



**CHAPTER
ONE**

INTEGRATING DESIGN-TO-MANUFACTURING WITH SOLIDWORKS

SHORTEN CYCLE TIMES, LOWER COSTS, AND IMPROVE QUALITY





CHAPTER ONE

THE ADVANTAGES OF DESIGN AND MANUFACTURING INTEGRATION

Surviving in today's global economy means companies must simultaneously shorten cycle times and lower costs while improving product quality and performance. Those who do it best will enjoy a competitive advantage.

BRINGING DESIGN AND MANUFACTURING TOGETHER:

One of the single best decisions you can make to accelerate your product development process while lowering cost and improving quality

Success in today's global market requires more than creativity and innovation. Products must also offer the features customers want to buy, at a price customers consider affordable. Even more importantly, you must be able to design and manufacture your products at a profit. Of course, you must accomplish all this while racing against the constant time constraints imposed by your customers and competition. Surviving in today's global economy is so competitive, companies must simultaneously shorten cycle times and lower costs while improving product quality and performance. Those who do it best will enjoy a competitive advantage.

Achieving these goals requires a coordinated effort from everyone involved in product development, from concept to delivery. Processes must be streamlined to eliminate the hiccups that often occur when designs progress from one phase to the next. One potential disconnect is between design and manufacturing, as a result of disparate tools and the lack of a common, unified platform. This combination causes miscommunication between teams. Plus, different tools require translation to communicate, which wastes time and often results in a loss of information.

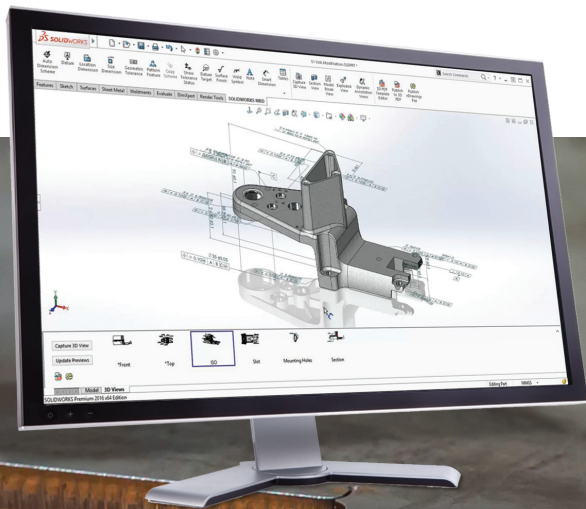
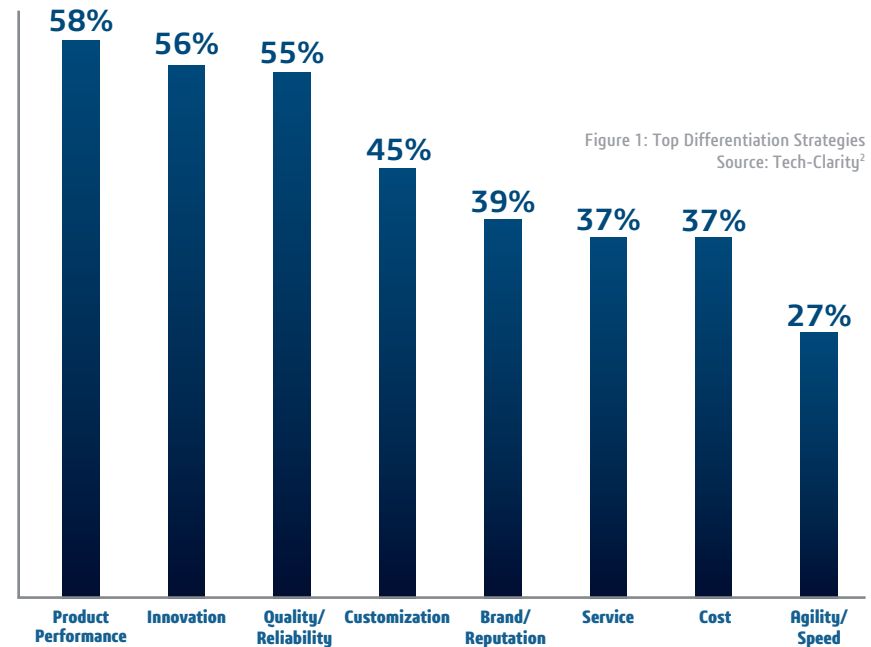
This ebook will unveil how adopting an integrated design and manufacturing solution enables concurrent engineering, which helps companies make the seamless transition from design to manufacturing. A unified platform connects product development participants so that they can collaborate, problem-solve, and communicate. As a result, there will be less miscommunication, which will boost productivity, reduce costs, and improve product quality. Research finds that concurrent engineering leads to a 20 to 90 percent reduction in time-to-market, up to 75 percent less scrap and rework, up to 40 percent lower manufacturing costs, and 200 to 600 percent higher overall quality.¹

CONSIDER WHAT'S REQUIRED TO MAKE PRODUCTS COMPETITIVE

Ensure a balance of performance, innovation, quality, cost, and time.

In today's very competitive global economy, it is increasingly difficult to stand out from the competition. Figure 1 shows the top ways companies differentiate their products. What's especially interesting is that it is no longer enough to focus on just one aspect. Staying ahead means products must have excellent performance, be innovative, and offer high quality. Balancing this is hard, especially because these goals often conflict with other business criteria. Too much focus on product differentiation might put schedules at risk and drive up costs. Too little, and competitors might steal market share.

With this in mind, you should take advantage of opportunities that will streamline processes. Streamlining will give you more time to focus on differentiation and on getting to market sooner. You'll also have more time to concentrate on quality issues that hurt product reputation and drive up costs. Integrating engineering and manufacturing is one of the best ways to achieve all of this. The added efficiency will give you more bandwidth to lower costs, improve quality, and get to market sooner. As a result, you can win over customers, bring in more revenue, and boost profitability.

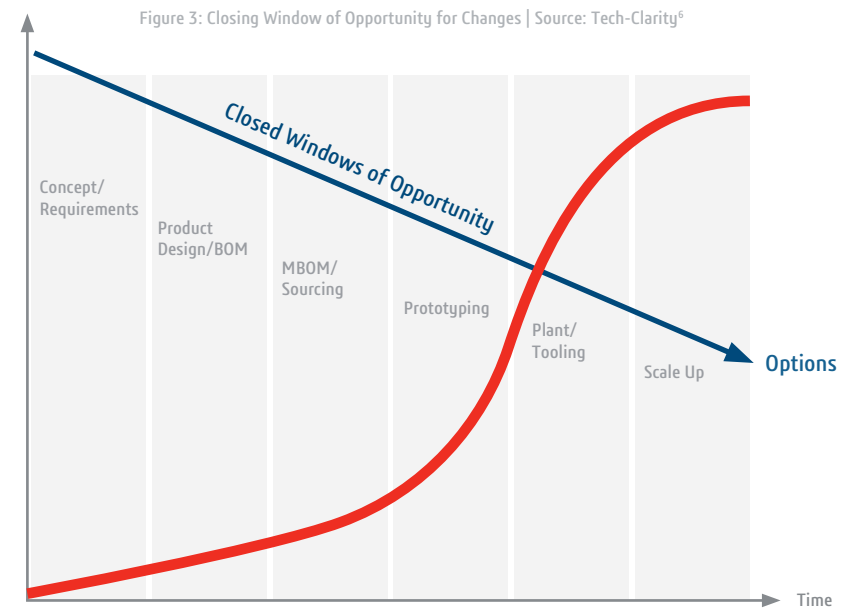
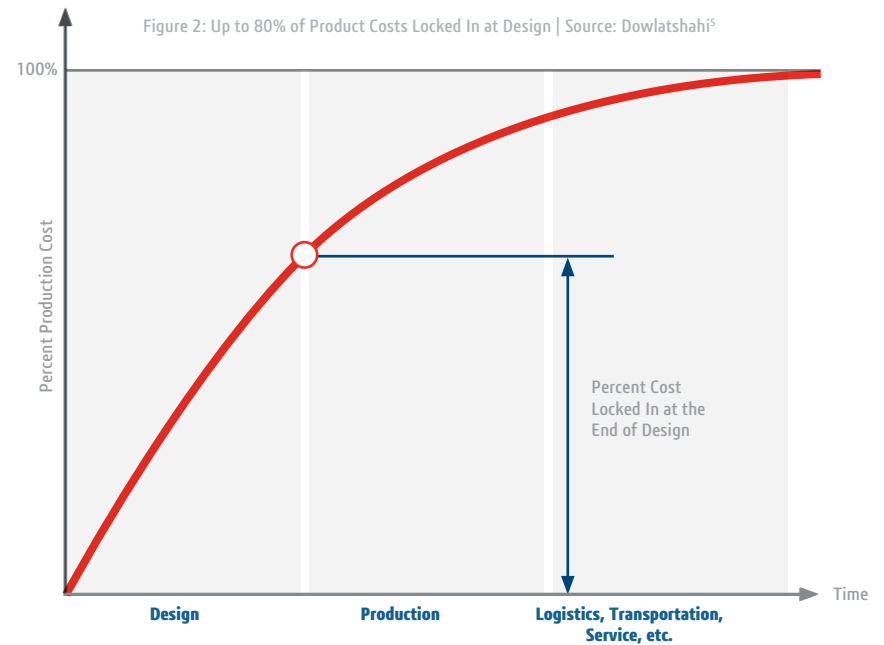


USE DESIGN AND MANUFACTURING TIME EFFECTIVELY

The sooner you find problems, the better.

Numerous studies have shown that design decisions have a significant impact on production costs and product quality.³ By the end of the design phase, you've determined 70 to 80 percent of the final production costs and 80 percent of the work impacting product quality⁴ (Figure 2). On top of that, the further along you are in the development cycle, the more expensive it becomes to make changes (Figure 3). As the design evolves, more of it is locked in and there are dependencies across components. This means even small changes can impact multiple components and before long, small changes become extremely complicated. Once you order steel and have tooling in place, the cost implications skyrocket. At this stage, you quickly get to the point where any change means costly scrap and rework.

As a result, if manufacturing doesn't have insight into the design until after design release, options to improve manufacturability are very limited. Changes become far more difficult and costly. However, since design decisions impact 80 percent of production costs, without early manufacturing input, you could be missing lots of opportunities to cut costs and improve quality. Also, any problem found on the production floor becomes extremely costly to correct. To avoid this, engineering and manufacturing teams need to collaborate. In fact, when they do not, it often comes at a significant cost to the company.



COST OF POOR COLLABORATION BETWEEN ENGINEERING AND MANUFACTURING

Don't create a competitive disadvantage.

While collaboration is important, it is also abstract, so it's difficult to measure its impact on cost. However, when engineering and manufacturing operate in silos, problems arise, and there are bottlenecks. Figure 4 shows the business cost of poor collaboration.

The very nature of releasing design data to manufacturing requires collaboration. Engineering and manufacturing must share and exchange design information. Usually, that data needs to be imported and repaired, which is not only tedious and time-consuming, but the translation process can introduce errors.

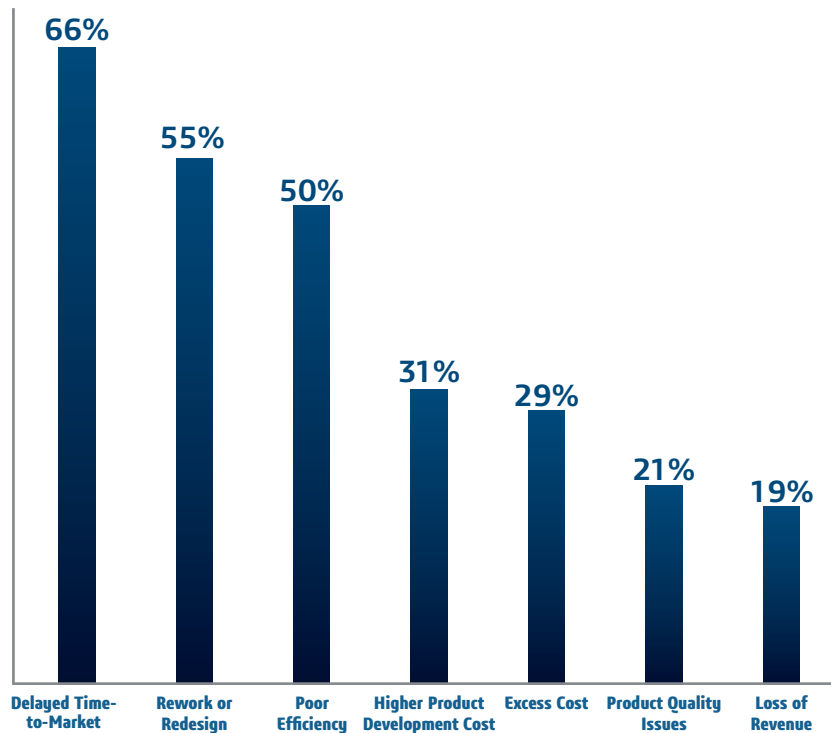


Figure 4: Top Impacts of Poor Collaboration | Source: Tech-Clarity⁷

Any design problem found during production can cause further delays. Perhaps there isn't enough clearance to drill a hole, or maybe tolerance stackup has created a misalignment with the mounting holes. Whatever the problem, it takes time to come up with a solution. This puts schedules at risk and can delay time-to-market. On top of that, bad parts need to be scrapped or reworked, adding even more cost.

Involving the engineering department in the solution adds to development cost and takes them off other work, hurting productivity and potentially delaying other new projects. To minimize delays and cost, the fix will often be whatever is quick and easy. Unfortunately, that may hurt quality, which can impede market success and may mean lost revenue opportunities. Extended delays may give competitors time to beat you to market and steal market share, further limiting your revenue potential.

By supporting better collaboration between engineering and manufacturing, you can greatly reduce the risk. You can avoid added costs by finding these problems earlier. To make this possible, you must overcome some obstacles.





ENGINEERING AND MANUFACTURING COLLABORATION IS BECOMING EVEN MORE IMPORTANT

Prepare for the future.

