



21ST CENTURY
TECHNOLOGIES

A New Approach to Design and Manufacturing Collaboration Whitepaper

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Contents

The Need for Digital Collaboration	2
eDrawings for Collaboration	2
The Next Level of Collaboration.....	3
Automated DFM Review Reports in eDrawings.....	3
Visualize CAMWorks Generated Tool Paths in eDrawings	8
Future Directions	9
About the Author	10
About HCL Technologies	10

The Need for Digital Collaboration

Any development process, software or hardware, goes through numerous stages. Right from conceptualization to the stage where it reaches the hands of the consumer, a product goes through many stages - design, analysis, manufacturing and so on. Each process not only adds value but also contributes to the cost of the product. However, the price of the product is not entirely in the control of the producer. In a competitive environment, the price is determined by the market. Hence, all organizations take definitive steps to keep the production and development costs of the product under control. In such a competitive environment, any rework is taboo and the later in the product life cycle any rework has to be done, the more it costs. If any design flaws are detected during manufacture, it costs the organization time and money to correct the same. If such flaws are detected during operation at the customer site, it dents the reputation of the producing organization.

To avoid such scenarios, organizations apply review mechanisms for critical steps in the development and production steps of a product. Design for X reviews are intended to catch any issues at the earliest since rectifying a defect later in the cycle drastically increases the cost of the fix. In some cases, for example between a vendor and a customer, reviews are conducted to reconfirm the specifications and the progress made in a delivery.

Traditionally, reviews between vendor and customer included face-to-face meetings to confirm the solution provided and the associated cost. Within organizations, review mechanisms would include comments on the drawing prints. With the introduction of CAD, email and the web, comments were now added to drawing snapshot images and added to an email trail. It is not easy to communicate technical details in 2D. However, due to confidentiality issues and the size of the CAD data, sharing of these files for reviews were not a feasible option. The required collaboration for conducting reviews was still a long way off especially in case of globally dispersed teams.

eDrawings for Collaboration

Collaboration during reviews got a boost with the advent of viewers and markup tools. One of the most popular among them is eDrawings from SolidWorks. It is now easier to share your designs for a variety of purposes. An eDrawings file contains relevant information for visualizing the file. Based on the options set by the creator of the eDrawings file, a user can also perform measurements; add comments and markups on the same file. Such a reviewed eDrawings file now contains all the relevant review information and history which is valuable for an organization. One of the critical advantages of an eDrawings file is that even with all the above capabilities, the size of an eDrawings file is a fraction of the original CAD model or assembly thus making it easier to send across the web.

Designers, Analysts, Manufacturing Engineers among others have now started conducting reviews in 3D using the commenting and markup facilities offered by eDrawings. It is easy to add your review comments in the eDrawings and share the file back and forth.

The Next Level of Collaboration

Using eDrawings, manufacturing engineers can provide their review feedback on the designs to the designer. A customer can provide feedback to the supplier on any required modifications in a design. A manufacturing contractor can provide feedback on any required changes in the design to reduce manufacturing cost. Thus, reviews at many levels have attained a digital nature in this manner.

However, reviews which eat into a development schedule can be a cause for concern. Manual reviews consume time and are always susceptible to errors. Anyone involved in reviews of CAD/CAM data such as 3D models or tool-paths will appreciate the attention to detail required while conducting such reviews to reduce the possibility of overlooking some critical errors. The time to incorporate the review feedback in a document is proportional to the number of detected issues. Tools providing automation, better visualization and reporting mechanisms will help users collaborate in a faster and accurate manner.

Utilities like thickness analysis in SolidWorks and Products like CAMWorks and DFMPPro enhance and improve the collaboration process by automating the reporting mechanisms and also extending the reported data far beyond mere comments and markups. Let us consider a part moving through various stages in the design-manufacturing cycle and how these tools leverage eDrawings.

