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Implementation of DFMA in VAVE methodology at Sanmina-SCI's Mechanical Systems Division

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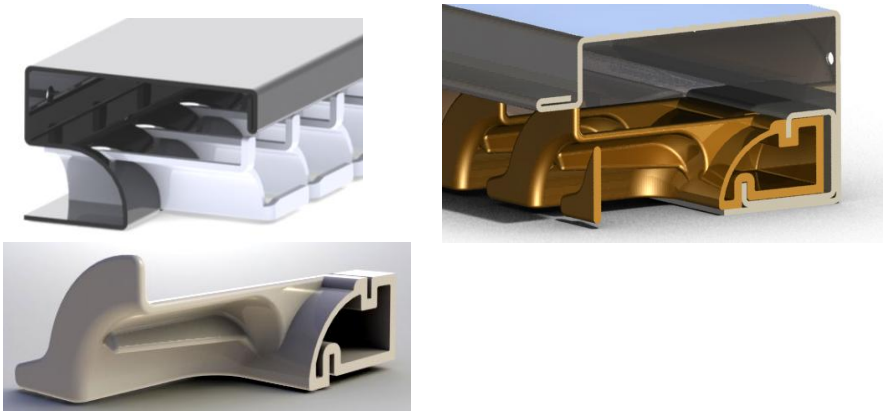
The Designer's Cost Dilemma

Driven by business and time to market needs, most OEM development teams' primary focus is to meet the functional performance targets of the product they are designing. At the conceptual phase, the priorities are to ensure that the product will satisfy customer and market needs; very little, if any, emphasis is placed on material or component selection, fabrication concerns, or ease of assembly of the product. The impact on product cost as a result of poor manufacturability is of secondary concern to the designer. It is left to someone else like the manufacturer of the product to resolve cost issues later. However, once the product has been fully designed, the cost savings that can be realized tend to be quite limited, usually no more than 10% to 15% of the original cost. It is generally accepted that 60% to 80% of product costs get locked in during early design phase, i.e. during specification and concept development. Consequently, early involvement of DFMA resources and tools can help improve product costs well beyond the 10% to 15% savings normally seen in the post-design or pre-production phases.

The Solution is Early Involvement (EI)

The ideal scenario is where the design can be optimized for manufacturability in the early phase of the project, so that upon completion of the design, it can be manufactured to meet product feature, function and cost targets. Timely manufacturing feedback to the design engineering team would be a great confidence builder, in committing to, and meeting product launch deadlines with few delays or setbacks. As we know only too well, in the real world this ideal scenario is very hard to achieve. But, with some advance planning and incorporation of Early Involvement of DFMA (EI-DFMA) steps in the initial design cycle, it is possible to improve the design output performance.

Our experience has shown that EI-DFMA concepts during the design cycle can lead to significantly higher cost savings, even as much as 25 to 40% at the component level. And this does not include the savings attributed to cost avoidance measures identified in early DFMA analysis.



Example 1: Redesign from a welded sheet metal part to a UL-94VO Plastic resin molded part, justified thru BDI DFMA analysis which showed cost savings of 42% per piece.

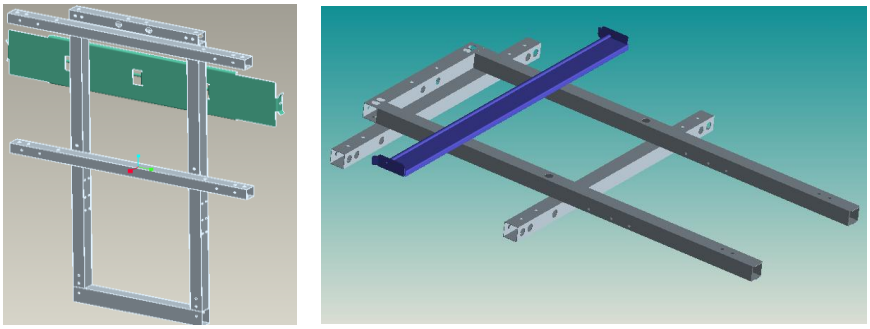
When time to market is critical to the OEM, Early Involvement of the manufacturing partner is a must in order to incorporate cost saving ideas early enough in the first design cycle. The initial design can be rough and incomplete but adequate enough for concept reviews with marketing, (sometimes involving customer focus groups), and, to seek management approvals for full scale development. Once concept approval is thru, the pressure is on design engineers to meet marketing and launch timelines, which usually means that the product must meet functionality and cost targets in its very first design cycle, without the option of going thru additional design re-spins to get product costs in line. The likelihood of hitting the cost target is much greater when the OEM initiates EI-DFMA with the manufacturing partner. This can help define material, fabrication and assembly processes options and develop what-if scenarios on cost trade-offs versus feature, function, form and appearance. The manufacturer is responsible to feedback to the OEM design team the cost down options and product manufacturability pros and cons as a function of design choices.

