



BUYER'S GUIDE TO CAD ENGINEERING SOFTWARE

WHITE PAPER

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Table of Contents

- 3 Does Your Selection Really Matter?**
- 4 Design Modeling**
- 5 Design Documentation**
- 6 Design Collaboration**
- 7 Design Simulation**
- 8 Integration**
- 9 Provider and Support Considerations**
- 9 Your Selection Does Matter**
- 9 Buyer's Guide Checklist**



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.

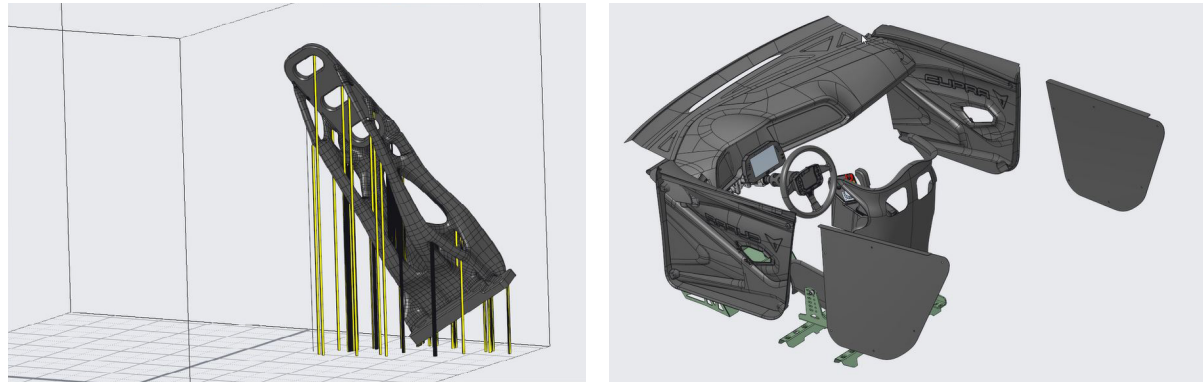
Despite this, not all 3D CAD solutions are the same. Depending on your needs and priorities, you might have a 3D CAD solution that isn't the best fit for your organization.

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.
- **Performant 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.

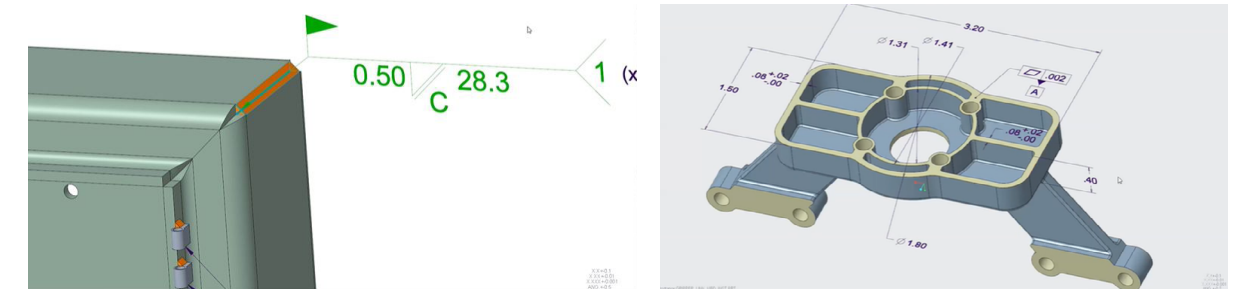
THE INNOVATIONS

- **Mesh Modeling:** Includes 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 plies 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 are quickly becoming the preferred ways of working for benefits in cross-functional collaboration, early validation, risk reduction, enhanced traceability and more.



THE FUNDAMENTALS

- **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.

