

### Concurrent engineering/design for manufacturability

A. Sandy Munro

President, Munro & Associates, Inc., Troy, Michigan, USA

While North American automakers and suppliers are scrambling to acquire new technology and implement lean production strategies which will help them catch up to, and compete with, Japanese and European companies, most are missing the chance to leap-frog ahead of and actually annihilate the competition in the marketplace.

That chance is afforded by the strategic use of Concurrent Engineering/Design for Manufacturability (CE/DFM) principles. Initial North American automaker forays into CE/DFM have shown that by taking a more strategic, long-term view of the product at initial design stages — and incorporating the input of the people who will use, purchase the materials for, manufacture, assemble, service and support the product — dramatic improvements in the product and the product's profitability can be enjoyed. In addition to total product manufacturing cost reductions of 30 to 60 percent, other benefits of CE/DFM have proven to be:

- Improved product quality/reliability due to significantly reduced variation;
- Reduced labour, overheads, manufacturing floor injuries and administrative paperwork;
- Lower product service and warranty costs and easier product service;
- Reduced product development and manufacturing cycle times.



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In the war for market share and survival, CE/DFM can be the most potent weapon in the arsenal for automakers. Yet, while CE/DFM is heard in corporate speeches and extolled in corporate strategies, it can only be found in actual practice in a few, small pockets of excellence — usually at the subsystem or system level. In fact, today, no North American automaker, division or platform can boast a true concurrently engineered/DFM'ed vehicle because of carryover parts, piece-cost accounting procedures and 'car versus career' decision-making.

The power of CE/DFM revolves around two indisputable, but often overlooked, facts:

- The design process is the only step in the product cycle where value and profit can be created;
- Product design, which accounts for only five percent of a product's total cost, actually dictates 75 percent of the product's total manufacturing cost.

With CE/DFM, a company considers all of the downstream activities during the earliest design stages. It uses analytical tools to quantify and test for the best possible processes and approaches up front, so that a team can get the product right the first time — and avoid costly, late fixes on the factory floor.

By taking a teamwork approach to incorporating the critical input of finance, marketing, purchasing, manufacturing and factory floor labour in the earliest design phases, significant reductions in total manufacturing cost, product development time and manufacturing variation can be generated. The result is a more elegant, reliable design that is easier to manufacture and assemble, and substantially more profitable to produce. In other words, a design that can help to annihilate the competition.

The key challenge in successfully adopting CE/DFM is in changing the way individuals think and corporations act. CE/DFM requires people and companies to cast off tried and true approaches. It requires them to see what everyone has seen, but thinking differently from the way everyone else has thought. It requires them to attack—

rather than revere — the company's 'sacred cows' and venture into uncharted, uncomfortable territory. Such dramatic paradigm shifts do not occur easily or quickly. But they can occur with a committed and supportive leadership.

Today, the three most common reasons for a company failing to realise CE/DFM's full potential stem from the old corporate cultures.

First is what the Japanese call the 'fast gun/slow bullet' syndrome. This is a company's propensity to rush through initial engineering to produce a design quickly, only to spend exorbitant amounts of time, effort and money to correct the design and perfect the manufacturing processes after the product is on the factory floor. CE/DFM usually requires 20 percent more engineering cost and time up front, but typically yields a 50 percent saving in cost and time downstream.

The second most common reason for CE/DFM not reaching its huge potential is the nomadic migration of key team personnel in and out of a project. In the North American auto industry, it is not uncommon for as much as 60 percent of programme personnel to turnover during a development programme.

This turnover tends to erode ownership of team goals, cloud the team vision and weaken individual commitment to the project. Individuals lose a sense of ownership in the new solutions, lose sight of the team's long-term goals and revert back to the old ways.

The third major obstacle to CE/DFM success stems from the fact that in most corporate cultures, radical new designs or innovative approaches are not only left unrewarded, they are often negatively rewarded. Sometimes the parts reduction or cost reduction generated by a CE/DFM innovation is so drastic and so incredible that the senior executive cannot accept it. When this happens, they lash out at the very team they are supposed to nurture, banish them to a less desirable position, and occasionally even fire the person responsible for the breakthrough idea.

## Keys to a winning CE/DFM strategy

In our work over the past decade in helping North American automakers (and manufacturers of all types of other products) implement CE/DFM, it appears that the companies that have been truly successful with CE/DFM have five factors in common.

First, the company's leadership has acquired an intimate, detailed knowledge of CE/DFM, has 'hands-on' experience on a CE/DFM project team, and demonstrates a fervent, long-term commitment to the discipline. A half-hearted commitment by senior managers or the limiting of a key executive's experience to an afternoon executive briefing session jeopardises the success of the entire project.

