DFMA with Current Product: It's never too late!

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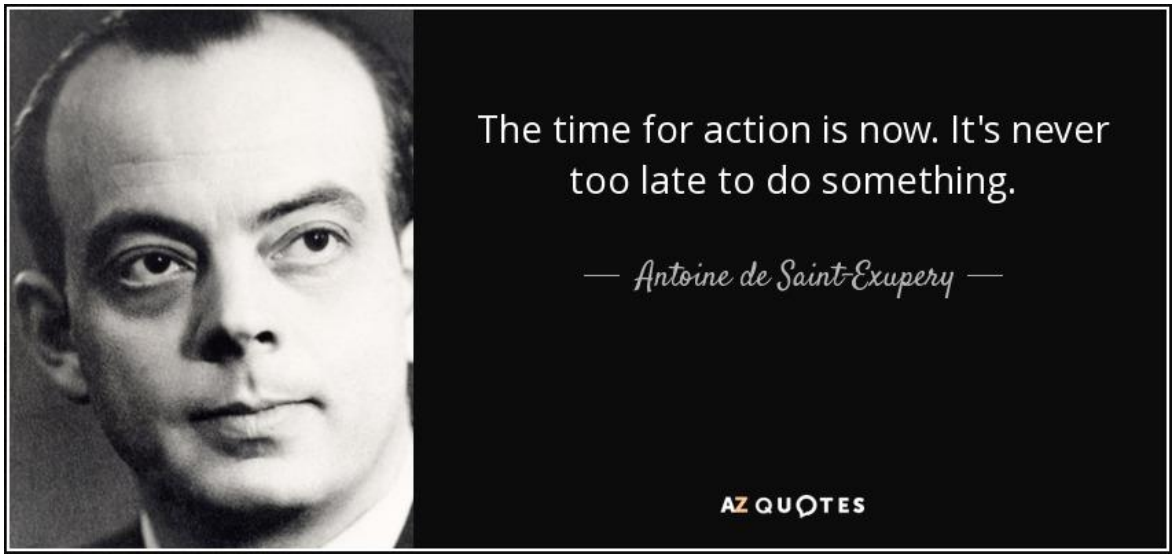

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INTRODUCTION

You've heard that it's best to bring cross-functional teams together as early in the design process as possible. Well, what happens when you are in production, is it too late? After nearly 5 years with the New Product Integration Team and creating the foundation for DFMA at Kohler, I now have the privilege of leading a team of Manufacturing Engineers in our Assembly area. It turns out there are numerous ways that DFMA can have an impact on the business even when it appears that ship has already sailed. The following paper will review those areas of impact.

Early Insights

I started my journey at Kohler as a part of the New Product Integration (NPI) team. At the time, this was a newly formed group consisting of two other associates and myself for all the Global Faucets New Product Development (NPD) team. Our mission at the time, was to pave the path to be the voice of manufacturing on the NPD teams. As we started looking for the best methodologies to help manufacturing have a voice during new product development cycles, we were drawn to DFMA. I became one of the early adopters of DFMA within my team and was very excited about the opportunities it opened for the work I was doing to bring manufacturing into the design process early.

As our NPI team gained influence and grew within NPD, so did the buy-in for the use of DFMA. The Kitchen Faucet design team I was on, has gotten to the point where they don't want to design without DFMA and they are expanding efforts to create relationships with vendors utilizing DFMA on component development. We even got to the point where we used DFMA to help us even before drawings were even made. These are some of my most memorable moments on that team. The passion I developed for DFMA, and collaboration to change things for the better, followed me to my new role as the Leader for Faucet Assembly Manufacturing Engineering.

I quickly discovered that within my Engineering team was an untapped potential for effectively making changes and improvements and helping the cost position of current products. I will go into detail in the areas of estimates for rework, quoting, product improvement, and process improvement.

Estimates for rework

One of the first challenges I came across in my new leadership position was on a product that I had helped to launch 2 years previously. There was an issue found with the product that wasn't acceptable for our customers. We had determined that we had 3 options to consider:

- Rework all the inventory we have in stock
- Disassemble a portion of it that could be reused, and scrap the rest
- Scrap all our current inventory

The team felt that, due to the complexity of the rework, that the obvious option was to scrap everything and start over. This was a perfect first case for me to bring in the experiences I had in my previous position with DFMA, and show the benefits of data driven decision making. Immediately, I gravitated to using DFA to identify the process to rework the complete assembly or do partial rework.

DFMA can be used to compare options for rework verses scrapping assemblies

Since this was a project that I had worked on in the NPD group, I had the benefit of already having a complete DFMA file available that contained the entire assembly. I went out to our DFMA SharePoint site and downloaded a copy of this file to start with. Since I wanted to get a cost breakdown of what it would take to rework the product, I removed all the components that wouldn't be touched and only looked at those that would be needed for the rework. I had to disassemble to get to the internal part that needed replacing and reassemble and water test once complete.