Even if you are managing without good collaboration between engineering and manufacturing, industry trends will make it even more crucial than ever before. Companies who are thinking about this and preparing for the future will be better positioned to be industry leaders.

As the most experienced design engineers approach retirement, much of their manufacturing knowledge will be lost. Consequently, newer engineers will need to rely on manufacturing input as they develop that expertise. Without it, there will be even more risk of manufacturability issues that will further drive up cost and waste time.

Further, when new manufacturing techniques such as 3D printing are combined with advancements in materials, the old rules of thumb for manufacturing get thrown out. But to truly take advantage of the benefits of these new technologies, close collaboration between design and manufacturing will be required as the impacts on both design and manufacturing become better understood, and new rules of thumb are developed.



“The improvements to our product development process that SOLIDWORKS has enabled us to achieve have helped us to support growth of more than 500 percent.”

— Jorge Smart Cruz Arenal,
Director General, DCF Mexicana, S.A. de C.V.

WHY IS COLLABORATION SO HARD? Integrate engineering and manufacturing to enable better collaboration.

While collaboration between engineering and manufacturing is important, the lack of integrated software tools across the organization creates a fundamental barrier. Unfortunately, this is commonly the top challenge of today’s engineering environments (Figure 5).⁷

Manufacturing planning typically involves translating and converting design data, such as NC toolpaths, to product information. Plastic parts are especially problematic because they involve multiple translations to design the mold core and cavity, bring in the mold base, and then create NC toolpaths. Each translation requires importing and repairing data, which eats up valuable time. Then, every time the designer introduces a change, the cycle of importing and exporting information repeats itself.

Segregated engineering and manufacturing systems create a host of problems. Not only do data translations add extra steps, but they can also introduce errors. Also, you now have to determine which system holds the “master” representation. Plus, maintaining and training people on multiple systems is expensive.

The result is many missed opportunities for improved efficiency because colleagues can’t work concurrently. They have to wait until one process is complete to begin the next. With any change, downstream work such as tooling and fixture creation, inspection documentation, shop floor assembly instructions, in-process drawings, and NC toolpath data, has to be recreated entirely or updated manually. Either option is time-consuming and often error-prone.

The good news is that you can avoid these challenges by integrating design and manufacturing systems.

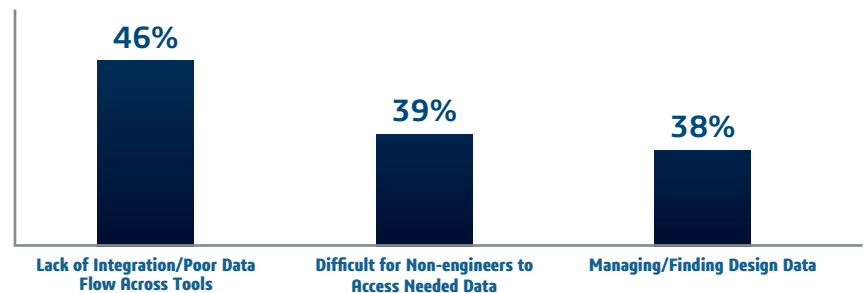


Figure 5: Top Impacts of Today’s Design Environments | Source: Tech-Clarity⁷

When you integrate design and manufacturing systems, design changes automatically propagate to manufacturing, so you can incorporate last-minute design changes and minimize the need to push out delivery dates.

INTEGRATE DESIGN AND MANUFACTURING SYSTEMS

Provide a collaborative platform that enables faster and easier sharing of manufacturing data.

By integrating design and manufacturing systems, teams can share design information seamlessly and avoid the excess costs, delays, and quality issues that arise with poor collaboration. An integrated platform streamlines workflows and enables concurrent design and manufacturing so you can do the following:

- Accelerate time-to-market by 20 to 90 percent, catch problems sooner, reduce scrap by up to 75 percent, and lower manufacturing costs by up to 40 percent.
- Save time by avoiding the need to import/export/repair model data.
- Avoid errors introduced during data translation.
- Lower software maintenance costs due to fewer systems and reduced training.

You accomplish this by integrating a manufacturing software application (e.g., mold design software, quoting software, inspection software, and 2D and 3D CAM software), with product design (CAD) software.

An integrated design-to-manufacturing system allows all departments to use the same software system, eliminating the need for data translation. Plus, you can easily make late design changes without significant impact on product delivery. Because changes propagate from design to manufacturing, you can incorporate them and minimize the need to push out delivery dates. So if you must make last-minute changes—for design, competitive reasons, new features, or to accommodate suggestions from manufacturing or industrial designers and stylists—you are covered!

An integrated system enables designs to move seamlessly back and forth between design and manufacturing, facilitating a collaborative workflow (Figure 6).

By working collaboratively, you can catch problems impacting manufacturability much sooner, avoiding excess cost and wasted time. This way, companies can focus more of their energy on the qualities that will make their products more competitive.

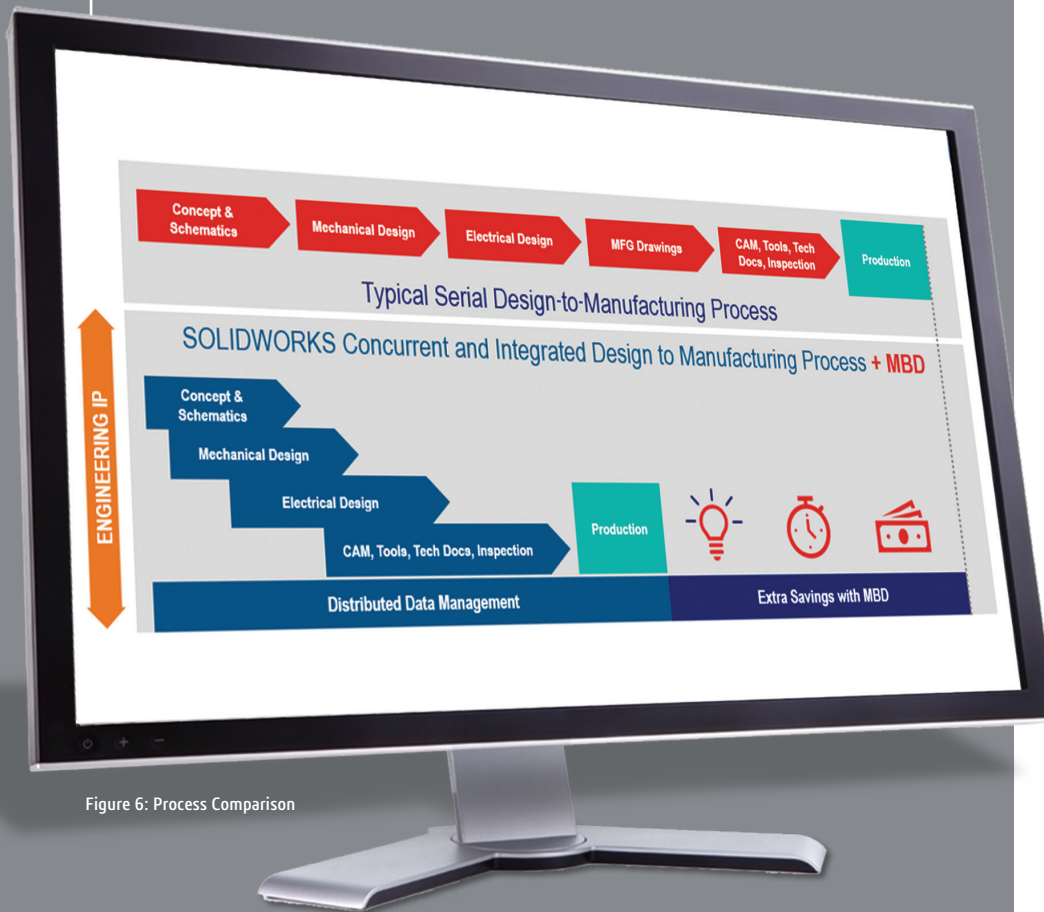


Figure 6: Process Comparison

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Don't miss the next ebook in our
"Integrating Design-to-Manufacturing
With SOLIDWORKS" series.

CHAPTER 2

YOUR COMPLETE 3D DESIGN SOLUTION

Now that you've seen the tremendous advantages of integrating your design and manufacturing processes and teams, be sure to download the next ebook in the "Integrating Design-to-Manufacturing With SOLIDWORKS" series. It will describe how you can design exceptional products with SOLIDWORKS solutions, while also bridging the gap between your design and manufacturing teams.

Learn more about how SOLIDWORKS solutions can take you from design to manufacturing by visiting
<https://www.solidworks.com/whatsnew2019>.

References

¹Thankachan, T. Pullan, M. Bhasi, and G. Madhu. "Application of concurrent engineering in manufacturing industry," International Journal of Computer Integrated Manufacturing, 23:5, 425-440, DOI: 10.1080/09511921003643152, 2010.

²Brown, Jim. "Product Lifecycle Management Beyond Managing CAD," Tech-Clarity, 2015.

³Zhu, Yanmei, Alard, Robert, You, Jianxin, and Schönsleben, Paul. "Collaboration in the Design-Manufacturing Chain: A Key to Improve Product Quality," Supply Chain Management—New Perspectives, Prof. Sanda Renko (Ed.), ISBN: 978-953-307-633-1, InTech, 2011.

⁴Huthwaite, B. "Designing in Quality," 27(11), 34-50, 1988.

⁵Dowlatshahi, S. "Purchasing's role in a concurrent engineering environment," International Journal of Purchasing and Material Management, 28(2), 21-25, 1992.

⁶Brown, Jim. "Leveraging the Digital Factory: Enhancing Productivity, From Operator to Enterprise," Tech-Clarity, 2009.

⁷Boucher, Michelle. "Empower Design Engineers With Easy Collaboration Powered by the Cloud: How the Advantages of Modern Infrastructures Improve Competitiveness," Tech-Clarity, 2018.



**CHAPTER
TWO**

INTEGRATING DESIGN-TO-MANUFACTURING WITH SOLIDWORKS

YOUR COMPLETE 3D DESIGN SOLUTION





CHAPTER TWO

CHAPTER 1: RECAP

In the first chapter of our ebook series on integrating design and manufacturing with SOLIDWORKS® solutions, we discussed the need to develop products that are innovative, as well as high-quality and cost-effective. We explained how hard it is to achieve all of these goals simultaneously. We outlined how streamlined design-to-manufacturing product development processes can give you the time to focus on product differentiation, and we concluded that one of the best ways to accomplish this is to integrate design and manufacturing.

Involving manufacturing earlier in the process creates some of your best opportunities to lower cost and improve quality. Plus, integration enables a seamless transition from design to manufacturing. This leads to improvements in manufacturability, plus fewer errors due to translation and miscommunication. The key is using tools that speak a common language. The result is a boost in productivity, reduction in cost, and higher-quality 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. In this second chapter of our series of ebooks, we will focus on the Design portion of the process.

In this ebook, you'll learn how SOLIDWORKS can help you design exceptional products while also bridging the gap between your design and manufacturing teams.





WHY SOLIDWORKS?

The complete solution from concept to manufacturing

Innovation, quality, and performance all come from great design. To create and make great designs, you need the right tools. Your design tools should be flexible enough to support creative thinking, yet powerful enough to handle the complexity of today's products. They also need to enable exceptional design without getting in the way. In addition, your design tools should allow you to provide manufacturing with everything they need to take the design to finished product.

With SOLIDWORKS, you get all of this and more. First, as a 3D CAD software, it is easier to create, visualize, and even animate the final product. You can easily identify interferences between components and hole misalignments, and also check for tolerance stackup issues. For these reasons and more, with 3D, you reduce the risk of finding problems late in the game—during production and final assembly.

For documenting and detailing your designs, SOLIDWORKS offers three options. First, you can design in 3D and create [2D drawings](#) that are associative, or update automatically, whenever changes are made in 3D. Second, you can design and detail in 3D only—commonly referred to as Model-Based Definition, or [MBD](#). For those who want to work in 2D only, SOLIDWORKS also offers [DraftSight](#).

You can also use SOLIDWORKS to run simulations and validate a design, ensuring it meets the performance and quality criteria customers expect. Then, you can correct any problems you find before manufacturing.

It is also easy to evaluate different design iterations so that your final design is more innovative and optimized. Associativity is part of what makes this so easy. With associativity, changes to the design model automatically propagate to all associated components, as well as related drawings, tooling, NC toolpaths, and other downstream deliverables. SOLIDWORKS also enables manufacturing planning and preparation work while concurrently developing the design.

SOLIDWORKS also offers a complete suite of tools to manufacture, inspect, and create technical documentation for the product. It is all tied together with a powerful data management tool, [SOLIDWORKS PDM](#), to manage and control all product information and create a single source of truth.

A Community to Raise Your Design Game

One of the biggest benefits for users is the [SOLIDWORKS Community](#) of individuals. SOLIDWORKS software is so intuitive that it's the tool of choice for more than 5.6 million users and over 33,000 [educational institutions](#) around the world. With this presence, it's easy to staff your organization with designers who already know SOLIDWORKS.

You can tap into the power of this vast network of worldwide users to share best practices, refine tasks, and rapidly work through design challenges. At [MySolidWorks.com](#) you can also leverage knowledge and resources from a global network of suppliers, consultants, manufacturers, and designers. Even better, the **3DEXPERIENCE** Marketplace gives you a simple way to find and connect with reliable manufacturers using SOLIDWORKS. As a part of the network, you can also promote your services and respond to requests for quotes.

A COMPLETE 3D DESIGN SOLUTION

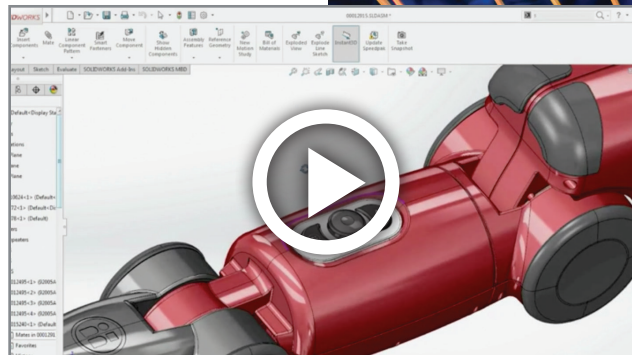
SOLIDWORKS scales to meet your solid modeling needs, whether large or small, simple or complex.

