Design for manufacture can work

Consultants to Cadillac share the reasons why, after two tries, the third DFM attempt was the charm.

By A. Sandy Munro

I tell this design for manufacture (DFM) story of Cadillac Motor Car Div. of General Motors Corp. (GMC) for a reason. If DFM works in a company like Cadillac, one that is trying to shake off the old Harvard cost-accounting paradigms and explore new lean-build techniques, it can work at your OEM, too.

It all began with a decision. Cadillac's leaders realized that to implement all Dr. Deming's quality and elimination of waste teachings, they needed to explore DFM.

Initially, DFM was brought into Cadillac by two sources prior to our firm being asked for help. One was internal and the other was an outside consultant. Both actually did more harm than good.

In many companies, these two tries would have been enough to end any DFM stuff, so they could get back to the old way of doing business. But, Cadillac knew of Chevrolet's successes with the process. By using our DFM approach, Chevrolet-Pontiac-Canada group (CPC) had saved the Camaro/Firebird (F Car) program.

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The process

Bob Dorn, Cadillac's chief engineer, and Gary Cowger, manufacturing manager, had worked together to bring simultaneous engineering into the company. Their teams of product design and manufacturing engineers, and hourly, purchasing, financial, and service people were already in place. The Deming philosophy was very strong.

They believed they needed more. This led them to hire us as their DFM consultants to review the newly restyled Eldorado and Seville. Dorn and Cowger wanted the new cars to be easy to build with a quality level that can only be designed in. They knew that 5% of a product's cost influences 70% of the quality, manufacturability, serviceability and general acceptance in the marketplace. They felt that if they did a good job designing with DFM principles, the customers and profitability would come.

The one thing these men were sure of was that old paradigms were going to be the biggest road blocks to getting the job done right. To give a new paradigm a fair chance, they would have to get involved personally and show their commitment.

Dorn and Cowger took our training themselves — not a one-hour executive overview but two days of intensive training. We began with a structured workshop. The first day consisted of training on DFM prin-

ciples and scorekeeping the results. Only one "canned" example was used for analysis — all others were product-specific. The components and subsystems we analyzed in the workshop were characterized by high warranty, high cost and/or labor intensity.

The managers supplemented this by taking benchmarking trips to successful DFM companies and various DFM seminars. They listened to those who had gone through the metamorpheses, receiving first-hand information about what worked and what didn't. Then they formulated their vision.

Vision and organization

Dorn and Cowger shared their vision with their subordinate managers. As Deming says, "Everyone doing their best is not the answer; first it's necessary that people know what it is they are to do."

The plan the two leaders presented wasn't a "best guess" but a tried-and-true recipe. The process empowers the multifunctional teams to think differently. It allows for a take-action approach.

Dorn and Cowger also realized that with two false starts, DFM was going to be a tough sell. They needed a success story. They decided to run a test case workshop of 40 engineers who had taken training from the two prior sources. These were engineers who didn't believe the process worked on cars and felt the two previous consultants were "smoke and mirrors" specialists. This group was joined by 10 people from areas such as purchasing, finance and the hourly work force.

The participants were jammed into a conference room that was too small and cold. They were told to work on designs that everyone thought had been a "done deal."

This was a tough crowd. The first two days of training were almost nonstop arguing and contradicting. Disquieting apprehension sums up the third day. But, during the last two days, the room was vibrating with an almost lost commodity —American ingenuity. Cadillac got their success stories and we got DFM converts.

The participants were charged and ready to see if management would "walk like they talked."

Management support

The worst thing that can happen to a company trying to implement DFM is to have upper management not show up for the last day reports. "No shows" tell those who worked on the projects that the seminar was just a fad to amuse the troops.

At Cadillac the leadership did appear. They attended every workshop, in force — not to sit politely and listen, but to volunteer as DFM champions. Their task was to remove obstacles that got in the way of idea implementation. This, in many ways, is tougher than the engineering work because it involves shifting of both technical and financial paradigms.

Every session we facilitate ends with what we refer to as a report-out session. During the report-outs, the existing (starting) design, which has been benchmarked with an assembly diagram, piece cost list and assembly labor analysis, is reviewed with management. The teams then report final analysis results utilizing three levels of technology risk:

- **Low level risk:** These ideas can be implemented almost immediately. The technology isn't new to the product market and team members feel comfortable that, with minimal testing and validation, the ideas can be incorporated.
- **Medium risk:** These take a greater amount of research. They may involve a technology utilized by another industry or a combination of materials and processes unfamiliar to the team. This level can sometimes produce patentable ideas and is the most likely level to be implemented.
- **Stretch:** Ideas in this level require experimentation, research, testing and validation. They are on the edge of a new paradigm and, in some cases, thrust their companies to the forefront of their industry. Almost always patentable, these ideas are the ones which have the potential to leap frog past the competition.

