Geometric

Turning designs into reality:

The Manufacturability paradigm

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WHITE PAPER

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Design Impact on Cost, Quality and Schedule

Various studies have proven that an error detected and rectified during the design stage costs almost a hundred to thousand times less than when rectified at manufacturing or further downstream stages. Research also indicates that around 70% of the product cost is committed during the design stage itself. Handling possible manufacturing problems during the design stage is important because the impact is not only on time, but also on cost and quality. For example, a non-standard hole detected during machining impacts the schedule if the design has to be reworked upon. If a non-standard tool has to be procured for machining, it leads to increased cost. Thick ribs and non-uniform walls can lead to sink marks and other quality problems in plastics components. If such defects are detected during inspection, it leads to scrap and rework, thus affecting both time and cost. Defective products being shipped into the market have a high and long term impact on the brand value of the company. Hence, it is important to ensure that designs released downstream for manufacturing and assembly meet the organizational standards and global best practices. This goes a long way in helping the organization stay competitive, profitable and improve its brand image in the market.

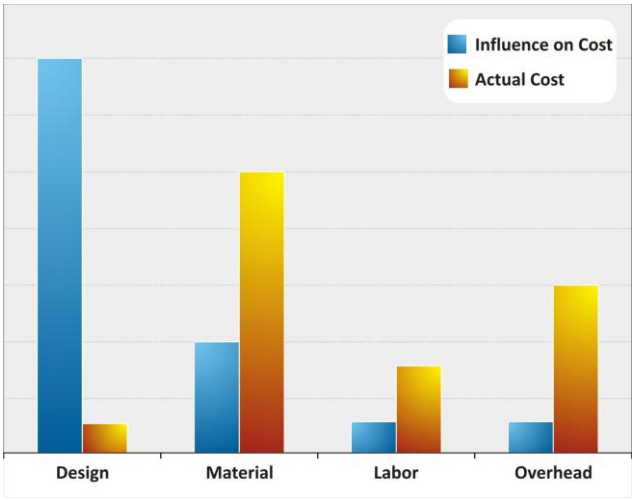

Figure 1: Design Impact

Design for Manufacturability

'Design for Manufacturability' or 'Design for Manufacturing' (DFM) is a methodology that involves designing with intent to minimize the cost of production and time-to-market, without compromising on the quality of the product.

Eli Whitney can be credited with the application of a process involving DFM practices many years before the origin of the term. A book, *Metals Engineering Processes*, edited by Roger Bolz and published by ASME in 1958, provided guidelines for assisting designers in enhancing the manufacturability of their designs. The term, DFM though became popular only around 1985.

Organizations have been practicing DFM mainly by maintaining DFM handbooks, periodically training design engineers for latest manufacturing practices, and conducting design reviews. To create good designs, which can be manufactured with ease, the primary tool is a good CAD system. A crucial accompanying tool is a virtual design assistant for DFM. Creo Parametric from PTC® and DFMPro from Geometric form such a pair of tools in the designers' toolkit, which allow them freedom and flexibility to create innovative designs; at the same time ensures that the recommended manufacturing guidelines are respected. This results in better designs for manufacturing and assembly.

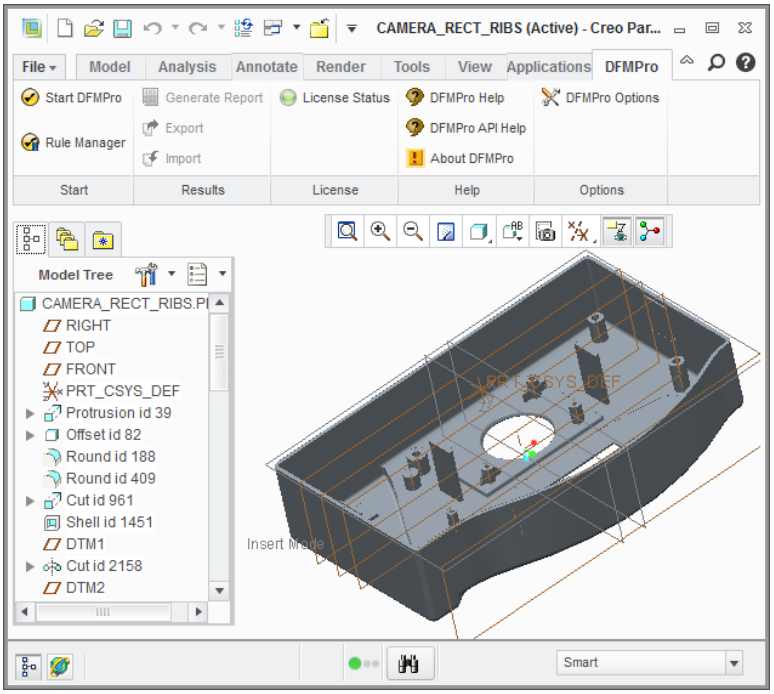

Figure 2 : DFMPro for Creo Parametric

Depending on the manufacturing process, the design engineer can ensure that the design is suitable for production. For example, plastic parts should have uniform walls and features like ribs and bosses for strengthening and fastener insertion respectively, while machined parts may have features like holes, pockets and slots. Creo Parametric allows designers to innovate and create designs using a variety of features, like extrude, revolve, pattern, rib, round, chamfer, hole, etc.

