

Blindly automating — which could also be called "throw a robot on it to remove the human factor" — is an oft heard but hardly proven approach to process improvement. At best, it reduces challenges to our performers by simplifying their task and cognitive burden, but at worst, it is a straw man, as those random causes may not in fact be due to human failures. As quantities increase, so do opportunities for random fluctuations, as well as the appearance of rare but conceivable systemic anomalies. The 99.72% covered by plus or minus three standard deviations of process capability are a solid assurance when the lot size is in the double or triple digits range. But when the quantities scale up into the thousands, hundreds of thousands or millions, our enterprise volumes are in the medium to high double-digit millions. Then that 0.28% residual suddenly becomes a real possibility — 0.28% of 1 million results with 2,800 "normally expected" deviations from the control limits.

Now how many million parts does your shop produce over the course of a year? Multiply that by 2,800 and tell me how many opportunities for rejection, failure to meet specification, and increased chances a claim is possible based on your volume, even if you are statistically capable at plus and minus 3 standard deviations?

If it costs your shop just $100 per reported occurrence from a customer (a very low estimate to be sure, but suitable for our discussion here) how much "risk" could you be facing? Keep in mind that I define risk as the destruction of capital. The product of 2,800 times $100 is $280,000. That is the potential capital that you could waste should your process just behave normally for every million parts sold.

Again, how many million parts does your shop produce over the course of a year? My guess is that you do not have $280,000 built into your pricing per million parts sold for "just in case."

The point is, every step, every operation that you can eliminate reduces (by a multiplicative factor) your odds of a non-conformance. If the tag is already filled out by the system, then a human error creating the tag will not happen. How many steps does one of your products take to get from order to shipment to customer? 25? 50? 100? My guess is the number of discreet steps is higher than these round numbers for the typical, highly complex precision engineered component that you make in your shop. I am talking about each and every step from order

acceptance, order entry, engineering review, material and tool ordering, scheduling, set up, quality, production, further processing/outside processing, mark, pack, load, release and ship. Every phone call, conversation, written note or computer entry is a step. Does your order entry software preload the engineering and quality software with the data, or must there be redundant manual entry of critical inspection notes or other must-have factors? How does this double entry affect the potential for error occurrence now that your millions just got doubled by this additional (and every other repeated) non-value adding step?

Continuous Improvement

Continuous improvement in our shops is not the result of automation per se. Continuous improvement of our processes and systems is the direct result of process simplification reducing the opportunity for probabilistic occurrences to appear as we scale our production to ever higher volumes. Reducing redundant steps — in all of our systems — is the real power underlying an automation solution. It is removing the opportunities for variability. Removing the opportunities for non-compliance. If we do not have to do a particular step, eliminating it reduces our odds of failing when we do (or fail) to do it.

As our sales grow, as our volumes grow, I hope that we are smart enough to recognize that the opportunities for risk grow as well. When we are working in volumes of millions, a simple doubling of potential opportunities (from one needed step to two steps, one needed, one not) will be multiplied by those volumes of millions. Expected occurrence is only 2,800 per million, right? So, what is your potential risk (capital destroyed) by having to investigate, solve and remediate these unneeded failures? More than you can afford.

Automation is not the answer. Process parsimony — simplification is. Continuous improvement is driven by eliminating the waste of unneeded process complexity. Automation is the cover story. The real power is to eliminate the unnecessary steps in your process. Show me a team focused on eliminating steps in process and I will show you a team that will continue to succeed in scaling up their business as they reduce the opportunities for anomalies to occur.

Miles Free III is the PMPA Director of Industry Affairs with over 50 years of experience in the areas of manufacturing, quality and steelmaking. Miles' podcast is at **pmpa.org/podcast.** Email: **mfree@pmpa.org** — Website: **pmpa.org.**