Your CAD software should be your design team's favorite tool. Just like any other tool—a saw, a drill, or a wrench—it should be easy to use and reliable, but powerful and sophisticated enough to get the job done quickly. If a tool is overly complicated, or unreliable or can't get the whole job done, it tends to be left on the shelf unused.

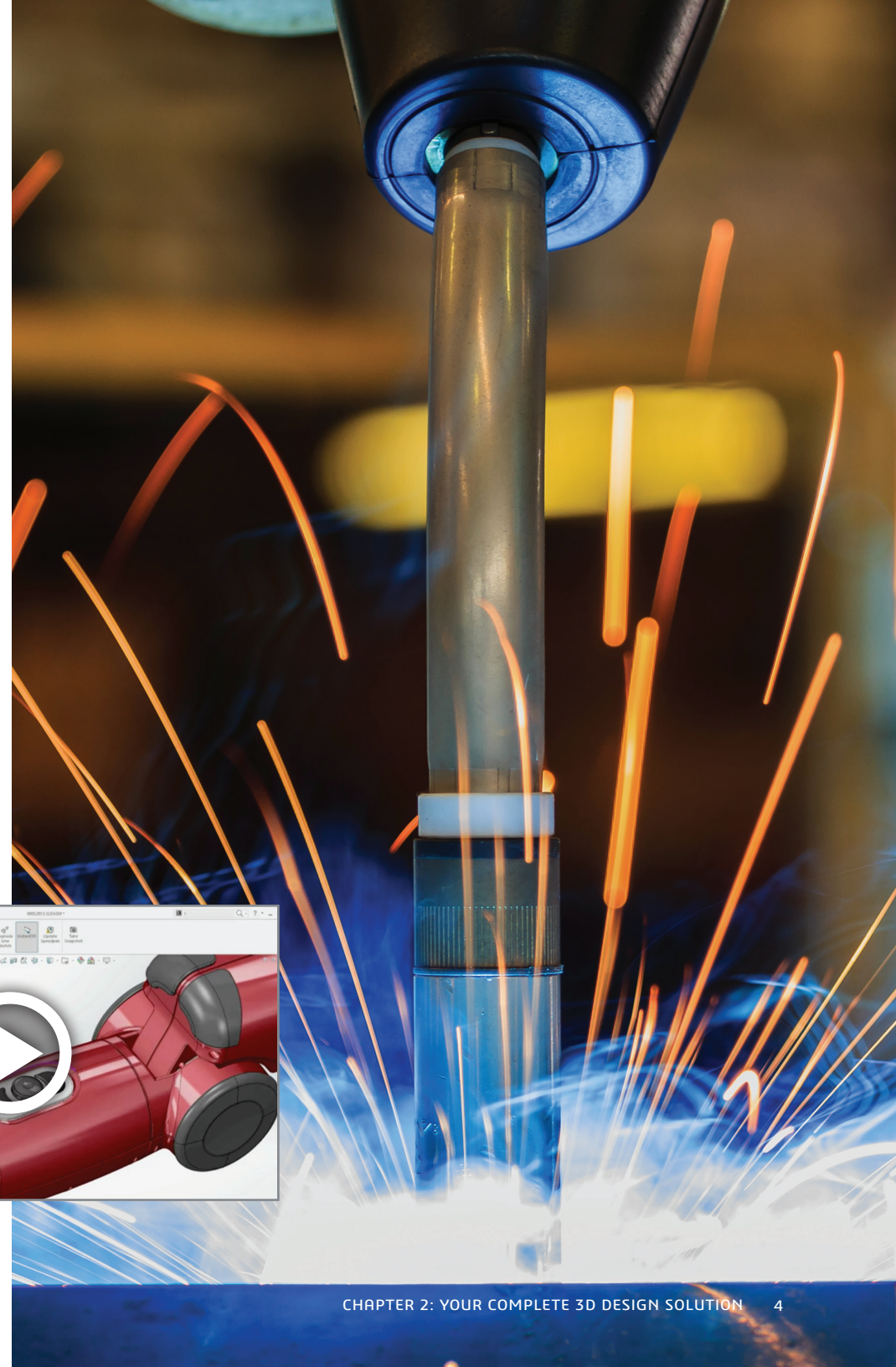
SOLIDWORKS 3D CAD is best known for its ease-of-use and reliability. Its robust capabilities shorten product development time, reduce costs, and improve quality. Intuitive 3D design and manufacturing solutions from SOLIDWORKS let you [conceptualize](#), [create](#), [validate](#), [communicate](#), [manage](#), and transform your innovative ideas into great product designs. Along with advanced part, assembly, and 2D drawing functionality, there are also specialized tools to support manufacturing options such as sheet metal design, weldments and fabrications, [mold design](#), DFM (Design for Manufacturability), and even [CAM](#) programming—all in one integrated package. Electrical cable and pipe routing is also available, which helps with planning and significantly cuts down assembly time.

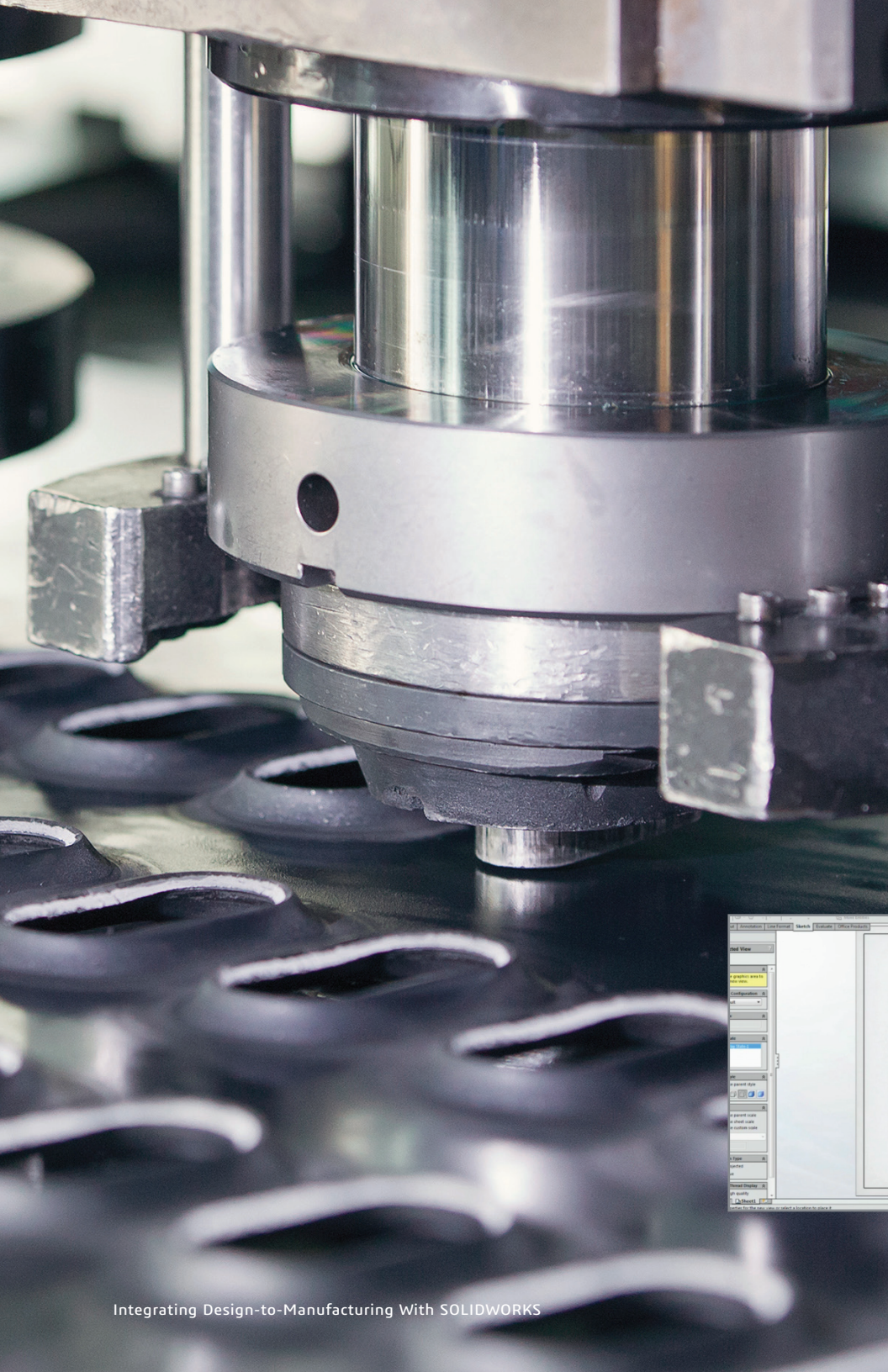
SOLIDWORKS also supports advanced design capabilities such as surfacing, advanced surface flattening, and reverse engineering. In addition, it offers a sophisticated components and parts library, which will save you time.

SOLIDWORKS offers additional capabilities to help meet customer needs. [Product configuration](#) functionality will help meet individual customer needs while automated [cost estimation](#) will help make better decisions around product cost so that you can keep your products affordable for your customers. SOLIDWORKS also offers the tools to help you improve quality with design and drawing checking and [structural and motion analysis capabilities](#). With the growing demand for smarter products, SOLIDWORKS will support you with solutions for [ECAD design and ECAD/MCAD](#) collaboration. You can even start to showcase your products before the physical product exists with advanced [photorealistic rendering](#). Finally, to bring your teams together and improve efficiency, SOLIDWORKS offers [advanced collaboration capabilities](#).



VIDEO: User Interface





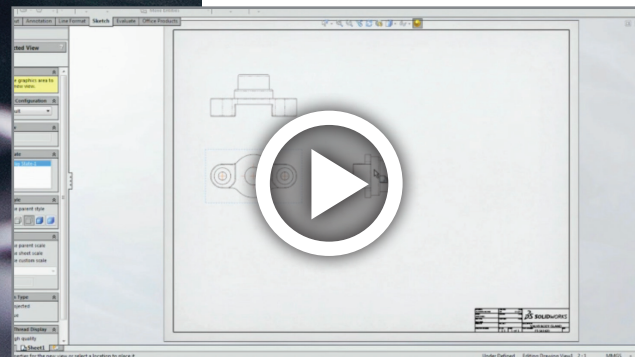
CREATE 2D DRAWINGS WITH EASE

Use [SOLIDWORKS 2D Drawing](#) for fast and easy creation of production-ready manufacturing drawings.

Do you find creating 2D drawings tedious or time-consuming? You're not alone. SOLIDWORKS reduces the tedium with powerful features that make it as painless and efficient as possible, while still providing everything you need to clearly communicate how to manufacture and assemble your design.

First, SOLIDWORKS associativity allows you to link a 2D drawing directly with the 3D solid model, so updates to the 3D model automatically update in all affected views of the 2D drawing. There are no more tedious updates to each drawing every time there's a change. More importantly, you do not have to worry about manufacturing errors due to conflicting information. For example, have you ever updated everything impacted by a change, but missed that cutout view in the corner? Those times are over. Associativity also means you can start your detail work sooner because the drawings are automatically kept up-to-date as the design evolves.

SOLIDWORKS also provides you with numerous functions to simplify drawing creation. You can place [views](#) with a simple click of the mouse. [Dimensions, annotations, and balloons](#) are automatically arranged in a clean layout, making it easy for manufacturing to interpret. Manufacturing standards are automatically enforced with templates to ensure consistent high quality. For example, hole callouts automatically include all of the information manufacturing needs, such as hole type, hole size, and tap-drill size.



With [SOLIDWORKS PDM](#), you will also never have to worry about releasing the wrong [version](#) of the drawing to manufacturing. Access controls limit who can make changes, so no one can inadvertently make changes after design release, without getting approval.

Discover all the innovative [drawing features in SOLIDWORKS](#).

VIDEO: SOLIDWORKS Drawings

ACCELERATE RELEASE TO MANUFACTURING WITH MODEL-BASED DEFINITION (MBD)

SOLIDWORKS MBD helps streamline manufacturing, offering both time and cost savings.

Tech-Clarity research found that 33 percent of design time is spent producing 2D drawings. For those who would prefer to invest that time in innovation or enabling manufacturing to produce parts sooner, [SOLIDWORKS MBD](#) may just be the answer. The research shows that those who have adopted it have enjoyed improved communication with suppliers and manufacturing. This leads to fewer mistakes and less rework.

MBD uses the 3D model engineering has developed, but instead of creating separate 2D drawings from it, the 3D model displays all the required information manufacturing needs to produce the part. Consequently, time isn't wasted creating additional 2D deliverables. Plus, a 3D model is easier to understand as no one has to mentally project 2D views in their head. This greatly reduces the risk of errors, especially for newer workers.

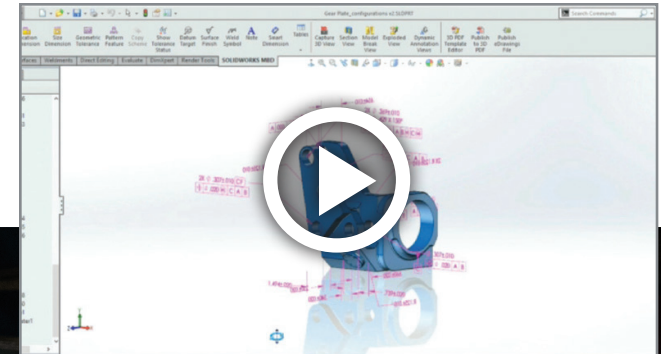
SOLIDWORKS MBD supports industry standards such as Military Standard 31000A, ASME Y14.41, ISO 16792, and DIN ISO 16792. It organizes all the rich product and manufacturing information (PMI) into clean and structured 3D presentations with different views and display settings. It can even intelligently show and hide 3D annotations while you rotate the model to give extra clarity.