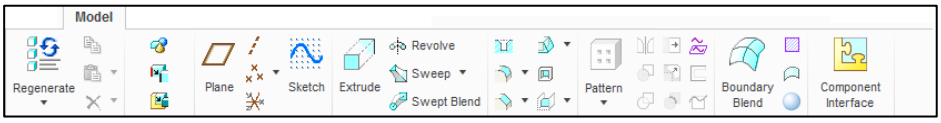

Figure 3 : Creo Parametric Design Features

DFMPro allows users to verify if the created design is in accordance with organizational manufacturing guidelines or standards. The organizational standards can be captured as a set of rules or checks, which can be quickly verified during design. One of the significant advantages of DFMPro is that it can identify manufacturing features of the model directly from the final geometry. This means that one may design a hole as a revolve, or a cut-extrude, or a hole feature; DFMPro identifies the manufacturing intent and then checks the feature for ease of manufacturing. This frees the designer to use his choice of feature, the one he is most comfortable with while working with Creo Parametric. Not only can the design engineer work on a new model but using Creo's interoperability function, it is possible to work with a variety of CAD models as a starting design. Even designs created or updated using Creo Direct and brought into Creo Parametric or modified using Flexible Modeling Extension can be analyzed using DFMPro.

As the design evolves with addition of every feature, Creo helps in building the design quickly, while DFMPro validates the manufacturability at the click of a button. It supports checks for a variety of manufacturing processes, including machining, sheet metal fabrication, injection molding and assembly. Any modifications to the design required for improving manufacturability are shown to the designer within the Creo environment itself.

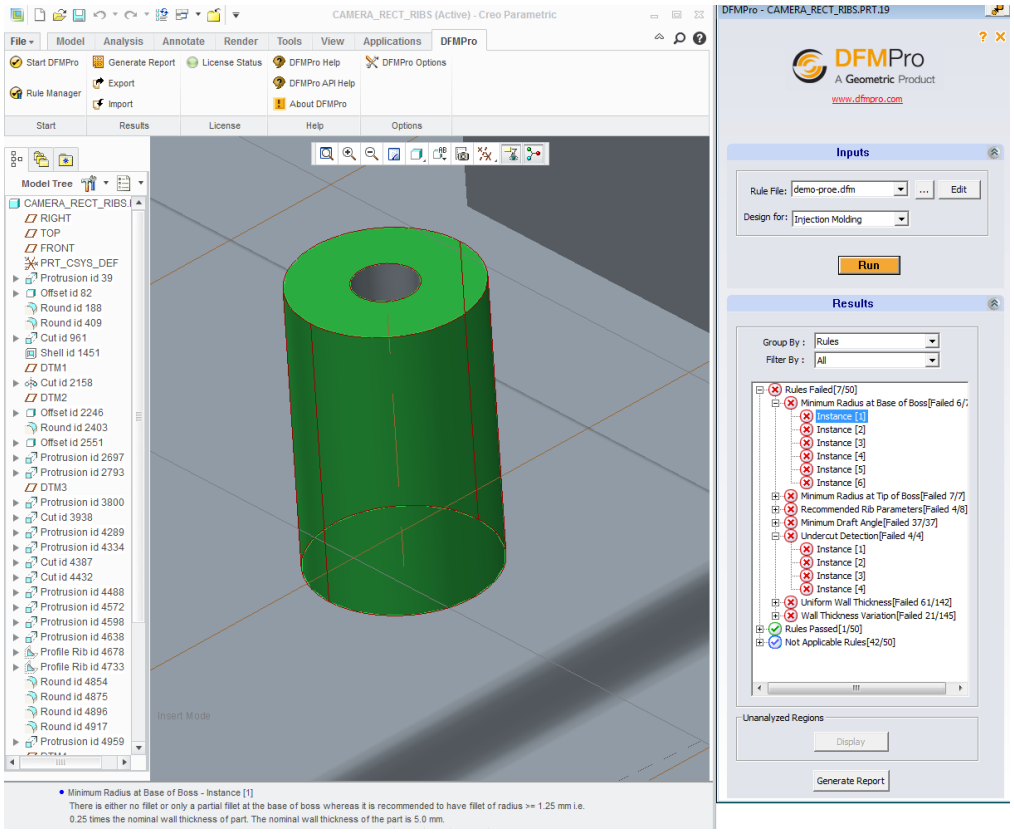

Figure 4 : DFMPro validation result highlighted in Creo Parametric

Create improved designs for manufacturing

Typical manufacturing problems associated with operations like drilling, milling include sharp corners, non-standard holes, inaccessibility of features, deep pockets with small corner radii among others. DFMPro for Creo Parametric helps designers easily validate and update the designs within their CAD environment.