Second, the company has developed and implemented a detailed, strategic and all-inclusive action plan. This plan helps to immerse the whole organisation into the CE/DFM process and nurtures the team-oriented culture so crucial to CE/DFM success. It also includes the key elements involved, such as the scope of knowledge, timing, tools, methodology and resources which will be required.

Third, the action plan is 'owned' by everyone involved. It is not enough to distribute the plan to the organisation. To be successful, the plan must be understood and accepted by the individuals involved. They need to agree with the objectives, know how they fit into the plan, know what is expected of them, know that risk-taking will not be penalised and make their own personal commitment.

Fourth, the successful companies have turned to an outside organisation for what Dr. Deming has called profound knowledge. Since most companies and industries become myopic because of shared paradigms, they need someone to shake up their thinking, get them to question the old ways and bring new ideas and new approaches and technologies that have worked in other companies and other industries. This outside perspective is crucial in guiding the company through the inevitable doubts and rough spots, and in keeping them from reverting back to old, more comfortable ways.

And fifth, the successful companies admit they have enjoyed some luck. But the strategic manager — just like the strategic general — can make his or her own luck by keeping two four-leaf clovers with them throughout their campaign.

The first four-leaf clover outlines the crucial ingredients for CE/DFM success:

- True top management commitment — not just contribution;
- Early involvement — at the concept stage;
- A multi-disciplinary team that includes shop floor operators — the most product knowledgeable, yet underutilised resource a company has; and
- Analytical approaches — so decisions are made based on data and numbers, not emotions.

The second four-leaf clover emphasises the key considerations for CE/DFM success:

- Teamwork — a focused, committed team will outperform a group of individuals with more technology but less focus every time;
- Timing — extra time must be allotted at the design stage. In the end, CE/DFM will save time by doing things right the first time... and probably gain a product generation advantage over the competition;
- Training — People will not think in new ways or use new rules without training. Training helps people discover and tear down the limitations they have put on their own creativity. And it helps the team to see the product and the processes in the new and different perspective that is needed to create a breakthrough design;
- Tools — Several analytical tools and computer methodologies are available to provide CE/DFM teams with the data they need to make wise choices.

These tools include such various approaches to quality function deployment (QFD), concept convergence, design for assembly, design for manufacturability, failure mode and effect analysis (FMEA) and design to target cost. Teams should benchmark CE/DFM tools rather than using the most readily available. For maximum advantage, they should pick the tools and approaches which best fit their specific needs and should consider integrated software suites which allow data to easily and quickly be moved among these various phases of the development process.

If done properly, CE/DFM conducted in the team approach not only cuts investment cost, improves product quality and customer satisfaction by reducing variation, and reduces lead time; it can also yield the additional benefit of patents. Hundreds of such patents have been generated by teams we've counselled. And the serendipity of

patents is that they double your payback — first providing you a cost advantage over the competition and then providing a second income stream from selling patent rights.

As we look ahead, CE/DFM will be used increasingly for the next generation of North American vehicles. As implementation and experience grows, the discipline will continue to broaden and increasingly include other downstream factors such as service and recycling in the initial design.

As a result, CE/DFM will not only help the automakers who embrace it become more profitable and more competitive, it can also help the auto industry address other key societal issues.

For example, by considering the factory floor operator in the initial design, ergonomic workplace injuries and related health care costs can be contained. And, by considering service and recycling issues in the initial design, auto manufacturers can make the product easier to service for the consumer and easier to recycle to help preserve the environment. One customer's elegant design is based upon a strategy to actually make profit on the return of a used product, by starting with an easily recyclable material. A product like that, one that generates profit for a company twice, is truly a winning product.

Some 2,000 years ago, the great Chinese general and philosopher Sun Tzu developed a strategy he entitled *The Art of War*. Two quotes from that body of work apply to CE/DFM in today's automotive industry: "...Plan for what is difficult when it is easy, do what is great while it is still small" and "The battle is won in the strategy room, not on the battlefield."

For us in the automotive battle, it is still good advice today. Take the extra effort to design the product right in the first place, and win the battle for market share in the design room, not on the manufacturing floor.

*A. Sandy Munro was one of the pioneers in the application of design for assembly (DFA) and design for manufacturability (DFM) principles. He founded his consulting firm, Munro & Associates, Inc. in 1988 to help North American manufacturers harness the power of concurrent engineering/DFM to reach new levels of global competitiveness. In 1978 Sandy joined Ford Motor Company and went from manufacturing engineer to Corporate Coordinator — Design for Assembly.*