SOLIDWORKS

ELEVATING DESIGN FOR MANUFACTURABILITY

To the next level of productivity

goengineer

DASSAULT SYSTEMES

ELEVATING DESIGN FOR MANUFACTURABILITY TO THE NEXT LEVEL OF PRODUCTIVITY

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Small to midsize manufacturers face seemingly countless challenges. When demand for products is high, supply chain disruptions may slow the delivery of critical materials and components, derailing delivery dates. Constantly changing regulations and worker safety requirements may force manufacturers to make last-minute adjustments that are difficult to manage with limited resources, potentially bloating costs.

An infrastructure of disconnected design and manufacturing systems that does not provide insights into the performance of day-to-day operations, which is critical to business planning and success, inhibits a manufacturer's ability to overcome challenges. Separate systems add unnecessary friction to the design and manufacturing process, often leading to errors, rework, and needless delays.

Transitioning to the cloud will be critical for manufacturing companies, especially small and midsize organizations competing with larger counterparts. Even though most companies developing products today have adopted parametric 3D CAD tools and have significantly improved the design process, more is required to beat the competition.

This white paper will show that product design does not occur in a vacuum and how it significantly influences manufacturing. In fact, 3D design carries even greater potential for streamlining production processes, especially when you couple the power of a cloud-based platform with the advantage of design for manufacturability (DFM) tools.

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DESIGN AND MANUFACTURING GO HAND IN HAND

Winning in today's global marketplace requires more than innovative and creative product designs. To succeed, manufacturers must also beat the competition to market while controlling development costs and maintaining high levels of quality. Efficient and consistent processes must be maintained throughout the product development cycle to accomplish these objectives. If you create fantastic product designs but experience difficulties in manufacturing, you cannot effectively meet customer requirements or demands, and clients may look elsewhere for future orders.

Today several design tools allow engineers to conduct routine checks to assess proper manufacturability. These functions make it easy for a designer to be closer to a "ready-to-make" product before the product is released into a production schedule. This process expedites the design, although it puts the entire burden of solving manufacturability issues on the designer or engineer.

Cloud-based platforms allow everyone on the product development team, regardless of department or physical location, to easily share their expertise and provide feedback at critical junctures in the product development process. What's more, the built-in traceability on the cloud ensures that the manufacturing process flows as smoothly as possible. With the addition of cloud-based platforms, the next evolution of DFM is taking place as engineers, programmers, operators, and production personnel communicate and provide feedback to each other in real time at any point in the product development process.

Design is an important piece of the manufacturing puzzle because it can truly make your manufacturing processes run like clockwork. Connect everything from design through manufacturing to a cloud-based platform, and in addition to helping you shorten design cycles, the DFM tools and associated cloud applications can help you proactively address production pitfalls by automating and streamlining manufacturing. Whether you are machining parts, building molds, fabricating sheet metal, forging or casting metal components, or assembling pieces and subassemblies, you can trim product development time, cut costs, and improve quality with integrated, cloud-based tools.

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DESIGN FOR MACHINING

The use of CAM software was a quantum leap in machining productivity. Still, no matter what process you utilize, be it milling, drilling, punching, laser/waterjet cutting, multi-access machining, or wire EDM, the critical requirements start with accurate, clean 3D design geometry. DFM tools become a bridge between the worlds of design and manufacturing that allow you to reap additional advances in product development efficiencies.

When CAM software was first introduced, it was typically used as a method to program parts offline to prepare for the next job needed on a machine. Like CAD, however, CAM solutions have become a very powerful addition to the product development process. The resulting data generated from the CAM system provides additional insights that can lead to identifying gaps in operational efficiencies.

Companies today are buying more complex, multi-tasking machines and adding automation through robotics. These solutions require expert skills in programming and CAD. The collaboration required that is enabled by cloud-based platforms is key to ensuring equipment isn't sitting idle and costing a company production time.