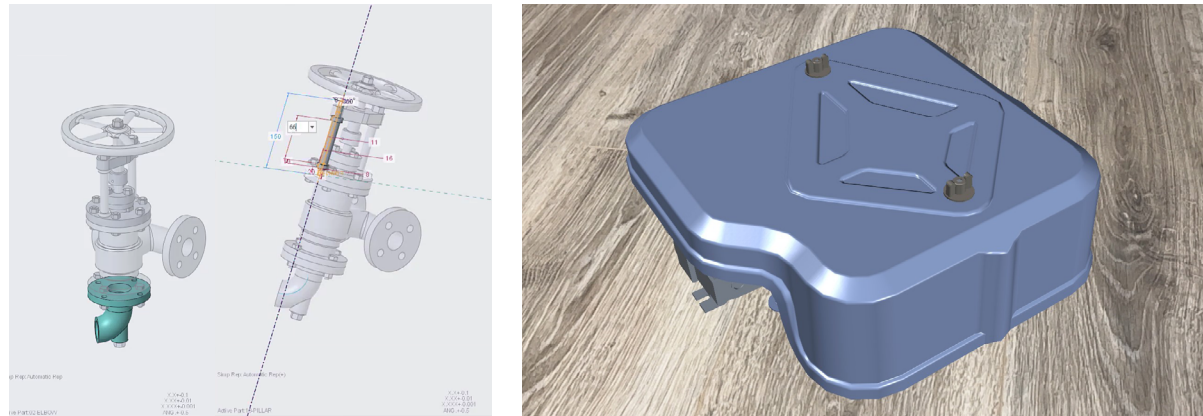
THE INNOVATIONS

- **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.
- **Enhanced file import & export capabilities:** Includes neutral file capabilities (STEP AP242 Edition 3, 3D PDF, etc.), and capabilities for conversion into other common 3D CAD formats.



Design Collaboration

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



THE FUNDAMENTALS

- 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.

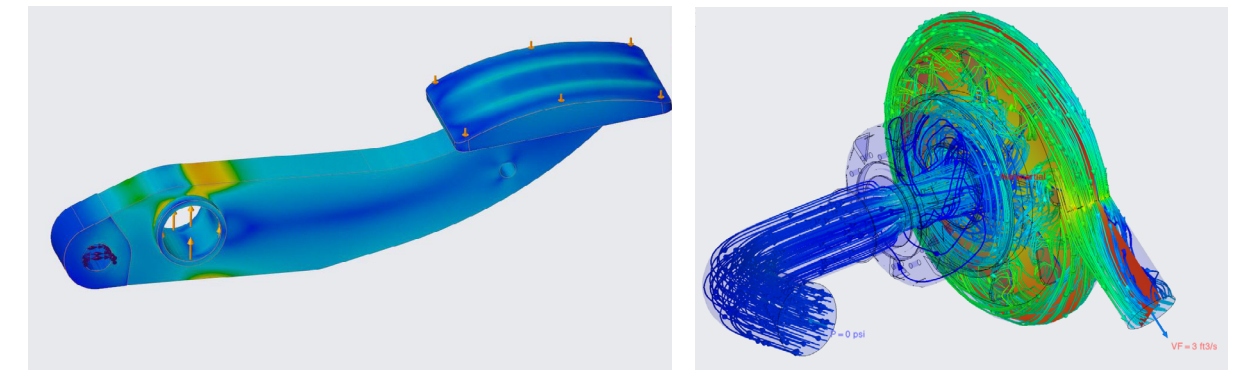
THE INNOVATIONS

- 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.



THE FUNDAMENTALS

- 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.

