CHAPTERS 1 AND 2: RECAP

In the first of our series of eBooks on integrating design and manufacturing with SOLIDWORKS® solutions, we discussed the advantages offered by adopting an integrated design and manufacturing solution. We described how integrating design and manufacturing can represent some of the best opportunities to lower cost and improve quality. In the second eBook chapter, we discussed the advantages offered by SOLIDWORKS CAD to design exceptional products.

SOLIDWORKS provides a complete design-to-manufacturing process solution that allows you to design, visualize, communicate, validate, cost, manufacture, inspect, compose, and manage—all in one environment. For many people “validate” is just stress analysis—is the design strong enough. In this third chapter of our eBook series, we will discuss the wider meaning for SOLIDWORKS users. Before moving to production, you want to validate that the parts can actually be manufactured.

In this eBook, we will discuss the benefits of validating your product’s manufacturability while you’re still in the design phase. Catching manufacturability problems early on can save you significant time and cut costs.
ENSURE PRODUCTS CAN BE MANUFACTURED AS DESIGNED

Catch problems early on with the Design for Manufacturability solutions in SOLIDWORKS to save time and money.

Engineers excel at solving problems. Designers can incorporate all sorts of innovative features, meet all targets for performance and quality, and deliver the design to the manufacturing team ahead of schedule. However, even if you accomplish all this, it doesn’t mean your design is a success. A truly great design is one that meets all those targets, but can also be manufactured. The best engineers understand the manufacturing processes involved in producing their design. They anticipate potential manufacturing problems and avoid them, saving the company money. An engineer who understands the impact of tolerances on manufacturing costs, identifies problems with tool clearances, or designs plastic parts that eject from the mold without warpage, is one who truly shines.

The Experience Gap

Engineers graduate from school with a deep understanding of engineering theory, science, and math. However, the practical experience of what happens during production can be much harder to develop. Engineers no longer have the luxury of walking over to the shop floor and observing how their design is manufactured. It is harder to see the impact of putting a mounting hole too close to the edge wall. This is because manufacturing is either outsourced or done in a separate facility from the design office, so new engineers miss out on these learning experiences when interacting with manufacturing.

Without this shop floor experience, it is hard to identify areas that can add significant cost to manufacturing just because the tolerance is tighter than necessary. It is not easy recognizing when certain geometry will require special operations, or worse, can’t be produced at all. Now, designs just get sent back requiring a redesign. Wouldn’t it be nice if engineers could acquire that knowledge another way?

This is precisely what the Design for Manufacturability functions in SOLIDWORKS offer. These solutions provide automated checks to find potential problems, avoid redesign costs, and prevent delays. Parts will assemble as intended and perform as designed, without surprises. As we discussed in Chapter 1, finding these problems as early as possible will significantly lower the cost of correcting them. Then with SOLIDWORKS PDM, you can manage your updates so you always work with the latest version, and there is never confusion around releasing outdated revisions to manufacturing.

Quickly identify design areas that might cause fabrication problems or increase production costs using DFMXpress in SOLIDWORKS 3D CAD.
CATCH PROBLEMS AND IDENTIFY COST DRIVERS THAT WILL IMPACT FABRICATION

Make better design decisions that will lower production costs with SOLIDWORKS DFMXpress

CAD and CAE tools can help you ensure your designs meet requirements for form, fit, and function. Unfortunately, even if the design meets those requirements, it doesn’t necessarily mean it can be manufactured. Perhaps you have a hole going through a surface that a drill cannot reach. Without help, it is hard to visualize exactly how much clearance tooling will need. There may be situations where just a minor adjustment in the geometry can mean the difference between a quick single operation and several costly operations with multiple setups. Without deep manufacturing expertise, it is hard to identify features like this. There may be other situations where there is nothing wrong with the manufacturability, but the production facility lacks the proper tooling.

Small changes can mean the difference between completing the work at the intended location or sending the part elsewhere, adding both time and cost. This will be very dependent on the available tooling, which can be very difficult to manage.

These are exactly the types of problems SOLIDWORKS DFMXpress solves. DFMXpress visually flags surfaces and features that could be a potential problem for manufacturing. You can then investigate the feature and determine if another feature will work, or even remove the feature so that you can drastically lower production costs.

SOLIDWORKS DFMXpress includes standards for milling, turning, sheet metal, and injection molding, and allows you to specify or modify these properties to meet your own company standards. You can even define the existing tooling at the production facility you will use.

