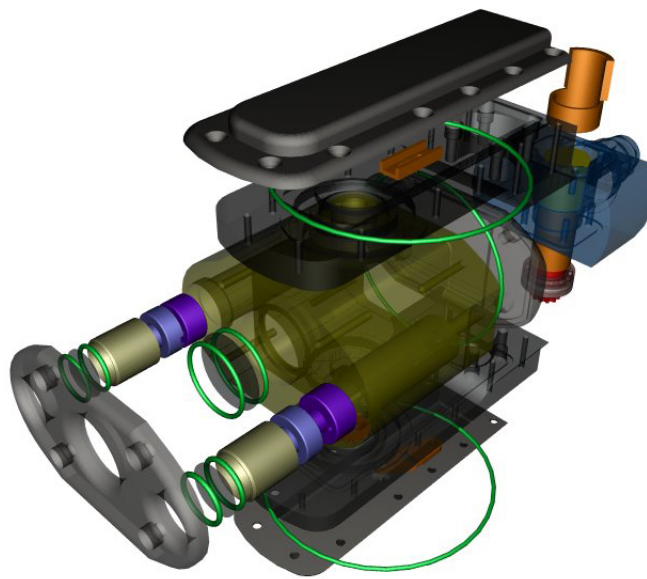




3D CAD BUYER'S GUIDE

There is only one time when it is essential to awaken. That time is now.

Siddhartha Gotama (a.k.a. Buddha)



If You Are A Mechanical Designer, Engineer or Manufacturer, Solid Modeling Software Will Increase Productivity and Improve the Quality of Your Designs

3D parametric solid modeling can save you an enormous amount of time and effort when designing mechanical parts and assemblies as compared to 2D. That said, the time has never been better to move to 3D CAD. The current low cost of high-performance computers plus the emergence of affordable high-powered 3D solid modeling software has created the best opportunity ever for you to take advantage of 3D design technology.

This buyer's guide will help you understand what to look for and which questions to ask when thinking about purchasing 3D solid modeling software.

7 Benefits of 3D Solid Modeling over 2D

Before deciding which product to purchase you need to know what to expect from any professional-level 3D solid modeling software. Even if you are already familiar with this software, it's a good idea to review the key benefits listed in this section. The industry is rapidly advancing, and, as with any technology, major changes can (and have) come about very quickly.

By using a single 3D master model to create 2D drawings, check for interferences, calculate mass properties, and improve visualization and communication, design flaws are discovered earlier and avoided, reducing the product development cycle and improving quality. Changes are quick; often accomplished by simply typing in a new parametric dimension value rather than painstakingly editing and checking each view of a traditional 2D drawing.

Capture and Communicate Design Intent

When designing with a parametric, feature-based solid modeler, information is implicitly captured in the 3D model. In addition to just the form of the design (for example, the design's geometric shape, position and orientation) a parametric, feature-based 3D model captures the intent of the designer, making it very intuitive. For instance, with feature-based modeling, a hole is more than an image made up of lines and arcs. It's an object with the specific attributes of a hole. It can be defined as a countersunk hole with a certain diameter that passes through the entire model and has a certain type of threads (figure 1). As the model is passed from the designer to manufacturing it is clear what the hole represents because it is defined in the model. The same goes for other features like fillets/rounds, chamfers, shells, patterns, lofts, etc.