Automated DFM Review Reports in eDrawings

Design-for-Manufacturing (DFM) reviews contribute in ensuring that the design can be manufactured at optimal cost with no rework and minimal scrap (if at all). To be updated on the DFM requirements, design engineers refer to DFM handbooks and documents on best practices. Designs are reviewed by manufacturing engineers to ascertain whether the design can be manufactured given the manufacturing capabilities with minimum interruptions to work or material flow. DFM teams involving members drawn from design and manufacturing departments (among others) work collaboratively on DFM practices.

However, such reviews can become bottlenecks due to the difficulties in communicating the technicalities of the issue using 2D images and text. Additionally, it takes time and effort for manufacturing engineers to transfer manufacturing related inputs to the design team. There's no automatic reporting mechanism to transfer the manufacturing related inputs to a 3D report. This implies that the manufacturing engineers may have to manually markup and comment on each issue in the eDrawings file. For a situation involving a vendor (designer or manufacturer) external to the organization, quick and easy communication of the design or manufacturing related issues is critical to meet product deadlines.

DFMPPro for SolidWorks helps users automatically validate the design based on standard manufacturing guidelines and transfer the relevant result data to an eDrawings file. Users can view the DFM analysis results and select which results are to be ignored or included for reporting in the eDrawings file.

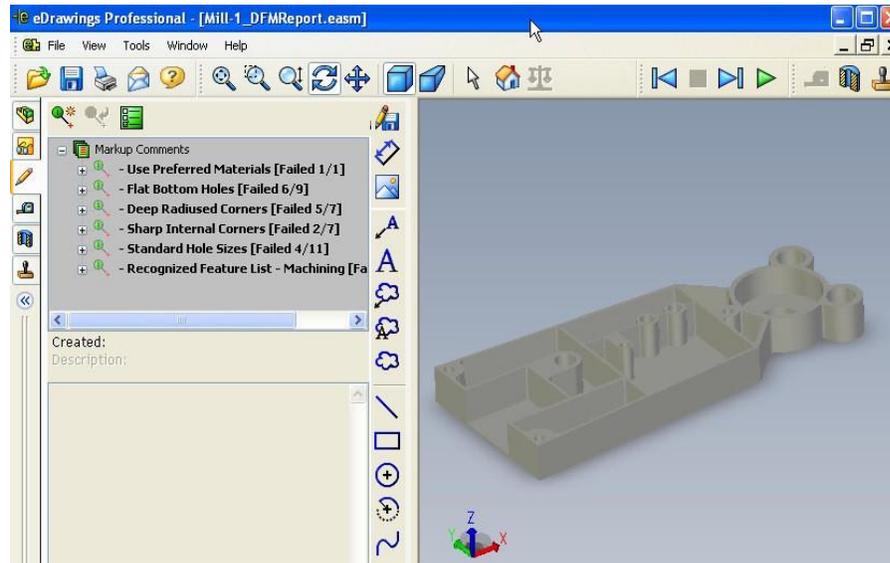


Figure 1: Automated DFM review report in eDrawings

For example, refer to Figure 1, which shows a DFM review report for a CAD model in an eDrawings file. In the markup comments area on the left, we can see a node -- "11Flat Bottom Holes [Failed 6/9]". This indicates that 6 cases of flat bottom holes were detected in the design which may lead to additional machining processes and consequently increased cost. Hence, the design must be revisited to confirm if the flat bottoms are crucial to the function of the hole feature in this case. Similarly, there are other categories of DFM rule failures which can be browsed to get more details of each scenario.

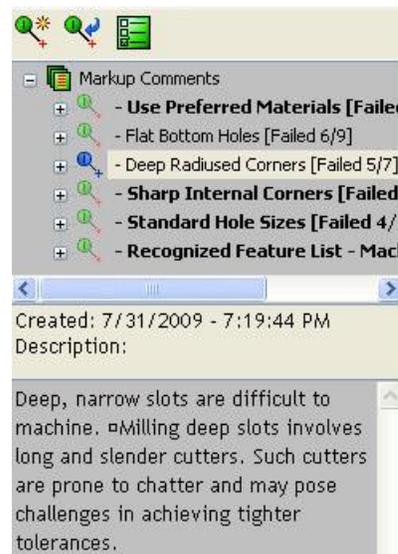


Figure 2 : Details about the DFM Rule

Clicking on the node – 11 Deep Radiused Corners [Failed 5/7]" provides more details about the guidelines, its importance and implications of not following the same. Selecting a particular instance of this rule zooms in on the associated region in the model and highlights the relevant entities as shown in Figure 3. This indicates to the user the design areas which need to be updated.

