Concurrent Engineering and DFMA®: The Path to Innovation and Competitiveness

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Disclaimer

The following represents the authors perspectives of the changing industrial landscape based on his 35 years of experience in product development and manufacturing related roles. Historical data presented is accurate only to the degree offered by the internet and the authors memory ;0).

Introduction

I was fortunate to start my professional career working for the Eastman Kodak Company … a company with its roots in the "second industrial revolution" where the concept of vertical integration was born ("total self-sufficiency" … Henry Ford). Kodak's manufacturing plants were nearly 100% vertically integrated … a great place to "grow up" as an engineer. A lot has changed since then. In this post-COVID era where many of the "norms" would have been unimaginable just a decade ago, we find that some "old" things are "new" again. Millenials and Gen Z's are into records/LP's and film photography again augmenting modern "digital" solutions. Boomers and Gen X's have gone ga ga over 1970's interior decorating trends … the so called "postmodern" design elements. "We" (the royal "we") in industry have spent the last three decades dismantling our industrial infrastructure and lengthening our supply chains significantly increasing complexity in our value streams and now, "remote" work has become somewhat of a new "norm". However, the path to innovation and competitiveness is the same as it has always been and those "old" practices need to be made "new" again.

The Beginning

Starting in the mid-1980's, Design for Manufacture & Assembly (DFMA®) and the initial concepts that became "concurrent engineering" (CE) were being developed and utilized in industry. IBM famously developed the ProPrinter dot matrix printer to replace the sourced Epson printer that was being bundled with the IBM Personal Computer (PC). Following key CE and DFMA® principles, the IBM team developed and launched not only a best-in-class printer but also a fully automated assembly factory to produce those printers (Charlotte, NC). This "skunk works" approach had a total development-to-launch time of approximately 24 months … less than half the time of what would have been considered normal. Those key principles included:

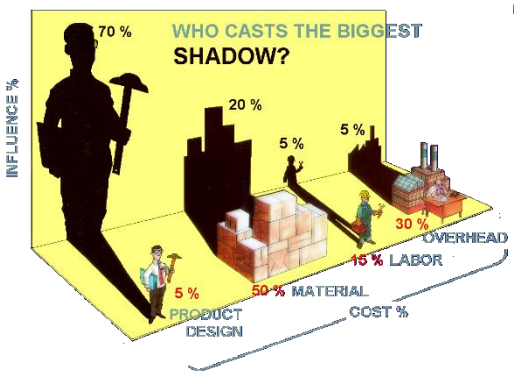
- Cross-functional, dedicated core team that included product marketing, design, manufacturing, automation engineers, quality engineers, etc.
- Co-locating the core team in a separate location away from all the usual "corporate" distractions

- Design rules that included z-axis assembly (i.e. no reorientations), no flexible parts, and no screws or separate fasteners

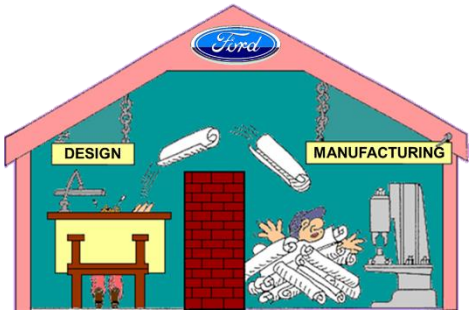
While strict z-axis assembly was not achieved the other rules prevailed and the assembly was 100% automated. By the late 1980's, manufacturing and, eventually, all of the support roles for the printer division had been moved to Lexington, KY and, in 1991, became the Lexmark Corporation.

Transforming Product Development

By the early 1990's, in collaboration with many key corporate partners, DFMA® and CE became recognized core product development "best practices". The US auto manufacturers, appliance manufacturers, heavy equipment manufacturers, and many others helped evolve and mature these methods into standard industrial product development practices. At The International Forum on DFMA®, champions of the process presented their case studies and learnings. Vince Render from Ford made plain the impact of design on a product's life cycle costs stating that roughly 5% of the commercialization costs of a product dedicated to design had a 70% impact on the product's overall life cycle costs. He claimed that Ford was successfully implemented CE knocking down the "wall" between design and manufacturing. As evidence, from 1992 – 1996, the Ford Taurus (Gen 2) held the record as the most produced car model sold in the US.