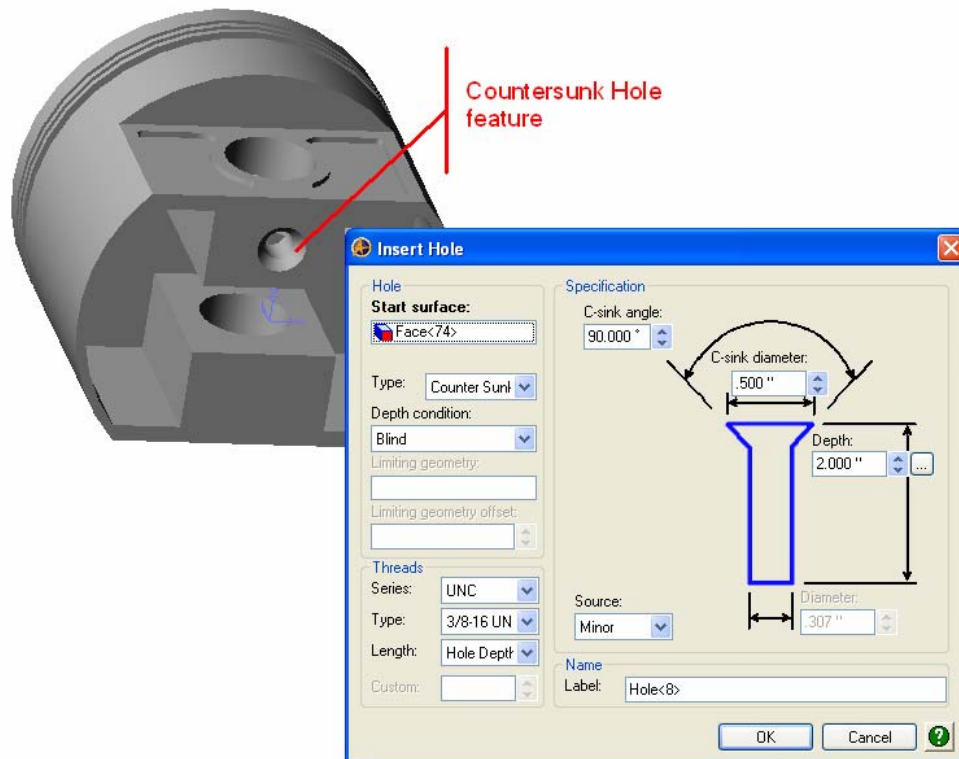


Figure 1. Insert Hole dialog box and resulting countersunk hole feature. The feature may be modified at anytime during the design process.

Efficient Handling and Management of Assemblies

Modern 3D solid modelers are not just geometry generators like traditional 2D drafting or 3D wireframe CAD software. A complete 3D solid modeler is equipped with the tools to support designs consisting of a single part, or a complex hierarchical assembly with multiple subassemblies. Managing an assembly of hundreds or thousands of parts using traditional 2D drawings is difficult at best.

In a parametric 3D solid model, the assembly contains the relationships between parts. Users can check the fit between parts, check interference, create a Bill of Materials (BOM) for manufacturing and production, and generate exploded views. When a part is changed, the assembly is updated and vice versa.

Full-featured products support the creation of assemblies in two modes: Bottom Up, where parts are designed separately and then pieced together or assembled, or Top Down, where parts are constructed in the assembly, using other parts as reference. Often both methods are used. The ability to quickly switch between the two modes gives you the most efficient and productive way to build the final production assembly.

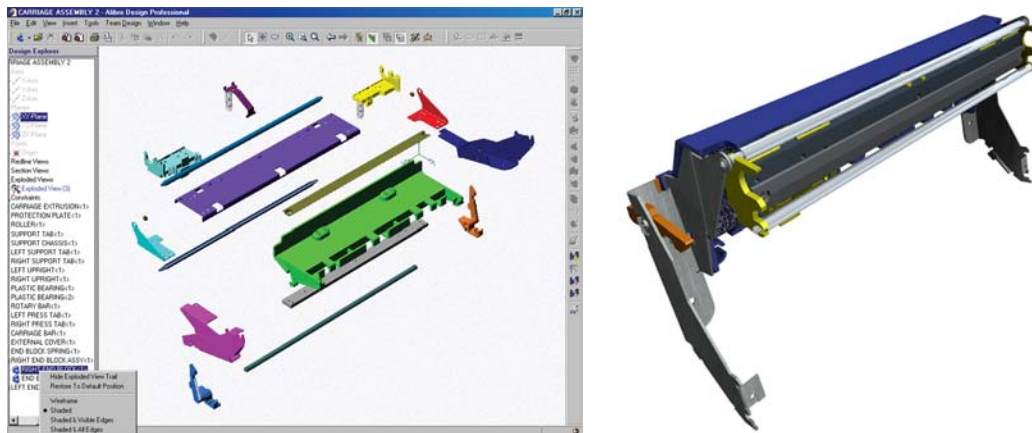


Figure 2. A carriage assembly and its exploded view.

Improved Checking of Fit and Function

As mentioned before, complete and accurate 3D models can be used to quickly and accurately check fit and function. With a solid model, checking for interference in a complex assembly is as easy as pushing a button. Moreover, an assembly with moving parts can be moved through its full range of motion to check for collisions or other design flaws in any position. Catching these issues early, before going to production, can save you a lot of time and money.

