DFMA – Where It's Going
2012 International Forum on Design for Manufacturing and Assembly
Mike Shipulski

DFMA has been around for a long time. Here is some thinking on where it will be in the future.

DFMA Engineers Will Be Heroes Of The Company
If I was a company, the first thing I'd do is invest in my engineering teams. But not for the reasons we normally associate with engineering. Not for more function and features, not for product robustness, not technology, and not patents. I would invest in engineering for increased profits. I would teach them DFMA.

When it comes to their engineering divisions, other companies think minimization – fewest heads, lowest wages, least expensive tools. Not me. I'm all about maximization – smartest, best trained, and the best tools. That's how I like to maximize profits. To me, investing in my engineering teams gives me the highest return on my investment. I would teach them DFMA and provide support resources to make them successful.

Engineers create the products I sell to my customers. I've found when my best engineers sit down and think for a while they come up with magical ideas that translate into super-performing products, products with features that differentiate me from my cousin companies, and products that flat-out don't break. My sales teams love to sell them (Sure, I pay a lot in bonuses, but it's worth it.), my marketing teams love to market them, and my factory folks build them with a smile.

Over my life I've developed some simple truisms that I live by: When I sell more products, I make more profits; when my products allow a differentiated marketing message, I sell more and make more profits; and when my product jumps together, my quality is better, and, you guessed it, I make more profits. All these are good reasons to invest in engineering, but it's not my reason. All this increased sales stuff is good, but it's not great. It's not my real reason to invest in engineering. It's not my secret.

When I was younger I vowed to take my secret to the grave, but now that I've matured (and filled up several banks with money), I think it's okay to share it. So, here goes.

My real reason to invest in engineering is material cost reduction. Yes, material cost reduction. My materials budget is one of my largest line items and I help my engineers reduce it with reckless abandon (and the right tools, time, training, and teacher.) I've asked my lean folks to reduce material cost, but they've not been able to dent it. Sure, they've done a super job with inventory reduction (I get a one-time carrying cost reduction.), but no material cost reduction from my lean projects. I've also asked my six sigma organization to reduce material costs, but they, too, have not made a dent. They've improved my product quality, but that doesn't translate into piles of money like material cost reduction. I would train them in DFMA so they create big piles.

Now, I know what you're thinking: Why, Mrs. Company, are you wasting engineering's time with cost? Cost is manufacturing's responsibility – they should reduce it, not engineering. Plain and simple – that's not what I believe, and neither do my engineers. They know they create cost to enable function, good material cost – worth every penny. But they also know all other cost is bad. And since they know they design in cost, they know they're the ones that must design it out. And they're good at it. With the right tools, time, and training, they typically reduce material costs by 50%. Do the math –material cost for your highest volume product times 50% – year-on-year. Piles of money.

I've learned over the years increasing sales is difficult and takes a lot of work. I've also learned I can make lots of money reducing material costs without increasing sales. In fact, even during the recent downturn, through my material cost reductions I made more money than ever. I have my design engineers to thank for that. (And DFMA.)

Company-to-company, I know things have been tough for us over the last years, and money is still tight. But if you have a little extra stashed away, I urge you to invest in your engineering organization. It makes for great profits.

DFMA Will Be Linked To Unreasonable Profits (Not Savings)

There's an unnatural attraction to lean – a methodology to change the value stream to reduce waste. And it's the same with Design for Manufacturing (DFM) – a methodology to design out cost of your piece-parts. The real rain maker is Design for Assembly (DFA) which eliminates parts altogether (50% reductions are commonplace.) DFA is far more powerful.

The cost for a designed out part is zero. Floor space for a designed out part is zero. Transportation cost for a designed out part is zero. (Can you say Green?) From a lean perspective, for a designed out part there is zero waste. For a designed out part the seven wastes do not apply.

Here's a recipe for unreasonable profits:
Design out half the parts with DFA. For the ones that remain, choose the three highest cost parts and design out the cost. Then, and only then, do lean on the manufacturing processes.

DFMA Will Be Foundation Of Green Initiatives

There's a big push to be green. Though we want to be green, we're not sure how to get there. We've got high-level metrics, but they're not actionable. It's time to figure out what we can change to be green.

One way manufacturers can be green is to reduce their carbon footprint. That's one level deeper than simply "being green," but it's not actionable either. Digging deeper, manufacturers can reduce their carbon footprint by generating less greenhouse gases, specifically carbon dioxide. Reducing carbon dioxide production is a good goal, but it's still not actionable.

Looking deeper, carbon dioxide is the result of burning fossil fuels, and the two biggest

consumers of fossil fuel are electricity to run our factories and transportation to move what we make and sell. If we reduce electricity and fuel consumption, we will be greener. That's almost actionable, but we need to go deeper still. We can't design out electricity and fuel until we know where it's consumed. We've got to drill down to the part level.