But what if vendors or customers don't have SOLIDWORKS? The answer is simple. SOLIDWORKS MBD allows you to save 3D models with 3D dimensions and notes in a variety of formats, including PDF (some call it 3D PDF), eDrawings, and STEP 242. In these formats, you not only view your design, but you can rotate it, highlight dimensions, and see the features they relate to highlighted in the model. You can measure, explode views, and section views all interactively. Try doing that with a static 2D drawing. The viewers are free, so anyone can benefit, even if they don't have SOLIDWORKS.

As with 2D drawings, SOLIDWORKS MBD has customizable templates so you always include standard company information. Because 3D models are so easy to understand, multiple departments will find them useful. You can take advantage of predefined templates or customize your own for different audiences, such as manufacturing, operations, QA, and procurement. In addition to drawing information, you can use SOLIDWORKS MBD to create requests for quotes (RFQs), and inspection reports when they are combined with [SOLIDWORKS Inspection](#). Plus, these deliverables are available in a variety of formats such as [eDrawings](#) and 3D PDFs. You can even print 2D drawings from the 3D model if needed.

Take a look at the powerful capabilities of [SOLIDWORKS MBD](#).

VIDEO:
SOLIDWORKS MBD



Viecelli Móveis accelerated their custom furniture business with SOLIDWORKS MBD capabilities.

INNOVATE WITH SMART PRODUCTS

SOLIDWORKS Electrical solutions embed the intelligence in your designs.

Making products smarter is an incredibly powerful way to add innovation and differentiate products. In fact, Tech-Clarity research finds that 52 percent of companies developing smart products fear losing market share unless they continually make products smarter. On top of that, 47 percent worry about reduced revenue. Considering this, the amount of software and electronics going into products will continue to increase. However, Tech-Clarity's research also finds that an overwhelming 89 percent report that they have challenges due to poor collaboration. Respondents reported that these challenges hurt profitably by driving up costs, creating market delays, and causing missed customer expectations. Consequently, it is essential that engineers across disciplines have tools that support better collaboration. With this in mind, SOLIDWORKS offers a full suite of tools that integrate mechanical and electrical design.



VIDEO: SOLIDWORKS PCB

[SOLIDWORKS Electrical solutions](#) maintain bidirectional links with the mechanical design, so you never have to worry about them becoming out of sync. This helps you avoid potential conflicts in design information that could lead to manufacturing problems later on.

[SOLIDWORKS PCB](#) allows you to bring together the PCB design with the mechanical design, so you never have to worry about discovering problems during assembly, like an enclosure not fitting around the PCB. When you combine it with the other powerful validation capabilities in SOLIDWORKS, you can identify potential problems with the PCB overheating and adjust the enclosure as needed, before beginning any manufacturing work.

With SOLIDWORKS [Electrical 3D](#), you can take the guesswork out of final assemblies by optimizing wire routing in the virtual design and calculating the optimal lengths for wires, cables, and harnesses.

Explore the power of [SOLIDWORKS Electrical solutions](#).



COLLABORATE SEAMLESSLY WITH SUPPLIERS AND CUSTOMERS

Import, reuse, and share data no matter where they came from, or where they're going.

In addition to exceptional design tools, you also need the capabilities to collaborate with customers and suppliers. SOLIDWORKS product collaboration tools help members of your design team work closely with other project stakeholders. SOLIDWORKS also provides ways to protect your designs before sharing them with those outside of your organization. With [eDrawings](#), your suppliers and customers can easily view your CAD data so you can collaborate, while still protecting your intellectual property (IP).

While the vast network of 5.6 million SOLIDWORKS users makes it easy to find suppliers using SOLIDWORKS, there will still be times when you need to work with [multi-CAD data](#). SOLIDWORKS has multiple functions to simplify the process, so you have the flexibility to work with the data the way you want. With [SOLIDWORKS 3D Interconnect](#), you can maintain a direct integration with native multi-CAD data. And if you need to work with them as native SOLIDWORKS data, Automatic Feature Recognition makes that possible too.

Take a closer look at the powerful capabilities available in [SOLIDWORKS for working with multi-CAD data](#).



VIDEO:
3D Interop



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Don't miss the next ebook in our
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With SOLIDWORKS" series.

CHAPTER 3

VALIDATING MANUFACTURABILITY

Download the next ebook 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:

- Catch problems and identify cost drivers that will impact fabrication.
- Take the guesswork out of injection molding and produce high-quality parts the first time.
- Avoid assembly problems leading to costly scrap and rework.
- Manage and understand changes to keep all design details up-to-date.
- Improve quality by enforcing standards.

Learn more about how SOLIDWORKS solutions can take you from design to manufacturing by visiting
<https://www.solidworks.com/whatsnew2019>.



**CHAPTER
THREE**

INTEGRATING DESIGN-TO-MANUFACTURING WITH SOLIDWORKS

VALIDATING MANUFACTURABILITY





CHAPTER THREE



CHAPTERS 1 AND 2: RECAP

In our first ebook chapter on integrating design and manufacturing with SOLIDWORKS® solutions, we discussed the advantages of adopting an integrated design and manufacturing solution. We described how integrating design and manufacturing could represent some of the best opportunities to lower cost and improve quality. In the second ebook chapter, we also discussed the advantages of using 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—asking if the design is strong enough. In this third chapter of our ebook series, we will discuss the broader meaning for SOLIDWORKS users.

In this ebook, we will discuss how SOLIDWORKS solutions enable you to validate 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—and save time and money—with the [Design for Manufacturability](#) solutions in SOLIDWORKS.

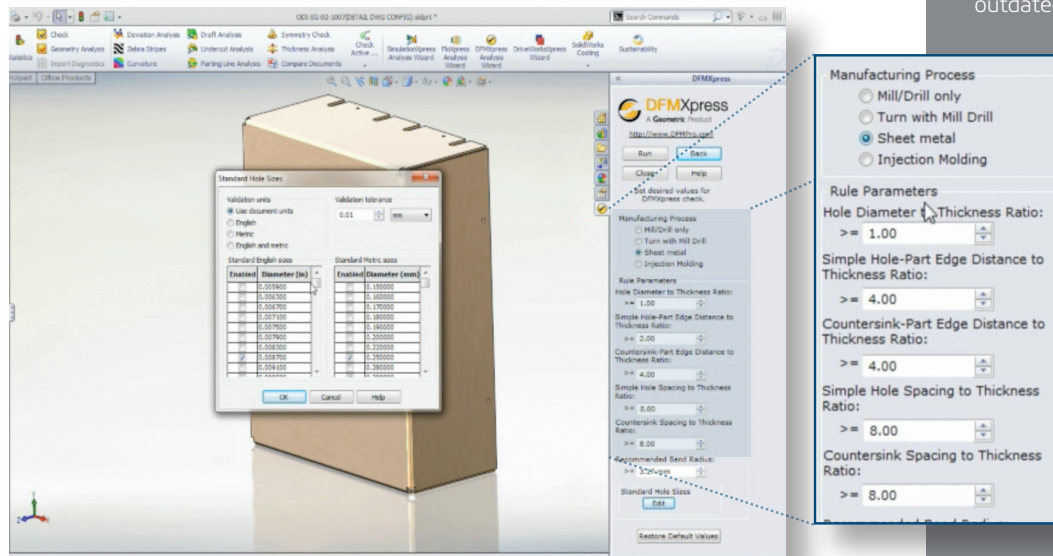
Even if engineers incorporate all sorts of innovative features, meet all targets for performance and quality, and release the design ahead of schedule, it still may not be a success. A truly great design needs to meet all those targets but still be manufacturable. The best engineers understand the manufacturing processes required to produce their design. They anticipate potential manufacturing problems and avoid them, saving the company money. An engineer who truly shines understands the impact of tolerances on manufacturing costs, identifies problems with tool clearances, and designs plastic parts that eject from the mold without warpage.

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 to observe manufacturing. Consequently, it is harder to recognize manufacturing challenges such as the impact of putting a mounting hole too close to an edge wall. This is because manufacturing is either outsourced or inside a facility that is separate from the design office. As a result, new engineers miss out on learning experiences when they're not interacting with manufacturing.

Without shop floor experience, engineers struggle 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. These days, problematic designs just get sent back for a redesign. But 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 early will significantly lower the cost of correcting them. And with [SOLIDWORKS PDM](#), you can manage your updates on the latest version, without confusion or releasing outdated revisions.



Quickly identify design areas that might cause fabrication problems or increase production costs using DFMxpress and SOLIDWORKS Costing 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 help ensure 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's hard to visualize exactly how much clearance the tooling will need. There may be situations where a minor geometry adjustment can mean the difference between a single quick 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 nothing is 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 facility or sending it elsewhere, adding both time and cost. These decisions depend on available tooling, which can be very difficult to manage.

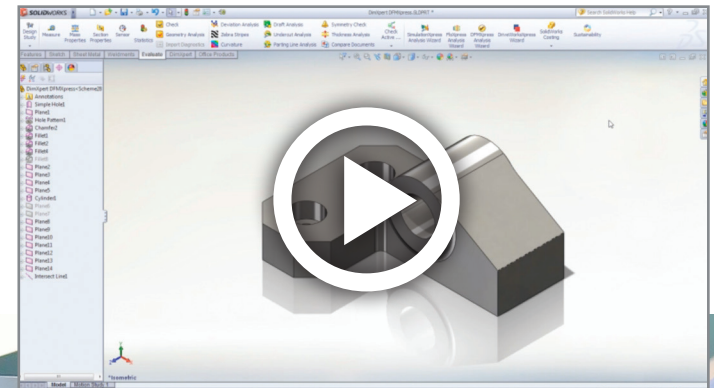
These are exactly the types of problems SOLIDWORKS DFMXpress solves. DFMXpress visually flags surfaces and features that could be a problem for manufacturing. You can then investigate the feature and determine if another feature will work, or even remove it so that you can drastically lower production 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 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 paying to send the part to an outside vendor. Increasing the hole diameter or reducing the hole depth may avoid the problem altogether. Even if the hole dimensions can't change, knowing the requirement in advance means you can make arrangements early on for special operations, such as gun barreling. This way you can plan schedule adjustments to avoid delays, rather than scramble at the last minute.

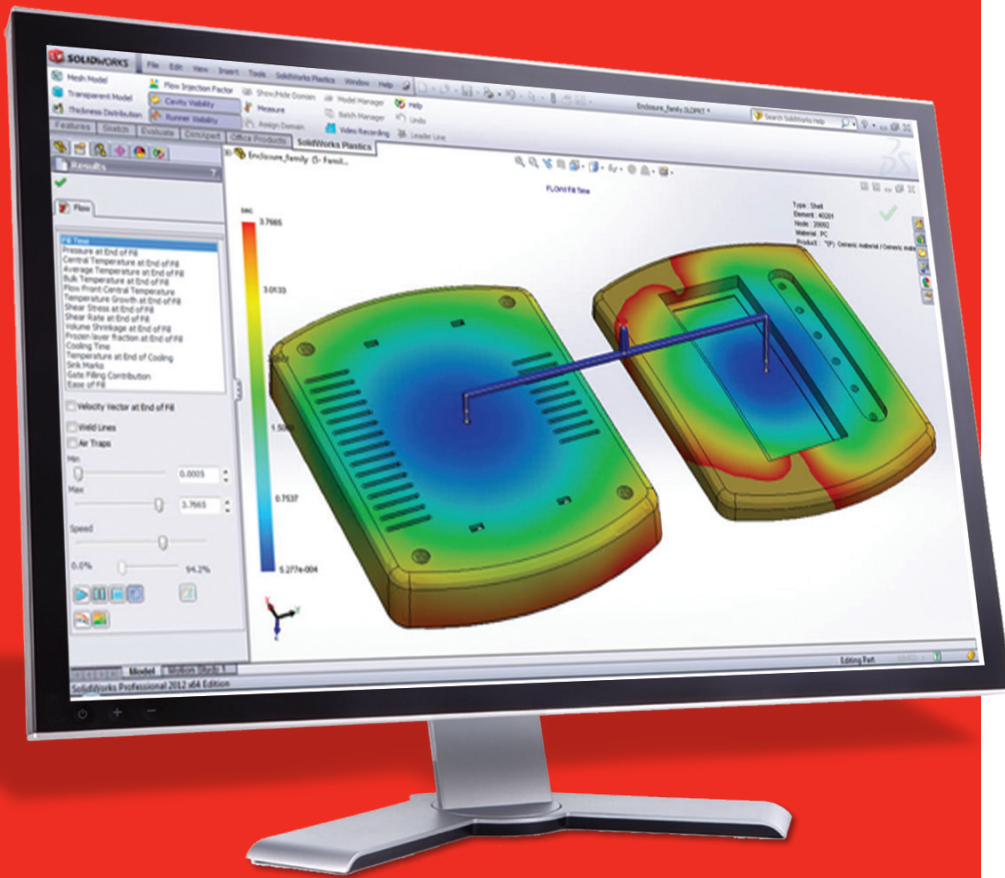
Learn more about SOLIDWORKS DFMXpress and the numerous automated manufacturability checks.

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 incredibly complex, involving molten plastic, variable injection pressures and locations, mold temperatures, and cooling. You need to consider all of these variables to optimize cycle time and produce the maximum number of parts per hour. The balance is critical, as 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, you unnecessarily extend cycle time.

All the variability in injection molding makes it extremely difficult to predict how the part will fill. It is common to have no 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, and 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.

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 prevent potential problems.

Of course you can apply the rules of thumb for good plastic part design, such as ensuring that the 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 cutting any steel. 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 LOST TIME AND COSTLY REWORK OF MOLD TOOLING BY GETTING IT RIGHT THE FIRST TIME WITH SOLIDWORKS PLASTICS

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 you design in 2D, it is especially difficult to catch components that interfere with each other. If you are using 3D, you can find interferences between static components 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. And even if your components fit together, you need to make sure the assembly method you specify doesn't have a negative impact on quality.

SOLIDWORKS solves this with [Interference Check](#) so that you find these problems during design and never get caught by surprise during assembly.