Fast and Accurate Creation of 2D Engineering Drawings for Manufacturing

One of the primary justifications for a modern 3D solid modeler is the automated generation of 2D engineering drawings. This is critical since most manufacturing operations still rely on 2D drawings as their fundamental guide to building a part. Once parts or assemblies are created in 3D, a good modeler should allow users to quickly choose different drawing views (for example, orthographic, detail, section, etc.), place them on drawing sheets using a user-defined template for the drawing border, and define the scale factor. Hidden lines and dimensions used to create the design should be automatically generated. Dimensions can be moved and modified to make the drawing easy to read. New dimensions, as well as any annotations necessary to describe the model or manufacturing requirements, can be added for reference. The best part is that, if the model changes, all views and dimensions are updated automatically. This saves a huge amount of time and reduces error by eliminating the possibility that a dimension is overlooked when a change occurs. Anyone creating 2D drawings manually will find this to be one of the single biggest benefits of moving to 3D.

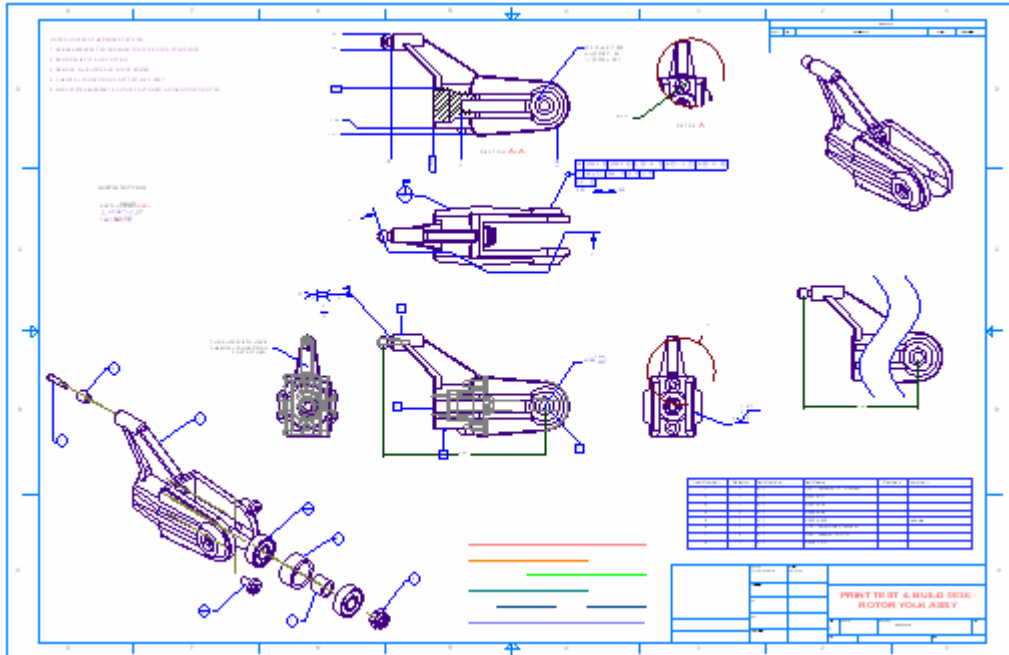


Figure 3. Sample drawing shows examples of many types of drawing views.

Reduction or Elimination of Physical Prototyping

Building physical prototypes can be one of the most expensive and time consuming aspects of producing a new product. With a 3D solid modeler, you can create an accurate virtual prototype, which reduces or eliminates the need for a physical prototype. A virtual prototype is a 3D model that you can look at from any angle or distance, measure, slice (section view) explode, check for interferences, calculate mass property and so on. By doing this, you can answer many, if not all, questions that formerly required a physical prototype. Even if a physical prototype is still made, many of the “unknowns” associated with the design process are eliminated. This is another key benefit of 3D that can dramatically reduce time and cost.

Quick and Easy Design Changes

Probably the most significant benefit of a complete parametric 3D model is how quickly changes can be made. Since all dimensions are defined as parameters, the model is easily editable. Constraints are used to define certain characteristics of the model that have to remain constant during changes. For example, two edges remaining perpendicular or parallel, a hole remaining concentric to a circular edge, or a hole or cut always remaining located halfway between two other points on the part. As the model is built, this design intent is captured by the modeling software. To make a change, simply edit a dimension. Not only does this facilitate extremely fast design changes, it allows the designer to perform “what if” studies to quickly check design alternatives. And don't forget, all changes are applied to any existing related assemblies or 2D drawings.

