

Explicit Modeling: What To Do When Your 3D CAD Productivity Isn't What You Expected

Introduction

When you began your search for a 3D CAD (computer-aided design) system, you did everything right: You read the analyst reviews, researched the benchmark studies, and evaluated a few trial versions before you invested in a legitimate 3D CAD system. And yet, somehow, you're still not getting the 3D CAD productivity gains that you expected.

Perhaps your engineers are struggling to learn the new CAD system, or you've noticed engineers spending too much time re-creating designs, or engineers can't respond to unexpected changes fast enough, or your design cycles are actually taking longer because of unexpected software performance issues.

The good news is that this situation is fairly common, and your 3D modeling system is not to blame. The not-so-good news? You may actually have a more fundamental problem: your 3D modeling system might be using the wrong approach to 3D design.

Don't worry, there's still hope. If you're having these kinds of problems, it might be time to consider the "explicit modeling" approach to 3D design. For companies where one-off or highly customized product designs are common, explicit modeling provides the optimal level of flexibility in the design process, as well as a profitable, lasting addition to your business.

There's multiple approaches to 3D design

Traditionally, CAD software providers have directed their customers to choose a high-performance CAD system to meet their design needs. And while choosing the right CAD solution is certainly a critical decision, leaders in the CAD software industry now recognize that companies actually have a far more basic question to answer first: Which approach to 3D design best suits their own unique design process?

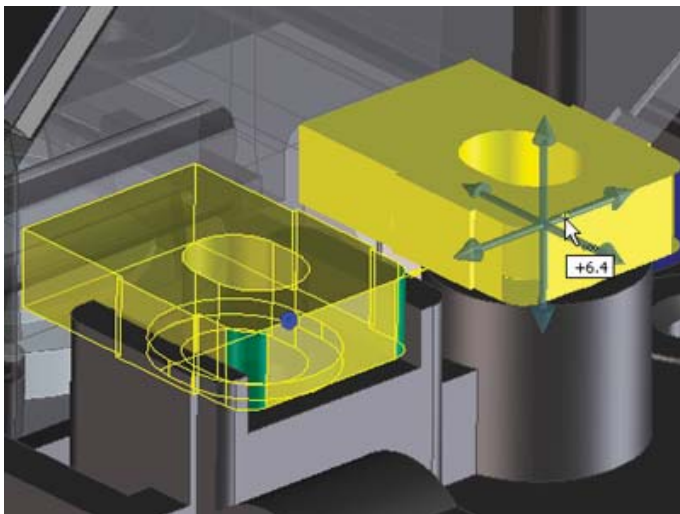
The fact is, there are two mainstream, accepted approaches to 3D design within the manufacturing industry: parametric and explicit. Each approach is different and each offers its own benefits and applications. The trick is determining which approach is right for your company.

Parametric approach

With the parametric approach, designers use parameters, dimensions, features, and relationships to capture intended product behavior. Designers essentially create a "recipe" of embedded engineering constraints and relationships that automates and optimizes the design and product development processes. This methodology makes the parametric approach very powerful and rich, but it does require expert knowledge about how best to embed engineering constraints and relationships within a model.

Explicit approach

With the explicit approach, designers quickly and easily create 3D designs, which they then modify through direct, on-the-fly interactions with the model geometry. The explicit approach is flexible and easy to use, so it's ideal for companies that create one-off or highly customized products—products that simply don't require all the extra effort of up-front planning and the embedding of information within models.



With the explicit approach to 3D design, you can modify 3D models through direct, on-the-fly interactions with geometry.

Other approaches

Within the manufacturing industry, you can find other, less prevalent approaches to 3D design. For example, some CAD vendors offer 3D systems based on a hybrid approach which combines two or more approaches—parametric, explicit, or another approach, like specialized modeling, for example. With the specialized modeling approach, designers leverage rule-based modeling, standards-based inputs, or other databases to drive model parameters.

On face value, these hybrid approaches seem to offer the best of everything, but unfortunately, it's not that simple. With hybrid approaches, designers lose flexibility and often don't achieve the full benefits of either approach because product design strategies typically prescribe one approach over another. Additionally, 3D CAD systems based on a hybrid approach often result in a more complicated product that's more difficult to learn because designers need to master more than one design approach.

Importance of choosing the correct approach for your design process

The correct approach to 3D design should enable you to do much more than just design 3D models. At the highest level, it should make your company more effective, profitable, and innovative by helping you overcome increasing business pressures. A 2006 survey by the Aberdeen Group cites the top five business pressures manufacturers face:

1. Shortened time-to-market (65%)
2. Customer demand for new products (47%)
3. Increasingly complex customer requirements (43%)
4. Accelerating product commoditization (29%)
5. Threatening competitive products (27%)

This list of business pressures is challenging enough without adding "problematic CAD system" to the list. But when companies choose the wrong 3D design approach, that's essentially what they're doing—adding another layer of complexity to product development..

