ptc®

DIGITAL TRANSFORMS PHYSICAL

BUYER'S GUIDE TO CAD ENGINEERING SOFTWARE

WHITE PAPER

July 2023

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Does Your Selection Really Matter?

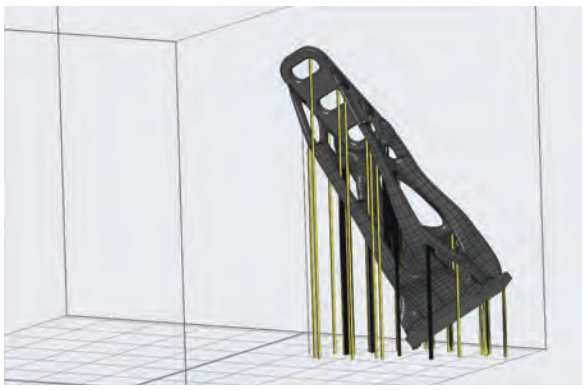
There is little doubt: 3D CAD is an essential technology to developing physical parts or products. Once considered a commodity, 3D CAD solutions have now evolved to differentiate themselves from one another. There are now new methods to build complex geometry, streamline model-based documentation efforts and integrate artificial intelligence and machine learning to aid designers. Today, 3D CAD is experiencing a transformation.

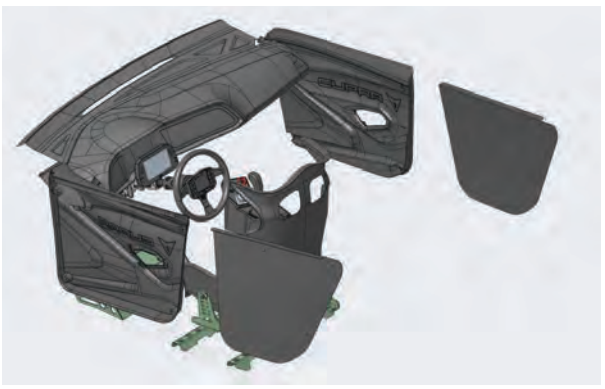
Despite this, not all 3D CAD solutions are the same. Depending on your needs and priorities, you might have a 3D CAD solution that isn't the best fit for your organization.

All of this leads to a critical question: how do you select the right solution for your organization? This report is here to help you determine what's the best fit. Here, you will find a selection process supported by capability definitions to help you choose the right solution for you.

Design Modeling

Design geometry is where it all begins. For many years, the primary focus was parametric, feature-based modeling. Yet, recent advances have supplied an array of exciting modeling capabilities.





THE FUNDAMENTALS

- Sketching: Includes creating and modifying points, lines and arcs, and other simple geometries on 2D planes or in 3D spaces. These capabilities are critical to concept design and top-down design.
- Solid and Surface Modeling: Includes producing and modifying solid and surfacing geometry through parametric, direct, surface methods. This includes sheetmetal design. Modern designs frequently use these features.
- Assembly Modeling: Includes spatially placing, constraining and constructing relationships between components into assemblies. This also includes the ability to define kinematic constraints for mechanism design.
- Performance Part and Assembly Modeling: Responsiveness while working with large, complex part models and assemblies with a number of components.
- Top-Down Part and Assembly Design: Includes capabilities to define space claims and interfaces, and other geometry to control collaboration concurrently.
- Single Definition Associativity: Includes automatic, controlled updates anywhere a model exists. Most companies require this core capability.
- Capturing and Embedding Design Intent: Includes creating and modifying parameters, equations, relationships and logical arguments to drive design geometry. This functionality is critical to intelligent parts, design automation and configure-to-order approaches.
- Structures-Based Topology Optimization: Includes automatically removing non-load bearing material from design geometry based on structural analyses. This capability is incredibly useful for cost out and light weighting initiatives.
- Ergonomics/Human Factors: Includes the ability to visualize, simulate, optimize and communicate human-product interactions early in the design process. This functionality is critical to improving detailed design.