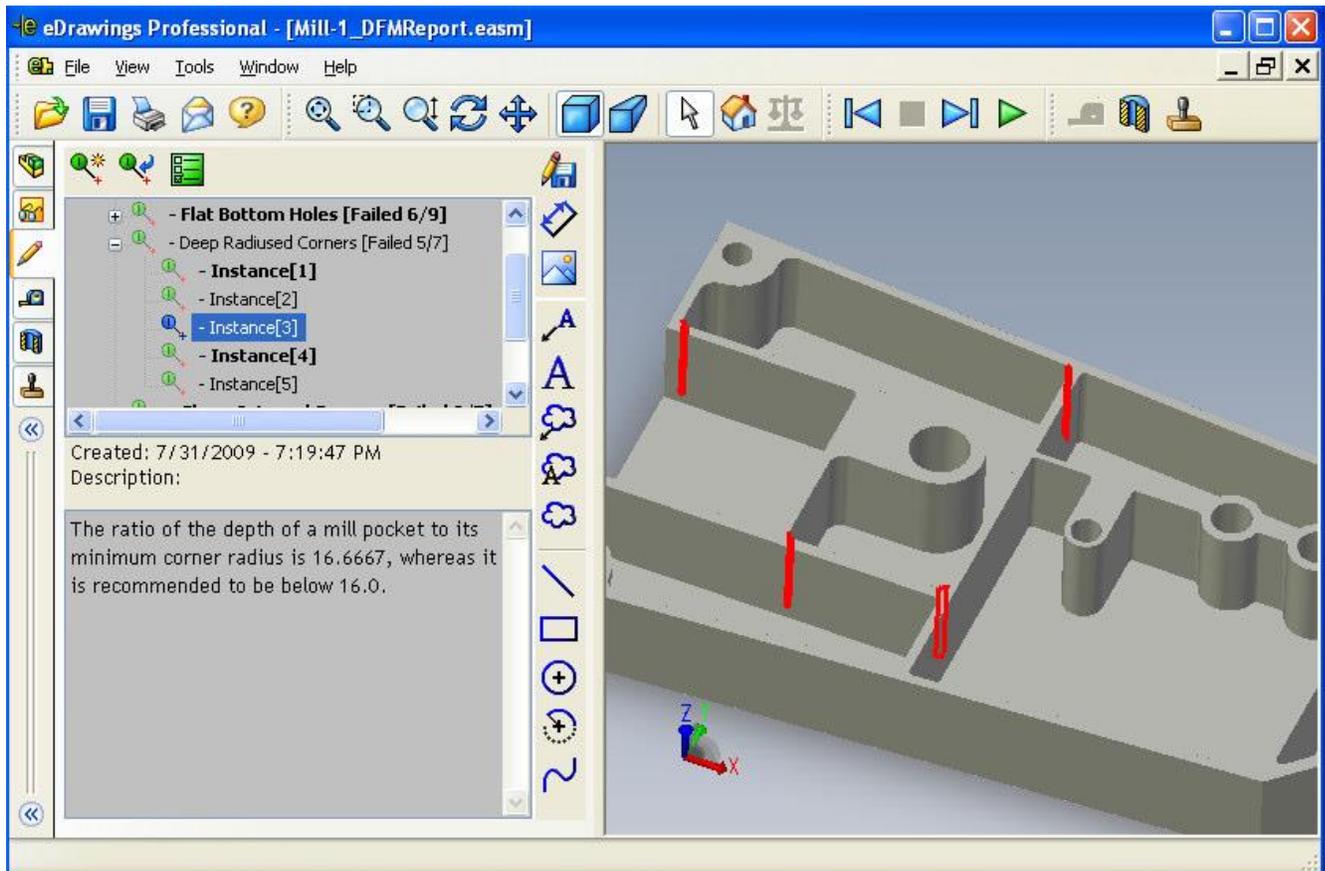


Figure 3: Instance violating the DFM Rule

Additional benefits of having the automated DFM review inside an eDrawings file include

