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MANUFACTURING
WHITE PAPER

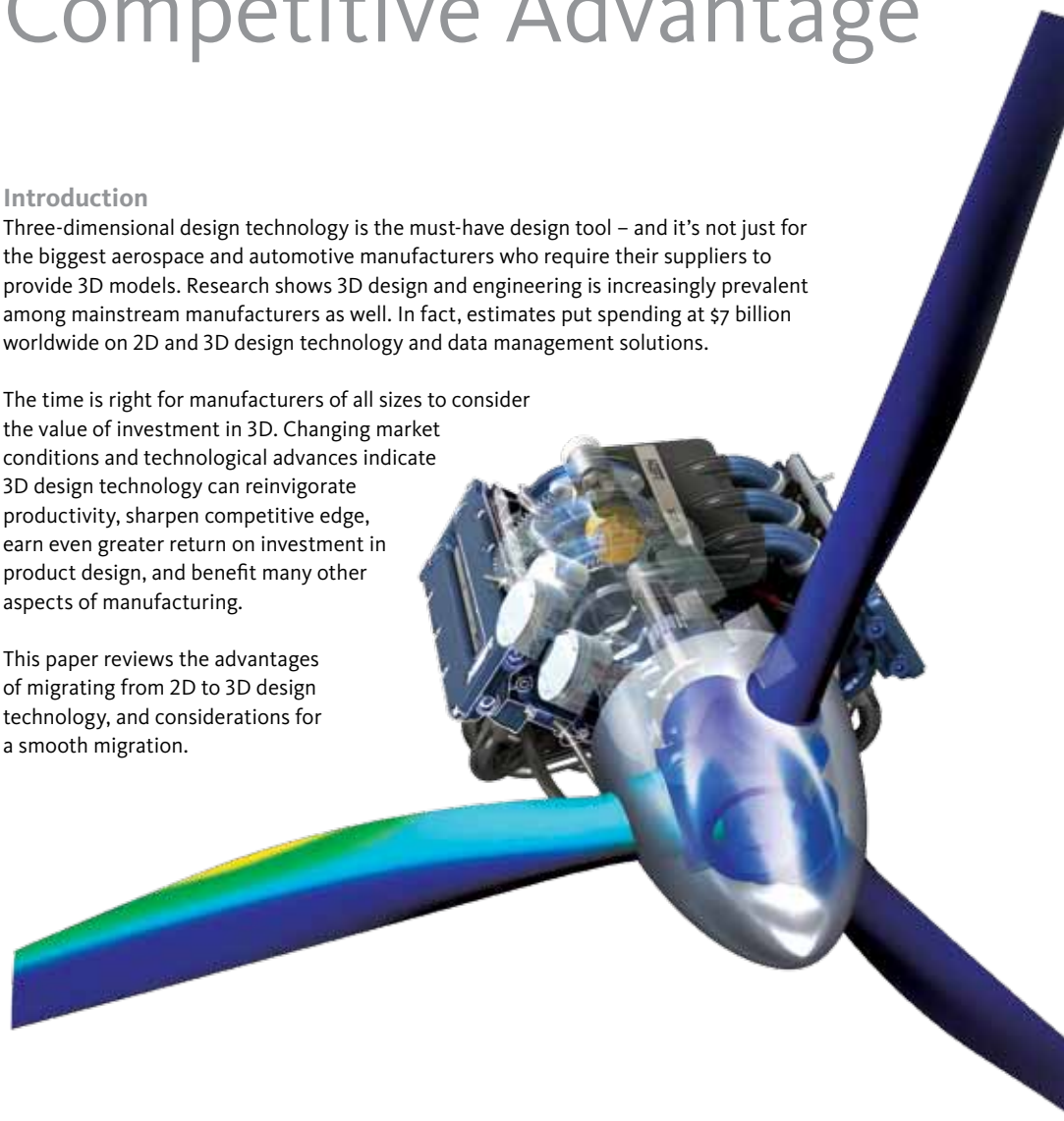
3D: Designing Competitive Advantage

Introduction

Three-dimensional design technology is the must-have design tool – and it's not just for the biggest aerospace and automotive manufacturers who require their suppliers to provide 3D models. Research shows 3D design and engineering is increasingly prevalent among mainstream manufacturers as well. In fact, estimates put spending at $7 billion worldwide on 2D and 3D design technology and data management solutions.