Because engineers often need to make revisions and changes to components, today's machining solutions need to be programmable and able to receive updates within a virtual twin, which lets you visualize, model, and simulate the entire environment. These virtual representations of real-world components need to include the CNC machine, the machine parts, and all the extra accessories that must be scheduled. Virtual representations also need to include any automation components, such as industrial robots.

On top of this, these solutions must match the production schedule and the availability of the necessary components and resources to ensure all the requirements are on hand at the right time. This process sounds complex, because today's manufacturing process is more like Iron Man Tony Stark (the latest and greatest technologies) than the Flintstones (old school methods).

When you integrate your CAD, CAM, and robotics solutions into a single cloud-based platform, all your data and revisions flow together, and everyone has access to the information they need at the right time. No translation or zip files are needed. This unified space for all your data removes the extra steps often found in a traditional process. The goal is always to eliminate potential downtime, unanticipated costs, increased scrap/rework, and other unwelcomed surprises in the product development process.

... A CASE IN POINT

RoboRisen develops educationally focused robotic systems. The company leverages SOLIDWORKS software in conjunction with **3D**EXPERIENCE Works solutions for collaboration and data management on the cloud. RoboRisen reduced product development cycles by 20 percent, reduced prototype costs by 30 percent, and decreased defects related to revision errors by 20 percent.

READ THE WHOLE STORY

To read the full RoboRisen story, click here.

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DESIGN FOR MOLDABILITY

Manufacturers utilize molds to produce a growing number of products. As any mold maker will tell you, however, not all shapes are moldable. Regardless of the mold method used, such as injection molding, thermoforming, resin fills, blow-molding, and rotational molding, a design's moldability is a key factor for shooting quality parts at volume. Although 3D core-and-cavity capabilities can facilitate the development of molds, using DFM tools to assess moldability can help you avoid production problems and extend mold service life.

For example, has someone done a draft analysis to ensure the part will pop out of the mold without incurring damage? What about undercuts, which increase the cost of the mold? Can you locate undercuts and eliminate them before the tooling design? Is the part thickness consistent, and is it too thick? Is your parting line in a good location for the aesthetics of your design? Would a fluid flow or thermal simulation help optimize your mold design and forming? Have you compensated for shrinkage in your mold design? When changes need to be made, does your mold tool update automatically with part design changes? Can you quickly compare a new part's design to see where material has been added and removed, as well as what aspects have been modified?

Avoiding mold production issues and extending mold service life can help your company save time and money. DFM tools can help you achieve your mold production objectives.

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... A CASE IN POINT

By implementing DELMIAWorks, SEA-LECT Plastics can access all job details at any time in the process. "We can see exactly what is happening on each of 16 different machines in real time," says Vice President and General Manager Matt Poischbeg. SEA-LECT Plastics increased operational efficiency—from 70 percent to 98.5 percent—while simultaneously improving injection-molded part quality.

READ THE WHOLE STORY

To read the full SEA-LECT story, click here.

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DESIGN FOR CASTING AND FORGING

Many manufacturers produce metal parts that are not machined, either through forging or casting. Forging is the preferred method for creating extra-strong metal parts, in which the metal's grain is hammered or pressed into the shape of a part using a combination of pressure and temperature. Casting is typically reserved for metal parts having complex geometries that preclude machining or in instances where casting is faster and less expensive than machining. Cast parts are produced by pouring molten metal into sand, metal, or investment-cast molds. As with mold development, manufacturers are using DFM tools that can benefit both processes.

Whether you cast or forge parts, 3D design and DFM tools can help you check the draft of your parts, and evaluate the strength and precision of your fixtures, dies, and molds. For example, can you improve the performance of your power hammers and presses during forging operations? Would you like to avoid die lock? Can you leverage 3D printing to create starch-based molds for economical casting? Would integrated PDM allow you to manage production better?

DFM tools can help you more accurately predict the outcome of your forging and casting operations instead of working through trial and error, saving you time and money.

