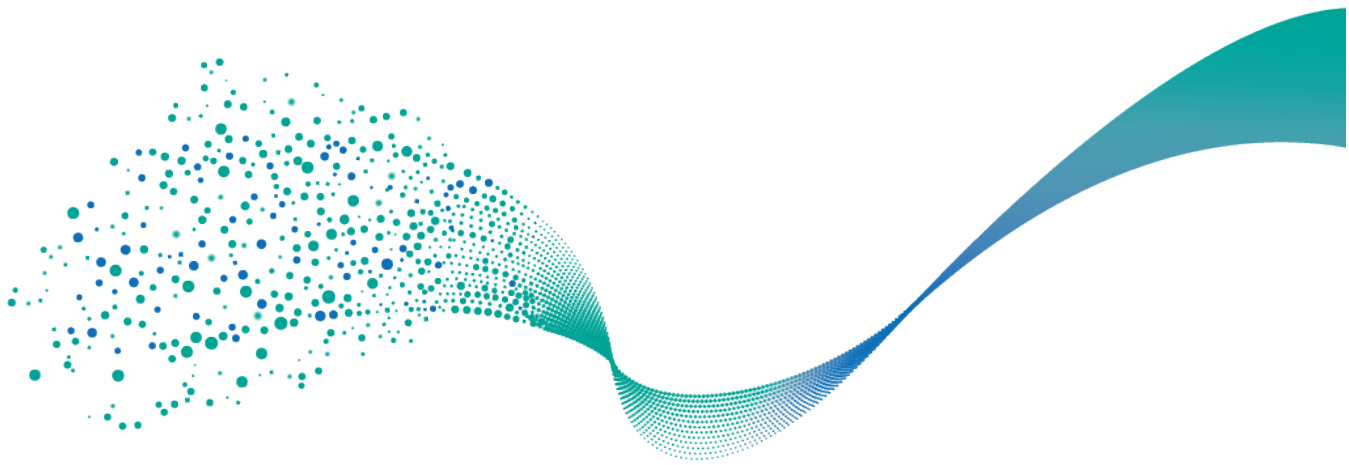
ELYSIUM

Accelerating DX in Manufacturing with the DFM Solution

Automated Design Quality Verification



Introduction — The Importance of DFM (Design for Manufacturability)

In recent years, designs using 3D CAD instead of 2D drawings have become the mainstream in the field of manufacturing. At the same time, however, it is becoming more difficult for companies to maintain and improve design quality due to the globalization of development and production systems overseas and the retirement of experienced engineers. CAD models with low design quality cause rework in the downstream processes and hinder the construction of efficient production processes. If no improvements are made, the 3D design process and the introduction of IT tools for this purpose will become a mere pretense of digitalization, which is far from the original purpose of digitalization—efficient and high-quality manufacturing.

This background spots the light on "Design for Manufacturability (DFM)", i.e., design that considers manufacturability and other factors from the initial stage of product development using model based (3D) data.

Ideally, in order to achieve DFM, the designer should understand all the manufacturing requirements and design without causing defects in the manufacturing process. In reality, however, it is difficult for designers to reflect all manufacturing requirements in their designs. In many cases, designers try to improve design quality by using in-house design standards in design reviews before drawings are submitted, but omissions occur in visual checks. Therefore, verification by designers themselves is incomplete as a measure to prevent defects in later processes.

Especially in companies and organizations where the know-how of experienced engineers are not handed down within the company, where the intuition and experience of individual designer is not shared as a design standard because it is confined to the individual, or where design standard exists, but not all know-how are reflected in it, the level of prior verification is lowered, and omissions are likely to occur when checking design quality.

Advantages of Automating Design Quality Verification with Software

We offer "DFM Studio" as a software that supports the realization of DFM. This software is a tool that enables designers to detect potential problems that may occur in the subsequent process by automatically verifying the quality of models created by the designer in the 3D CAD system based on predetermined rules (design standards).

By systematizing the verification work that used to be done individually by designers, the following effects can be achieved.

1. Labor saving and quality improvement through automation

Normally, the verification of 3D models is done visually by the designer, which requires a great deal of time and effort. By automating this process, the

burden on designers can be greatly reduced. In addition, problems that are easily overlooked by visual inspection can be thoroughly extracted by the software, thus improving the quality of the model.

In DFM Studio, the areas that do not meet the design standard are listed on the screen after data verification. Therefore, the designer can check the list efficiently and comprehensively, and complete the process from data verification to correction in a short lead time.

Reducing the number of man-hours required for checking by designers will create an environment where designers can concentrate on the creative work they should be doing, such as designing products with excellent functionality, design, and low cost.