The time is right for manufacturers of all sizes to consider the value of investment in 3D. Changing market conditions and technological advances indicate 3D design technology can reinvigorate productivity, sharpen competitive edge, earn even greater return on investment in product design, and benefit many other aspects of manufacturing.

This paper reviews the advantages of migrating from 2D to 3D design technology, and considerations for a smooth migration.



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The Impact of 3D: A Second Look

Three-dimensional design technology helps improve the design process that in turn benefits business. Manufacturers find that migrating from 2D to 3D tools makes design work more efficient and accurate, producing better overall design quality and fewer (expensive) errors. Exploration of new design ideas becomes easier because engineers don't have to spend time making new 2D drawings in order to look at design alternatives. The use of 3D tools also can help communicate concepts to a diverse audience, without sacrificing tried-and-true modes of communication with suppliers and partners.

As a result, design teams are more productive; companies can get better products to manufacturing – and even get them to market faster; and firms can improve styling and innovation cost-effectively for competitive advantage, as well as business growth.

Efficient Design: Faster, Easier Drafting

Three-dimensional modeling software handles a number of tough drawing exercises to help users understand their designs and make better decisions earlier in the product development process to save time and reduce the likelihood of error.

When it comes to representation, 3D design software can create everything that a 2D application can. But new 3D modeling tools make it possible to create and modify some of the most challenging objects to design. These 3D applications produce accurate representations of highly complex parts, such as casings that have curved surfaces; very large assemblies containing thousands of parts; and appropriately routed tubes and wiring.

New 3D tools also automatically generate front, side, iso, detail, section, and auxiliary views based on automatic retrieval of model dimensions. Layering capabilities make it easier to map groups of elements between 3D and 2D applications, for easy importing and exporting of data. Quite simply, 3D technology is the fastest way to create a drawing.

Powerful computational capabilities and content libraries built into 3D software streamline mechanical design tasks such as shaft, cam, and gear generation as well. In addition, 3D tools perform interference detection and calculate weight and mass. These automated functions make it faster and easier to change designs, too. All of these capabilities mean that 3D models can be created and updated easily and quickly, and concepts can be visualized more clearly than is possible from a collection of 2D elements.

Accuracy Matters: Design Updates and Associativity

Getting a design finished and into production is more than a question of speed; it's a matter of accuracy. When complex designs incorporate thousands of parts and assemblies, accuracy can have a huge impact on the time and cost of bringing a new product to market.

Three-dimensional models offer huge advances in error checking. In part, this is possible because 3D design applications capture product parts' association to one another and show users how those parts interact. Design changes are made more efficiently using 3D design technology, too, because the software updates all associated drawings and assembly components automatically – where 2D designs might require days or weeks of modification.

The "smart" associative capabilities of 3D design technology also support design intent. By maintaining the connection among product elements, 3D tools help to ensure that the design remains intact as it was intended to fill a business or functional need, or both. This design intent is important when proven designs serve as the foundation for new products, and when their creators may have moved on to another project or company.

What's the Difference between 2D Drawing and 3D Modeling Technology?

Design engineers most often are focused on two major tasks: design and/or documentation. The primary difference between 2D and 3D technology is apparent in the amount of time designers spend on these tasks when they use the respective tools.

Unlike 2D drafting tools, 3D modeling technology provides lifelike representation of a design, from structural composition and the way parts fit and move together, to the performance impact of characteristics such as size, thickness, and weight. When engineers can see the sum of the parts in 3D, they can see issues and opportunities without ever having to spend time creating documentation. Rather than starting a new product concept with meticulous 2D technical drawings of elements that might not function as planned, 3D design technology quickly shows whether a design idea is viable.

This difference amounts to business advantage for companies that otherwise might have to retrace all manufacturing processes in search of an answer – or build physical prototypes of products that don't function as desired.

China's Unicorn Industrial Sewing Machine Co. makes sewing machines for consumer and commercial use. The manufacturer evaluated several 3D software options specifically to make product design more efficient and reduce design cycle time and potential for error. Autodesk Inventor® Series software has made it possible even for new engineers to design the most complex aspects of industrial sewing machines, which can have more than 1,000 precision parts and assemblies, in a third less time.