Hole Checking

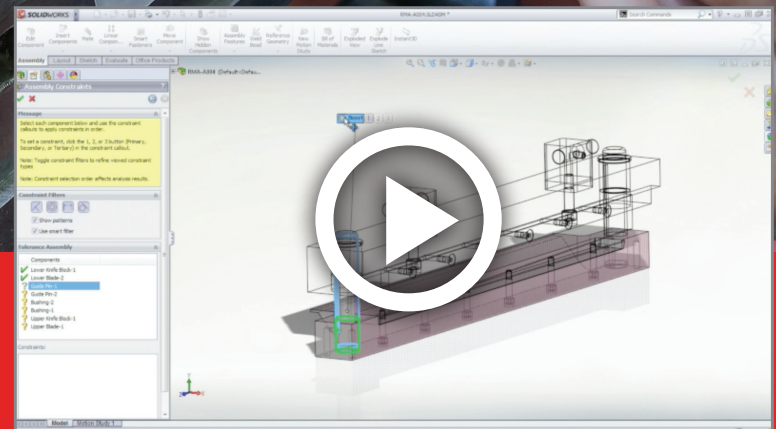
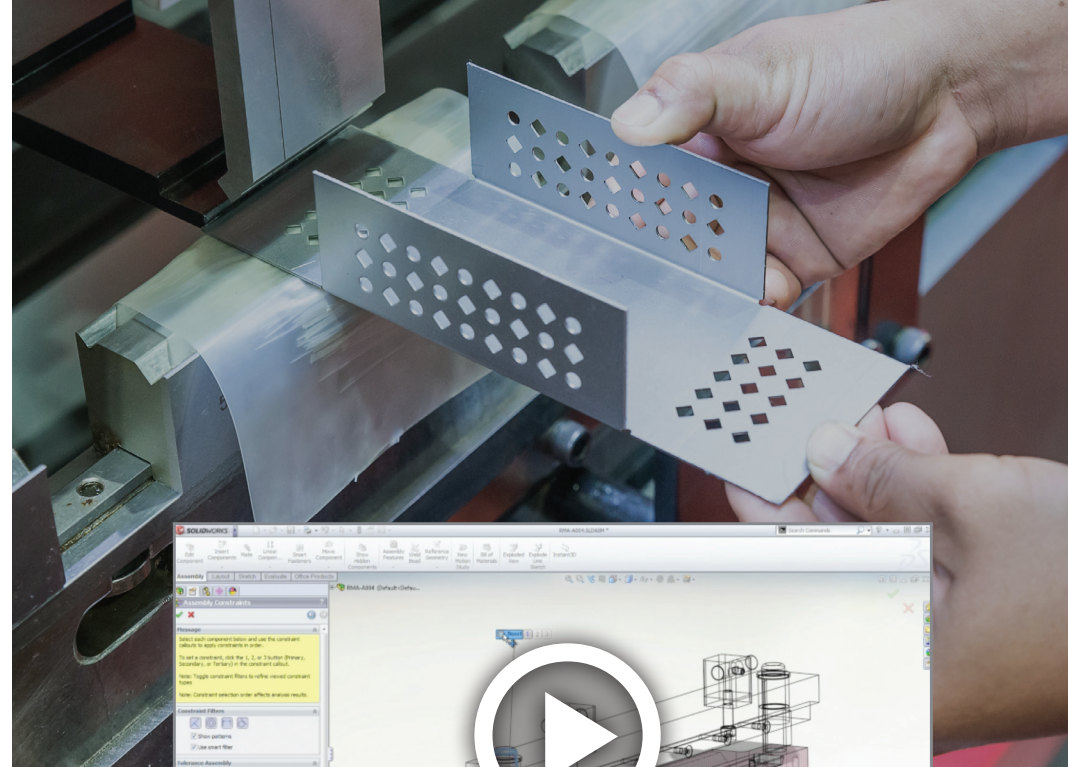
Hole Misalignment and Thread Mismatch functionality checks for holes that do not line up properly. SOLIDWORKS lists all the holes that are misaligned so you can easily find and correct them. Also, the software detects interferences resulting from mismatched or misaligned threads and other interfering 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 must be considered. [Tolerance Analysis](#) does just this by analyzing the impact of maximum and minimum tolerances. When tolerance stackup creates a problem, SOLIDWORKS identifies the root cause by listing all features and tolerances that are contributing to it. Then it 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.



VIDEO: Tolerance Analysis

Simulation

While it is critical that all the components fit together, it is also essential to understand the impact of the assembly method. If a bolt creates a concentrated stress point or if 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 to see 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. And 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 has been altered. Perhaps there was a change in another part, and you need to understand how that will impact your part. Or maybe a supplier made a change, and you need to understand how it would impact the rest of the assembly so you can update other components as needed. If you miss these updates, there may be conflicts that will

create manufacturability problems. SOLIDWORKS Compare Parts and Drawings functionality solves this issue by quickly identifying exactly what changed.

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.

Investigate the many different types of comparisons you can make with SOLIDWORKS [Compare Parts and Drawings](#).





IMPROVE QUALITY BY ENFORCING STANDARDS Automatically check drawings and models with CAD Standards Checking.

Best practices are extremely valuable. Manufacturing is more productive when drawing information is complete and consistent. Design standards and drawing formats ensure this consistency and completeness so manufacturing doesn't have to waste time hunting for information or make assumptions that can lead to quality and manufacturability issues.

Unfortunately, it can be hard to enforce best practices without some level of automation. It can be pretty easy to inadvertently leave information off a drawing, particularly with the constant pressure of tight deadlines. It can also take a while for new engineers to learn a company's drawing standards. However, missing drawing information can cause confusion. Disregarding standards and overlooking drawing details typically leads to an engineering change order (ECO), drawing modifications, and reissues. All the while, work is delayed, wasting time and money.

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. 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. No one needs to waste time looking up standards either. The software will automatically let you know and enforce the standard. Manufacturing saves time, as well, because they receive more consistent and complete documentation.

Check out how easy it is to set up rules and how many types of checks you can have SOLIDWORKS perform using CAD Standards Checking functionality.

**DOWNLOAD
NOW**



Don't miss the next ebook in our
"Integrating Design-to-Manufacturing
With SOLIDWORKS" series.

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 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.

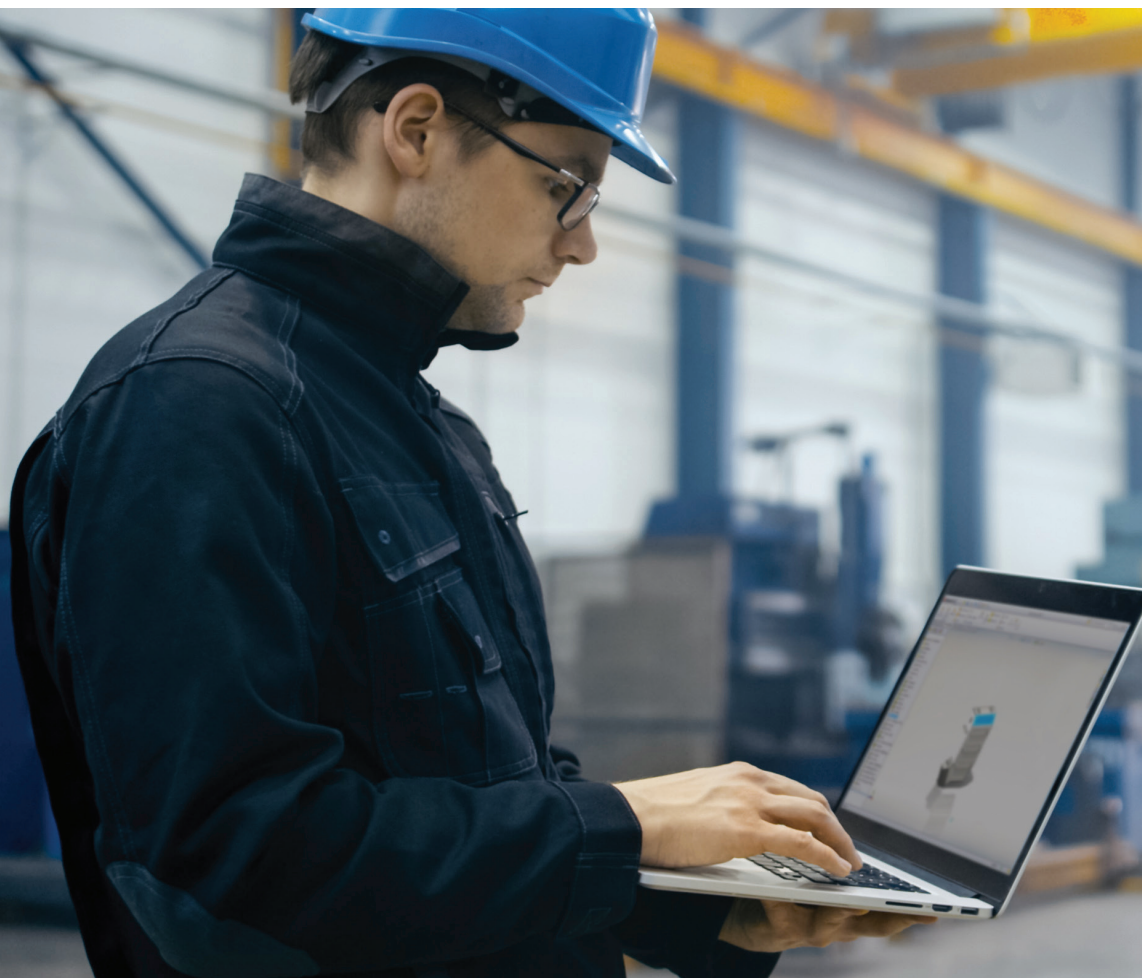
Learn more about how SOLIDWORKS solutions can take you from design to manufacturing by visiting
<https://www.solidworks.com/whatsnew2019>.



**CHAPTER
FOUR**

INTEGRATING DESIGN-TO-MANUFACTURING WITH SOLIDWORKS

ENABLING CONCURRENT ENGINEERING AND MANUFACTURING





CHAPTER FOUR

CHAPTERS 1 TO 3: RECAP

In the first chapter of our ebook series on integrating design and manufacturing with SOLIDWORKS® solutions, we discussed the advantages of adopting an integrated design and manufacturing solution. In the second ebook chapter, we examined the value available with SOLIDWORKS CAD. And in the third, we described how to validate manufacturing to ensure your design is manufacturable.

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. In this fourth chapter of our ebook series, we will focus on the Manufacture, Cost, and Inspect portions of the solution.



In this fourth ebook, you will learn how SOLIDWORKS enables you to provide manufacturing with what's needed to produce your designs.



THE IMPORTANCE OF CONCURRENT ENGINEERING AND MANUFACTURING

Start your work sooner with [SOLIDWORKS manufacturing outputs](#) so you can gain time for innovation and get to market faster.

As we discussed in Chapter 1, the majority of the decisions that impact cost and quality are made during the design phase. Involving manufacturing teams sooner enables them to have more influence over those key decisions that drive up cost during manufacturing and hurt quality. However, with traditional sequential processes where design work is “thrown over the wall,” it is tough for manufacturing to get the needed visibility to share insights early enough to make a difference.

With SOLIDWORKS solutions supporting the complete design-to-manufacturing process, collaboration between engineering and manufacturing becomes much easier. This integrated platform means that design and manufacturing data can be exchanged far more easily, with less risk of errors. Any changes to the design are propagated across the platform, ensuring everyone is working with up-to-date data. All of this gives manufacturing teams visibility into the work that will impact them, enabling them to provide more input. The result: More work is done concurrently, which saves time, improves quality, and lowers cost.

[SOLIDWORKS PDM](#) extends the value even further by managing all of your data and the associated workflow. This way you can better manage your process and never risk working with outdated information.



BOOST PROFITABILITY WITH BETTER INSIGHT INTO COST DRIVERS

Automate manufacturing cost estimation, check your designs against cost targets, and develop more-accurate quotes with SOLIDWORKS Costing.

Many opportunities arise to lower your cost across design and manufacturing. The challenge is identifying the cost drivers so you can make better decisions to remove cost. With SOLIDWORKS as your guide, you can identify precisely which areas of your design add the most cost, so that you can make design improvements and hit your cost targets.

Manufacturability problems are one of the biggest sources of added cost. In Chapter 3, we discussed several of the SOLIDWORKS tools that help you identify issues that will impact manufacturability. SOLIDWORKS has the tools to check for proper draft, undercuts, [interference](#), [tolerance stackup](#), and [Design for Manufacturability \(DFM\)](#). There are also tools for [simulating and analyzing the injection molding process](#). This combination gives you everything you need to get the design right before it goes to manufacturing. By catching these problems during design, you avoid the expensive late-stage problems discussed in Chapter 1.

While eliminating manufacturability problems removes a huge source of product cost, more can be done to optimize a design for cost. As we saw in Chapter 1, engineers are making the most out of the critical decisions that will determine the cost of a product. However, products are so complex, identifying the source of cost drivers can be very difficult. As we discussed in Chapter 3, engineers typically have far less exposure to production environments, which makes it hard to know what drives cost on the shop floor. Plus, engineers tend not to have the training or access to the resources to properly assess the cost impact of a design decision. Consequently, while they have the most influence on cost, engineers are making most of those decisions blindly.



VIDEO: SOLIDWORKS Costing

With [SOLIDWORKS Costing](#), you have a perfect solution. With a click of a button, designers, engineers, and manufacturers get cost estimates in just seconds. SOLIDWORKS Costing uses customizable inputs reflecting actual labor costs, equipment costs, and material costs. It can account for speeds, feeds, and set-up costs, as well as secondary operations such as deburring, painting, and anodizing. After you define your cost target, SOLIDWORKS Costing will guide your design decisions so your products stay on target.

SOLIDWORKS Costing also helps with quoting. You can respond to your customers more quickly and with a more accurate price. Because SOLIDWORKS quickly helps you determine what it will cost to produce the part, you can confidently respond with a competitive bid that will not hurt your margins. When you are sourcing parts, you will also know if your supplier's quote is overpriced. Armed with this information, you can reduce the length of the RFQ (request for quote) phase because you know when you have been quoted a fair price.