2. Prevention of rework

When quality is improved in the design department, it naturally reduces the time and effort required for the verification process in the downstream process. Generally, the later the process, the higher the cost of defect countermeasures, so it is obviously important to reduce and prevent rework. Additionally, eliminate wasting time to point out defects to the design department, or proceeding with prototyping without noticing the defects, only to realize the errors and redo them later.

3. Standardization of design and verification know-how

Advanced verification can be performed without depending on the knowledge of individual designers. By converting the know-how (tacit knowledge) possessed by experienced and skilled designers into a system (formal knowledge), stable and high-quality design can be achieved as an organization. In particular, in recent years, as experienced engineers have retired, the lack of human resources who can perform strict inspection of drawings has become a problem, but even in such a situation, the software can guarantee design quality and maintain design quality as an organization.

Many companies print out design standards on paper, but it is difficult for designers to reflect them in data without omissions. Digitization can improve the quality of design.

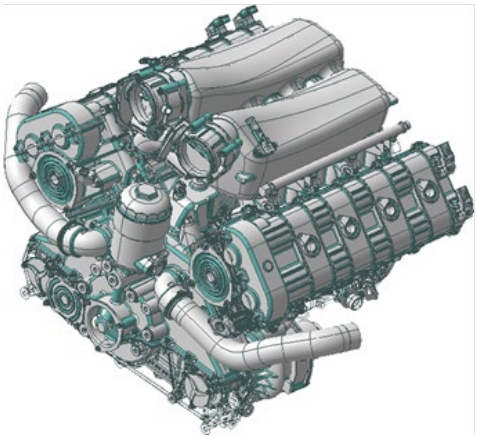
4. Lowering the cost of verification process

Computer Aided Engineering (CAE) and prototyping based on CAD models are currently the main methods for final verification of design quality. However, CAE requires specialized knowledge as an analyst and the knowledge to judge the results. In addition, there are many cases where defects that are different from those confirmed during prototyping occur during mass production. By using DFM Studio to verify the design data, it is possible to significantly reduce the time and cost of such verification. Moreover, the ease of verification enables the verification of design quality at an early stage of design, which results in the detection of problems ahead of schedule, which is expected to reduce the total development cost considerably.

Characteristics of DFM Studio - Recognition by Geometry.

The most important factor that enables the software to verify the design quality of CAD models is the geometry recognition technology that Elysium possesses. For over 35 years, we have been providing data conversion technology for all kinds of CAD systems. In this context, no matter which CAD system the user is using, it is possible to find the intended "geometry" from a mathematical standpoint and use official information from the CAD system developer.

Once the "geometry" is detected, it can then be judged for conformance to the criteria, and the results can be output in an easy-to-read report format. DFM Studio has a series of built-in functions that allow users to complete the complicated and time-consuming verification process quickly and simply.



Example of detecting a specific geometry (fillet) from a CAD model

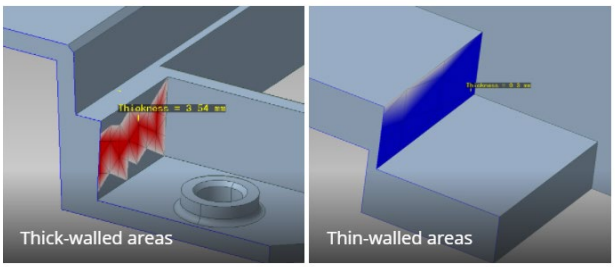
Preset Verification Items Derived through Collaboration with Major Manufacturing Companies

We have been providing DFM Studio to a wide variety of users in the manufacturing industry, including the automotive, automotive parts, electrical, and precision equipment industries. Based on the knowledge gained from this experience, we have reflected the check items that are crucial for the design quality of plastic and sheet metal parts in the preset verification items of DFM Studio.

Example of verification item 1: Product wall thickness

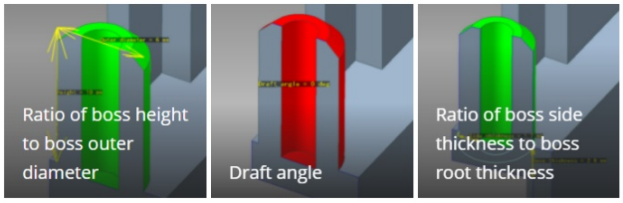
A mixture of thick-walled and thin-walled parts in a design model can cause molding defects such as sink marks and unfilled parts.

After automatically measuring the wall thickness, DFM Studio verifies the difference from the reference values and displays the extent of the difference in the result list. The designer can review the list of verification results to determine whether or not the wall thickness should be changed efficiently and without omissions.