The estimate for rework was going to take us about 10 minutes per assembly. Since we weren't evaluating the assembly to make improvements we didn't consider the DFA index or candidates for elimination. We only focused on the Total assembly labor time.

Next, I made a copy of the rework tab and looked at what effort would be needed to minimize the disassembly. In this scenario, we would be salvaging as many of the components as possible to reuse in new assemblies. The theory behind this was we could utilize lower cost labor to disassemble while we assembled replacements in parallel. In addition to the time that it would take to disassemble these assemblies, we also needed to include the cost of the scrap. This estimate to disassemble and scrap was going to take us about 4.5 minutes per assembly.

The final scenario that was looked at was to scrap the entire assembly and build new. This effort would take minimal time per assembly and would maximize scrap. See the following table for a comparison of the results.

	Scrap Full Assembly Costs	Disassemble and Scrap Costs	Full Rework Costs
Assembly Labor Time per unit	0	4.5 min	10 min
Time to Replenish Inventory	4+ weeks	3 weeks	2 weeks
% Cost of product value (including labor for rework)	100%	53%	18%
Notes/Risks	-Will run short on some parts	- Potential for damage to finished components during rework	- Potential for damage to finished components during rework - Potential for new packaging needed

We also needed to look at the risks associated with each of these scenarios and the impact to our customers. The disassemble and scrap option was estimated to take about 3 weeks to recover and had a risk of damaging finished components due to the added handling. The option to scrap the whole assembly would take over a month to recover and runs the risk of running short on components and has a higher potential for further delays. The option to rework was estimated to take 2 weeks to recover and ran the risk of damage to the finished components due to handling and rework.

Not surprisingly, the option to scrap everything and start over was the most expensive out of the three of these options. Through the use of DFA and using the fully burdened associate rate, I determined that the option to disassemble, scrap and rebuild was 47% less than the cost to scrap everything. The option to rework and minimize the scrap was going to cost 82% less than the cost to scrap everything.

With the DFMA tool, I helped to guide my new area of the business to save close to $47,000. It was a great quick win to start the buy-in needed in support of using DFMA in production. When using DFMA for rework, you can determine an accurate labor estimate, and identify risks and impact to the customer and the business.

Quoting

When we look at establishing DFMA on new products, one area of focus is to use it as a tool to help partner with potential suppliers on the cost of the product to ensure a reasonable quote is given. I used this successfully on numerous occasions while I was on the NPI team and built confidence in the tool with our assembly team at our Arkansas facility.

Since I knew that this was the direction that the business and NPD team were heading, I was happy to support the use of DFMA to help us with quoting in assembly. One way we can do that is every time we see a request for quote (RFQ) we need to look for a DFMA file. If there isn't a DFMA file included, then we need to push back and ask if there was one created for this particular product. If not, then we can request that it be done prior to quoting. In this way, we can help drive the teams to think about the need for DFMA earlier in the process.

All Requests for Assembly Quotes should be accompanied by a DFA file

I have given my team the training on DFMA so that they are able to review and understand the DFMA files and have compared it to other assemblies they have quoted and that are currently in production. They find that it's a very helpful tool when it comes to quoting. Previously, our rates were estimated by one person who sits at their desks and mimics the assembly steps while he times himself. Generally, there was a short print process review prior to this where some of the complexities in the assembly were identified but not all the assembly steps were reviewed in detail, leaving some up for interpretation. In this way, we occasionally end up with rates that aren't quite accurate and leads to challenges on the floor by the associates who are building. Then we must take extra time to do rate studies to see if the rates need to be updated. If we had the rates set using DFMA first, the rates would be more accurate. We have seen this on those assemblies where DFMA was completed prior to the launch of the product. Then, if there are problems that come up after launch, we could compare the assembly order and techniques used to help us determine where the changes are. It helps us identify the root cause of those changes in a data driven way.

Another great benefit of completing the DFMA prior to quoting is that now when an RFQ is submitted, the turnaround time for it to be complete is reduced from a week down to a matter of hours. This is especially true if the Assembly Team was included in the DFA event.

By using DFMA for quoting, we can get a quote and assembly rate that is more accurate, use it as a tool to help confirm rates during production, and have a faster response time to RFQs.

Product Improvement

Kohler's journey on continuous improvement has really been amped up within the last couple of years. We have worked to implement lean systems and drive improvements through Kaizen. We are training our teams to identify areas for improvement and empowering them to make changes. Everything is on the table when it comes to opportunities for improvement. We have a low volume and high mix of product so there have been many engineers using many techniques for designing assemblies. This often leads to assemblies with inconsistent screw sizes or components that only slightly differ. The legacy product that we assemble often hasn't been reviewed at all since it was launched. There are so many opportunities for improvements and DFMA can help.