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... A CASE IN POINT

Vector-Praxis cut design time by 75 percent, went from concept to cut files in two weeks, saved $100,000 on tooling and production by leveraging simulation, and introduced a revolutionary modular construction system using SOLIDWORKS Design, Simulation, and PDM tools.

READ THE WHOLE STORY

To read the full Vector-Praxis story, click here.

Vector Praxis

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DESIGN FOR FABRICATION

Fabricating assemblies requires the accurate and efficient processing of sheet-metal parts, welded structures, and fastening systems. Turning sheet-metal designs into finished pieces consistently, quickly, and cost-effectively, including the precise handling of weldments and fasteners, is imperative to saving time and trimming costs.

Many manufacturers work closely with companies that specialize in fabricating assemblies. You want to ensure that the sheet metal parts and structural components you design are ready to go to the shop floor for manufacturing with little or no need to modify or re-engineer the part to meet your partner's manufacturing capabilities.

DFM tools can streamline interaction with fabrication vendors and automate and increase the accuracy of fabrication operations. Are you using folding/unfolding capabilities and forming tools to view sheet metal models as flat patterns in their bent shapes? Can you assess manufacturability before handing off a design to a fabricated-assembly vendor? Can you model weldments effectively based on stock structural shapes readily available at your supplier or access libraries of commonly used fasteners?

Reducing iterations with fabricating vendors and eliminating rework during fabrication makes the process faster and more cost-effective.

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... A CASE IN POINT

Using SOLIDWORKS 3D CAD connected to the **3D**EXPERIENCE platform gives Skinny Guy Campers the capabilities needed to achieve product development goals without having to make a large investment in server hardware. Cloud-connected **3D**EXPERIENCE SOLIDWORKS allows the company to design and manufacture its innovative products from any location with web access.

READ THE WHOLE STORY

To read the full Skinny Guy Campers story, click here.

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“Seed Terminator added **3D**EXPERIENCE Works solutions to its SOLIDWORKS design and simulation implementation to support collaboration across distributed teams, automate management of product data, and prepare for international growth. We use SOLIDWORKS design configurations to simplify the creation of all of these design variants automatically from the base design, and **3D**EXPERIENCE Works solutions to manage all of this product data and associated life cycles.”

- Dr. Roger Dunlop,
Engineering Manager,
Seed Terminator

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DESIGN FOR ASSEMBLY

The methods used to assemble parts and subassemblies into final products can vary greatly, from pick-and-place robotics to machine-driven assembly/packaging, to manual operations. Visualizing and simulating how a product goes together with any assembly operation is essential for preventing assembly-related bottlenecks. This capability can also help you develop the best-performing, most cost-effective assembly machine system by using simulation data to create the perfect design at the perfect size.

Simulating assembly operations, whether manual or automated, is becoming increasingly important for squeezing additional time and costs out of production. Are you creating assembly animations or using paper-based instructional methods for your operators to follow? What about mechatronics? Are you using kinematics and dynamics simulation tools to design and size your machinery appropriately? Are you selecting electric motors and drive mechanisms that balance service life versus cost? Can you use 3D design data to streamline assembly operations, improve packaging, or create documentation?

Assembling manufactured parts into final products is an important aspect of many manufacturing operations. You can leverage 3D design data in ways that can transform your assembly operations into a more efficient and cost-effective operation.

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DFM tools can help you streamline interaction with fabrication vendors and automate and increase fabrication operations' accuracy.

... A CASE IN POINT

ZETR is redefining style and innovation in electrical fixture design. The company used SOLIDWORKS and **3D**EXPERIENCE Works to cut development time by up to 40 percent, support growth rate of 50 percent, and eliminate revision errors. ZETR leverages the cloud-based **3D**EXPERIENCE platform to reduce internal design iterations and back-and-forth communications with suppliers and manufacturers.

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To read the full ZETR story, click here.

