

Explicit 3D Modeling: An Alluring Alternative for 2D Holdouts

Introduction

Despite the growing market pressures and the advantages of 3D CAD, many companies still rely exclusively on 2D design or drafting for their design process. In fact, a recent Aberdeen Group study suggests that as many as 85% of those who design products primarily employ 2D design or drafting only.

Why? Because 2D design still works. For companies with a large amount of geometry and multiple revisions of data, like those that develop specialist processing equipment for example, the challenges and risks of adding 3D modeling to their design process simply outweigh the benefits. With 2D design, companies know they have a functional, tested, and reliable system already in place.

This paper discusses explicit modeling, an alternative approach to 3D design that offers a more palatable solution for those still working in 2D. For companies where one-off or highly customized product designs are common, explicit modeling provides less disruption to existing processes as well as a profitable, lasting addition to the business.

Driving business pressures

Most companies add 3D modeling to their product design process to overcome increased pressures in manufacturing. A 2006 survey by the Aberdeen Group cites the top five business pressures manufacturers face:

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

But most in the industry don't need an analyst survey to know that consumers consistently opt for newer, better products that are increasingly more complex than those that came before. And more often than not, competitors are rarely far behind.

To succeed, manufacturers must develop innovative products, optimize the efficiency of operations, and adopt practices, methods, or tools to save their most precious commodities: time and money.

“Cost pressures and time to market challenge us the most. Not only do we have to develop and produce our tools quickly to shorten production times and lower costs, but we also need to constantly refine our manufacturing processes.”

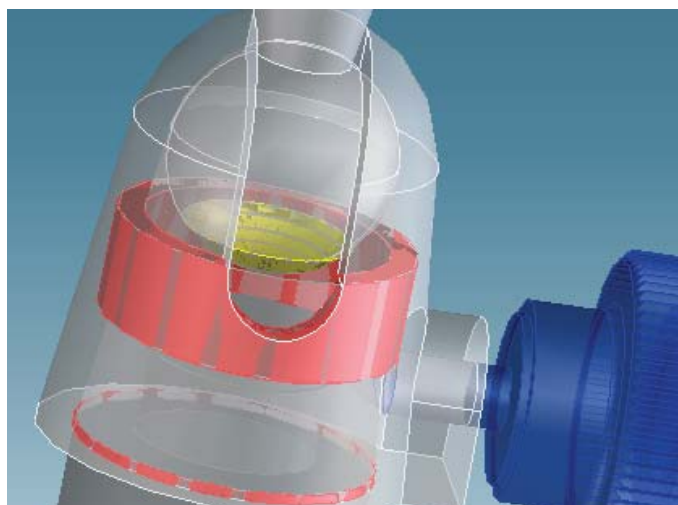
— André Kissling, Head of Technology, Stanzwerk AG

3D modeling benefits

Since their birth twenty years ago, 3D CAD systems have grown exponentially more sophisticated, powerful, and robust. Today, 3D modeling can offer considerable benefits through virtual prototypes, extended add-on capabilities, and improved external and internal communication – all of which address the major business pressures of manufacturers, regardless of the specific 3D modeling approach or CAD system.

“In the past we sometimes had to manufacture prototypes of machine parts. With [3D modeling], we avoid expensive prototyping completely.”

— Peter Johnsson, CAD/PDM Manager, Norden Machinery A/B



You can use 3D models to check for potential collision problems. In this example, red areas show where parts overlap, and yellow shows where parts touch.

Virtual prototypes

Companies that only use 2D development often remain unaware of collision problems until they assemble a physical prototype. With 3D CAD, however, manufacturers can develop virtual prototypes in 3D space. That means manufacturers can check models for both potential problems and overall quality before making costly investments of both time and money on a physical prototype.

When manufacturers investigate potential problems earlier in the design process, they can also substantially reduce the number of expensive change orders later. Fewer physical prototypes and change orders means better quality designs, shorter time to market, and lower product development costs.

Extended add-on capabilities

Unlike 2D CAD, 3D CAD systems offer many extended add-on capabilities for both design teams and downstream departments. For example, design teams can use the extended design capabilities to automate, innovate, and reuse or repurpose designs – all of which ultimately lead to better products, developed faster, at reduced costs.

With 3D modeling, downstream departments can also work concurrently with design teams. 3D modeling systems automatically update design deliverables so downstream departments get to work earlier and don't worry about starting over when designs change. This type of concurrent product development both lowers the cost of product development and shortens time to market.