Haskell International, which makes pumps and other equipment, offers a compelling example of time and costs saved with 3D design applications. The company used 3D technology to model its product and within a matter of days had identified and corrected a flaw in the fit between two parts. Today, the company has a track record of perfect product function for virtually every pump that comes off the production line.

Cost-Effective Design: Fewer Errors, Fewer Prototypes

Three-dimensional design software's automatic, associative updates take the guesswork out of design accuracy, whereas 2D drawings are more difficult to keep accurate and current. With so many individual 2D elements to track and modify, design problems still can show up in the prototyping stage – or worse, on the shop floor. Exact time and money saved by using 3D technology varies for each manufacturer, but conventional wisdom holds that every error that gets through to the next phase of production without correction increases ten-fold in cost. And it's no secret that engineering change orders are costly when they're issued after a design is signed off.

For Unicorn Industrial Sewing Machine Co., 3D technology meant a dramatic transformation in a design process that typically required creating, reviewing, and refining as many as five prototypes. Using Autodesk Inventor, the sewing machine maker was able to refine product design using 3D solid models and make the very first physical prototype a successful one.

Simulation capabilities in 3D design tools also help trim spending on costly prototypes, and reduce time spent iterating design and producing new physical models in order to get to a prototype that works. In conjunction with performance testing and analysis software, 3D solutions help manufacturers make significant refinements to product designs before they reach the prototype stage.

Product development with fewer prototypes leads to more than lower cost. In fact, 3D development tools may eliminate the need for prototypes altogether, because engineers can perform all of the testing and make the refinements that once were possible only through use of physical models. As a result, the real-world model produced from the virtual one is often production quality, and can be shipped to customers as a sample.

Faster Time to Market: Design Reuse, Reduced Redundancy

Because it's easier to create and test concepts with 3D design tools, engineers more quickly arrive at designs that work. And data management technology, often integrated right into 2D and 3D CAD applications, makes it easy to find and use them again and again.

Commercial lighting industry giant Lightolier cut its product development costs by 35 percent in the first 10 months of using Autodesk® 3D design technology.

In addition, 2D-compatible tools make it convenient to take advantage of legacy drawings and previous work – for greater productivity and lower cost. In fact, design reuse avoids redundant efforts and is an example of the kind of design process improvement that can help trim time to market and cost of developing a new product by 80 percent or more.i

However, time to market is not the only proof of superior performance. Some companies find that the time it takes to produce goods remains the same, but 3D modeling reveals issues that can be corrected for greater product quality. Other manufacturers find 3D design technology helps make better use of engineers' time because it provides as lifelike a model as is possible, and helps pinpoint the problems designers should focus on solving, instead of spending time documenting product ideas that would prove to be unworkable at the prototype stage.

Design Quality: Maintaining Standards, Earlier Testing

From outsourcing to departmental organization, a host of circumstances outside the design department can make it hard to maintain quality standards. For example, when an assembly's components are designed by separate teams or separate companies, it's difficult and time-consuming to do interference checking and confirm that parts will fit and work together.

Three-dimensional design software gives engineers the power to model their designs' performance before they go to physical prototype. When manufacturers can standardize product development using a proven set of core components, they raise the bar for quality, as well.

Better Communication: Addressing Different Audiences

Three-dimensional design technology helps manufacturers communicate and collaborate better with their supply chain. The development process can be fragmented by outsourcing (or simply the way a company is organized), but 3D technology helps minimize misinterpretations between companies and cultures by providing early and accurate 3D solid models – without disrupting established practices such as exchanging 2D data with suppliers. The potential for misunderstanding that can lead to ineffective selling strategies, production and assembly errors, and lost revenue opportunities is nearly eliminated.

Communication with non-engineers inside and outside the firm becomes more productive with 3D, as well. Sales and marketing personnel, production-line staff, vendors, partners, and clients unaccustomed to looking at flat 2D drawings may have a hard time imagining a product concept, but 3D models offer lifelike representations of objects and even simulate motion of parts working together.

For Genlyte Thomas Group, parent of commercial lighting maker Lightolier, Autodesk 3D design technology, data management, and collaboration software helps unify research and development for common engineering components across 29 brands. Lightolier is using Autodesk 3D design and collaboration technologies to share data across its extended manufacturing teams, and to exchange data with suppliers and customers worldwide including Taiwan and China. The Autodesk solutions serve as a platform for delivering parts and products of consistently high quality that Lightolier and its parent regard as competitive advantage. Famecs, a global manufacturer that exports equipment for factory and agricultural automation, is using Autodesk Inventor Series to better communicate within the organization. By adding 3D design capabilities, the Korea-based company's design engineers now share data with the rest of the company to purchase supplies, plan production, and develop effective marketing materials.