VAVE Methodology and BDI Implementation

The essence of VAVE (Value Analysis Value Engineering) approach is to seek product cost improvement opportunities by optimizing the product feature needs with the cost impact of alternative design ideas that enhance manufacturability and value. Such ideas usually arise from applying best engineering practices for alternative materials, fabrication or assembly processes.

To meet the challenges of providing effective EI-DFMA services, Sanmina-SCI Customer Engineering Technology Group has implemented Design for Manufacture and Assembly (DFMA) analysis software from Boothroyd Dewhurst, Inc. (Wakefield, RI) as part of the VAVE methodology in the Mechanical Systems Division. This division's mission is to design and manufacture electro-mechanical systems, sub-systems and components for OEMs in networking, telecommunications, industrial, semiconductor capital equipment, medical, and related markets. These systems include mechanical components which require fabrication processes like, sheet metal fabrication, complex welding, precision machining, injection molded plastics and aluminum die castings.

Most customers require "build-to-print" (BTP) services where they have done the complete product design and need a contract manufacturing partner like Sanmina-SCI to build volume products. Other customers may request either collaborative design support or turnkey design services in addition to product manufacturing services.



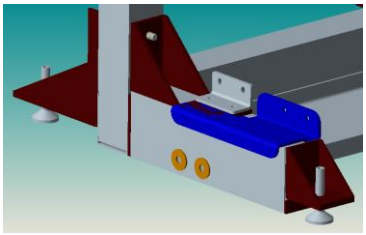
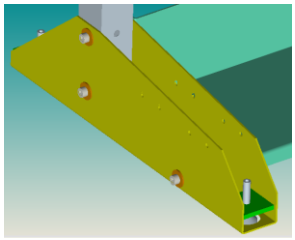
Example 2: Redesign the frame structure from a welded tubing structure to a riveted sheet metal design. BDI DFMA analysis shows cost savings of 58%, significant enough to justify the change.

In the case of BTP customers, the customer will submit their design package for manufacturing quote preparation. As part of the quoting process, and where it makes sense, our Engineering group will use the BDI DFMA approach to develop "should costing" data and verify potential cost savings from proposed design, material or fabrication process changes to the existing design. The costing proposal

sent back to the OEM will include recommendations for alternatives based on DFMA and value engineering best practices for machining, sheet metal, plastics, die castings and assembly which can help reduce component costs. By incorporating the BDI analysis in our VAVE approach, there is improved confidence in the recommendations made re: Alternatives or What-If scenarios, which helps the OEM to move forward with their product decisions.

In the case of turnkey or collaborative design customers, the BDI based VAVE analysis is introduced early in the design cycle and findings are discussed during concept design reviews with manufacturing engineers. Clearly, this is a more effective way of applying EI-DFMA with the BDI tool and leads to higher savings than the BTP application.

Sanmina-SCI uses the Design for Concurrent costing (DFC) and DFA to apply to not only different Material and Machinery Process selection options in the "What If" scenario, but also in seeking alternate Assembly Processes. One advantage with the BDI software is it asks material or process questions which the user would normally tend to ignore, and this helps to refine the product development process. The DFC/DFA software enables engineering to manage the product complexity by consolidating parts in a seamless manner and provide cost savings. At the end of the session, reports can be generated for the OEM and the factory to show in detail what exactly has changed in the product.

Example 3: Redesign of a frame pedestal foot combines front and back features.
Results: Part reduction from 11 parts to 5 parts and eliminates other brackets. The hardware reduction went from 5 bolts to 3 bolts. The changes were supported thru BDI DFMA analysis which showed projected cost savings of 37%.

Sanmina-SCI customers are continuously challenging our engineering team to "think out of the box" and generate cost savings while maintaining the look or feel of their product. Many factors have to be considered in order to stay within the realm of the customer's constraints. This also applies to redesign of existing products when requested as part of a broader sustaining engineering effort. DFMA driven changes must also consider impact on integrity of the components functions being manipulated and changed. Safety and structural integrity are additional considerations, which are sometimes the major cost drivers that will dictate the final decision of the customer regarding change approval.

Keys to Customer Success with Sanmina's VAVE /DFMA approach

The EI-DFMA methodology that Sanmina-SCI's Mechanical Systems' customer engineering team has developed and implemented successfully has evolved over a period of 2 to 3 years with constructive application from the group's collective learning on various projects. Experienced engineers trained in the use of the BDI tool are involved. A cross-functional team including design, estimation, tooling, supply chain, component engineering and manufacturing engineering all work together in the case of major VAVE projects. The technique is proactively applied in the cost proposal phase of build to print projects. It is embedded in the concept phase of design projects when the customer requests design services. As a result, DFMA driven cost reduction changes to the design can be managed within the constraints of a time to market schedule. A structured process and reporting format are in place, and the analysis report makes it easier for OEM engineering teams to understand recommendations and approve the requested changes.