- The review can be extended to include manual comments and markups in addition to those added by DFMPPro
- All additional functionalities of eDrawings such as Stamp, Measure and Cross-section are available (subject to report generation options and usage restrictions)
- The compressed eDrawings file can be sent back and forth by users who will add their comments and markups and retain the original markups.

Thus a typical eDrawings based DFMPPro report having a combination of comments added by the software and the user would look as shown in Figure 4. In the description section, comment added by the user as replies to existing markups can be seen. Also is seen a cloud with a leader marking the area needing modification.

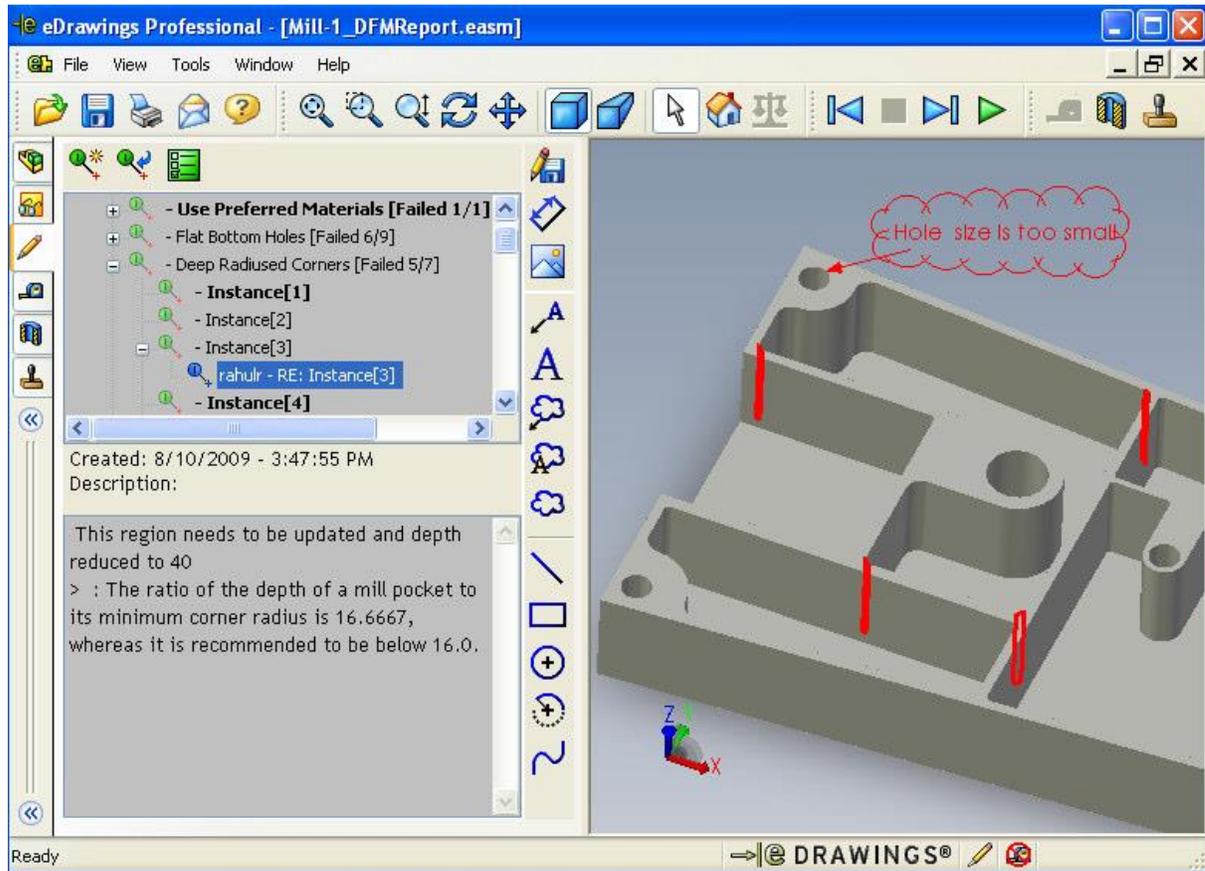


Figure 4: User-added comments and markups

DFMPro also comes with a built customization facility using which users can quickly write their own DFX rules using DFMPro features or the design features and VBA Macros. In addition to the standard rules provided with the software, DFMPro also publishes the results for such customized user defined rules in the eDrawings file. Thus a user gets the benefits of savings in time and reduced possible errors while reviewing a design. In Figure 5, the top image shows a customized rule being defined in DFMPro and its validation result as in an eDrawings based report.

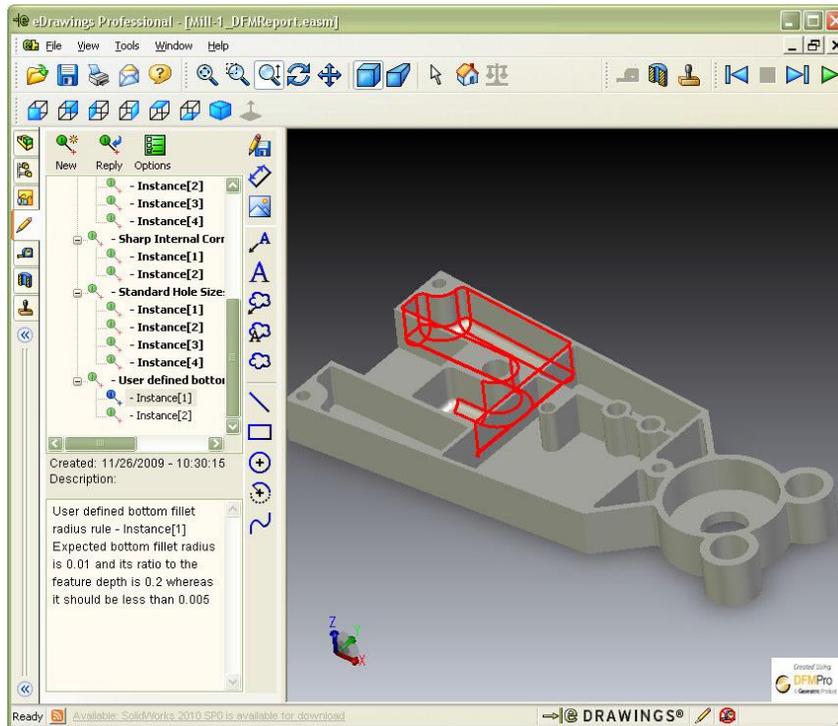
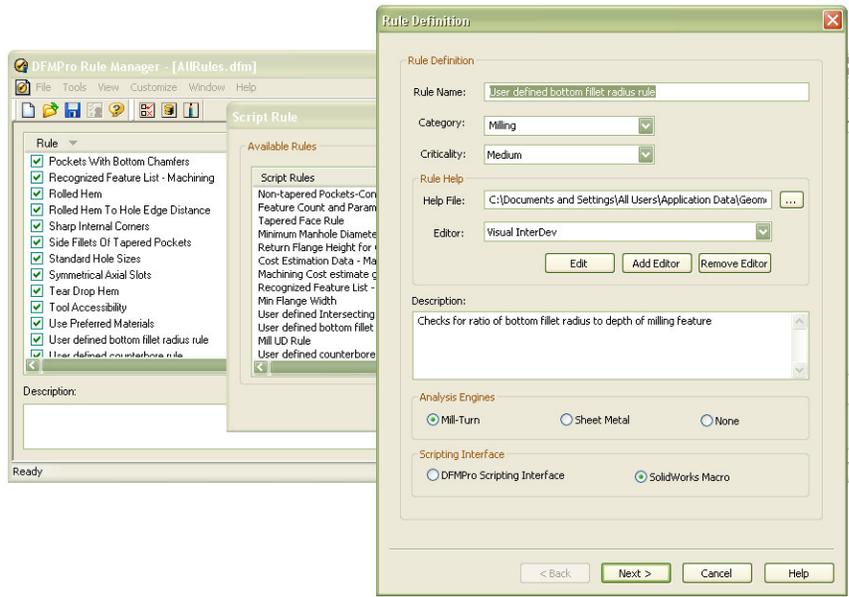