A New Era of Style: Form and Function

With the power to generate sophisticated 3D models, manufacturers find they have new styling options. Sleek design is making its way to the industrial products showroom floor, where makers of heavy equipment are finding that a streamlined housing around complex machinery, for example, helps sell product. Three-dimensional solid models visualize styling alternatives in a way that is not possible in 2D.

Most important, 3D models present new opportunities for product function in the form of superior ergonomic design. Highway safety device manufacturer Energy Absorption Systems Inc. relies heavily on 3D modeling technology to visualize the fit and function of devices such as truck-mounted crash attenuators.

For Energy Absorption Systems Inc., a leading provider of highway safety products, 3D drawings created and animated using Autodesk Inventor Series help customers understand how a safety device will work in conjunction with their own equipment.

These capabilities allow more initial prototyping using computers rather than building physical models and manipulating them by hand. The nature of safety products requires physical prototyping for crash testing and simulation, but because early computer models can be evaluated with ANSYS and LS-DYNA stress-analysis software, the manufacturer can build physical models with better confidence in their function.

Productivity: Design – Not Software – Engineers

There are many examples of how 3D design technology can boost engineers' productivity. Faster development, design reuse and more efficient, effective communication are the tangible effects 3D tools have on engineers' time. There are some intangible productivity benefits that come with the technology, too. These include incentive, career growth, motivation and focus.

Because 3D product development is a cutting-edge capability, it helps position manufacturers as progressive, desirable partners or vendors. Employees also find the opportunity to use 3D tools appeals on a personal level and on a professional one, in terms of improving their skills and staying current with market demand.

According to Tim Morris, director of Global Engineering Systems at Joy Mining Machinery, 3D modeling technology lets engineers focus on being engineers, instead of CAD experts.

Innovation and Growth

The technical capabilities of today's 3D software pave the way for faster innovation and growth. Engineers who use proven designs as the basis for product enhancements and development spend less time designing parts that already exist.

When as much as 75 percent of a product's cost over its lifecycle is determined up front by its design, building on top of and reusing proven product elements is critical for decreasing time to market and reducing costs. Three-dimensional design tools make better use of engineering resources and free staff to tackle meaningful problems and invent new solutions.

Choosing to Migrate

The first step in migration from 2D to 3D design technology is to see the technology in action. A professional demonstration will show what different product suites can do, and help you come up with a complete set of considerations for making the decision to migrate.

In addition, answering several questions will help you understand your company's real potential for return on investment in 3D technology, and can help you evaluate which package is right for your organization.

- Is the software compatible with legacy designs?
- Is the software compatible with the way our company interacts with suppliers?
- Can it be integrated with stress test, performance analysis, and other software?
- Can we stage the migration at our own pace?
- How quickly can we improve productivity?
- What resources do we need to dedicate to the migration, to make sure it's successful?
- What outside resources are available to help make the decision?

Using Legacy Designs

Look for 3D design technology that integrates with legacy 2D designs. This capability makes it easier to migrate to 3D. It also ensures that valuable, proven designs rendered in 2D continue to be available for use in new product development. A good 3D solution not only allows 2D and 3D design data to coexist and interoperate, but also makes it easy to organize and find those designs and components.

Support for Supplier Relationships

A smooth transition from 2D to 3D technology will affect not only the work of design and production personnel, but interaction with the supply chain. It's worthwhile to consider technology that accommodates the real or de facto standards that customers, partners, and prospects have for exchanging drawings and information with your team. Software from an established, industry-leading vendor gives you even greater assurance that your selection will be compatible with customers' and vendors' systems, as well.

Integration with 2D technology is important for manufacturers who regularly share 2D design data with their suppliers. At Joy Global Inc., a worldwide leader in mining machinery and services, this aspect of Autodesk 3D modeling technology helps the manufacturer communicate designs more quickly to its vendors.