OVERCOME MANUFACTURING KNOWLEDGE GAPS

Drive quality and consistency with the embedded intelligence of SOLIDWORKS CAM.

As we discussed in Chapter 3, engineers have far less opportunity to spend time in a manufacturing environment and tap into that expertise. As a result, it has become much harder to develop a foundation of manufacturing knowledge inside of the engineering department.

**Now, some executives find themselves saying,
“I wish my people knew how to design products
that can be manufactured.”**

While this is a challenge for engineering, it is a problem for manufacturing too. In some cases, companies want to increase the amount of production they do themselves. This can occur in situations where they can't get the needed quality or surface finish when they outsource. Lower energy prices have also brought down the cost of local manufacturing. Also, there is a surplus of used production equipment left over from companies that either didn't survive the recent recession or no longer need it. Consequently, buying production equipment can be very economical. However, it is the cost of developing lost manufacturing knowledge that is the biggest challenge. As manufacturing jobs moved overseas or were lost as a result of the recession or retirements, companies lost a source of highly skilled manufacturing knowledge.

But with [SOLIDWORKS CAM](#), companies can tap into that knowledge resource once again. [SOLIDWORKS CAM](#) powered by CAMWorks™ is a fully integrated, rules-based technology that allows you to bring together design and manufacturing processes in one application. It recognizes a hole with a certain tolerance and knows which production routine to attach to it. You avoid the tedious process of manually defining all those parameters individually. [SOLIDWORKS](#) just takes care of it. This saves time and ensures greater consistency.

Previously there could be many undocumented best practices on the shop floor that people “just knew.” Unfortunately, if those people are no longer available, that knowledge can be lost forever, which can be devastating for a company. With [SOLIDWORKS CAM](#), that knowledge can be captured and reused. What's especially powerful is that manufacturing knowledge can be applied as standards to answer questions such as these:

- Which toolpath is best for a specific tolerance?
- Which tool would be best for this geometry?
- How deep should the tool go on the first pass?
- What finishing operations are best for this surface finish?
- Should it be milled or drilled?

Even better, as standards evolve, they can be easily updated as needed. The CAM system “learns” how individuals prefer to program toolpaths.

What's exciting is that because all this rich knowledge is embedded directly in the CAD model, you can start evaluating the design for manufacturing much sooner. This means you can catch potential problems earlier and make improvements that will lower production cost and improve quality. Then, as the design evolves and changes, your toolpaths update with it!

Learn more about all of the powerful features of [SOLIDWORKS CAM](#).

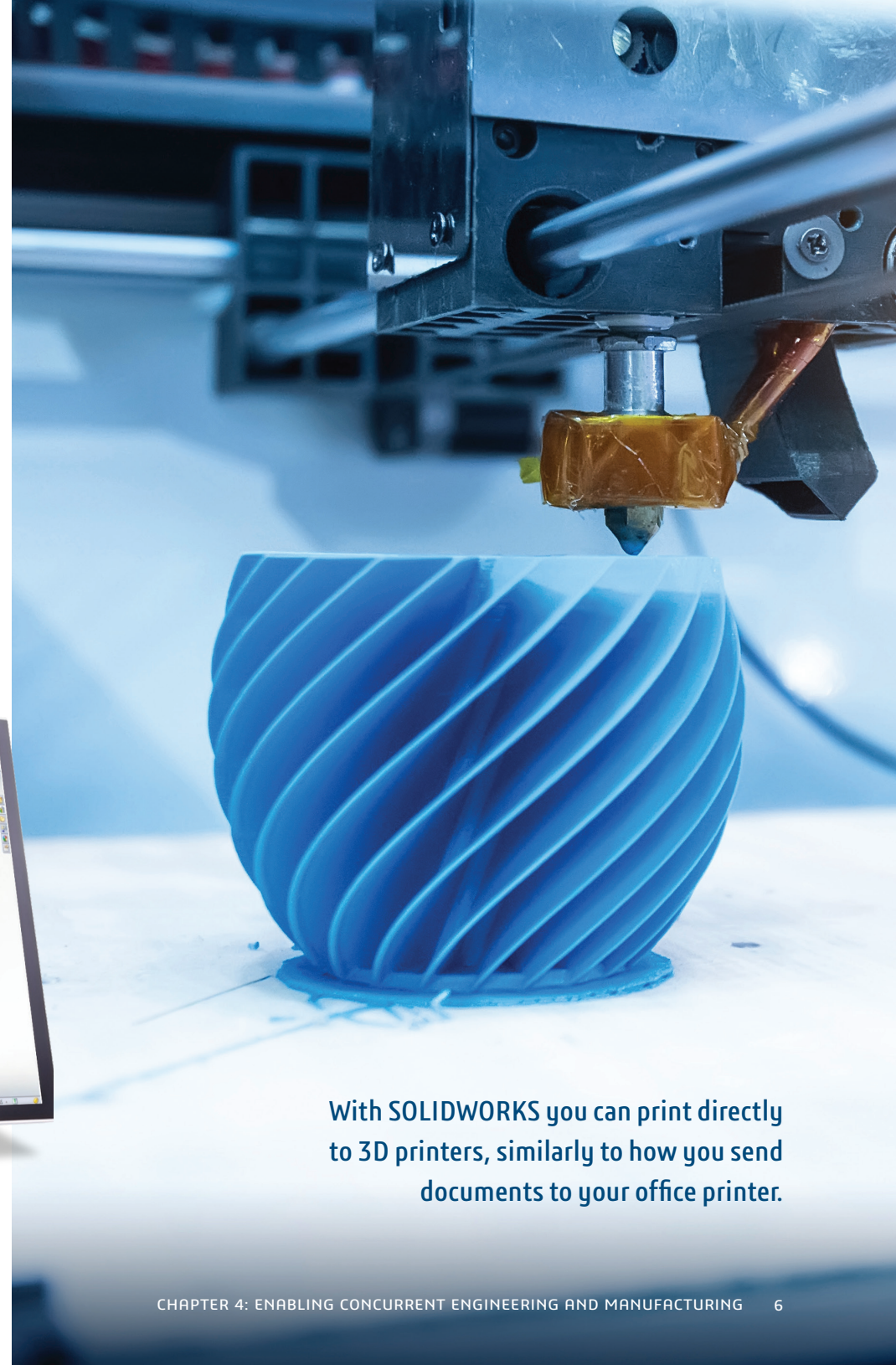
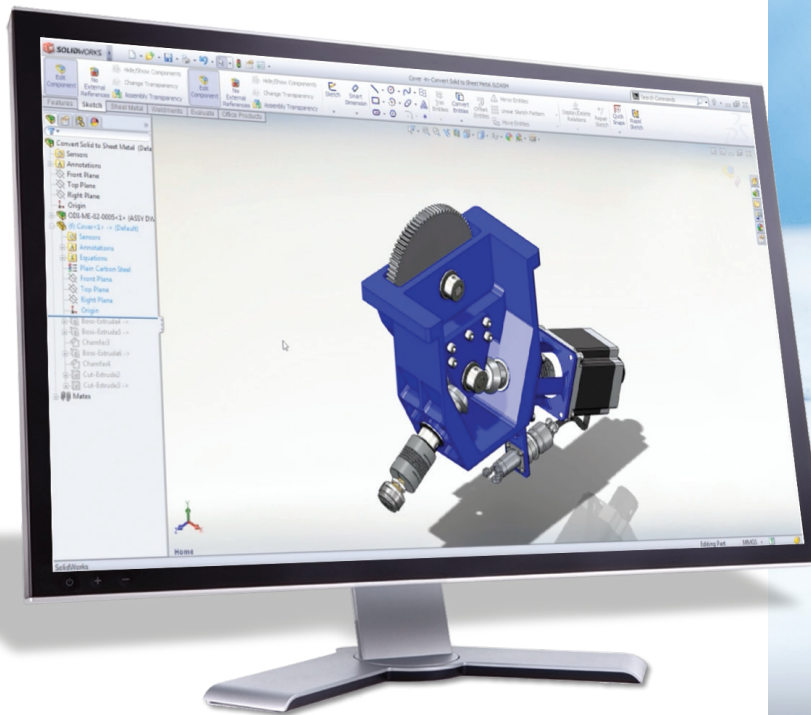


TAKE ADVANTAGE OF 3D PRINTING

Send models directly to a 3D printer with SOLIDWORKS Print to 3D.

Additive manufacturing, or 3D printing, offers several advantages for manufacturers to consider. Because tooling isn't required, it can significantly reduce the lead-time for a working prototype. It also allows you to produce geometry that cannot be machined with traditional manufacturing. For example, strong but lightweight shapes such as lattice structures are now possible with 3D printing.

SOLIDWORKS supports 3D printing by allowing you to send your design model directly to a 3D printer, similarly to how you send documents to your office printer. While SOLIDWORKS can output STL, a widely accepted format for 3D printing, it also supports 3MF and AMF formats. These formats provide more information about the model. As a result, you do not need to spend time defining things such as the position of your model relative to the selected 3D printer, orientation, color, materials, and so on.



With SOLIDWORKS you can print directly to 3D printers, similarly to how you send documents to your office printer.



Remove tedious manual work and reduce the risk of errors by automating your creation of inspection reports with **SOLIDWORKS Inspection**.



VIDEO: SOLIDWORKS Inspection

AUTOMATE THE CREATION OF INSPECTION DOCUMENTATION, SAVING 90 PERCENT OF TIME REQUIRED

Create ballooned inspection drawings and inspection sheets for first article inspection (FAI) and in-process inspections using [SOLIDWORKS Inspection](#).

Many industries must adhere to strict safety regulations that require industry standard reports, including inspection documents such as AS91003 or PPAP forms. To comply with these regulations and requirements, product designers or engineers must inspect their parts. To do so, they must create first article inspections (FAI), inspection reports, and ballooned drawings. This process has traditionally been manual, time-consuming, and error-prone.

[SOLIDWORKS Inspection](#) accelerates this process by automating the creation of these inspection documents. In fact, it reduces the time to create inspection documentation by up to 90 percent.

It extracts part numbers, notes, and other critical information directly from the drawing. It also pulls inspection and reference dimensions. This eliminates the need to manually copy required details into the inspection documentation, saving time and removing a source of errors.

It also makes recording and analyzing the inspection results easier because dimensions can be color-coded for comparison. In addition, it imports results from a coordinate measuring machine (CMM) or digital caliper, eliminating another tedious process.

Resulting reports can be exported to Excel spreadsheets using either standard templates or customized templates created with the Template Editor. These templates support compliance with company or industry standards.

Learn more about [SOLIDWORKS Inspection](#) and how it can save you time.

AVOID COMMON PROBLEMS IN PLASTIC PARTS

Improve quality and eliminate costly mold rework using SOLIDWORKS Plastic and Cast Part Design and Mold Design tools.

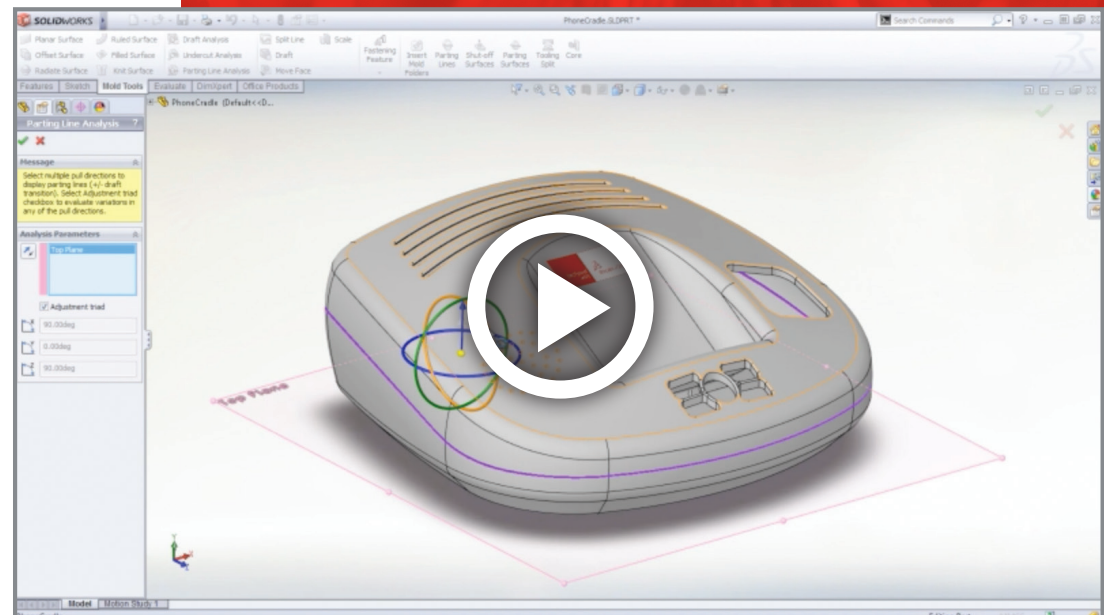
Designing and producing plastic parts is an exceptionally complex process. You have to design the part, design the mold for that part, order the mold base, and send the mold design to be manufactured. When all of that is done, you can finally start producing parts. Even then, problems are often found during the mold trial and even more time is needed to find solutions.

The numerous steps create extremely long lead-times. If the supply chain uses different CAD systems, additional complications arise because with each handoff, CAD data has to be imported, cleaned up, and repaired. This makes handoffs especially tedious and time-consuming. Unfortunately, if you order the mold too far in advance to compensate for long lead-times, the mold designer will need to deal with the numerous changes the part will likely go through. With each change, you have to go through that painful process of importing, cleaning, and repairing CAD data. The alternative is waiting even longer for the mold, but that isn't a good option either, as it just adds to time-to-market.

SOLIDWORKS mold design capabilities take care of this. With this solution, you can design both the mold and the part on the same platform. Because SOLIDWORKS is associative, as the part changes, the model design and all associated references update, including the NC toolpaths to machine the mold. By taking out that painful process of cleaning imported data, you can start the mold design sooner, and produce parts that much faster. In addition to plastic, the software can be used for cast, stamped, formed, and forged designs. Mold designers working with customers who design their parts in something other than SOLIDWORKS can still benefit. [SOLIDWORKS 3D Interconnect](#) will maintain the link to native multi-CAD data so part changes will update in the mold.