Figure 5: Customized DFX rule report

DFMPro provides an API based functionality to analyze CAD models automatically without manual intervention, generate the eDrawings file embedding the DFM review comments and examine the reports de-linked from any CAD system.

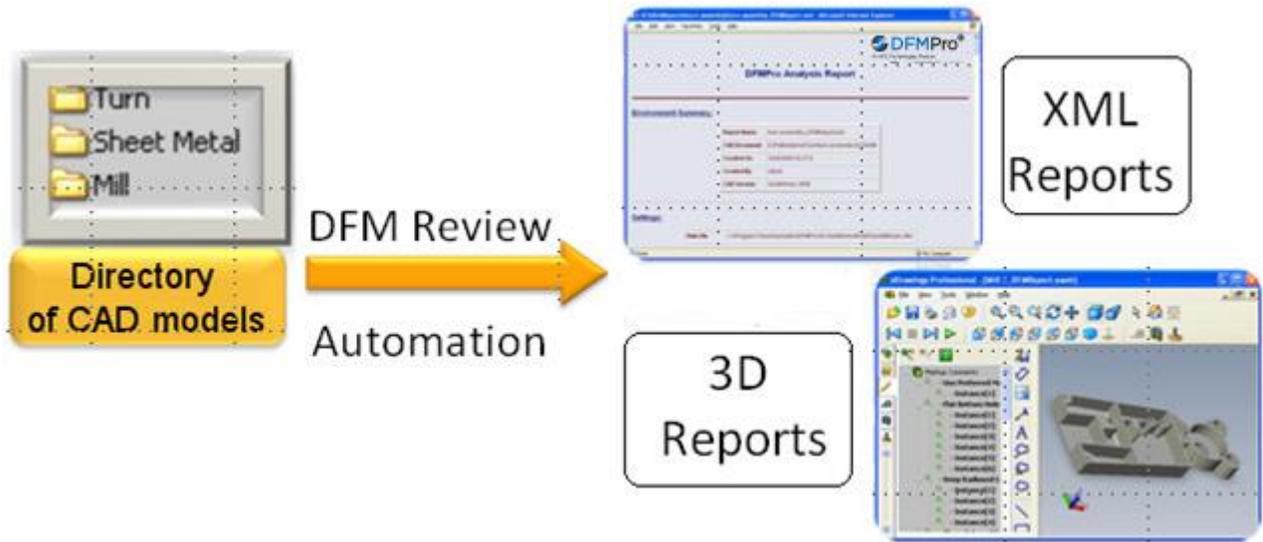


Figure 6: Automated DFM Review Reports for Manufacturing Engineers

Figure 6 shows how a non-CAD user can use batch report generation facility of DFMPro to analyze the manufacturability of a set of models.

Because of the DFM review automation provided by DFMPro, either the designer can detect and correct costly errors right at the design stage or the CAM programmer can detect the errors automatically using DFMPro without having to spend time manually inspecting the design. In addition, he can share the eDrawings report with the design and either get it corrected or get his comments, all within the same eDrawings file.

Visualize CAMWorks Generated Tool Paths in eDrawings

In the current global manufacturing environment, not only are design and manufacturing outsourced, even activities like CNC programming and G-code generation are outsourced to vendors providing those services with reliable quality and lower cost. In such cases, in addition to design reviews, it may be necessary to conduct tool-path reviews. For example, depending on the review, a customer may ask the vendor to employ a lower depth of cut or change the sequence of machining. For reviewing this scenario, it may be cumbersome to transfer the complete model with tool-paths across the web.

