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A Case for Collaboration Between Product and Manufacturing Engineers

This paper is for professionals who want to improve business performance through better product design, lower manufacturing costs and lower supply chain investment.

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Contents

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Introduction

Product design covers a lot of territory. Customer requirements need to match up to product features. Those features must be evaluated based on how important they are to customers and how they contribute to competitive advantage. On top of these considerations, short and long-term manufacturing requirements associated with a roadmap of potential cost reductions and product enhancements also play a factor. Product design is a heavy responsibility. Read on to learn how manufacturing engineering can carry some of the load while improving supply chain efficiency.

Market Drivers

Need for Innovation:

Companies are in a race up the "Innovation Curve" or to create "Market Disruptors" according to *Innovators Dilemma* author Clayton M. Christensen. And W. Chan Kim and Renée Mauborgne detailed in *Blue Ocean Strategy* the need to find un-served markets. With a practically unlimited number of innovators in a global economy, the need for speed and focus in product development is top of mind now more than ever. A classic example of success from innovation is 3M. 3M is a $25 billion diversified technology company and one of 30 companies that make up the Dow Jones Industrial Average.In 2004, sales topped $20 billion for the first time, with innovative new products contributing significantly to growth. Recent innovations include Post-it® Super Sticky Notes, Scotch® Transparent Duct Tape, optical films for LCD televisions, and a new family of Scotch-Brite® cleaning products that give consumers the right scrubbing power for a host of cleaning jobs. 3M was founded in 1902 in the Lake Superior town of Two Harbors, Minnesota. Five businessmen set out to mine a mineral deposit for grinding-wheel abrasives. But the deposits proved to be of little value, and the new Minnesota Mining and

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Manufacturing Co. quickly moved to nearby Duluth in 1905 to focus on sandpaper products.**Years of struggle ensued until the company could master quality, production and supply chain.**

Need for World-Class Production and Supply Chain Management:

3M has over 100 years of experience. This is not the norm, however. How do start-up companies, or even companies with 10 years or more experience, master quality production and establish an effective supply chain? In his book *The World is Flat*, Thomas L. Friedman offers outsourcing as the answer. Friedman contends companies should identify their core competence and outsource non-core functions. The key is to not get trapped in the thinking that outsourcing should only be considered when a function is "not important" or too costly to execute in-house: think partnership.

Successful outsourcing can make or break a business. When companies specialize in marketing and product development, they should consider partnering with a world-class manufacturer to better capitalize on their strengths. As 3M learned, a company will continue to struggle until they master quality, production and supply chain management.

A popular example is Dell Computer. Dell specializes in the buyer experience. They make it easier to configure and buy a computer than anyone else. How much of the product thatthey sell does Dell manufacture? Zero. They rely instead on outside manufacturers and vendor managed inventory (VMI).

Implications

Improved Economic Growth

People won't buy yesterday's products. The reality of today's economy is that companies that stand still will be replaced by those that focus on product development. Consumers and industrial buyers can purchase the fresh offering that

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provides what they really want or need – in any economic climate.In the 2008-2009 recession for example, many commercial and industrial buyers are seeking only to invest in short term projects with low capital requirements. Aggressive companies have adjusted their product and service offering, are addressing that need and are connecting with customers, while others have simply watched as their sales have evaporated. A site survey consulting firm recently shared some amazing statistics about their business:

- 80% of their active customers are newer than 6-months old. While their long-time customers haven't gone anywhere, they are not buying right now.
- Buying patterns have changed significantly, and average order size has decreased from almost $6,000 per order to just over $300 per order.

How did they accomplish this? They had to completely transform their offering and infrastructure to generate enough volume to keep sales from declining. Rather than hire full time staff, they instead called on industry freelancers for much of the volume.

The take-away is that outsourcing removes the distraction of managing any functions not essential to your core competency (i.e. manufacturing) and frees the market-oriented firm, allowing it to most efficiently serve the rapidly changing demands of the market.

<u>Increased Manufacturing Utilization and Innovation:</u>

Notice the immediate specialization that develops when marketers focus on the market and the supply chain players focus on their functions. The prior examples focused on the benefits for the marketing side. Now, let's look at the manufacturing and fulfillment side.

When a manufacturing company serves only one market its maximum throughput[1] is constrained by the number or orders received for the

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limited range of products offered. However, if a manufacturing company can serve more than one market, its maximum potential throughput is increased. Serving this larger demand encourages innovations on the most popular work cells causing the processes in most demand will evolve and improve. This innovation creates additional capacity, which in turn results in higher overall production output.

As we mentioned earlier, it is very difficult and takes a long time to reach the proficient level of vertical integration achieved by leaders like 3M. Instead of world-class manufacturing, most companies that try to vertically integrate find themselves handicapped by antiquated manufacturing systems.