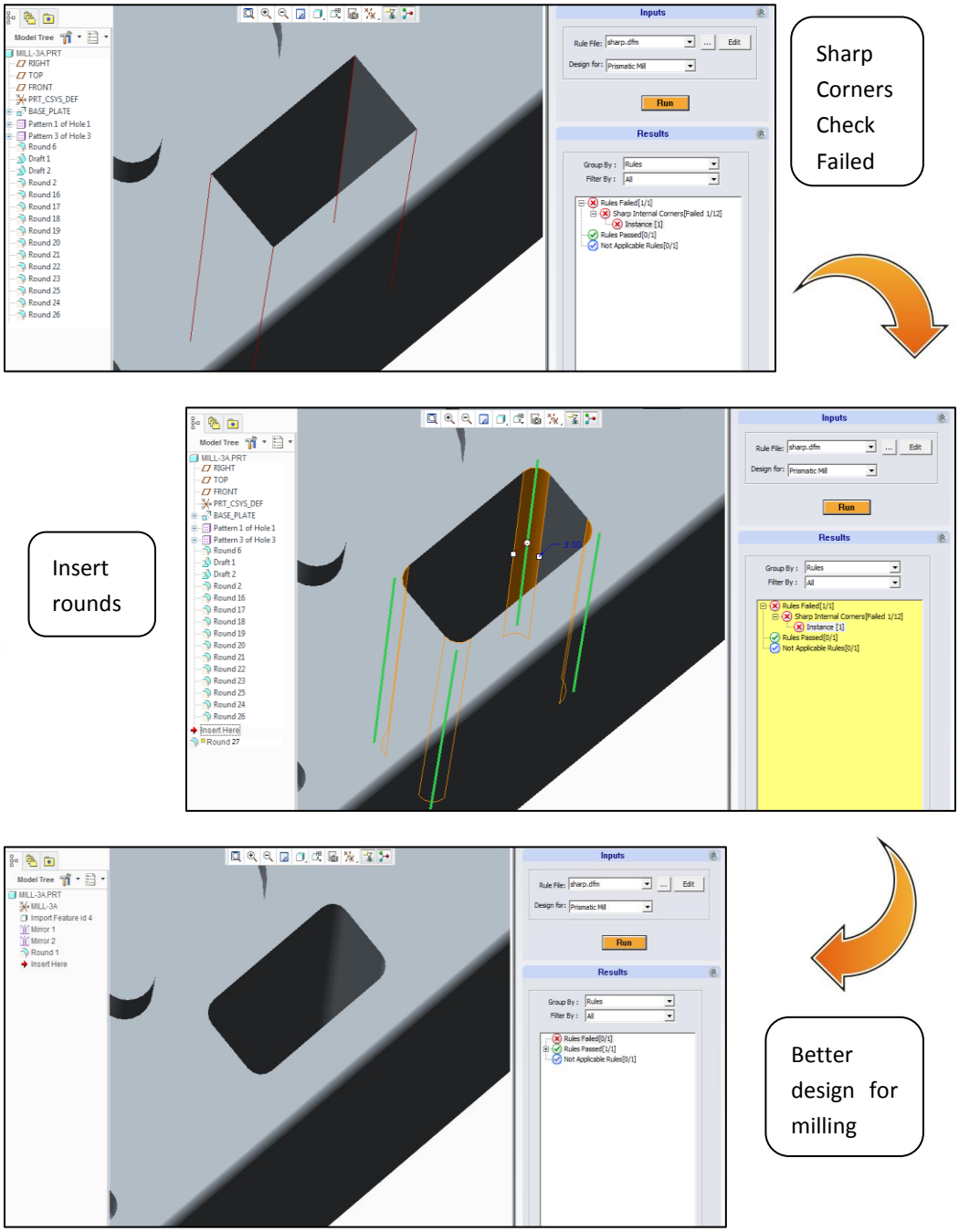

Figure 5 : Manufacturability improvements through DFMPro for Creo Parametric

Similar to machining, typical problems in plastic designs include non-uniform walls, thick/tall ribs, sharp corners, etc. Sheet metal fabrication poses problems when holes are too close to bends or to each other, or when bend radius is not adequate, among others. Failure to check for assembly requirements like component clearance, fastener engagement length, fastener clearance, hole alignment can also lead to problems during assembly or operation. DFMPro can help easily detect all these issues, and effortlessly update the designs using Creo.