CamWorks provides a utility to report tool paths to an eDrawings file. In this case, the eDrawings based tool-path provides the perfect review solution with the additional convenience of eDrawings markups. The tool movements can be visualized and animated as a series of point to point operations as shown in Figure 7.

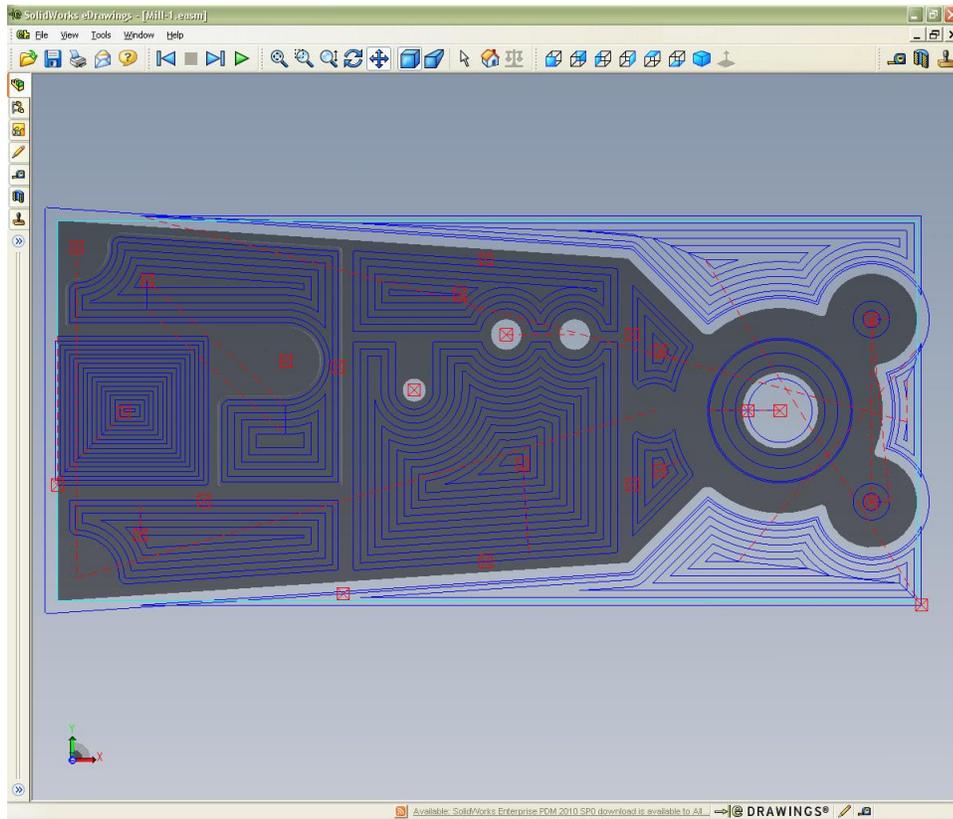


Figure 7: Tool paths in eDrawings

Future Directions

In the previous sections, we have seen just a few of the many productivity and collaboration benefits using eDrawings based reporting facilities provided by DFMPPro and CAMWorks. Using such collaboration mechanisms right when it matters (early in the product life cycle) users can gain cost and time savings. Forthcoming versions of the tools mentioned above and possibly newer ones will take collaboration to more exciting levels.

Even in manufacturing applications, many aspects of the complete process plan may be captured in eDrawings. Possibly, one could even view complete machine simulations completely inside the same eDrawings file.

DFMPPro, CAMWorks and eDrawings together improve collaboration by making it faster and easier.

About the Author

Rahul Rajadhyaksha is product Manager for DFMPPro, an easy to use Design for Manufacturability (DFM) tool for design and manufacturing engineers. Rahul is a mechanical engineer and has worked with many CAD/CAM packages. He has product development and product management experience of over nine years.

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