"A designer's job is to design, and 3D tools are instruments for achieving this. Tools that get in the way are not wanted."

— Yoji Sasai, General Manager, IJP Design Department, Seiko Epson Corporation

When companies that are better suited to the explicit approach select a parametric-based CAD system instead, they run the risk of carrying unnecessary overhead in their design process. This can include manually recreating design variations that could have been automated, or manually remodeling existing parts that could have been repurposed.

Consequently, companies experience slower deployment across product development teams, and longer product design cycles. Why? Because their designers 1) can't learn the software, 2) they can't repurpose or reuse designs, 3) they can't work efficiently because of performance issues, and 4) they can't respond to unexpected changes. Here's why:

Difficult-to-learn software

Why can't designers learn software? First of all, manufacturers generally hesitate to remove designers from critical projects and deadlines to learn new software, and product development schedules offer little room for retraining. Secondly, many traditional 3D CAD systems require specific knowledge that doesn't easily transfer to other designers.

Ultimately, both situations result in longer-than-expected deployment across product development teams. New users struggle to learn traditional 3D CAD systems quickly because they require expert knowledge about how best to embed engineering constraints and relationships within a model. Even after a model is created, other designers can't easily modify the design because they don't possess the knowledge about how it was created and the original design intent.

Inability to re-create designs

In order for companies to make the most of their valuable resources, they absolutely require the ability to reuse or repurpose designs. Designers simply shouldn't have to re-create designs from scratch when they could save precious time and money by reusing or repurposing designs that are already complete and tested. However, according to a 2007 report from the Aberdeen Group, many companies don't meet their expectations for design reuse or repurposing because of four major challenges:

1. Model modification requires expert CAD knowledge (57%)
2. Models are inflexible and fail after changes (48%)
3. Users cannot find models to reuse (46%)
4. Only original designer can change models successfully (40%)

With traditional CAD systems, designers shape designs by creating a recipe of geometric features. This complex recipe depends on the order in which the designer added each feature to the structure. While this approach is very powerful when designers want to make large, extensive changes, it's also very limiting. Even a minor change to a single feature could cause invalid geometry and the subsequent failure of a model. It's the geometrical equivalent of pulling a loose string on a sweater and watching the entire garment unravel.

“Too often, I would remodel parts rather than spend the time to reorder the feature tree to make the changes. That wasted both my time and my customer's money.”

– Larry Potts, President, Two Rivers Studio

Performance issues

In a situation where time-to-market is critical for a company's success, software and hardware performance issues can have an unacceptable and detrimental impact on product design cycle length. In the 2006 Aberdeen Group study, companies that typically develop large, complex designs reported slow application performance (31%) and difficulty in managing the complex CAD relationships associated with their large assemblies (39%) among their foremost concerns or problems with their current CAD technology.

Unexpected changes

Companies that frequently face changing customer and product requirements throughout the development cycle require an approach to 3D design that's flexible to change. Unfortunately, many traditional CAD systems limit designers' ability to respond to unexpected changes, just as these systems inhibit designers when they want to repurpose designs. Once again, traditional parametric CAD systems require knowledge about the design intent of a model, particularly knowledge of how it was created.

“We found [traditional CAD systems] to be incompatible with our design environment. It is too difficult to make changes to designs, especially when working in a team environment where our designers will work on each other's models. The resulting delays put the project at risk of not meeting development deadlines.”

– Hideki Obuchi, Olympus Team Leader

Explicit modeling

Because of its unique approach, explicit modeling can help address these concerns and significantly boost CAD productivity.

Easy to learn

With an explicit approach to 3D design, you only interact with model geometry and not with an intricate sequence of design features. That makes initial training on the software easier. But it also means designers working with an explicit 3D CAD system can easily pick up a design where others left off—much like anyone can open up and immediately continue working on a Microsoft Word document. Thus explicit modeling appeals to a variety of audiences: companies with flexible staff; infrequent users of 3D CAD; and anyone who is concurrently involved in a large number of design projects.

“I downloaded the CoCreate Modeling Personal Edition and within 45 minutes I was able to create a molded 3D part. It is so intuitive. I was able to use the software just by following the prompts on the screen without even looking at the Help menu. From there, I was hooked. Within four hours I was making actual parts for my business.”