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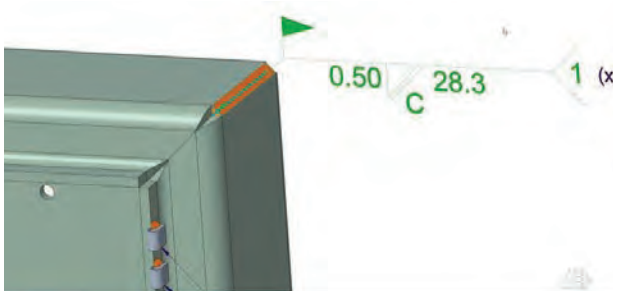
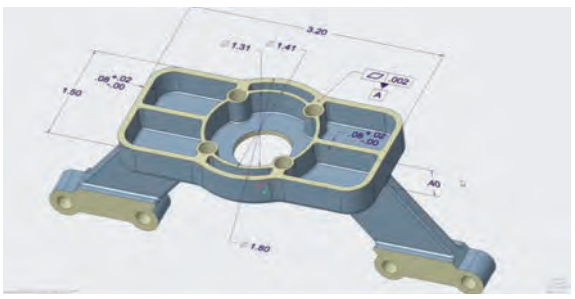
- Mesh Modeling: Incudes modifying facet geometry such as 3D scanned data, tessellated point clouds, finite element meshes and STL models that lack parametric controls.
- Lattice Modeling: Includes the ability to build lattice-filled geometry, offering controls over how the lattice varies spatially.
- Subdivision Modeling: Includes creating and modifying design geometry progressively and organically. This method is most used for the aesthetic design of consumer products.
- Framework Modeling: Includes creating and altering geometry built with parts with standard cross-sections. This capability is applicable to machine design, plant design and heavy equipment.
- Divergent Generative Design: Includes automatically creating design geometry to produce many different versions using algorithms. This can yield many unique design alternatives for various fabrication techniques. This can be applied in the concept design stage to generate innovative alternatives.
- Design for Additive Manufacturing: Includes geometrically preparing a design for 3D printing. Covers the analysis of the additive manufacturing process, adjusting the model sent to a 3D printer so that the final cooled part matches the original design. This also includes parametric, mathematical and volumetric modeling for design geometry and support structures.
- Composite Design: Includes the ability to design plys to mix and match materials to create strength, flexibility and impact absorption very locally within the design.

Design Documentation

Another core 3D CAD capability is the development of design documentation. Engineering releases such deliverables to downstream consumers to drive the product development process. While 2D drawings have been traditionally used, model-based approaches have quickly become the norm.





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- Drawing Generation: Includes creating, detailing and modifying 2D drawings based on design models. Many consider these deliverables as the specification for manufacturing and procurement.
- Model-Based Definitions (Human Readable): Includes adding Product and Manufacturing Information (PMI) to design models which augments or eliminates 2D drawings for human viewing and interrogating.
- Manipulating Legacy Drawings: Includes reworking 2D entities on drawings like lines and arcs, that are not associated with design models. Companies often have many legacy drawings in this condition.
- Model Animation: Includes creating and reworking the spatial animation of design models in a series of sequenced steps. This capability is applied to create instructions for manufacturing, service or product operation.

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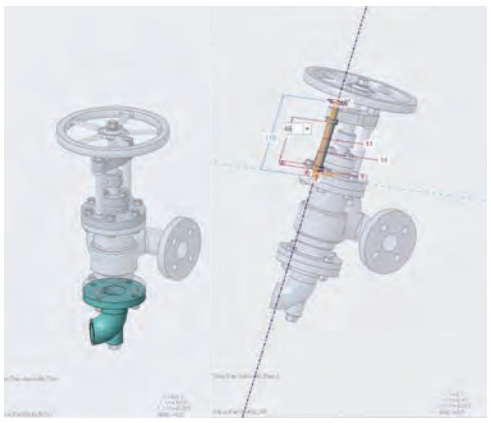
- Direct Sketching: Includes the application of direct modeling approaches to manipulate 2D entities like lines and arcs on large-scale drawings not associated with design models. Users can apply these capabilities to large-scale drawings with thousands of entities with high performance.
- Model-Based Definitions (Machine Readable): Includes creating and modifying design models with semantic PMI that other software can read to automatically create toolpaths.