“SOLIDWORKS has allowed us to reduce design cycle times significantly, which saves time and money, while simultaneously improving quality.”

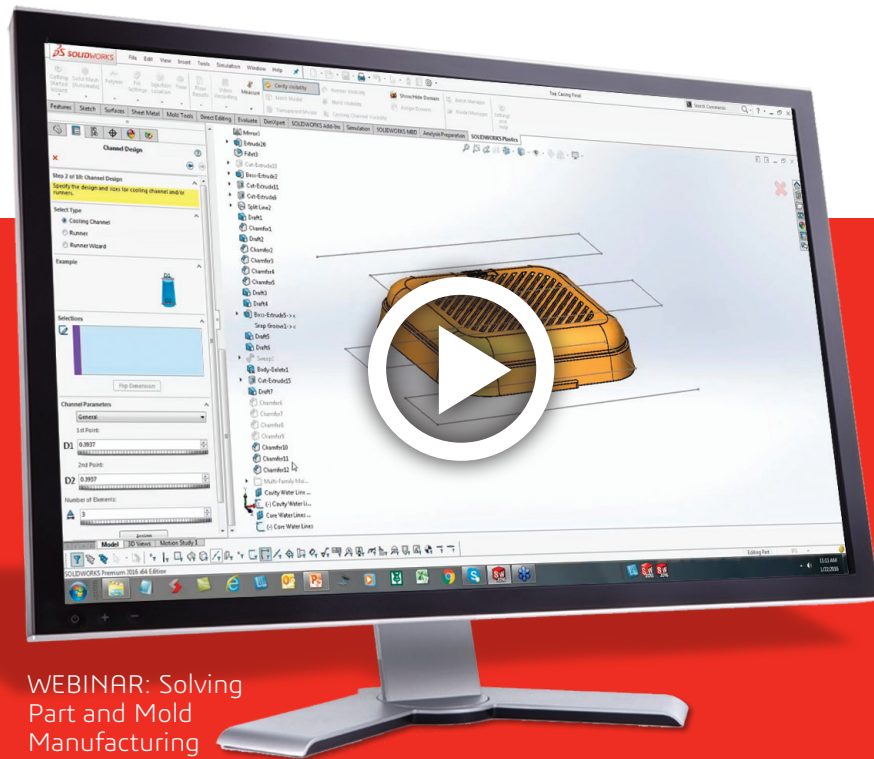
— Mike Derus, Lead Engineer,
THE OUTDOOR GROUP LLC



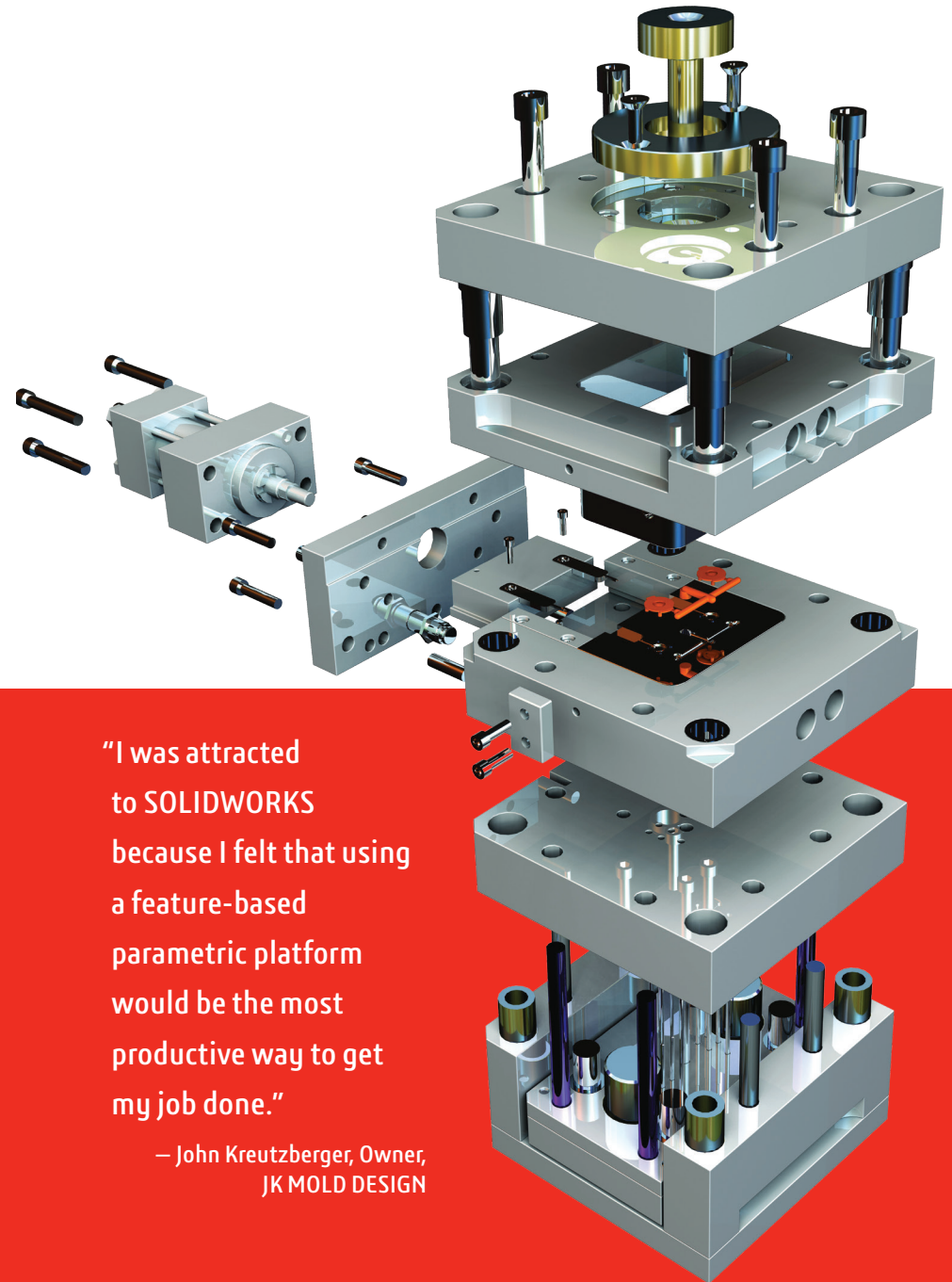
VIDEO: Plastic Part Design

Designing plastic parts is not straightforward. Unless you are extremely knowledgeable about plastics, what comes out of the mold may not necessarily be what you designed. If your design lacks proper draft angles, or undercuts are not sized properly, the part will not eject from the mold. Shrinkage must be accounted for as well. It is hard to predict exactly what will happen without years and years of experience working with plastics. SOLIDWORKS [Plastic and Cast Part Design](#) solves this problem by doing the analysis for you and letting you know where your potential problem areas are in your design. It can check draft angles, analyze undercuts, assess part thickness, and empower you to avoid other common problems with plastic parts. It can even guide you to adjust your design to locate the parting line in an optimal, less conspicuous area.

Discover the numerous advantages of SOLIDWORKS [Plastic and Cast Part Design](#) and [Mold Design](#). The power of these combined solutions will help you reduce the lead-time of your plastic parts and improve their quality.



WEBINAR: Solving Part and Mold Manufacturing Design Issues



“I was attracted to SOLIDWORKS because I felt that using a feature-based parametric platform would be the most productive way to get my job done.”

— John Kreutzberger, Owner, JK MOLD DESIGN

ENSURE THE MANUFACTURABILITY OF SHEET METAL PARTS

Design for manufacturing with SOLIDWORKS sheet metal capabilities.

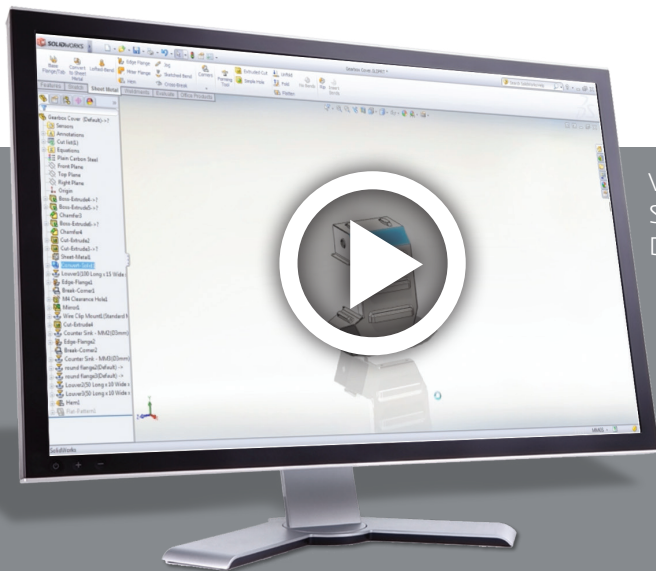
Like plastic, sheet metal parts are also very common in many products, especially for enclosures, covers, and guards. As such, sheet metal design should be a part of an integrated design and manufacturing platform. The solution should help you minimize scrap so you can manage costs. It should also ensure manufacturing can produce the sheet metal part as designed so you avoid quality issues.

With SOLIDWORKS sheet metal design capabilities, you can easily convert a part to sheet metal. SOLIDWORKS will then automatically flatten it and generate flat patterns with bend allowance for manufacturing. This provides an excellent check for manufacturability.

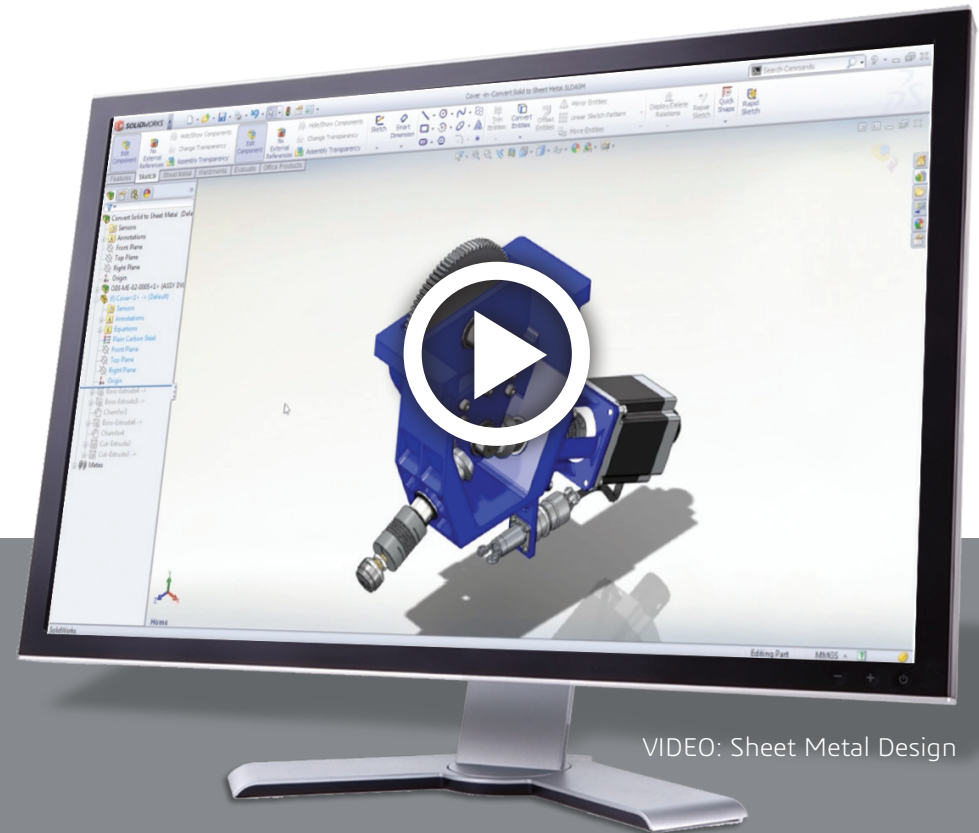
Because the design and manufacturing information is integrated, manufacturability problems can be corrected in the design, so the manufacturing information will automatically update.

In addition, if you need to make a change to the components enclosed by the sheet metal part, you can easily see the impact on the enclosure and update it as needed. The change will automatically propagate to all impacted punch, hole, bend, and weld tables, avoiding any errors due to outdated information.

Explore the numerous features SOLIDWORKS offers that simplify the process of [designing sheet metal parts](#) and providing manufacturing with everything needed to produce cost-effective, high-quality parts.



VIDEO:
Sheet Metal
Documentation



VIDEO: Sheet Metal Design



ACCELERATE THE DESIGN AND MANUFACTURE OF WELDMENTS

Save design time and automate the creation of manufacturing information with SOLIDWORKS Weldments.

When designing weldment structures, frames, and bases, you need the design process to be as efficient as possible. You also need to make sure the information handed off to manufacturing is accurate, so that you can manage costs, avoid duplication of efforts, and order the right stock.

SOLIDWORKS allows you to streamline the design and manufacture of [welded structures](#).

With libraries of predefined structural shapes, you can quickly design your frames in less time. SOLIDWORKS then automatically generates the cut lists, bills of materials (BOMs), and other documentation needed for manufacturing.

Not only does this save time, but since the design model drives the manufacturing information, you can ensure its accuracy. This means you avoid expensive errors and scrap. As with all of SOLIDWORKS functionality, any change to the design model automatically updates the manufacturing information—so you never have to worry about outdated information. With [SOLIDWORKS Costing](#) you can also automatically estimate welded structure manufacturing cost and create automatic quotes, helping you boost profitability.

Discover the many features available with SOLIDWORKS Weldments functionality that will streamline your process.



VIDEO: Weldments

PREVENT ERRORS AND SAVE TIME WITH AUTOMATION FOR PIPING AND TUBING DESIGN

Auto-route piping and automatically generate manufacturing output using SOLIDWORKS piping and tubing design.