—Dan Corbosiero, Engineering Manager, DynoTune

Easy to repurpose designs

When designers repurpose a model, they take an existing 3D design and radically transform it by cutting/copying/pasting geometry to derive a new model that has no relationship to the original model. With an explicit approach, companies have demonstrated accelerated product development by repurposing existing designs into new and completely different products. Customers of CoCreate® Modeling, the market leader in explicit modeling, give examples where 50% of parts within new product development are repurposed from previous designs. This unique characteristic of an explicit approach can shave weeks or even months from project schedules.

“In our glass wall system, we have both a curvilinear and rectilinear family of extrusions. It took nearly four months to develop all of the curvilinear family. The rectilinear version took 2.5 hours. We repurposed what already existed and just changed the shape of the skin.”

—Geoff Gosling, Director of Design, DIRTT Environmental Solutions

While some parametric CAD systems may offer direct modeling or direct editing, you shouldn't equate this type of functionality with the explicit approach. Direct modeling is only available as part of a parametric 3D CAD system, so that designers can make minor edits to a design by directly interacting with the model rather than interacting with menus or dialog boxes. The parametric CAD system automatically inserts or appends these minor edits within the feature tree to preserve the benefits of a parametric model.



When designers repurpose a model, they use an existing 3D design and radically transform it to derive a new model that has no relationship to the original.

Even with direct modeling capabilities, the parametric approach is still designed to leverage embedded product information. The explicit approach, on the other hand, intentionally limits the amount of information captured as part of the model definition in order to provide a genuinely lightweight and flexible product design process.

Lightweight

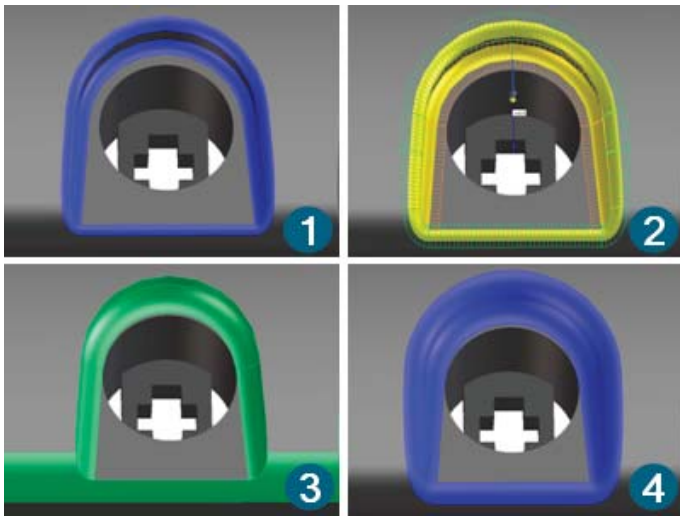
With a parametric approach, data files include parameters, dimensions, features, and relationships that capture intended behavior. An explicit approach, however, reduces data files to the 3D geometry only, dramatically reducing the design data of each individual part, so large and complex designs don't overwhelm hardware or software.

Customers of CoCreate Modeling report that files can be as little as 33% the size of a similar design file from a parametric CAD system. Smaller file sizes mean designers can load and store data files faster, reload and update parts to new revisions instantly, and make better overall use of their computer memory.

When combined with a data management system, an explicit 3D CAD system can also help manage complex relationships associated with large assemblies. For example, an integrated data management system automates revisioning and encourages true concurrent team design because all designers have access to the most up-to-date design data. When all design data is centralized in a common database, companies can ensure that no one works on the wrong revision of a component, or changes a component reserved by someone else.

Flexible

Companies that develop new-to-market and one-off product designs often face changing customer and product requirements throughout the development cycle. An explicit approach is always open to change, so companies can keep the window for new product information and major product changes open longer. Unlike other 3D design approaches, including hybrids, explicit modeling can offer true flexibility because it doesn't require any upfront planning or the embedding of design information within models.



An explicit approach is always open to change, so you can easily, quickly, and even radically modify geometry throughout the development cycle – often in just a few steps.