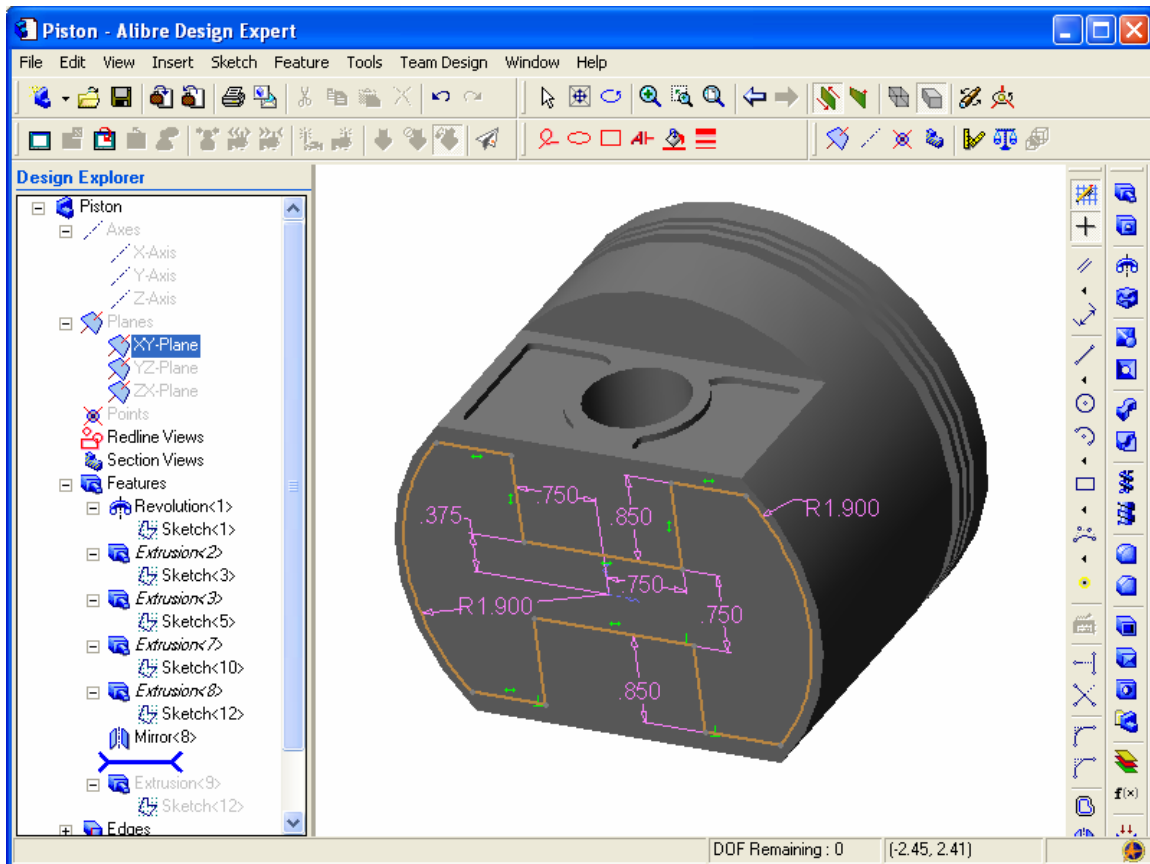


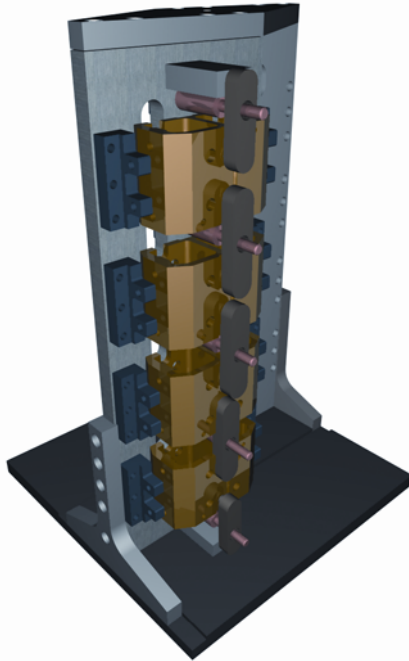
Figure 4. Parametric dimensions are editable to the degree that changes do not violate pre-defined constraints (shown in green).

Driving Downstream Applications like NC Machining, FEA or Documentation

And last, but not least, once a 3D model exists it can be used in downstream processes like manufacturing. The 3D model may be used to generate NC toolpaths for cutting metal, or for engineering analysis with finite element analysis (FEA) software to check structural integrity or performance in a simulated working environment. It can also be used to generate illustrations for product manuals, assembly instructions and marketing literature. Traditionally, these processes involve time consuming re-creation of data. This introduces the possibility of misinterpretation and errors. A 3D design is an investment that keeps providing returns.