Design Collaboration

Collaboration is critical for modern product development. This category is the focus of many recent innovations.



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- Natively Opening Foreign Models: Includes opening design models originating from other 3D CAD solutions in native CAD formats.
- Securely Sharing Models: Includes sharing design models securely and directly with those inside and outside of your company.

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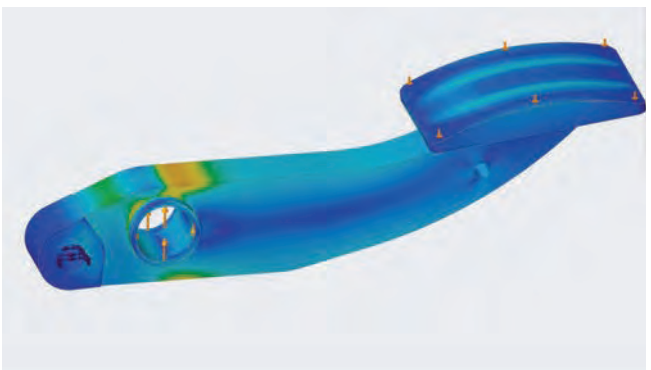
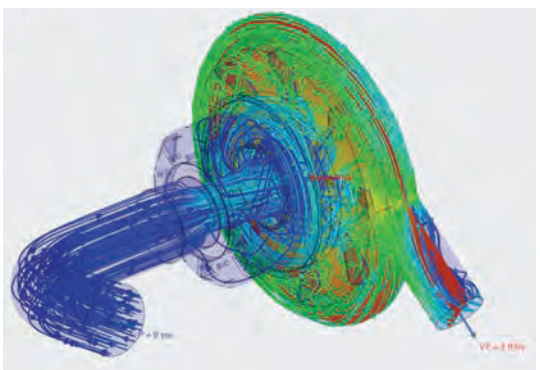
- Associative Foreign Models: Includes automatically updating design models once they have been changed in their original 3D CAD solution.
- Multi-User Real-Time Collaboration: Includes allowing multiple people to create and modify geometry in the same model simultaneously. This can help resolve any conflicting requirements and constraints.
- Augmented Reality (AR) Collaboration: Includes creating and sharing cloud downloadable AR experiences of an interactive full-scale design model with other users.

Design Simulation

All designs must fulfill some set of requirements within a given group of constraints. Given the difficulties of physically validating a model, many companies are checking their designs virtually through simulation. This category captures the capabilities across form, fit, function, aesthetic and other measures.





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- Geometry-Based Properties and Checks: Includes performing geometry-based checks such as surface area, mass, clearances and interferences.
- Design-Driven Engineering Analysis: Includes preparing and conducting simple and fast simulations based on physics such as kinematics and dynamics, fluid dynamics and thermodynamics.