Design based on organizational and global best practices

Creo provides engineers with easy to use tools and capabilities to configure and apply their design best practices. Linked with a PLM system like Windchill, the design process truly becomes global by facilitating multi-location design and manufacturing. DFMPro provides organizations a framework to capture and use organizational and global best practices for manufacturing and assembly in the forms of rules or checks, which can be easily validated within Creo Parametric. Thus, it helps avoid costly and time consuming design iterations across multiple departments. It also helps ensure that all design centers in any corner of the world use the same standards for manufacturability and assembly. '*Design Anywhere, Manufacture Anywhere*' becomes a reality.

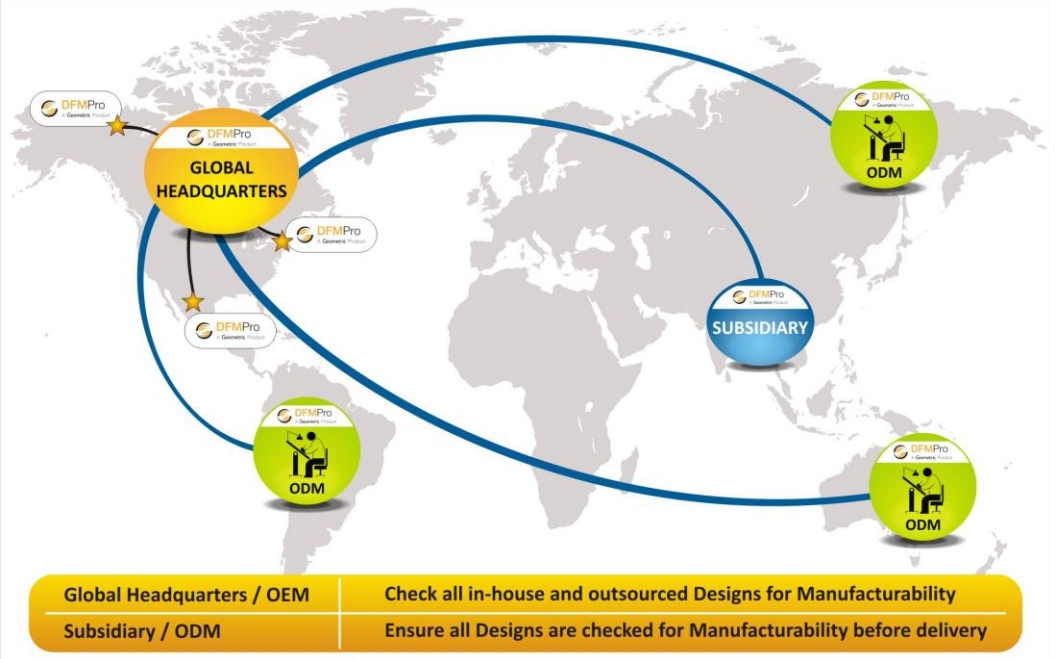

Figure 6 : Global Delivery Model

Benefits

By adopting tools like Creo and DFMPro during the design process, organizations can avoid rework, scrap and late fixes when designs are being released to manufacturing or assembly, or in the worst case, have already been shipped. Rule-based validation and correction within the

design environment can save designers, hundreds of hours in repetitive tasks and rework. A rules based process linked to the CAD environment ensures that documented standard and guidelines are embedded in software, reusable, easy to update and form part of the design cycle.

References

Bralla James G., Design For Manufacturability Handbook, Second Edition

Poli C., Design for Manufacturing: A Structured Approach

www.dfmpro.com

http://www.ptc.com/products/creo/

About the Author

Rahul Rajadhyaksha is Product Manager for DFMPro, an easy-to-use Design for Manufacturability (DFM) tool developed by Geometric for design and manufacturing engineers. Rahul is a mechanical engineer and has CAD/CAM product development and product management experience of over eleven years.

About Geometric

Geometric is a specialist in the domain of engineering solutions, services and technologies. Its portfolio of Global Engineering services and Digital Technology solutions for Product Lifecycle Management (PLM) enables companies to formulate, implement, and execute global engineering and manufacturing strategies aimed at achieving greater efficiencies in the product realization lifecycle.

Geometric's Geometry Technology Solutions (GTS) business unit develops cutting-edge point productivity solutions that enhance design and improve manufacturing operations. The end-user products from Geometric include CAMWorks®, eDrawings® Publisher, DFMPro, GeomCaliper®, 3DPaintBrush™ and Glovius®. The key technologies from Geometric are NestLib®, Feature Recognition (FR), GeomDiff and 3DSearchIT®. Geometric licenses these technologies to OEM partners and also designs and implements customized process solutions using these technologies for industrial customers.

For further details about Geometric's GTS business unit, please visit www.geometricglobal.com/products or call +1.480.367.0132