The Bottom Line

Most of the documents like this that give you an “unbiased” description of 2D or 3D CAD systems will try to “wow” you with claims of “40% reduction in product development cycles”, or official looking ROI calculators that show the thousands of dollars you will save on reduced engineering changes and scrap. Of course there are big gains to be had in these areas, but the savings you see and efficiencies you gain will be unique to your business. **The bottom line is that 3D parametric solid modeling is the state of the art in mechanical design and manufacturing. Just like having a fax machine or a cell phone is commonplace today, 3D CAD should be in the arsenal of every company designing or manufacturing mechanical products. Continuing to use only 2D CAD, missing out on the benefits of parametric solid modeling, puts any business involved in mechanical design, engineering or manufacturing at a disadvantage relative to their competition.** Fortunately, the path to using 3D CAD is now short and affordable, much shorter and much more affordable than you may think.



"For what we do, for what most people do, Alibre Design has what we need. I am very pleased with how it handles. It's a great product."

Engineering Manager,
General Machine Diecron

Machine tool fixture, modeled in
Alibre Design, enables General Machine
Diecron to machine an entire part at once.

9 Questions to Ask Any CAD Software Vendor to Protect Yourself from Making the Wrong Choice

During your selection process, there's no doubt you'll be swamped with information from web sites, advertisements and magazines, and most of it will sound the same. What should you believe?

The goal of this buyer's guide is not necessarily to compare 3D CAD software products, but to give you the basics on what to look for and the right questions to ask to make sure you don't spend money on a product that doesn't do enough, or worse, tries to do everything, making it difficult to learn and use. It's intended to help you sort through all the claims and make the best decision possible in choosing a 3D CAD system. After all, you understand your products better than anyone, and can best assess whether a given product will do what you need it to do.

It's likely that you will find a number of systems capable of doing the job. CAD software, even 3D CAD software, has become commonplace, almost a commodity. There are many products to choose from (some would say too many) and the difference between them often seems negligible. What differentiates CAD systems today is not necessarily a feature-by-feature comparison, but is primarily about a few key factors.

Does The CAD System Design Your Parts?

Don't get swayed by fancy product literature or huge feature lists. Take a look at the parts that represent the bulk of your work and model them in the software. Whether or not you can do your job is the most important question, not whether someone else can do theirs or which feature the CAD vendor claims you can't do without. This is the key to the most efficient use of your money and time.

Next, check the list of features offered by the products you are interested in. Again, focus on the features you need, not on the number of features in the list. Remember, a bunch of features that you'll rarely use, if ever, only makes the product harder to learn and use. Exhaustive feature-to-feature comparisons are simply tools vendors use to dazzle you with

how much they pack into their product. A handy **3D CAD Solution Checklist** is provided at the end of this document to use in your research.

Can you get a 30-day free trial of the full-featured product - with no obligations?

If it is difficult to get an evaluation copy, or you need to visit a sales person just to try it out, steer clear. This should be easy and hassle-free. If it isn't easy to start, it isn't getting any easier from here. Before you purchase is when vendors will be the most charming and accommodating of your needs. You should at least be able to get a 30-day trial without any commitments or expectations at this time. Make sure you have access to technical support as well during the trial period. You want to be able to evaluate ALL of the features you'll need, just as if you're already a customer.

Is the software easy to learn and use?

Determining whether or not you can learn and use the software in a reasonable time is extremely important. Once you've determined that the software is capable of modeling your designs, you need to be able to figure out how to use it, quickly and with a minimum of hassle. Ease of learning and use will be key factors that determine how productive you will be with your choice of CAD software. Learning and becoming proficient with a 3D CAD system can be daunting – ***unless ease-of-use and direct support are a primary focus of the vendor.***

The real test is just sitting down with the software and trying it out. Can you make progress on your own without training? Does the product have a well organized help system and integrated tutorials? Does the vendor offer self-paced video-based training CDs at a reasonable cost (<\$200) or include them at no charge?

Is the CAD software more than you need?

It should be apparent by now that this buyer's guide stresses that, when moving to 3D, it only makes sense to buy just what you need. In general, having the most features and making the product easy to learn at the same time is next to impossible. If you're not familiar with CAD, there will be a learning curve with any CAD software you buy. 3D CAD, by its nature, is more complex than 2D CAD, but with on-demand live support, this is easily overcome. The biggest impact of a bunch of extra features you never use, sometimes even hundreds of them, is the time it takes to wade through the menus to figure out which ones you do need. Unless you're one of the few who can spend ALL their time running CAD software, you will likely have to re-train yourself each time you come back from the inevitable periods spent doing other tasks. Focus on what you need to get the job done.