By using this idea migration, a Dorn-sponsored DFM engineering fund, and with

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NOTE:
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the help of management to remove traditional roadblocks, a high percentage of medium risk ideas were successfully implemented into the 1992 Eldorado and Seville.

The achievements (see box) are a great success story. With the lower volumes seen in the luxury car class, wise use of investment dollars is critical. DFM played an important role. One example is the rear suspension system. After taking out $2.1 million from the design, another $1.2 million was eliminated through DFM on the one-of-a-kind automation system used to manufacture it.

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Collectively, the resulting cars turned the heads of the buying public. The 1992 Cadillac Seville was the *Motor Trend* Car of the Year, *Car & Driver* voted it one of its Top Ten and *Automobile* magazine honored it with "Car of the Year." That's the auto industry triple crown and no car company has ever won all three before. From Germany to Japan the orders for this car make it a true American success.

Cadillac's pursuit of perfection is still going on Many subtle DFM changes have been made to the product after launch on subsystems that we had no time for during the design phase. There is a work force committed to quality at the Detroit

DFM success stories, Cadillac style

Design for manufacture (DFM) used on the Cadillac Eldorado and Seville saved the company large sums of money and brought customer acceptance. Here are two success stories:

• **Shifter console assembly** — The existing console, used on an Oldsmobile, was a nightmare for the floor personnel to build. It was so difficult that it stopped the line on a regular basis. Dealers who had orders for the car were hopping mad at how long it took to fill an order.

The initial design (shown in Figures 1 and 2) is still typical of a non-DFM full console build. The shifter was bolted to the tunnel. The console was bolted to the instrument panel and tunnel. Then the gear-position indicator (PRNDL) cover was installed, and all the cables and wires were hooked up. The PRNDL was adjusted, the rear cover attached and trim pieces added. The parts were given a functional check and the final PRNDL adjust was made. Sounds easy, and it would have been, if operators had thin fingers 3 ft. long.

The new design (Figure 3) incorporated the shifter as part of the console assembly. This idea improved buildability. A locking tab located the shifter to the console and improved the quality of fit (net build) while reducing parts and labor. The end cap became part of console, which eliminated tough assembly build and improves appearance.

To improved buildability, the PRNDL plate now

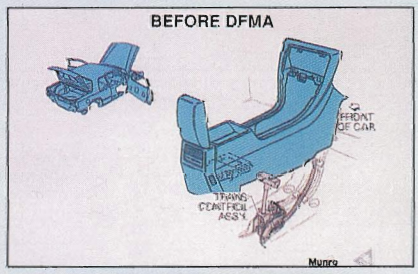

Figure 1: The shifter assembly before DFMA.

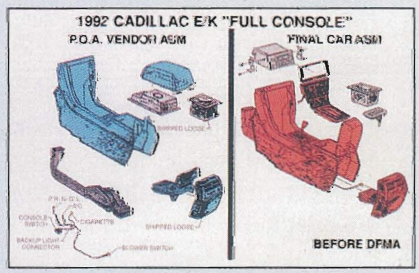

Figure 2: The console subassembly and final car assembly, both before DFMA.

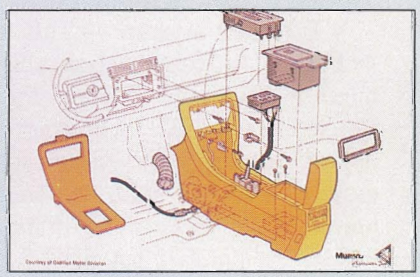

Figure 3: The new console design (after DFMA).

Hamtramck plant and the voice of the assembler is clearly heard.

Gary Cowger and Bob Dorn were right in 1988. They knew the car was a winner and DFM was a tool worthy of investment. ■

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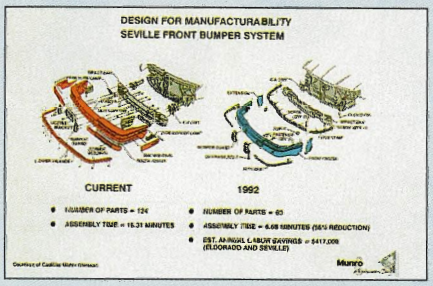

Figure 4: A redesigned bumper dropped assembly time by 56% and reduced the number of parts by 50%.

snap fits (no threaded fasteners, no adjusting). To attach the console, net locating pins were built in. This eliminated two difficult angled threaded fasteners, made it easier to build and improved its appearance.

These ideas and many more allowed Cadillac to reduce build time by 40%, the number of parts by 33% and the piece cost by 12%.

• **Bumper system** — This team's ideas, shown in Figure 4, dropped assembly time by 56%, the number of parts by 50% and the piece cost by $50. The use of net build techniques (no shims), a single bolt attachment to the energy-absorbing shocks and extensive use of snap fits made this the easiest bumper build in General Motors. This system also has several pending patents.