Our supply chains move parts to our factories; our factories use electricity to convert parts into product; and our distribution engines move parts (in the form of finished products) to customers. It's all about our parts-they're what consume electricity and fuel. Therefore, to be green, we must change our parts.

Our supply chains consume fuel to move parts to our factories, but some parts consume more than others. Make a Pareto chart of transportation cost by part number, and give it to your engineering team. Ask them to design out the high-consuming parts (the ones on the left of the Pareto chart). Make the remaining parts smaller and lighter. (Smaller, lighter parts require less fossil fuel to move.)

Our factories consume electricity to convert parts into product, but some parts consume more than others. Make a Pareto chart of electricity cost by process step, and then map the parts to the process steps to make a Pareto chart of electricity cost by part number. Give it to your engineering team, and ask them to design out the biggest consumers. Make the remaining parts smaller and lighter.

Our distribution engines consume fuel to move finished products to customers, but some products consume more than others. Make a Pareto chart of transportation cost by product. Then, for the products with highest cost, drill down and make two more Paretos: weight by part number and size (in cubic millimeters) by part number. Give the Paretos to your engineering team, and ask them to design out the biggest and heaviest parts. Make the remaining parts smaller and lighter.

Fossil fuel and electricity are consumed by our processes, but caused by our products, so it's vital to understand green from a product framework since that's what we, as engineers, can influence. Process owners must translate from a process framework to a product framework, and help engineering understand which elements of the product consume the most fuel and electricity. When engineering knows what to change, green programs become actionable.

There's good reason to be green; it's good for the planet and good for profits. With radical reductions in fossil fuel and electricity, companies become greener and profits increase. Redesigning our products to be smaller, lighter and simpler yields direct, one-for-one increases in profits from savings in transportation and electricity costs.

Though meaningful, these profit increases are just a side benefit of product simplification. With half the parts, factory throughput doubles (one factory performs like two), and material costs are reduced by half (and hit the bottom line as profit).

Whether you want to save the planet and make money along the way, or vice versa, your task is the same: simplify your product using DFMA.

DFMA Will Be The Foundation Of A Simplified Value Stream

The next level of factory simplification won't come from your factory. It will come from *outside* your factory. The next level of simplification will come from upstream savings – your suppliers' factories – and downstream savings – your distribution system. And this next level of simplification will create radically shorter value streams (from raw materials to customer.)

To reinvent your value stream, traditional lean techniques – reduction of non-value added (NVA) time through process change – aren't the best way. The best way is to eliminate value added (VA) time through product redesign – product change. Reduction of VA time generates a massive NVA savings multiple. (Value streams are mostly NVA with a little VA sprinkled in.)

At first this seems like backward thinking (It is bit since lean focuses exclusively on NVA.), but NVA time exists only to enable VA time (VA work). No VA time, no associated NVA time. Value streams are all about parts (making them, counting them, measuring them, boxing them, moving them, and un-boxing them) and products (making, boxing, moving.) The making – touch time, spindle time – is VA time and everything else is VA time. Design out the parts themselves (VA time) using DFMA and NVA time is designed out. Massive multiple achieved.

But the design community is the only group that can design out the parts. How to get them involved? Not all parts are created equal. How to choose the ones that matter? Value streams cut across departments and companies. How to get everyone pulling together? DFMA, that's how.

DFMAWill Connect The Engineer To The Factory

Rumor has it, manufacturing is back. Yes, manufacturing jobs are coming back, but they're coming back in dribbles. (They left in a geyser, so we still have much to do.) What we need is a fire hose of new manufacturing jobs.

Manufacturing jobs are trickling back from low cost countries because companies now realize the promised labor savings are not there and neither is product quality. But a trickle isn't good enough; we need to turn the tide; we need the Mississippi river.

For flow like that we need a fundamental change. We need labor costs so low our focus becomes good quality; labor costs so low our focus becomes speed to market; labor costs so low our focus becomes speed to customer. But the secret is not labor rate. In fact, the secret isn't even in the factory.

The secret is a secret because we've mistakenly mapped manufacturing solely to making (to factories). We've forgotten manufacturing is about designing and making. And that's the secret: designing – adding product thinking to the mix. Design out the labor using DFMA.

There are many names for designing and making done together. Most commonly it's called concurrent engineering. Though seemingly innocuous, taken together, those words have over a thousand meanings layered with even more nuances. (Ask someone for a simple description of

concurrent engineering. You'll see.) It's time to take a step back and demystify designing and making done together. We can do this with two simple questions:

- What behavior do we want?
- How do we get it?

What's the behavior we want? We want design engineers to understand what drives cost in the factory (and suppliers' factories) and design out cost using DFMA. In short, we want to connect the engineer to the factory.