As for CAD vendors releasing new versions, ask this question: How can the product that had "everything you need" suddenly have "things you can't live without" the following year? The answer is this: by adding features used only by a small minority, features you may never need. Many times it's more to the software vendor's benefit than to yours that you buy the next release. Some well-known CAD vendors have made selling upgrades their main business. Often it's a challenge just to explain the nuances of the new features in each new release.

Does the CAD vendor offer direct, on-demand live support online, by phone and by email—at no extra charge?

This is extremely important; we all need support from time to time. When you need it, if it is available and easily obtained, it outweighs almost everything else. We all know how good it feels to have a company truly stand behind their product and put you, the customer, first. Conversely, we all know how frustrating it can be to search for a phone number on a web site and then get brushed off when you call to get the support the vendor promised before they had your money.

Many CAD vendors charge a significant premium for direct support. Some charge per incident or call. Others simply require that a reseller support you. Choose a vendor and product that

include direct support with the purchase of the software. And if they offer unique support mechanisms like live chat or collaborative technical assistance be sure to take advantage of those value-added tools. They can prove to be invaluable when you find yourself in a pinch.

Is there a standard money-back guarantee?

If a CAD provider does not let you "test-drive" the software for at least 30-days with a hassle-free money-back guarantee, look elsewhere. In fact, 60 or 90 days is even better since that should give you enough time to make it through a complete design. Of course, this may present you with an opportunity to return the software after successfully completing your work, but if the product worked for you and was affordable what would be the point? The point is, there are simply too many options to make a choice without the freedom to return the software if it does not live up to your expectations. This is the surest sign that a vendor has your best interests in mind, and is confident that you will be satisfied with your decision.

Does the software allow you to exchange data with other systems?

CAD vendors are notorious for locking in customers with proprietary data formats, which prevent you from moving design data from their system to another. In fact, there have actually been attempts by vendors in the past to encrypt their format when new products came on the market that could read their files. In order to protect your investment in your design data, be sure to ask your vendor whether they have published their primary data format to facilitate data exchange with other companies. Also check to see that they support the basic data standards for file exchange like STEP, IGES, DXF/DWG, and STL. If not, move on.

Will the company producing the software be around in the future?

CAD providers can be split into 3 categories: the frontrunners, new vendors and everyone else in the middle. Your best bet is to go with either a frontrunner or a new vendor. Stay away from the ones in the middle; these are companies that essentially copy the frontrunners and offer products similar in price and capabilities, or the product doesn't live up to expectations and service and support is poor. Either way, it doesn't warrant choosing them over the leader.

Clearly, your CAD vendor must not only remain in business, but be healthy and profitable. This is a very interesting topic because this is the argument used by established vendors to prevent new, entrepreneurial companies from entering the market. The fact is tomorrow's dominant products or services are new today. Dell, Microsoft, Apple, etc. didn't start off as multi-billion dollar companies.

If you opt for a large, established vendor it makes sense that you'll typically pay more and get less service and support. But in return, you'll most likely get a product lots of people are using today. Is this the right choice for you? It might be if you are in a situation that requires you to work only with others using the same system.

On the other hand, new products typically benefit from advancements in technology, whereas older products often become limited by code that has been around a long time. These days, ten years in the software industry is a very long time. If you find a new product that offers advantages in price, support, ease of use, and new technologies such as Internet integration, here are a few suggestions:

1. Speak to current customers and get their opinions. Ask the vendor if they have a user group or web forum. This is the best most objective source of information.
2. Assess the strength of the company. How long have they been in business? If they have been in business for several years, it is a good sign that the company has learned to sustain itself and is pioneering a new business model. Like Dell in the PC space, a new business model often precedes a change in the market at large.

3. Is the product sold in other countries and different languages? Developing localized versions of a CAD product is an expensive proposition and indicates widespread or growing demand. In today's global manufacturing economy, a successful product will have a presence in other major markets.
4. If the company is small or new, is it backed by reputable investors with strong track records? Check the company information section on the vendor's web site and see if they list their investors or board of directors. Then just do a quick check and see if the investors acknowledge the investment in the company on their web sites. Also, check to see what other companies they have invested in.

Ask vendors to provide a Total Cost of Ownership (TCO) calculator.

This will show you the hard facts about what it will cost to own a given vendor's software. If the TCO calculator compares the vendor's product to competitive products make sure the prices and costs associated with competitive products are clearly displayed and can be changed. It is often possible to get a discount on the suggested retail price, so you should be able to tune it to your particular situation.