Improved communication

Complex 2D drawings require a specialized education to fully grasp. However, with 3D models, non-engineers can easily visualize a design, which helps avoid misunderstandings and communication errors.

“Thanks to 3D, we can better visualize our product design. Many of our decision makers can’t read, or have trouble understanding complex 2D drawings. Most of our 3D models are easy to comprehend.”

— Bernard Haag, CAD Group Manager, A. Fritsch GmBH & Co. KG

Migration challenges

Despite the long-range benefits of 3D CAD implementation, migration from a 2D to 3D process disrupts teams and presents risk. Invariably, immediate concerns emerge for anyone considering the 2D to 3D transition.

Learning unfamiliar software

According to the 2006 Aberdeen Group study, up to 63% of companies cite learning unfamiliar software as one of their primary concerns. And it’s a legitimate reason to worry – with increasing business pressures, manufacturers hesitate to remove designers from critical projects and deadlines to learn new software. Product development schedules offer little room for re-training, and traditional 3D CAD systems sometimes require specific, unique knowledge that doesn’t easily transfer to other designers.

Performance issues

In the same study, companies that typically develop large, complex designs and who recently migrated to 3D listed slow application performance (31%) and managing the complex CAD relationships associated with their large assemblies (39%) among their foremost concerns.

Legacy data

Up to 44% of all respondents surveyed in the Aberdeen Group study reported a significant level of concern about what to do with legacy 2D data after the adoption of 3D CAD. If a company maintains a large set of 2D data, the prospect of converting it all to 3D is overwhelming and any company that makes this transition faces this critical question.

Return on investment

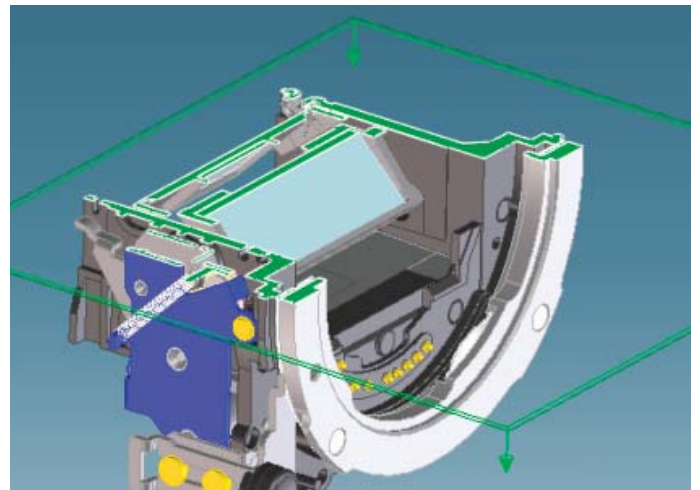
If a company can’t clearly identify the benefits of 3D modeling, it’s difficult to make a business case for such a significant investment. Indeed, up to 50% of companies who participated in the Aberdeen Group study listed this concern as a top reason they hadn’t yet migrated to 3D. These companies wisely recognize that making the transition to 3D modeling requires a significant investment of both time and money, resources typically already in short supply.

Explicit is different

There are two mainstream approaches to 3D design in discrete manufacturing – parametric and explicit.

With the parametric approach, designers use parameters, dimensions, features, and relationships to capture intended product behavior. Although the parametric approach is powerful, it does require expert knowledge about how best to embed engineering constraints and relationships within a model.

With the explicit approach, on the other hand, designers quickly and easily create 3D designs. Then they modify the models through direct, on-the-fly interactions with geometry, so it’s flexible and easy to use.



With an explicit approach, you can modify geometry on-the-fly, similar to 2D design methods. This example from CoCreate Modeling illustrates how you can design within a 2D cross section of a 3D model.

“Because [explicit modeling] is very easy to learn, designers can master it in a surprisingly short period of time. Engineers are fabricating models in only three hours after a brief introduction. Others are operating design work just as they did with 2D one week later.”

—Daishi Miyahara, design group member, Chikuma Seiki

Migration with explicit modeling

Because of its entirely different approach, explicit modeling helps make the challenges of migrating from 2D design to 3D modeling easier to overcome.

Easiest to learn

With an explicit approach to 3D design, you only interact with the model geometry. Designers don't have to create or maintain a complex recipe of parametric design features to produce model geometry. 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 come back and immediately continue working on a Microsoft Word document. So, explicit modeling appeals to companies with flexible staff, infrequent users of 3D CAD, and anyone concurrently involved in a large number of design projects.

