White Paper

Engineering Solutions for Manufacturing Problems

Brian D. Krichbaum

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Engineering Solutions for Manufacturing Improvement

Engineers must have a thorough understanding of the manufacturing process as well as the design process. The gains that are achievable by paying close attention to the processes are surprising. Indeed, while it's true that the emphasis on manufacturing improvements and on deploying lean thinking in our workplaces has had a dramatic effect on the productivity of manufacturing processes, these gains are only a primer for what can happen when design solutions are successfully integrated with the manufacturing processes. The interface between product development and manufacturing operations offer one of the biggest opportunities for improvement in our facilities. Just as 5S serves as an introduction to a full-fledged lean deployment, design and process integration serve as an introduction to facility wide lean transformation.

The Good Engineers…

With access to powerful CAD systems, it is easy for engineers and designers to stay at their computers, theorizing about the best way to make the parts and assemblies. But here's the catch; design which doesn't comprehend the details of the manufacturing process is not engineering; it is merely creative drawing. Likewise, when designing products "on the floor", obsolete and outdated process assumptions cannot be challenged. It becomes difficult to develop a good understanding of the effects and causes of variation. Without detailed design work, little improvement is made; parts won't fit together, and real improvement from previous projects cannot be made.

So what are we to do? The only answer is to immediately start forcing the issue by bringing the design elements into compatibility with the manufacturing processes. Designs must be completed with the manufacturing processes in mind.

When working with a specialty vehicle manufacturer, it was discovered that the production associate spent nearly 45 minutes trimming seat brackets to improve the appearance. Everyone agreed that this was too long and an extended discussion ensued which focused on removing much of the time from this operation. But it was the wrong discussion. The mounting brackets were impossible to see once installed in the vehicle, so there was no reason to trim them. In the lean vernacular, the entire operation was non-value added.

This happened because engineers didn't understand either the process or the requirements of the system. The finished assembly requirements were never checked. No one bothered to watch the production process, to understand the quality requirements, or to validate the logic.

Unfortunately, situations like this are not isolated or even rare. In every plant, in every operation similar findings are waiting to be discovered. But shortcuts are taken, CNC programs aren't optimized, manufacturing plans and design plans aren't integrated – and the profits suffer.

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While working on a project with Toyota, their assistant chief engineer summed it up “Brian”, be asked, “Do you know the difference between a good engineer and a bad engineer?” He continued, “A good engineer has to wash his hands before he goes to the bathroom”.

Use lean techniques to completely understand the process

In complex, multi-stepped processes, it isn’t unusual to discover that no one completely understands all the details from start to finish. Why is each step taken? Why are they taken in this particular sequence? Are certain techniques especially critical to success? When tools are required, how should they be set up, maintained or staged? Without satisfactory answers to these questions, it is doubtful that there is an adequate understanding of the process. In new product development projects, the same questions apply – they’re just much harder to answer.

An Illustration from my files: As engineering director of a large tier one automotive supplier, I had grown concerned with the efficiency of the process used to manufacture a component for one of our automotive customers. The numbers were good and improving. We had exceeded our productivity goals and quality goals for months in a row. Our delivered quality to the customer was outstanding, and we had been awarded both the design and the production for the next generation of the product.

But observing the line, it was easy to see that we were manufacturing products in large, unwieldy batches rather than single part flow. At my urging, it was decided that we would spend two weeks and conduct a detailed process review and develop a value stream map of the workcell. As we walked through the line, we immediately started learning about our process. In the first station, the parts were stored far away from the operator. In subsequent stations we found equipment maintenance problems, serious ergonomic issues, worn out tools and non-value added operations.

As we continued through the line, we found multiple operations that added no-value; there was rework built into the line and engineering specifications that were poorly done. After the two week review, we had identified over 100 major concerns. Two months later, when the issues were resolved and the testing complete, we had improved productivity by 50%, reduced cost by $2 million annually, and improved our first pass quality yield from 95% to 99.5%. Most importantly, we now knew how to better design the product and the process for the next generation.

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Understand the requirements

There are many entities that place demands on our products. Customers have functional and aesthetic requirements, governmental agencies have environmental, health and safety and reporting requirements, and we have internal standards. Don't make the assumption that you understand all of these requirements or know why a process step is taken or an engineering specification has been applied. To be sure it is understood – go and see for yourself. In the earlier seat bracket example, anyone could have asked the question "Can anyone see the mounting bracket once it is in the car?" But the question wasn't asked because all the managers, supervisors, engineers and operators already *knew* the answer – or so they thought. But their answer was wrong. It wasn't until we took the 5 minute "field trip" to look at a finished vehicle that the real requirements became known.

Of course, this was a simple solution. It isn't always so easy to determine the real requirements. Sometime we need validation tests, customer approvals, detailed engineering studies or design reviews to determine the requirements. In many cases you may need to work through the concerns one-on-one with customers. But it's always worth it.

Listen to those who really know

The most knowledgeable people in most manufacturing operations are the production, maintenance, and quality associates. But managers and engineers routinely change processes, revise or replace equipment, change designs, or implement other "Continuous Improvement" ideas without utilizing or even consulting these resources. This is a mistake. Even in the unlikely event that the ideas of the engineers are superior to those of the workers, the results will be better when the workforce is involved in the decision making and planning of the changes.

The quality issues were serious enough to for me to lead the Plant Superintendent, the Engineer, the Quality Manager, and even the Vice President of Operations to the work cell to review the problems. We had some ideas on what should be done to fix the issues once and for all, and were debating the proper approach.

The operator was working in the area, so we stepped back to stay out of his way. As we did, his under the breath grumbling became obvious, so I asked him what was going on. He answered: "I've only worked in this area for twelve years, so I probably don't know enough to help out on this "technical" problem". Of course, he knew exactly what should be done, and once we took the time to include him in our discussions, we had a roadmap that quickly led us to the fix.

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Establish the foundation for future improvements

As we go through the effort to learn about the process and the product and then implement the resulting improvements, it is important to document what we have learned. Guidelines or checklists need to be established to make sure that the lessons learned on this project do not get lost once the next generation product is designed.

In lean manufacturing we have found that significant gains are made when we take the effort to establish standardized work. By performing the work in a consistent manner, the job gets gone quicker, the results are more predictable, and quality performance improves. Additionally, when there is a problem, it can be more quickly identified and permanently rectified.

Design checklists are the standardized work for product development. The learnings, both positive and negative, from past projects are compiled in the checklists. In some cases, the checklist will essentially define the "how to" of the design, giving precise steps to be taken to ensure success. In other cases, the checklists will provide standardized solutions to common design problems.

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