Note that this is not necessarily about calculating a specific return on investment (ROI) since implementing 3D CAD software of comparable capabilities will deliver a similar ROI. It will be very hard for any vendor offering similar technology to show that they deliver X% reduction in the product development cycle, or Y% decrease in scrap, as compared to a similar product. Once you know that a software application works for your designs, the total cost of ownership will best help you forecast how long it will take to become profitable. The 3D CAD market has changed substantially. ***You'll be amazed at the difference in TCO among similar software products.***

Making the Decision

Undoubtedly the answers to these questions will be yes for more than one product. Over the last 20 years there have been several transitions in the market, and at each transition new products have come on the market that have changed the business model, including the way software is purchased in addition to the cost. Features and functions continue to advance, but the pace of advancement in any technology slows drastically as it matures. The advancements that then make the difference are related to the business model and how the business is run. So the final question to ask yourself once the previous questions have been answered is, "What is the best VALUE for me?" ***If after your analysis, you find that two CAD products work well for your situation, but one costs \$5000 and the other \$750, which would you choose?***

Call or go online for your free "How much will this really cost me?" Total Cost of Ownership calculator (TCO) to see just how good a value Alibre Design really is.

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3D CAD PRODUCT CHECKLIST

The following simple product checklist is provided to use as you review various 3D CAD systems. While you may not need all these features on every design, they are the ones most commonly required by the majority of those using parametric solid modeling.

Your 3D CAD application should support the following:

Part Modeling

The CAD system should support the ability to model your specific parts. In addition to standard features like holes, fillets/rounds, chamfers, draft and patterns, depending on your application, you may need lofts, sweeps and shells. Bosses (adding material) and Cuts (removing material) should be supported, along with a full complement of sketching commands including lines, circles/arcs, splines, trim/extend, fillet/chamfer, patterns, dimensions and constraints. An equation editor should be provided to allow for mathematical relationships between model parameters, and it should support mixed units. Boolean operations should be supported like subtract and join.

Sheet Metal design

The CAD system should provide the ability to create tabs, flanges, dimples and closed corners with various join conditions using the standard sketching commands of the core system. It should be possible to design parts in both the folded or unfolded state and easily switch between the two as you design. It should be possible to set global properties such as stock thickness, minimum bend radius, K-Factor, bend relief type and dimensions. Sheet metal parts should be supported in the same 2D drawings and assemblies as non-sheet metal parts.

Families of Parts

The CAD system should support the ability to automate the creation of multiple parts using Microsoft Excel.

Assembly Modeling

Top-Down Assembly Design

The CAD system should provide the ability to create parts in the context of the assembly using standard part modeling commands. It should be possible to reference other parts in the creation of new parts and establish relations between them. Assembly constraints such as mate, align, orient and tangency with a specified offset should be provided.

Bottom-Up Assembly Design

The CAD system should provide the ability to easily and quickly "assemble" parts created separately. Just as in Top-Down design, it should be possible to reference other parts in the creation of new parts and establish relations between them. Assembly constraints should include mate, align, orient and tangency with a specified offset.

Assembly Analysis and Verification

The CAD system should provide the ability to dynamically drag parts and sub-assemblies using the degrees of freedom defined by the method of assembly and associated constraints. Support for flexible interference checking should be provided between any two set of parts in the assembly, or the entire assembly in one step. Calculation of standard mass and volumetric properties should be provided.

2D Drafting and Detailing

The CAD system should support common engineering standards like ANSI, ISO and DIN. Part and assembly drawings, including exploded views with balloon callouts, should be supported. It should be possible to create drawings with one or more drawing sheets

included, each incorporating one or more views of the following types: orthographic, section, detail, auxiliary, and broken views. You should be able to easily control scale and position on the sheet. Hidden lines should be automatically calculated for each view but it should be possible to turn them off and on. Support should be available for user-defined templates including drawing borders and title blocks, standard drawing formats, dimensions, tolerances, GD&T, layers, cross hatching, and annotations, along with flexible configuration controls to accommodate custom practices or standards. In addition, a variety of flexible printing options should be supported.