In terms of flexibility and technique, the explicit approach to 3D design is also quite similar to the 2D approach. That makes the explicit approach easier to learn because existing 2D designers easily transfer their skills and quickly adopt explicit 3D CAD systems. Designers don't need to plan their designs in advance. Instead, they can let their designs evolve freely throughout the exhaustive design process, just as designers do when they work with 2D design. Plus, the explicit approach adapts certain 2D techniques to 3D modeling. For example, designers can move and stretch 2D geometry or even design within 2D cross sections of a 3D model.

Lightweight and data management compatible

With a parametric approach, data files include parameters, dimensions, features, and relationships which 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, the market leader in explicit 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 no one works on the wrong revision of a component, or changes a component reserved by someone else.

Self-paced migration

2D design still works, so for most companies the migration of legacy data doesn't have to occur all at once, if at all. Instead, companies can begin new projects in an explicit 3D CAD system, and leverage their existing 2D data to create new 3D models, if necessary.

For example, when Austrian machine tool producer, Emco, began the migration from 2D to 3D, they started by developing one complete project with CoCreate Modeling. Emco successfully created a functional prototype of their Hyperturn 665, a CNC machining center and the most complex machine the company has produced, within 12 months.

Plus, now that Emco applies their explicit 3D CAD system to all new projects, mass production of sheet metal components runs faster and more reliably than before.



The Hyperturn 665 is first project Emco developed with explicit modeling and the most complex machine the company produces.

Worth the investment

As demonstrated by Emco, companies can stage the adoption of 3D modeling so they initially develop only one project in an explicit 3D CAD system. In this manner, companies can evaluate the benefits of an explicit approach without compromising project development schedules.

Some explicit 3D CAD systems also include fully capable 2D design and drafting tools which can help minimize any risk. These integrated, add-on annotation modules create manufacturing drawings of 3D models so companies have the option to implement 3D modeling in the design process and still continue to use 2D for downstream processes.

However, as designers gain experience with a 3D to 2D annotation module, they also learn the concepts required for a full, standalone 2D drafting system. Vendors often offer these 2D CAD systems to

“Today the roll-out of a complete project takes 50% less time, due largely to the integrated 2D, 3D, and PDM processes.”

— Davide Nannetti, Senior Designer, MG2

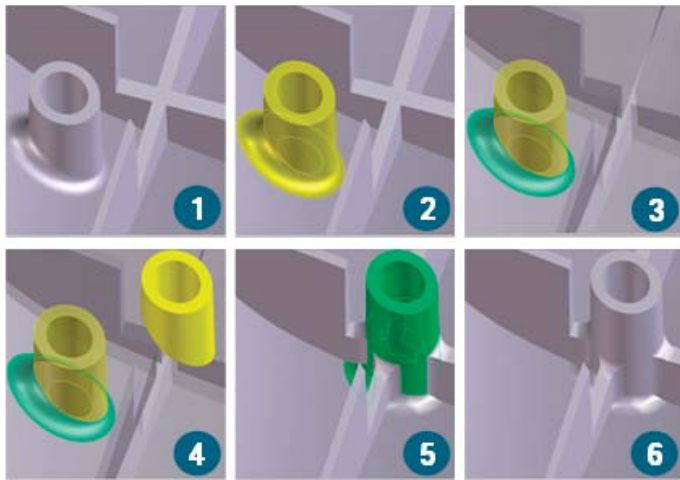
compliment their explicit 3D CAD systems. That means companies that migrate their 2D design processes, as well as add 3D modeling, would only require a single vendor for all their design needs. Plus, these companies can reap additional benefits by incorporating an integrated data management system for all their design data.

Lasting benefits of explicit modeling

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

Repurpose designs

With an explicit approach, companies have demonstrated accelerated product development by repurposing, or radically transforming, existing designs into new and completely different products. Customers of CoCreate 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.



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

Stay open to change

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 open longer for new product information and major product 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

An explicit approach allows companies to 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.

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 the import and modification of multi-source CAD data, benefiting 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 wrong approach to 3D design, 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.

When companies select the right approach, they 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 checkmarks you have, 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

For some companies that still rely exclusively on 2D design, the challenges and risks of adding 3D modeling to their design process consistently outweigh the benefits, despite growing industry pressures and clear advantages of 3D modeling.

The explicit approach to 3D design, with its lower overhead and flexibility, tips the balance for those companies so that 3D CAD is finally a viable and lucrative addition.

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, for 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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