Example of verification item 2: Boss / Ribs

When a draft angle is added based on the tip of the designed boss, it is necessary to pay attention to the increase in the side wall thickness near the boss root (a factor in the occurrence of sink marks). Also, if the draft angle is added based on the root, there is a concern about filling failure due to the smaller outer diameter of the tip.

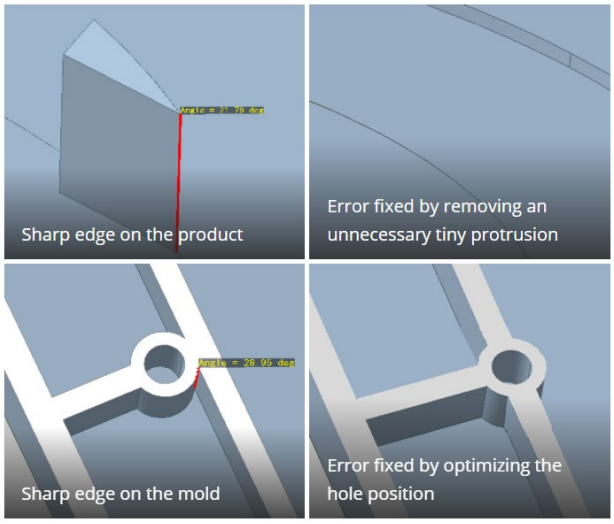


In DFM Studio, once the problem area has been corrected, the designer can immediately determine its impact by checking the results of related verification items.

Example of verification item 3: Sharp edge

Product sharp edges and mold sharp edges may occur unintentionally in the design model. Unnecessary sharp edges have negative impacts on mold cost, durability, and molded product cost, so it is necessary to detect all of them in advance to consider design changes.

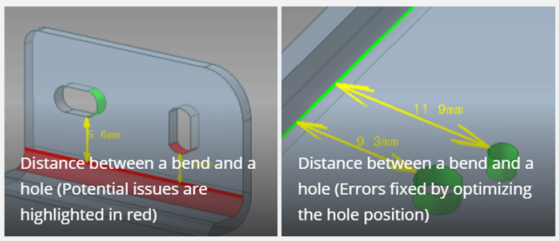
Other presets include undercut, small radius, mold thin wall, hole, and draft angle.



Preset Verification Items for Sheet Metal

DFM Studio has preset verification items for sheet metal parts as well as plastic parts.

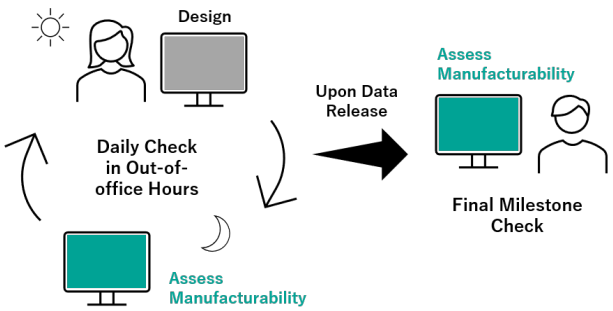
- Distance between Bend and Hole
- Width of Narrow Area
- Wall thickness
- Bosses
- Burring
- Holes
- Half-punching
- Engraving
- Dowels
- Bridges
- Overhangs
- Bends / Flanges / Hemings



Usage Scenarios

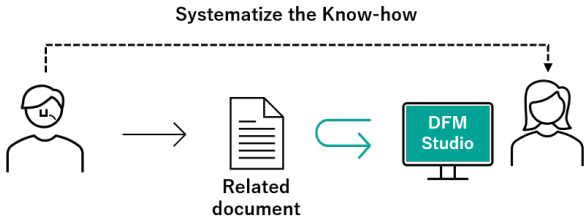
1. Daily check and final check when submitting drawings

In some companies that use DFM Studio, both the designer and the person in charge of inspection use the system. For example, a designer can start the verification process at the end of the daily design work and run the DFM Studio process while he goes home. The next day, he checks the results and makes changes to the CAD model if necessary. In this way, he can use his time efficiently and design without leaving any errors. In addition, since the designer can check and correct the model on a daily basis, the person in charge of inspection only needs to check the minimum necessary items in DFM Studio at the milestone check when submitting the drawing, which greatly reduces the time and effort required for inspection.