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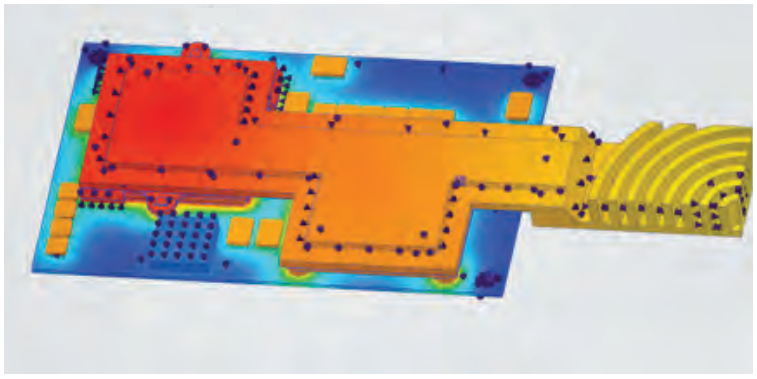
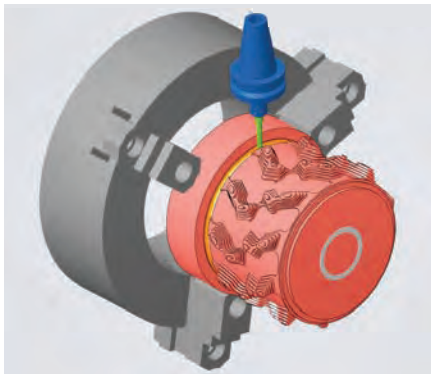
- Real-Time Rendering: Includes generating real-time interactive photorealistic images and animations in a lifelike environment. These tasks often support sales and marketing efforts.
- IoT Inputs for Engineering Analysis: Includes applying physical sensor readings from an IoT platform as an input to engineering analysis. Used to gain greater insight into performance.
- Virtually Prototyping an IoT Platform: Includes feeding virtual sensor readings from an engineering analysis to an IoT platform. This acts to virtually prototype the data model and other traits of the IoT platform.
- Real-Time Engineering Analysis: Includes running a real-time engineering analysis during design model modification. Provides immediate feedback on design experimentation. Covers a range of engineering physics such as structures and excitation, fluid dynamics and thermodynamics.

Integration

3D CAD solutions do not stand alone in a company's IT landscape. They must work with many other types of software to power product development. Several innovations in this category are bridging gaps to other engineering domains.





THE FUNDAMENTALS

- Data Management Solutions: Includes managing and tracking iterations and the interrelationships of all deliverables produced by 3D CAD solutions.
- Electrical CAD Solutions: Includes exchanging data between Mechanical and Electrical CAD solutions. Covers the interchange of board layouts to create 3D assembly models of boards. Encompasses sharing from-to signal information for harness design to route cables and wires in a 3D assembly of the product.
- Machining and Metrology Solutions: Includes intelligently exchanging a design model with machining solutions to generate NC toolpaths and metrology solutions to produce inspection toolpaths.

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- Branching Iterations: Includes branching multiple new designs off an existing one. Important capability for companies that need to explore many alternatives to find better designs.
- Design Change and Difference Highlighting: Includes tools to automatically highlight differences between two or more versions of a design model. Applicable when exchanging design changes between organizations or comparing two or more designs.
- Electrical CAD Updates and Interactivity: Includes exchanging information with Electrical CAD solutions in real time, powering associative changes. Separately covers the ability to interactively highlight items that correspond between the two solutions. For example, when a signal is selected in a wiring diagram, it highlights the wire carrying that signal in the 3D assembly model.

Provider and Support Considerations

Functional capabilities are important when selecting a 3D CAD solution. However, many other criteria are vital. This category includes all those other considerations. Study the implications of each of the following options and select the one that best fits your organization.

- Solution Accessibility Considerations: Includes accessing the solution from any device at any time. Highly applicable to companies with engineers who spend time away from their desks.
- Training and Support Considerations: Includes training users to learn how to use the solution and logging software issues with technical support. Online access for both is critical.
- Cost-of-Ownership Considerations: Includes procurement options for upfront purchase or ongoing subscriptions for the solution. Take ongoing maintenance costs into account when considering total cost-of-ownership.
- Provider Stability and Solvency Considerations: Includes the overall company financial health and viability as a solution provider. Should also consider dedicated and continued development to the solution. Also assess whether the provider has a long-term vision for the solution.
- Support for SaaS: Includes considering whether a user can scale a solution through a cloud-based version of the CAD solution.

Your Section Does Matter

With all the fundamentals and innovations in mind, assess what ground your CAD solution covers. Evaluate what functionalities your CAD solution supports and does not support. And explore the breadth and depth of the various CAD solutions out there. The choice is not easy—but with this guide as a tool, you're equipped with everything you need to make the best decision for you and your organization.

For more information, contact us here.

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