DFMXpress will then evaluate your part and flag anything that violates the standards. For example, it checks for hole diameter-to-depth ratio. When a hole gets beyond a certain length, the drill bit tends to “walk,” moving it a little off center, resulting in a misaligned hole. Identifying holes with too large of a diameter-to-depth ratio can mean the difference between doing the work in-house or sending the part to an outside vendor and paying more. Increasing the hole diameter or making the hole less deep may avoid the problem completely. Even if the hole dimensions can’t change, knowing the requirement in advance means you can make arrangements earlier for special operations, such as gun barreling. This way you can plan schedule adjustments to avoid delays, rather than scramble at the last minute.

Learn more about SOLIDWORKS DFMXpress and the numerous automated manufacturability checks.

VIDEO: SOLIDWORKS DFMXpress and DimXpert
TAKE THE GUESSWORK OUT OF INJECTION MOLDING AND PRODUCE HIGH-QUALITY PARTS, THE FIRST TIME

Identify manufacturability problems with the part and mold by simulating injection molding with SOLIDWORKS Plastics.

The injection-molding process is extremely complex, involving molten plastic and variable injection pressures and locations, mold temperatures, and cooling. You need to consider all of these variables to optimize molding cycle time and produce the maximum number of parts per hour. Balancing this is critical, as the melted plastic must stay molten just long enough to fill the mold. If it cools too soon, the cavity won’t fill and you will have a short shot. If it takes too long, cycle time will be extended unnecessarily.

Unlike other materials, with plastic, a bad design isn’t just one that won’t perform well. With a plastic part and its associated mold, the difference between a good design and bad one can mean the difference between having parts or not.

The Problem With Molds

All the variability in injection molding makes predicting how the part will fill extremely difficult. It is common to not have any insight until the mold trial. By this time, if there are any problems, and there usually are, it is very late to make changes. Of course you can adjust processing conditions such as mold temperature, material temperature, injection speed, and cooling time. However, this tedious and time-consuming process may not even be enough. You may still be forced to make costly modifications to the mold or part design. Even if the part fills, there is no guarantee it will be the high-quality part you designed. It can still suffer from cosmetic defects, weld lines, warpage, structural deficiencies, or a host of other problems.

Why leave it to chance? With SOLIDWORKS Plastics, you can simulate how the molten plastic flows during the injection molding process to predict manufacturing-related defects on parts and molds. You can quickly evaluate manufacturability and fix problems. You can easily improve part quality and avoid the time-consuming process of troubleshooting the mold, helping you accelerate time-to-market. You can even get troubleshooting steps and practical design advice to help diagnose and avoid potential problems.

Of course there are rules of thumb for good plastic part design, such as ensuring wall thickness is between 1 and 4 mm, but even that has a lot of variability. With SOLIDWORKS Plastics, you can test out different scenarios, such as tweaking processing conditions, materials, or gate locations. You can also make adjustments to the wall thickness, rib locations, and runner size. By doing this virtually, you save time, avoid scrapped parts, reduce energy consumption, and optimize the part and mold design before any steel is cut. With optimized designs, you minimize cycle time, lower manufacturing costs, and end up with higher-quality parts.

Learn about the powerful features in SOLIDWORKS Plastics.
AVOID ASSEMBLY PROBLEMS LEADING TO COSTLY SCRAP AND REWORK

Easily identify assembly issues during design with SOLIDWORKS Interference Check.

It doesn’t matter how good your design is—if you can’t assemble it, it’s useless. When designing in 2D, it is especially difficult to catch components that interfere with each other. If you are using 3D, interferences between static components can be found more easily, but tolerance stackups can lead to interferences that are much harder to identify. It can also be hard to spot collisions between moving components. Finding assembly problems at this late stage likely means costly rework, scrap, and delays, especially if parts need to be redesigned. Then even if your components fit together, you need to make sure the assembly method you specify does not have a negative impact on quality.

SOLIDWORKS solves this with Interference Check so that you find these problems during design. Then, you are never caught by surprise during assembly.

Hole Checking

Hole Misalignment and Thread Mismatch functionality checks for holes that do not line up properly. SOLIDWORKS lists all holes that are misaligned so you can easily find and correct them. In addition, the software detects interferences resulting from mismatched or misaligned threads and other interfering geometry.