Great idea. But what if the factory and engineer are separated by geography? How do we get the behavior we want? We need to create a stand-in for the factory, a factory surrogate, and connect the engineer to the surrogate. And that surrogate is cost. (Cost is realized in the factory.) We get the desired behavior when we connect the engineer to cost.

When we make engineering responsible for cost (connect them to cost), they must figure out where the cost is so they can design it out. And when they figure out where the cost is, they're effectively connected to the factory, and can design out cost with DFMA.

But the engineers don't need to understand the whole factory (or supply chain), they only need to understand places that create cost (where the cost is.) To understand where cost is, they must look to the baseline product – the one you're making today. To help them understand supply chain costs, ask for a Pareto chart of cost by part number for purchased parts. (The engineers will use cost to connect to suppliers' factories.) The new design will focus on the big bars on the left of the Pareto – where the supply chain cost is. Use DFMA on the bars.

To help them understand your factory's cost, they must make two more Paretos. The first one is a Pareto of part count by major subassembly. Factory costs are high where the parts are – time to put them together. The second is a Pareto chart of process times. Factory costs are high where the time is – machine capacity, machine operators, and floor space. And once costs are understood, they can be designed out using DFMA.

To make it stick, use design reviews. At the first design review – where their design approach is defined – ask engineering for the three Paretos for the baseline product. Use the Pareto data to set a cost reduction goal of 50% (It will be easily achieved, but not easily believed.) and part count reduction goal of 50%. (Easily achieved.) Here's a hint for the design review – their design approach should be strongly shaped by the Paretos. Use DFMA on the biggest bars and start printing money.

Going forward, at every design review, ask engineering to present the three Paretos (for the new design) and cost and part count data (for the new design.) Engineering must present the data themselves; otherwise they'll disconnect themselves from the factory.

To seal the deal, just before full production, engineering should present the go-to-production Paretos, cost, and part count data.

What I've described may not be concurrent engineering, but it's the most profitable activity you'll ever do. And, as a nice side benefit, you'll help turn around the economy one company at a time.

DFMA Will Grow As A Bottom-Up Methodology

The No. 1 reason initiatives are successful is support from top management. Unfortunately, there's never enough to go around, but that's the way it should be.

Whether it's lean, Six Sigma, Design for Six Sigma or DFMA, top management support is vital. No argument. It's easy with full support, but there's never enough to go around.

But that's the way it should be. Top management has a lot going on, much of it we don't see: legal matters, business relationships, press conferences, and the company's future. If all programs had top management support, they would fail due to resource cannibalization. And we'd have real fodder for our favorite complaint - too many managers.

When there's insufficient top management support, we have a choice. We can look outside and play the blame game. "This company doesn't do anything right." Or we can look inside and choose how we'll do our work. It's easy to look outside, then fabricate excuses to do nothing. It's difficult to look inside, then create the future, especially when we're drowning in the now. Layer on a new initiative, and frustration is natural. But it's a choice.

We will always have more work than time. But it's our work, and we choose how to do it. And it's how we shape the future. Every day we choose. Add another initiative and it's the same. We choose what to do and how. Here's where the look-outside crowd takes the accountability off-ramp and decrees they have no control. But the look-inside crew chooses personal responsibility because we know even the worst bosses listen to exceptional people. We have control and we know it. This is the seed for successful bottom-up work.

Bottom-up work has the fingerprints of folks that take responsibility - yours. You know your work better than anyone, and you behave that way. Eighty percent of your work is the same as last time, but 20 percent is colored by your character. This is the special work, magic work so innate you don't know how you do it. You just do. Here's how it goes: You decide what to try, try it, measure the situation before and after, and repeat. So I recommend you try, and re-try, DFMA.

More often than not, you improve the situation. The problem is, your good results stay local. There's a missing step-communicate. Too often, we don't make time to share our results. We're already onto the next bottom-up project.

But in this case slower is faster. Although communication work seems wasteful, do it anyway this time. Set up an informal meeting with your peers and discuss the results. (50% cost reduction, 50% part count reduction.) Figure out what worked and why. Do the same for what didn't. Write it up and, with your peers, present it to your boss. Tell the story and lay out the sequel. You don't ask. You define how the future will be. If the work was successful, do more of it. If it wasn't, try something else. Either way, your personal responsibility carries the day. You

know your work best, and you behave that way.

The next chapter is bigger, because your peers are with you. Their fingerprints smudge with yours, and personal responsibility impregnates the work. You decide, try, measure, communicate. But this time, you invite your boss's boss. You tell the story (50% part count reduction), lay out the future, and then get busy. You don't ask.

The next one is bigger still. It's beyond fingerprints. Decide, try, measure, communicate. This time you invite top management. You tell the story, explain what could be, and how to systematize it. Top management recognizes the value and says they'll fully support a companywide initiative. Systematic DFMA for all.

Now it's time to choose a new project without top management support and start another bottom-up revolution.