Additional benefits of explicit modeling

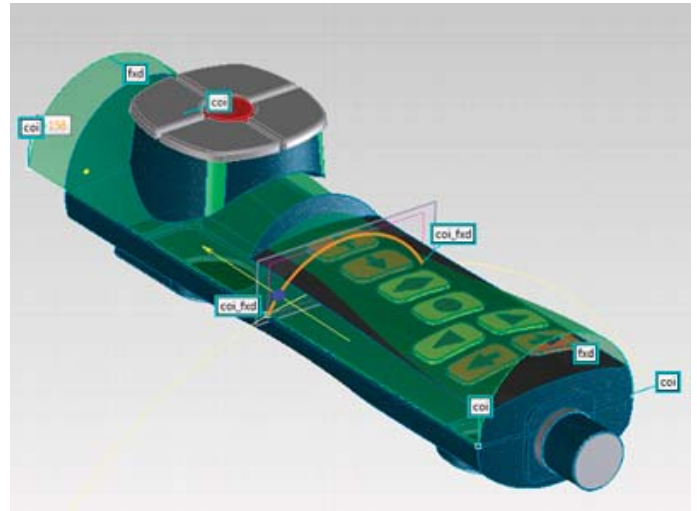
An explicit approach to 3D design offers lasting benefits to companies, especially where one-off or highly customized product designs are common and where companies require the highest level of flexibility in the design process to respond to unexpected changes.

Rapidly evolve and explore designs

Innovative product design involves exploration and discovery. An explicit approach gives designers the freedom to rapidly evolve a product design in unpredictable and new directions where modifications can't be anticipated in advance.

Rapidly iterate designs

With the explicit modeling approach, companies can rapidly test ideas, evaluate a broad range of options, and constantly adapt and refine a product as it moves through the development process. Companies benefit when they experiment with changes while changes are inexpensive and product designs aren't locked into a specific development path.



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“The explicit modeling approach has proven much faster for us. Even after many iterations of design changes, the models can be handled by anybody in the team. All our unexpected changes could easily be incorporated into the models.”

—Marten Verhoeven, Head of ICT, Van Beek BV

Maintain flexible design teams

An explicit 3D CAD system frees any team member to contribute to and carry a design forward so companies can rotate designs between engineers to increase engineering productivity and eliminate resource bottlenecks or project delays. When companies rotate designs between engineers, they also create opportunities for higher quality and more creative product designs, because different engineers can both review the work and add their own perspective.

Design responsibility is easily reassigned when different engineers or engineering teams become unavailable during the course of a project. For global companies, product development can move between different parts of the world, as needed, when anyone can contribute to and modify a design.

Work with multi-source CAD data

Explicit 3D CAD systems excel at importing and modifying of multi-source CAD data, which benefits companies working across an extended supply chain for procured components or subcontracted design.

STEP and IGES are essentially native 3D design data formats in an explicit approach because explicit 3D CAD systems interact intelligently and on-the-fly with geometry, and geometry is the only common element across all CAD systems.

“We use the explicit modeling-based approach to streamline our collaboration with development partners. For example, our team imports partner’s CAD models for diesel engines right into CoCreate Modeling, where we can easily fit fixture geometry to our current requirements.”

–Christian Herrmann, IT Director, MANITOU

The right approach

When companies select the right design approach, they can maximize their time savings from a 3D design process, which directly relates to design cycle length, engineering productivity, and time-to-market.

It’s a critical decision, so how do you know if an explicit approach to 3D design is right for your company?

Consider your company’s product strategy, design strategy, and the average development cycle length for new designs. Then evaluate how well each of the following statements describes your company. The more you agree with these statements, the more likely explicit modeling is the right approach for you.

Product Strategy

- We develop one-of-a-kind, new-to-market products.
- We develop custom, design-to-order products.

Design Strategy

- Our company would greatly benefit by repurposing previous design work to quickly reach new, unique product designs.
- Our product designs rely on the ability to radically adapt and change to new and shifting design requirements.
- Our company would greatly benefit from fast and responsive on-the-fly interactions with 3D models.

New-design Cycle Length

- Our product design cycles range from weeks to months.
- Our company needs to reach a design solution as fast as possible.
- Our company faces intense competition, time-to-market pressures and shorter marketing windows.

Conclusion

It’s simple: companies today need to be as profitable, efficient, and innovative as possible. They shouldn’t have to put up with inadequate CAD productivity.

The explicit approach to 3D design, with its lower overhead and flexibility, offers a better solution, especially for companies that rely on the ability to radically adapt and change to new and shifting design requirements.

And once you’ve determined that the explicit approach best suits your unique needs, you can choose a 3D CAD system that will bring your company the biggest benefit and long-term success.

Try the best in explicit modeling – free.

Download CoCreate Modeling Personal Edition (PE), the world’s first free explicit 3D CAD software, and see how the explicit modeling approach to design can help your products come to life.

When you try CoCreate Modeling PE, you’ll get all the flexibility of the standard CoCreate Modeling 3D CAD system, for assemblies up to 60 parts.

Visit www.cocreate.com/products/PE2/ModelingPE2.aspx to learn more.

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