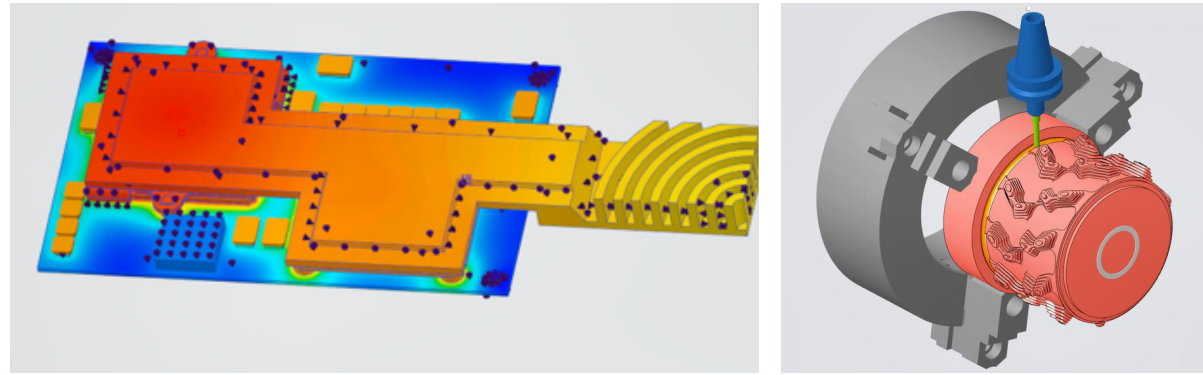
THE INNOVATIONS

- 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.
- Generative Design and Optimization: includes utilizing AI-powered tools to generate optimized designs to meet your design constraints and goals. Simulates multiple designs and converts them into B-rep geometry for uninterrupted parametric workflows.



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.

THE INNOVATIONS

- **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.
- **Ease of Collaboration for Electrical CAD:** Includes tools that simplify work with electric and cabling components such as reusable parts, BOM reports, enhanced libraries, and working with harness components as assemblies.



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 Selection 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.

Buyer's Guide Checklist

Method of Delivery	
On-Premise	
Software as a Service (SaaS)	
Concept Design and Styling	
Easily define complex, freeform and stylized geometry	
Sub-divisional surface modeling	
Parametric surface design	
Advanced freeform curve and surface design	
Rapidly iterate, explore and evaluate design concepts	
Rapid design exploration and capture of design alternatives	
Direct editing of any geometry within your CAD system	
Secure publishing, distribution and management of AR experiences	
Photorealistic image creation	
Design for additive manufacturing	

Improve quality and drive innovation	
High-performance cloud computing for generative design	
Real-time analysis results and feedback on design decisions	
Detailed Design	
Part modeling	
Sheet metal design and flat pattern creation	
Sub-divisional surface modeling	
Parametric surface design	
Advanced freeform curve and surface design	
Speed and simplify the design, analysis and manufacture of composite products	
Direct editing of any geometry within your CAD system	
Automatically solve for design goals and design criteria	
Real-time analysis results and feedback on design decisions	
High-performance cloud computing for generative design	
Creation, documentation and sharing of engineering calculations	
Assembly Modeling	
Multi-CAD design and collaboration	
Rapid fastener selection and assembly	
Rapid creation of structural framework assemblies	
Top-down design and concurrent engineering	
Automate 3D cable and pipe routings using schematic driven routing	
Define and capture true mechanical constraints	
2D and 3D Documentation	
Capture product and manufacturing information (PMI) of the 3D model	
GD&T authoring and model-based definition	
2D schematic design	
Wire harness manufacturing documentation	
Simulation and Analysis	
Real-time analysis results and feedback on design decisions	
Simulation-driven design optimization (including generative design)	
Kinematic motion analysis	
Plastic injection molding analysis	
Clearance and creepage analysis	
1D tolerance stack-up analysis	
Analyze human interaction, comfort, reach and vision	
Analyze human interactions against workplace standards	
Dynamic motion analysis	
High-fidelity simulation	
Structural, modal, buckling and thermal analysis	
Analyze and understand cycle fatigue and product durability	
Computational fluid dynamics	

Tooling and Manufacturing	
Subtractive Manufacturing (NC Machining)	
Multi-surface 3-axis milling with 4- and 5-axis positioning	
2.5- to 5-axis milling, 2- and 4-axis turning and 2- and 4-axis wire EDM	
Complete machining includes live tooling, 5-axis continuous milling and more	
3-axis high-speed machining	
5-axis HSM roughing, rest roughing, auto deburring and more	
Additive Manufacturing (3D Printing)	
Automated creation of 2.5D and 3D lattice structures	
3D metal printing model setup and preparation	
Mold Design and Production Tooling	
Automate and simplify the creation of mold and die tooling	
Automate and simplify moldbase design	
Automate and simplify progressive die design	
Collaboration	
Real-time collaboration	
Multi-CAD collaboration	
Subscription Benefits	
Free Standard E-Learning	
Support	
Available Online Training and Certification	
Digital Thread/Integration	
Augmented Reality	
Product Lifecycle Management	
Service Lifecycle Management	
Internet of Things Product Insight	
Applications Lifecycle Management	

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