Historical Way of Doing Business



Kodak's Adoption

My role as DFMA® champion started in the early 1990's when Kodak was implementing its reengineered product development process. With the help of Don Clausing, Genichi Taguchi, and other recognized global experts, Kodak engineers had designed a new process that was heavily based on CE and many new product development "best practices" … chief among them was Voice of the Customer (VOC), Robust Design, and Value Engineering (which included DFMA®). This new process was heavily "front-end loaded" … commonly referred to as the "do more engineering" product development process. Key elements of the Kodak process included:

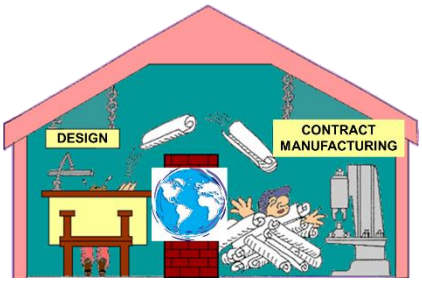
- Co-located, cross-functional product development teams
- VOC that was collected, analyzed, and deployed by the core team, not just Marketing

- Effective and efficient use of engineering best practices that included
    - Function Analysis
    - DFMA®
    - Set-based concurrent engineering
    - Statistical techniques such as Robust Design and Design for Reliability
- Decisions based on data not "gut feel"

In 1992, Kodak launched the newly designed Funsaver line of single-use cameras … a platform that was developed and commercialized in under 2 years and is still being manufactured today. Lean and Six Sigma methodologies aligned well with our new approach and were quickly adopted and effectively implemented. As an example, our injection molding processes achieved an eight sigma performance level … that's 2 parts per billion defective. When you're molding millions of parts per month, this level of process quality is critical.

Shiny New Thing

By the late 1990's, the pursuit of low labor cost solutions came into vogue (for a variety of reasons that would consume hours of speculative discussion). Kodak followed suit shutting down US manufacturing operations and outsourcing and off-shoring that work following the fad established by many other manufacturers in the country. Supply chains lengthened, vertical integration became a rarity, and ignorance of manufacturing process became the norm. Some companies went so far as to lay off their manufacturing engineering talent focusing their efforts only on product design and "innovation". Before we knew it, we were back to the 1960's with a "wall" that was now global between design and manufacturing. CAD and computer simulations took the place of cross-functional teams, creative dialog, and experimentation. DFM, to a large extent, is now done by RFQ (request for quote) which, by definition, requires a design to be complete enough to be quoted … the "ugly baby" conceived.



Crisis Induced Change

The COVID pandemic and supply chain challenges of 2020-2021 seems to have snapped companies out of their off-shoring frenzy. Based on data collected, tracked, and reported by the Reshoring Initiative, manufacturing jobs are returning to North America in huge numbers. Even with reported recessionary trends, job growth continues to shatter expectations. Unfortunately, on the design and administration side of the house, COVID has resulted in an exodus of those resources and a significant rise in "remote workers". Now, instead of empty manufacturing spaces, we're seeing empty office spaces. Companies are struggling to get their employees to return to the office. How is co-location of cross-functional teams going to be achieved? Can technology effectively recreate that dynamic, creative, problem solving venue?

Conclusion: The "Old" Should Be Made "New" Again

It's time to shift our focus back to the "fuzzy front end" … rejuvenating the "team sport" that is product development and commercialization. The "do more engineering" approach that is CE combined with DFMA® product simplification and costing results in significant improvements in design innovation, life cycle costs, value stream responsiveness, and time to market.

A vision for the "new" product development culture includes:

- Dedicated (not just involved) and co-located/interconnected cross-functional teams that span all aspects of the value stream … including suppliers
- Dynamic, facilitator led teams in judgment-free environments utilizing benchmarking data and DFA product simplification to stimulate multiple potential design options
- The "learning organization" characterized by highly effective communications, robust data generation and analysis, and rapid problem-solving
- Engineering and statistical analyses driving decision-making to architect the optimal solution path
- DFMA® driven design reviews and supplier costing activities that improve gross margins and commercialization times

These techniques, proven many times over in the last four decades, are the means to enhanced innovation and competitiveness … shattering "design by habit" and, in many cases, reinvigorating the excitement and camaraderie that was once the product development culture. The "constant pursuit of perfection" should not just be a Lean manufacturing mantra but rather the battle cry for the whole organization. This is how we drive innovation and competitiveness … this is how we maximize value.