ZETR

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Even though different manufacturing processes have unique characteristics, they have common goals. Manufacturers are asked to produce more with higher quality and lower cost. All manufacturers today compete and ship globally. The margin for error is becoming lower each year. The value of communication in effectively design for manufacturing is greater than ever.

By leveraging DFM tools in design and providing access to the data in a unified platform, as mentioned above, you can have better control over your processes. Using a unified platform also lessens your cyber security risk without the extra overhead of on-site servers for backing up and safeguarding data against hackers. This, coupled with the ability to work with teams anywhere at any time, means you can employ the best talent from any location, not just the best talent within a certain radius of your facility.

SOLIDWORKS solutions and the expanded **3D**EXPERIENCE Works portfolio help you tap into DFM capabilities, integrate design and manufacturing, and achieve your goals.

The innovation portfolio leverages the cloud-based **3D**EXPERIENCE platform to provide a single collaborative environment, enabling all stakeholders to contribute to the product development process. With more than one way to connect SOLIDWORKS CAD to the cloud, **3D**EXPERIENCE Works unites all the people, data, and applications needed to improve execution, increase productivity, and accelerate innovation. Built on the same foundations that helped SOLIDWORKS customers succeed, the portfolio scales to provide access to industry-leading tools for design, simulation, manufacturing and data management.

With SOLIDWORKS DFM tools, you will experience fewer geometry surprises on the production floor, resulting in less scrap and rework.

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Increasing profitability

Competition compels manufacturers to seek ways to grow profits. From the manufacturing perspective, there are several ways to contribute to increased profitability:

Cut or control manufacturing costs.

SOLIDWORKS is integrated with leading manufacturing systems, such as CAM, mold analysis, and mechatronics software. This integration gives you seamless access to SOLIDWORKS DFM tools, including DFMXpress, TolAnalyst, moldability (draft) analysis, and interference-checking capabilities. Integrated DFM can help you cut or hold the line on manufacturing costs.

Eliminate downtime and production stoppages.

SOLIDWORKS ensures precise 3D geometries for clean fit and assembly and facilitates the processing of design changes. The **3D**EXPERIENCE platform enables you to automate manufacturing workflows and accelerate engineering change orders (ECOs). These capabilities give you the agility you need to rectify changes on the fly and prevent downtime. DELMIA CAM and Robotics engineering data are re-used without extra translation steps. This allows engineering and manufacturing to communicate and collaborate in a common language. The design and manufacturing process also happens closer together to reduce the amount of rework or revisions needed in product release.

Reduce scrap, rework, and waste.

With SOLIDWORKS DFM tools, you will experience fewer geometry surprises on the production floor, resulting in less scrap and rework. Using SOLIDWORKS Simulation to validate designs and tooling, you can avoid waste related to production failures.

Optimize material usage.

Reducing material usage is an easy way to cut costs. With SOLIDWORKS Simulation, you can validate designs and trim away wasted material.

Eradicate wasted or duplicated effort.

In today's technology-based manufacturing environment, manufacturers should never need to redraw or remodel their designs. Because SOLIDWORKS is integrated with leading manufacturing systems, you can eliminate data translations, file conversions, or model redraws.

Making sure that a product is manufacturable requires using DFM tools to evaluate whether it can be made cost-effectively in the specified shape and material.

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Increasing profitability

Using DFM tools you can fully interrogate your design's manufacturability to ensure it’s ready for the shop floor. Using these tools, you can:

Check that your hole, tool, corner radius, and tolerance settings are correct.

Use Hole Wizard, Smart Hole Series, and Smart Components to ensure standardization of holes based on manufacturing requirements.

Leverage Library Features to standardize the modeling of typically machined features, such as milled pockets, tabs, oil passages, etc. This will improve standardization for manufacturability.

Easily adjust design features like fillets, holes, and chamfers.

Convert imported geometry to “machine friendly” features.

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Accelerating time to market

Manufacturing can help shorten time to market by ensuring a design is ready for prime time (ready for the shop floor without tedious alterations) and by streamlining processes and interactions.