2. Transfer of skills to inexperienced engineers

Within the DFM Studio application, links to related documents can be set up. If explanation materials about the verification items are embedded in advance, for example, when inexperienced engineers run the data verification by themselves in DFM Studio, they can follow the links from DFM Studio to check and study the knowledge of how the items detected as problems cause defects in molding and how they should correct them. Inexperienced engineers will use this as a reference to modify the design, but in many cases, they will face the problem that fixing one item will lead to defects in other items. Then it's time to ask advanced questions and receive advice from the experienced engineers, leading to dramatically increasing the knowledge of the inexperienced. If these communications can be reflected in the verification items and thresholds of DFM Studio, the system will grow, resulting in the improvement of each and every engineer's skill and the growth of the organization's design capability.



Scalability to Meet Specific Needs

1. Arranging the verification items

The preset verification items in DFM Studio are set to the recommended threshold values by default based on our experience. They can be used as they are, but users can change them individually according to the material of the product.

In addition, to comply with the user's own rules, it may be necessary to use a configuration or measurement point that is not provided in the preset. In such a case, DFM Studio can be customized to create unique verification items. DFM Studio also provides a dedicated tool for batch editing and updating of various parameters including verification threshold values.

2. Building a system that considers the linkage and operation of existing systems

DFM Studio can also be integrated into 3DxSUITE, a 3D data interoperability platform from Elysium, for automatic processing. 3DxSUITE has functions such as automatic conversion of a large number of CAD models into different data formats. With the integration of DFM Studio, the designers can automatically deploy the final model to the internal stakeholders and component suppliers in the downstream process after verifying its manufacturability.

Furthermore, by integrating 3DxSUITE with the existing PDM (Product Data Management) system, it is possible to specify design data from the PDM and perform verification regarding manufacturability, thus greatly increasing the level of digital engineering using model based (3D) data.

Achieving True Digitalization by Identifying the Geometry

Over the past 30 years, design methods have changed from handwriting to 2D CAD, and now model-based engineering by 3D CAD has become the mainstream. In the past, it was possible for downstream engineers to interpret the designer's intent and adjust the balance on site, but with the elimination of ambiguity in design with 3D data, downstream engineers began to mold the product exactly according to the design model, resulting in defects in various areas. In other words, in the past, there was room for experienced engineers in the downstream processes to follow up with the designers while adjusting the design content in a good balance; but with the advent of 3D CAD, such support has become difficult to provide. Moreover, the spread of digital tools such as 3D CAD has, ironically, made it impossible for people to perform labor-intensive processes such as data verification and conversion.

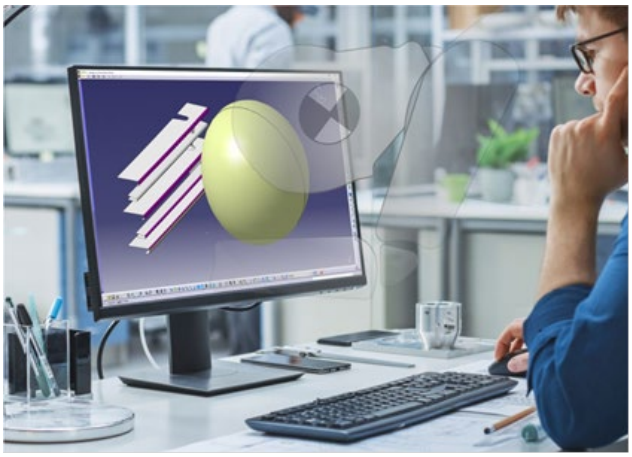
In the year 2020, COVID-19 drastically changed the way people work, and the importance of DX (Digital Transformation) is being talked about loudly in all fields. Taking this opportunity, we believe that engineers involved in manufacturing need to rethink what true digital engineering is.

Ever since Elysium started, we have consistently supported digital engineering in the manufacturing

industry by providing a variety of solutions that enable compatibility of design data in multi-CAD environments.

In particular, for the function of automatically detecting characteristic geometries from 3D data, we have developed a world-class technology based on the advanced mathematical skills and over 35 years of experience. By detecting feature geometries from CAD models with high accuracy and speed, it is possible to pre-verify design drawings from various perspectives such as DFM (Design for Manufacturability) which is introduced in this document, DFS (Design for Safety), and DFA (Design for Assembly). As a result, engineers are finally released from the manual work that occurred due to the use of IT tools, and an environment can be created where engineers can concentrate on the creative work that they are meant to engage in.

We believe that these concrete solutions will make DX not just a trendy buzzword, but a practical measure for innovation, and we will continue the challenge of developing highly effective software.



Elysium has developed Elysium DFAS, software that detects dangerous protrusions in 3D CAD data of automobiles on behalf of people and supports the realization of safe designs in accordance with Japanese MLIT regulations, in 2021. Companies introducing this system are expected to reduce their losses by several hundred million yen.

Contact

Elysium

www.elysium-global.com