Designing piping and tubing routes can be extremely complex, which makes it very easy to make mistakes. Getting accurate information to manufacturing can be even harder. With complex systems, mistakes can be very costly. Problems such as incorrectly sized fittings, short pipes, and inadequate piping clearance can completely blow the project budget and making changes can add further complications. Identifying all the impacts and ensuring all documents are up-to-date can be extremely painful. Even missing one update can mean very expensive delays at the job site.

SOLIDWORKS piping and tubing design simplifies the design process. A library of piping and tubing components makes design placement quick and easy. Auto-routing functionality creates and updates the piping path, so changes are painless. To get accurate information to manufacturing, SOLIDWORKS automatically generates the bill of materials (BOM), cut lists, bend tables, and other manufacturing documentation all based on the design model. Then any changes to the design model will automatically update in the manufacturing deliverables.

Learn more about how SOLIDWORKS piping and tubing design can save you time, minimize errors, and lower costs.

By integrating piping and tubing during the design process, designers can help ensure efficient assembly, operation, and serviceability to avoid rework, delays, and extra cost.

VIDEO: Design Complex Piping and Tubing Systems



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Don't miss the next ebook in our
"Integrating Design-to-Manufacturing
With SOLIDWORKS" series.

CHAPTER 5

SHOP-FLOOR AND CUSTOMER-FACING CONTENT, READY ON TIME

Download the next ebook chapter, which will cover everything you need to support the complete product lifecycle.

The next ebook will cover these topics:

- Create demand for your products before they ship.
- Leave a lasting impression during sales meetings.
- Give your customers a great experience and win their loyalty with impressive support resources.

Learn more about how SOLIDWORKS solutions can take you from design to manufacturing by visiting

<https://www.solidworks.com/whatsnew2019>.



INTEGRATING DESIGN-TO-MANUFACTURING WITH SOLIDWORKS

SHOP-FLOOR AND CUSTOMER-FACING CONTENT, READY ON TIME





CHAPTER FIVE

CHAPTERS 1 TO 4: RECAP

In the first chapter of our ebook series on integrating design and manufacturing with SOLIDWORKS® solutions, we discussed how adopting an integrated design and manufacturing solution can represent one of your best opportunities to lower cost and improve quality. In the second chapter, we described how SOLIDWORKS CAD helps you develop exceptional products. In the third, we described how to validate manufacturing, and the fourth explained all of the advantages SOLIDWORKS offers to help you produce your product as designed.

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. In this fifth chapter of our series, we will focus on the Visualize, Communicate, and Compose portions of the solution.

With SOLIDWORKS, you have a complete solution to produce content for the shop floor, customers, and other audiences. SOLIDWORKS associativity allows you to begin this content earlier, as it will stay in sync with design changes. As a result, your content will be completed much sooner than would ever be possible with traditional methods.



In this chapter, we will discuss how SOLIDWORKS solutions can help speed and improve the creation of content to support the assembly, use, servicing, sale, and advertising of your products.



SELLING YOUR IDEA TO CUSTOMERS AND INTERNAL MANAGEMENT

Get faster buy-in of your concept with SOLIDWORKS Industrial Designer and SOLIDWORKS Sell.

Nothing sells an idea like a stunning image that grabs your attention. However, it can be hard to sell your ideas before a design even exists. Ideally, you want to evaluate as many ideas as possible, focus your energies on ideas that get customers excited, and weed out the ones that don't resonate. This way you invest in the ideas that have the best chance of success.

Also, the more feedback you get during early design stages, the more likely your product will align with customer needs. You also need to sell those ideas to internal management so that you get the right amount of funding. The challenge is getting this feedback without too much investment.

[SOLIDWORKS Industrial Designer](#) (SWID) helps solve your geometry creation problems by allowing you to get from idea to 3D concept model faster, especially when dealing with organic or freeform shapes. Specialized tools are provided for the rapid creation, manipulation, modification, and rendering of both native and imported geometry.

[SOLIDWORKS Sell](#) is a web-based tool that allows you to swiftly configure products dynamically in 3D online. Quickly switch out components in an assembly or simply change colors and textures at the click of a button. It lets anyone from internal team members, to managers, to customers quickly reconfigure and try out different variations of your design without the need to be an expert. Just select option and click. In addition, SOLIDWORKS Sell provides capabilities such as augmented reality (AR), 3D printing, and digital catalogs to help transform your customers' online retail experiences.

CONNECT WITH YOUR CUSTOMERS

Leverage your SOLIDWORKS 3D models to create on-time, detailed, and exciting content to sell and support your products.

Whether presenting your ideas or products to internal company management or your customer, you'll want to make the best impression possible. If you are looking for initial approval for your concept, or creating final sales, marketing, and customer service content, SOLIDWORKS provides tools to quickly and easily create the exciting content you need. This includes artistic renderings, photo-quality images and animations, content for user manuals and assembly instructions, augmented-reality (AR) capabilities, as well as options for interactive and immersive 3D experiences. With SOLIDWORKS, you can start creating demand for your product, before it even exists.



CREATE DEMAND FOR YOUR PRODUCTS BEFORE THEY SHIP

Create photorealistic images, animations, and immersive web content before a physical product exists with SOLIDWORKS.

Even the most amazing product can still fail without effective marketing. Good marketing lets customers know about your product and creates demand. In today's age of social media, you have more channels than ever to reach your target audience, but it takes time to produce content for each channel. Customers are also bombarded with content, so your product must stand out. A picture is worth a thousand words and nothing showcases your product better than cool imagery and videos.

While an integrated design and manufacturing platform with SOLIDWORKS accelerates the engineering, prototyping, and production phases, marketing can pose some unique challenges. For marketing, you still have to wait until you have a physical product before you can start taking photographs and creating collateral. Any extra time needed for marketing delays the product launch, and your company has to wait even longer to recoup development costs. Plus today's markets have become so competitive, the window of maximum revenue potential is shrinking. You have less and less time before competing products become available. Anything you can do to get a jump on marketing can give you a significant competitive advantage.



VIDEO: SOLIDWORKS Visualize

[SOLIDWORKS Visualize](#) uses your CAD model to create photorealistic images, animations, and immersive web content so you can start working on your marketing content sooner. By starting early, you can take more time for feedback and get your content just right. You can adjust lighting, real-world scenes, and the environment to elicit the right emotional connection with your customers. The imagery is so high quality, it can be used for both print and online. The results are so realistic, you cannot tell the difference between the image from SOLIDWORKS Visualize and an actual photograph.

Worried about model changes? No problem—just update the image. No need to reschedule another expensive photo shoot! You can then start creating ads, web content, and animations to get your customers excited, even before the product ships!

eDrawings is an extremely powerful collaboration tool that clearly communicates 3D design information internally and externally. What makes it especially valuable is that you can view CAD models without a CAD tool.



LEAVE A LASTING IMPRESSION DURING SALES MEETINGS

Wow prospects with augmented reality from your mobile device using [eDrawings](#).

Powerful marketing will attract customers, but an impressive sales presentation closes the deal. Leaving customers with a memorable experience will help you win the business. If you can find a way to showcase your product in an impressive way that wows them, you will be well on your way.

Using AR, you can accomplish just this. You can point the camera of your tablet or phone at a marker and your screen will show the 3D model of your product, at scale, sitting on the table in the room with you! With such a captivating display, your customer gets a real-world view of what to expect and can start envisioning your product in their environment. The nice thing is, you can do this at any stage in the development cycle, even as early as the concept stage. This way you can start to get very early feedback from your customers. Even if the product is available, this is an exciting way to demonstrate your product without lugging parts around. Plus, you don't have to worry about making sure you have the right configuration with you. You'll have virtual models of the entire product line at your fingertips!



VIDEO: SOLIDWORKS eDrawings

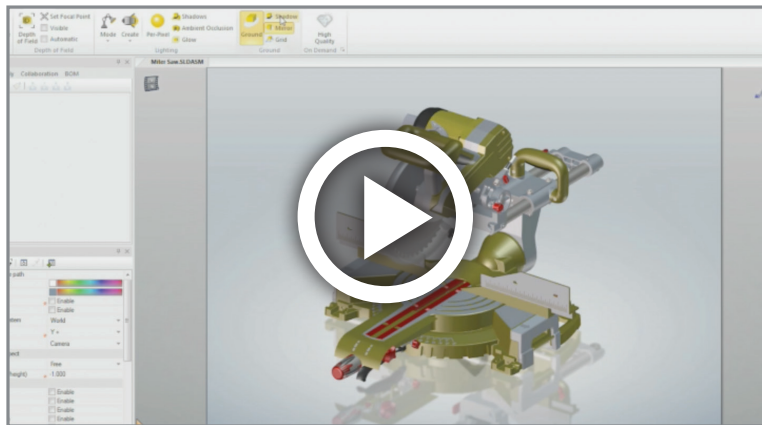
GIVE YOUR CUSTOMERS A GREAT EXPERIENCE AND WIN THEIR LOYALTY WITH IMPRESSIVE SUPPORT RESOURCES

Create interactive content for service manuals, user guides, online interactive catalogs, and other support resources using [SOLIDWORKS Composer](#).

The best way to ensure customers become repeat customers is to provide them with an outstanding experience. If a customer struggles to assemble, use, or fix your product, or can't order needed spare parts, he or she will become frustrated. Even if your product is exceptional, lack of support will undermine your hard work and leave customers disappointed.

Complicating the situation, documentation is often created at the end of the design process and is the last step before a product is released. Since it stands in the way of getting the product to market and collecting revenue, the documentation process must be as efficient as possible. This can lead to rushed documentation that is unclear or inaccurate, which reflects poorly on the product.

Fortunately, SOLIDWORKS solves this with [SOLIDWORKS Composer](#)™. SOLIDWORKS Composer empowers you to create illustrations for your technical publications from your 3D CAD data, as you design. You can create high-quality illustrations,



VIDEO: SOLIDWORKS Composer



VIDEO:
The Fundamentals of
Creating Great Technical
Communication

photorealistic images, and even interactive animations without waiting for a physical prototype. Then, because it is associative, the documentation updates with changes to the CAD model. This ensures the documentation never gets out-of-date, greatly reducing the risk of errors and removing a huge source of frustration for customers. Also, since the documentation uses CAD data, all of the valuable information embedded in the model, such as part numbers, can be referenced directly in the documentation without manually reentering it, saving time and avoiding another source of errors. Even nontechnical users will find it easy to use. One of the biggest benefits is that because you can work on technical communications in parallel with development work, you no longer have to wait for completed documentation before you can ship the product.

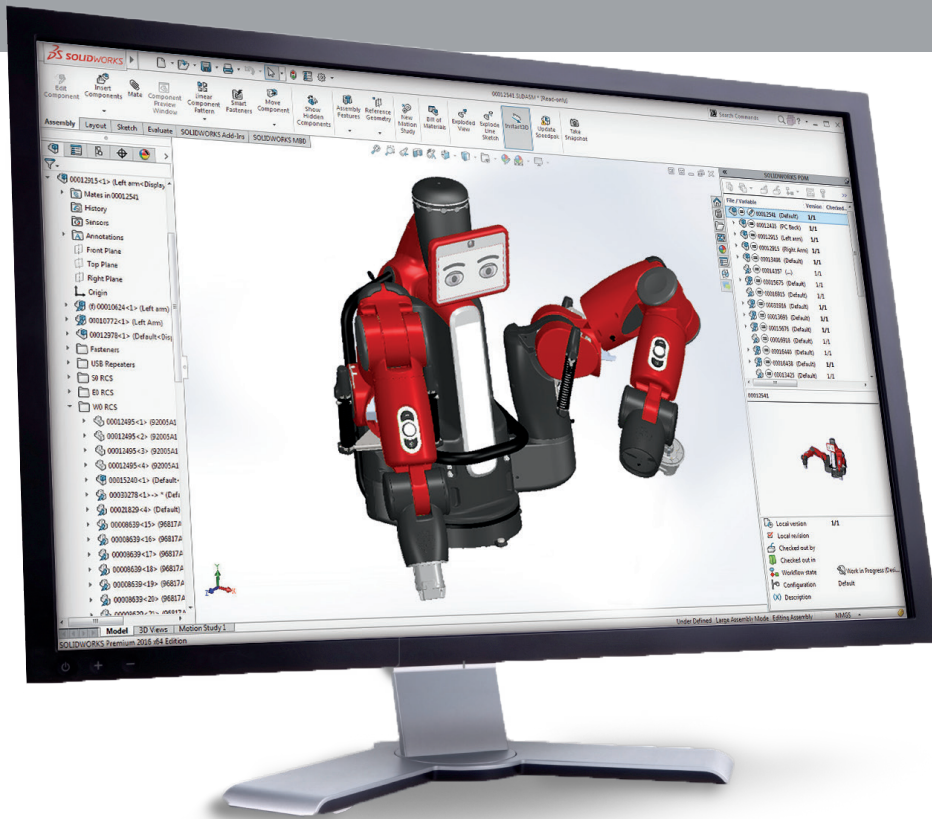
Clear documentation and localization is always a challenge. This is where 2D and 3D images and animations become especially powerful. A picture can often communicate more clearly what a whole page of text cannot, and it doesn't even need to be localized. This cuts down on translation costs and helps you to support more customers around the globe. Assembly, disassembly, and service instructions suddenly become far easier to follow. The interactive content means it is easy for customers to determine exactly which part number they need to order. You can even publish an online interactive parts catalog, giving customers a unique experience. This empowers them to get what they need while you avoid additional support costs.

Learn more about the many powerful functions in [SOLIDWORKS Composer](#), the numerous formats it supports, and the different use cases it can help with.

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Learn more about how SOLIDWORKS solutions can take you from design to manufacturing by visiting <https://www.solidworks.com/whatsnew2019>.



CATCH PROBLEMS EARLIER, GET TO MARKET SOONER

By using an integrated design and manufacturing platform, you will be able to catch problems sooner in the process, avoiding cost increases and lowered quality. Keeping the CAD data at the center of your design process allows you to create shop-floor and customer-facing content earlier and keep it in sync with design changes. With SOLIDWORKS, you have 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. The power of this platform enables you to design and produce innovative, high-quality, cost-effective products.