In assembly, changes are executed through the Continuous Product Development (CPD) team who are removed from the assembly area. They sit in a building across campus and receive request documents from a variety of sources for changes to current product. They get copious amounts of these and historically the backlog has been rather long. They review each request and determine where it falls in the list of priorities to determine when it should be worked on. So, if you want to get your change looked at and processed in a timely manner, you need to have the request filled out with details on what the benefits of executing the change are.

Let's face it, if I'm one of the CPD Engineers reviewing a change request and it says, 'There are design issues with this part and it needs to be changed,' it's likely to fall to the back burner and never get completed. Now, if I have used DFMA to help identify and validate a useful change, I easily have the data to show exactly how much better this change would be and the benefits in cost savings to the business.

DFMA can help to identify and validate improvement ideas on current products

Here's an example from a case used in one of our training workshops. As a part of the training exercise the teams were challenged to bring a real-world example of a product that could be modeled using DFMA. This team chose to bring a simple drain assembly. Throughout the training they identified a few ideas for improvements. One, was removing some assembly steps from our process where the end user would disassemble prior to installation anyway. The other was to look at the use of alternate materials for the parts. The ideas identified during this training could end up saving hundreds of thousands of dollars based on the volumes of this product.

Assembly Time Reduced	Assembly Efficiency	Per Unit Savings
25.3%	34.9%	27%

The data in the table above was attached to the change request along with the DFMA summary so that the CPD Engineer has everything they need to easily implement this change. This is useful in executing rapid changes by having a tool that will help to summarize the opportunities.

Process Improvements

The final opportunity I have found thus far, for the use of DFMA after a product has launched, is in aiding process improvements during assembly.

Since there is an abundance of opportunities for improvements through Kaizen, we start by identifying a low performing work cell. Then we gather a team and hold a 3 to 5 day event in order to evaluate the assembly process, identify waste and determine what can be done to improve process flow. There is a lot of pre-work associated with these events since you need to determine your takt time and current process map. The takt time is a simple calculation to determine at what rate you need to build the product in order to meet customer demand. The process map, is identifying the step by step process to assemble the product and the standard amount of time each of those steps take.

Use DFMA in conjunction with other Lean practices to enhance projects

This information is then reviewed during the event and further studies are done on the line to identify process improvements and general layout of the components so they are easily accessible to the associates and make the most sense for the order of operations. Time is also taken to identify the amount of distance traveled by the associate during assembly. One beautifully simple way to do this is to have an already completed DFA from some point in the products past. Then you just need to take that with you and review each step with the assembly associate to ensure accuracy. We haven't quite gotten to that point yet in our journey, so for now we need to create a DFA file prior to the Kaizen event.

After the data is reviewed and observations for waste in the process have been made, then the team goes through some brainstorming about all the ways the line can be set up differently in order to get better results. We identify areas, including tooling, to help reduce assembly steps where the associates need to do a lot of twisting or pressing. These are all things that could be easily modeled in DFA and compared against each other to see which ideas have the best benefits. I even push the boundaries a bit and challenge folks to identify any design changes that would help improve or eliminate difficult assembly steps. Those are longer term fixes that can't happen right away, but would make the product better in the long run.

The use of DFA for helping to guide and highlight potential areas for process improvements is an area we have yet to explore in depth, but we see the benefit of it and will continue to trial.

CONCLUSION

The past 5 years have taught me to push boundaries, ask a lot of questions and drive change. It not only helps yourself to grow and learn, but also challenges those who may not see things from other angles very easily. In a business where Engineers are heavily integrated, the best way to show the need for change or propose a new idea is with data. It's hard to convince someone that adding this widget first is better/easier/faster than the one that has gone first for the last 50 years. Show them the graphs and charts that have the concrete evidence and details on why this new way could be better, and that's hard to dismiss.

We can change the way we make decisions to rework product so that we can consider what is best for the business and customers. By using DFA, we can determine the amount of time associated with different options to help bring clarity to what may not be the obvious choice at first glance.

We have learned that its ok to push back on teams who submit RFQs without DFMA being completed prior, because we are all trying to help each other grow and develop and improve the business. We can work with those teams to drive the DFMA event earlier in their design process, but also show the benefit can still be realized at any point in the product. It's never too late to improve.

It's about having a tool to help you evaluate all of the great ideas people have to make the product and process better. Make the assembly easier for the associates or remove the frustrations all together by redesigning something.

We all have the ability to influence to make changes for the better. Sometimes we just need to know that it's ok to do so.