- Automatic and associative Bill of Materials (BOM) creation**
It should be simple to generate a Bill of Materials should for all parts contained in an assembly which can then be linked to balloon callouts in exploded views of the assembly. The BOM should be automatically updated when the assembly is changed. A flexible BOM editor should also be provided to tailor the format of the BOM with custom descriptions, columns, and so on.
- Bi-Directional Associativity**
2D drawings should be fully associative with the parts and assemblies they depict. When a part or assembly is edited, the changes should automatically be reflected in the 2D drawing. Associativity should work both ways, so that when a driving dimension is changed in the 2D drawing it will automatically update the "associated" 3D model.
- Integrated Data Management**
The CAD system you choose should provide an integrated data manager for securely controlling access to files, tracking revisions and managing check-in and check-out. If the CAD system does not provide it in the base product it should be available as an upgrade and add no more than \$500 to the total cost of the system.
- Data Exchange**
The CAD system should provide support for the import and export of STEP (AP203 and AP214) and IGES in 3D, the import and export of DWG and DXF in 2D, and the export of STL for manufacturing. Support for other formats like the SAT format supported by the ACIS solid modeling kernel or the XT format supported by the Parasolid modeling kernel are a plus.
- Support for Downstream Applications**
The system should provide support for add-on or downstream applications like photorealistic rendering, standard parts, finite element analysis (FEA), CAM, and so on. Ideally, these capabilities are included in some version of the product at minimal additional cost.
- User Interface and Ease of Learning and Use**
The CAD system should be easy to learn so that users can become productive in a week or less without any training, or with just the standard integrated tutorials and/or computer-based training tools provided by the vendor. These tools should include online help, a user guide, tutorials and video-based training CDs. Instructor-led training should be offered and should typically be no more than three days in length. The system should be easy enough to use that even casual or infrequent users can be productive with a minimum of assistance and relearning time after even significant time spent away from the system.
- Real-time Collaboration**
The CAD system you choose should provide integrated Internet-based functionality when an Internet connection is present. The system should not require it, but if you have an Internet connection it should be possible to directly and securely share files and conduct real-time design sessions or design reviews with other users. This technology is readily available in popular products on the market. Stay away from CAD systems that "bolt on" collaboration technologies to the software; look for a modern architecture providing collaboration and data sharing as core components that are built in.
- Total Cost of Ownership**

- Software Cost**

It is now possible to obtain a complete 3D parametric solid modeler for under \$1,000. Before spending \$3,000 - \$5,000, be sure to review all your options. Ask your vendor for a Total Cost of Ownership calculator to compare your options and to see the actual cost over time associated with a given choice.
- Direct Support at no extra cost**

The CAD system you choose should provide direct support from the vendor at no additional cost for at least one year. It should be possible to contact the vendor by phone, email or live chat over the Internet. The live chat capability is part of a new trend and represents the future of support. Live chat can provide instant answers that can be invaluable when you're under a deadline. And if the CAD system you use supports real-time collaboration, you should also be able to use it to access technical support. **Imagine how easy it is when the support engineer can analyze your design directly and even complete the next step for you.**
- Maintenance and Training Costs**

Ongoing maintenance costs should be less than \$500 per system. Ongoing training costs per new user should be less than \$200 for video-based training on CD-ROMs and \$750 or less for three days of instructor-led training.
- Free trial of at least 30 days**

Before you choose any CAD system, any vendor you are seriously considering should give you a no obligation 30-day trial as a standard part of the sales process. There is no substitute for trying the software before buying.
- Money-back Guarantee for at least 60, or even 90 days**

Hand-in-hand with a 30-day trial is a money-back guarantee. Often a CAD vendor will be on their best behavior when you are in the trial period. See how things change after you have actually "forked over the cash." A money-back guarantee is crucial to truly testing whether the vendor will live up to their claims.
- Supported Hardware and Operating System**

The CAD system should run well on a common PC that costs under \$1,000. It should be possible to run the application on a recent version of Windows such as Windows XP (Home or Professional), Windows 2000, Windows NT, or Windows 98 (note that support for Windows 98 is being phased out for many systems).
- Architecture and Ongoing Enhancements**

The newer the system, the more likely it is to take advantage of the latest advances in technology. The downside of an older system is that it will improve less over time and will eventually require a major redesign. On the other hand, the positive side of an older system is that it has had more time to mature and may be more stable – but this is not always the case. Again the key is to evaluate the product yourself. Also, there should be a consistent track record of ongoing releases, not just major releases. In other words, look for service pack releases showing responsiveness to customers' requests.
- Check Out The CAD Vendor's Business**

The CAD vendor you choose should be increasing their market share and profitability, while also receiving positive reviews and awards from objective third-party industry sources. They should also provide access to customer testimonials and have a thriving online user group. If the company is private or newer than other alternatives, check out their investors.
- Exclusive focus on Mechanical CAD**

The CAD vendor should be solely focused on mechanical CAD. If they support other applications, it's possible some of their attention and resources will be diverted to features and business issues that do not add value to you.