Product Designers and Manufacturing Engineers Collaborate:

When a marketing-oriented company is focused on its market and keeping up with the demand for new products and services it needs to collaborate with a trusted manufacturing partner so products can be produced efficiently and so inventories can be kept to an absolute minimum.

Considerations and Tips

The following are specific areas where manufacturing and product engineers can work together to improve product design, reduce manufacturing costs and reduce supply chain investment.

1) Tolerances

Dimensional tolerances are important for the intended use and market position of a product as well as to determine the manufacturing method. Too tight of a tolerance can create more processes in the manufacturing than are necessary. For example, if a simple thru hole is shown on a print as .250 +/- .005" it would require a drilling process and a reaming process. Whereas the same hole shown as .25 +/- .01" would only require a drilling process. A good rule of thumb is to allow as much tolerance

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as possible in order to keep manufacturing costs to a minimum.

2) Dimensioning and Surface Requirements:

A product designer alone can't possibly provide "manufacture ready" prints that can be sent to the shop floor. In order to do that, the designer would have to know exactly which work cells are available, determine a routing and then dimension each sub-component accordingly. This is the job of the manufacturing engineer.

However, a product designer can indicate the most critical dimensions and surfaces on the final assembly. This allows the creative process to continue in conjunction with the manufacturing engineer who can then suggest alternative sub-assembly strategies, surface ratings and dimensions. This is real collaboration and should occur during every product design.

A specific example would be a sheet metal shroud. A two-dimensional flat pattern sheet must be laid out based on fold allowances that are determined by thickness of the material and radius of each bend. If a designer calls out a radius that is not achievable for that material thickness, the 2D drawing would be incorrect. A better approach would be to collaborate with the manufacturing engineer during design so this can be laid out correctly the first time. The results, of course, are a faster design process, more accurate proto-types and reduced supply chain costs.

3) Material Selection:

This is a vital subject. Materials affect the aesthetics, structural integrity, longevity, recyclability and cost – as well as manufacturing and supply chain management. This puzzle can be tricky to put together. However, if the design engineer can rate the variables by level of importance, the manufacturing engineer can offer information such as cost, availability, economic order quantities, storage and handling requirements, and

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manufacturing risks related to particular choices.

4) Manufacturability:

Familiarity with available manufacturing capabilities gives manufacturing engineers perspective on products design engineers may not have. Attempting to build some designs without providing suggestions on how they can be optimized for ease of manufacture can create unnecessarily-high production costs. However, when manufacturing engineers have an opportunity to keep the design within readily-available means they can offer cost-effective solutions to conform with budget concerns.

Case Study:

40KW Generator Frame Re-Design and Inventory Management

Boss Industries supplied product designs in February 2008 so they could receive a competitive quote in order to select a supplier. Trusted Supply Chain Partners suggested an alternative approach that involved collaboration between Boss's product designers and Trusted manufacturing engineers. Within two months the product was redesigned and had a new direction for manufacturing and inventory management.

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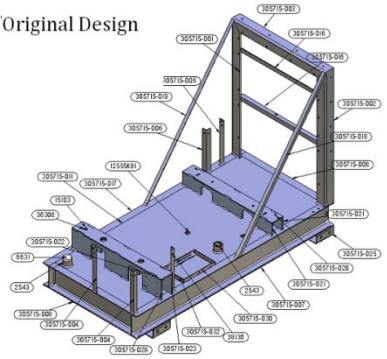
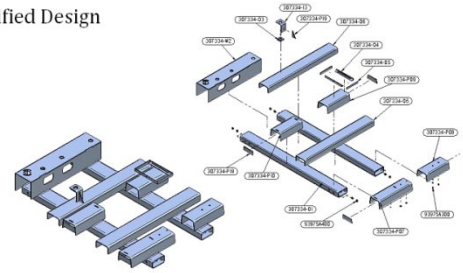
Original Design



Modified Design



Several things needed to occur in order for this approach to be effective:

1) Boss purchasing needed to be open to an alternative approach.
2) Boss purchasing needed to gain the time and commitment from Boss engineering to support the project.
3) Trusted engineering and Boss engineering needed to collaborate.

The results speak for themselves: **Boss benefited in an 83% reduction in supply chain investment.** This table shows the before and after results of the collaboration between Boss product engineers and Trusted manufacturing engineers.

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	Before	After	% Reduction
# of Main Parts	23	14	39%
# of Breakdown Parts	88	48	45%
Raw Material Cost	$495	$317	36%
Manufacturing Cost	$798	$576	28%
Total Cost	$1,294	$894	31%
Required Order Quantity	16	4	75%
Lead Time (Weeks)	8	2	75%
Total Inventory & On Order Qty	48	12	75%
Total Inventory & On Order $	**$62,123**	**$10,735**	**83%**