Ensure manufacturable designs.

Making sure that a product is manufacturable requires using DFM tools to evaluate whether it can be made cost-effectively in the specified shape and material. With SOLIDWORKS DFM tools, you can assess materials and geometries, deliver a problem-free design to production, and avoid unnecessary delays.

Guarantee production-ready data.

Providing your design in a CAD data format ready for production can help you save additional time. SOLIDWORKS is integrated with leading manufacturing systems and can even output DXF files. FeatureWorks can also help you quickly correct problem geometries.

Streamline vendor interaction.

Eliminating time-consuming iterations with vendors is vital for speeding time-to-market. With SOLIDWORKS DFM tools and SOLIDWORKS compatible data formats, you can gain back time spent with vendors addressing manufacturability and file compatibility issues.

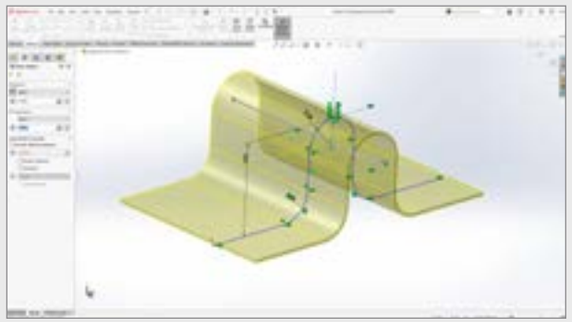
Accelerate assembly operations.

Assembly operations take time to perform and require time to design and develop. The integration of SOLIDWORKS Motion with leading electronics and control systems development packages enables you to leverage mechatronics to more quickly design assembly machines. SOLIDWORKS Composer can also help you configure assembly operations, make animated assembly instructions, and create product documentation.

Facilitate late-cycle changes.

Your manufacturing organization's approach to late-cycle design changes and ECOs is also a factor in reducing time-to-market. SOLIDWORKS 3D CAD facilitates design changes, and SOLIDWORKS PDM can automate manufacturing workflows and accelerate ECO processing.

With SOLIDWORKS DFM tools, you can address manufacturing problems before production.



You can check your sheet metal designs using DFM tools to ensure your fabricator can make them without a hitch. With these capabilities, you can:

- Check important sheet metal settings, such as the recommended bend radius, hole diameter to thickness ratio, hole to part edge distance ratio, etc.
- Easily create flat patterns and compensate for stretching due to bends.
- Automatically generate cut lists for welded structural frame members.

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Reducing returns/warranty costs

The best way to cut costs related to product returns and warranty claims is to manufacture a quality product.

Enhance product quality.

There are two facets to quality in manufacturing. One concerns manufacturability. The other involves performance. With SOLIDWORKS DFM tools you can address manufacturing problems before production. SOLIDWORKS and **3D**EXPERIENCE Works simulation tools allow you to validate design performance and pinpoint potential design errors before manufacturing. You can help your company reduce returns, warranty claims, and associated costs by improving quality.

Increase accuracy.

You can ensure product quality by increasing the accuracy of your development effort. SOLIDWORKS 3D CAD ensures precise 3D geometries for clean fit and assembly. When combined with SOLIDWORKS Simulation analysis software, you have the design tools you need to make sure your product performs as designed.

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> “We...used to outsource vibration analysis, which took longer. Based on our experience, it takes 40 percent less time to run vibration simulations in the cloud using Structural Performance Engineer versus outsourcing analysis. With 3DEXPERIENCE Works solutions, we have been able to shorten product development time overall by about 20 percent.”
>
> - Jung Jai-Lee
> Chief Technology Officer,
> KOSES Co., Ltd.

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SOLIDWORKS provides a range of DFM tools for addressing fit and function issues, such as the TolAnalyst, which automates tolerance stack-up analysis. Using other DFM tools to make sure that your parts will fit together for assembly, you can easily manage geometric dimensioning and tolerancing specifications with the SOLIDWORKS DimXpert.