Tolerance Analysis

While interference checks are powerful, parts are not manufactured to their nominal dimensions. Everything has a tolerance, so to truly assess interferences and clearances, tolerances much be considered. Tolerance Analysis does just this by analyzing the impact of maximum and minimum tolerances. When tolerance stackup causes a problem, SOLIDWORKS identifies the root cause by listing all features and tolerances that are contributing to it. It then rates each feature according to how severely it impacts the problem. You can then easily identify the tolerances that need to be tightened to avoid the problem.

Collision Detection

When working with mechanisms or other assemblies that have motion, Collision Detection assesses the full range of motion and alerts you if components will collide. You can also define the minimum clearance between two components while they are in motion so you can tell if they get too close at any one point.

Simulation

While ensuring components fit together is critical, it is also important to understand the impact of the assembly method. If a bolt creates a concentrated stress point or the residual stresses in a welded joint weaken the bond, product quality will suffer. SOLIDWORKS Simulation analyzes the physical connections between components, such as bolts, springs, and welds. It then calculates if the connections will sustain the applied loads during product use. If there are problems, you can then change the type of connection or resize it so that product performance and quality will not be compromised.

By identifying these assembly problems, you can avoid a costly source of scrap and rework. Also, with this early insight, you will have the flexibility to make decisions that will lower cost and improve quality, rather than just try to salvage the original flawed design. Explore the various functions offered in SOLIDWORKS to catch assembly problems early on.
MANAGE AND UNDERSTAND CHANGES TO ENSURE ALL DESIGN DETAILS ARE UP-TO-DATE

Understand how changes were implemented with SOLIDWORKS Compare Parts and Drawings.

After an engineering change it may not always be obvious what changed. Perhaps there was a change in another part and you need to understand how that change will impact your part. Or, maybe a supplier made a change and after sending you the revised file, you need to understand how the rest of the assembly is impacted so you can update other components as needed. SOLIDWORKS PDM allows you to automatically manage file versions so you always know which is the latest. As a result, you can catch potential manufacturability problems before you release the design to manufacturing. Investigate the many different types of comparisons you can make with SOLIDWORKS Compare Parts and Drawings.

SOLIDWORKS Compare Parts and Drawings functionality automates these comparisons for you. You just let it know which parts you want to compare, and it will visually highlight the changes.

VIDEO: Compare Geometry
IMPROVE QUALITY BY ENFORCING STANDARDS
Automatically check drawings and models with CAD standards checking.

Best practices are extremely valuable. Manufacturing is more productive when they know what to expect on a drawing and where to find it. Design standards and drawing formats also ensure quality and avoid manufacturability issues. Unfortunately, it can be hard to enforce best practices without some level of automation to ensure they are followed.

It can be pretty easy to inadvertently leave information off a drawing, particularly with the constant pressure of tight deadlines. Any new engineer can take a while to learn a new company’s drawing standards and formats that must be included in a drawing. If the drawing is released with missing information, it can cause confusion on the shop floor, the issuing of an engineering change order (ECO), drawing modifications, and reissues. All the while, work is delayed and time and money are wasted.

The good news is that with SOLIDWORKS CAD standards checking, SOLIDWORKS can automatically check your drawings and models. Simply define the company standards and best practices you would like it to check for. SOLIDWORKS will automatically find everywhere that fails the checks. Rules can include items such as dimensioning standards, fonts, overlapping dimension lines, and standard units.

By automating the checks, engineers save time because they don’t need to manually search for errors or omissions.

They also don’t need to waste time looking up standards. The software will automatically let them know and enforce the standards. Manufacturing saves time as well because they receive more consistent and complete documentation and avoid manufacturability issues.

Check out how easy it is to set up rules and the many types of checks you can have SOLIDWORKS do using CAD standards checking functionality.
CHAPTER 4

ENABLING CONCURRENT ENGINEERING AND MANUFACTURING

Download the next chapter to learn how SOLIDWORKS solutions can help you provide manufacturing with everything they need to produce your design. The next eBook chapter will cover these topics:

- Overcome manufacturing knowledge gaps with CAM.
- Avoid common problems in plastic parts with plastic and cast part design and mold design.
- Ensure the manufacturability of sheet metal parts.
- Accelerate the design and manufacture of weldments.
- Prevent errors and save time with automation for piping and tubing design.
- Take advantage of 3D printing.

Learn more about how SOLIDWORKS solutions can take you from design to manufacturing by visiting http://launch.solidworks.com.