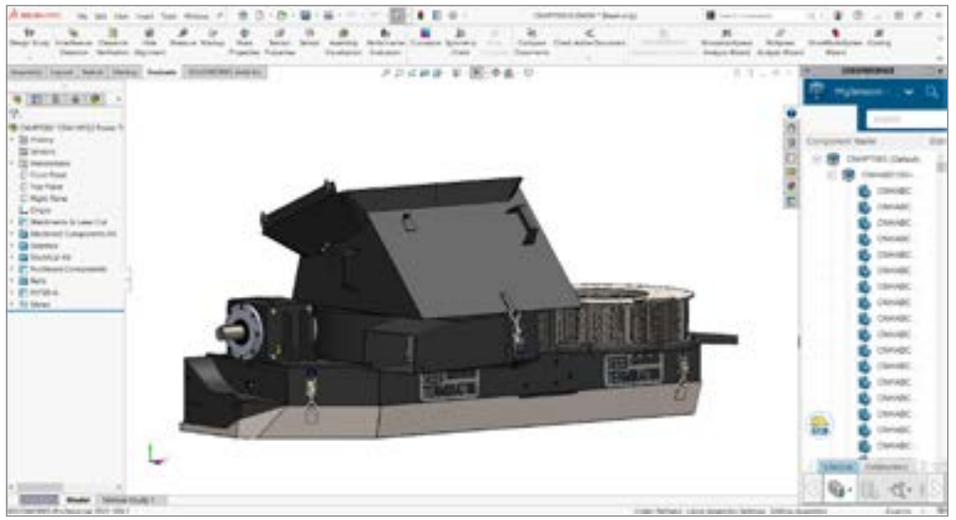
Use SOLIDWORKS Simulation's specialized functionality for fastening analysis to determine the correct size and number of fasteners required to hold your parts together. Reducing the number of fasteners in your design can decrease costs, complexity, weight, and manufacturing time.

Evaluate fastening methods, such as bolted connections, welded connections, etc., to determine which method works best to gain a cost advantage, reduce weight, or accelerate the assembly.

Leverage interference collision and clearance checks tools to ensure that the design will work properly at nominal tolerance values.

Conduct motion simulations to understand part deflections due to dynamic loads and ensure the design will operate properly while in motion.

Generate a bill of materials (BOM) for your design that updates automatically with design changes.



Energy costs are a big part of today's manufacturing operations, so the ability to reduce energy usage is important from both a cost and environmental standpoint.

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Energizing production through Design for Manufacturability

Product design and manufacturing are no longer separate autonomous functions but two sides of the same coin. Manufacturers can avoid time-consuming delays, unnecessary costs, and undesirable quality issues by considering manufacturing issues starting with the initial design.

With DFM tools like those available with the SOLIDWORKS design solution you can improve the performance of your manufacturing operations and make a valuable contribution to your company's bottom line.

Squeezing time and costs out of production are attainable objectives if you have the capabilities you need to ensure a product design is ready to leave the virtual world and become real. It does not matter how you make a product (whether by machining, mold-making, fabricating, metalworking, or assembly). If you can make sure the design can be made efficiently and cost-effectively with few unanticipated surprises, you will save your company time and money.

When you need the added flexibility and scalability to quickly respond to changes in the market, **3D**EXPERIENCE Works provides the tools to manage all facets of your product development process while leveraging your existing SOLIDWORKS investment. The portfolio provides access to the Dassault Systèmes industry-leading tools for design, simulation, manufacturing, and marketing when and how you need them. When every stakeholder has real-time access to the right tools and information, you can increase collaboration, improve productivity, and accelerate innovation.

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ENERGIZING PRODUCTION THROUGH DESIGN FOR MANUFACTURABILITY

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Squeezing time and costs out of production are very attainable objectives; if you have the capabilities, you need to make sure a product design is ready to leave the virtual world and become real.

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