Joy outsources most machining, casting, and forging tasks to companies whose 2D design engineering software is compatible with Autodesk Inventor, Joy's global 3D design platform. And as a result, drawings are exchanged easily, increasing the probability of accuracy and decreasing waste due to production specification errors.

Compatibility with Special Applications

To streamline your company's design process, look for 3D technology that's compatible with industry-specific software applications for design performance and stress testing, or evaluation against safety requirements. Because Autodesk 3D tools integrate with industry-standard ANSYS and LS-DYNA stress evaluation software, Energy Absorption Systems, Inc. engineers refine their designs electronically, increasing the success rate of physical prototypes when they are created. Moving forward, the highway safety equipment manufacturer anticipates integrating Autodesk Inventor Series with its ERP system so that part numbers will be linked to reference drawings and compatible partners for computer numerical control (CNC) machining, die design, mold flow, and more.

Pace of Migration

Just as there are reasons 2D drawings will continue to be necessary – for communicating with trading partners and as the basis for new designs, there are reasons to make your engineering team's transition to 3D a gradual one. Design tools that allow your organization to adopt 3D in stages minimize chance of business disruption. Incremental success measured in time or costs saved will create momentum for further adoption, while applications that require time-consuming, widespread deployment raise expectations and the prospect of greater risk if they fail.

Piloting 3D Design Technology

A pilot deployment is crucial to choosing 3D design software. Many companies rush this phase of the decision and don't explore product features and functions. They need to invest in time and training to understand how to operate the technology properly.

A well-designed pilot will reveal how easy or difficult it will be for your team to begin using the technology. The pilot also will show what it will take to make the technology part of the department's workflow and process. A pilot that's too brief or perfunctory may not give you enough information to understand the impact of 3D technology on design engineers' productivity, or on their collaboration with partners and clients. Larger firms may choose to call on value-added resellers or vendors' services teams to help them plan implementation strategies, too.

An effective pilot is more than a question of asking design engineers to try out technology for a month and report how it feels to use it. Good pilots are designed with a core set of users, and with specific goals that encompass a variety of tasks that simulate a company's likely use of 3D technology. These activities and actions could include:

- Product redesign;
- Integrating 2D drawings;
- Modifications to designs;
- Exchanging drawings and data with partners;
- Performance testing; and
- Design archive searching.

In addition, pilot programs should incorporate training – by the vendor or reseller, for example – on all of the features and functions of the software being tested. The project timeline should identify the point at which pilot activity will shift from product function and usage evaluation to assessment of deployment requirements. Each organization is unique in its needs, and this requirements-gathering phase should address specific user needs that will in turn impact the timeframe for actual deployment.

Improving ROI with 3D Design Technology

Three-dimensional design technology can extend return on investment in product development well beyond the engineering department. The Netherlands' Boon Edam is a good example. The world market leader for revolving doors is using Autodesk Inventor to automate the design process as well as a range of functions from pre-sales to service.

Boon Edam configures products with Autodesk Inventor to meet a wide range of requirements for customers around the globe, without reinventing proven components. Door design is now simply a matter of entering all required parameters into a database linked to the Autodesk technology, which automatically generates the model, the required drawings and the data for the NC (numerical controlled) sheet metal punch presses and laser cut machines, and a bill of materials.

Autodesk: Providing the Right Tools for the Job

Autodesk offers the most comprehensive design tools on the market, including Autodesk Inventor, the world's best selling 3D mechanical design software. Autodesk Inventor, integrates its 3D capabilities with AutoCAD Mechanical for 2D mechanical design, and works seamlessly with AutoCAD. When the majority of manufacturers use Autodesk products to create 2D drawings, Autodesk is a natural partner in the migration from 2D to 3D design.

Autodesk technology allows design teams to discover the benefits of 3D design and introduce it in stages, at the pace that's right for the company. Autodesk 3D tools encompass capabilities to design every element of a finished product, from tube and pipe and electrical controls, to analytical functions such as Finite Element Analysis. Lastly, only Autodesk design solutions for manufacturing incorporate data management tools that drive design reuse and help synchronize efforts across design teams, and drive efficiency throughout the manufacturing process.

Manufacturers like those you've seen here have transitioned to 3D design technology and are finding new ways to generate return on their investment in product designs and in engineers' time. These companies are using 3D technology to improve their teams' productivity, achieve new heights of innovation and speed to market – and greater competitive advantage. Their customers expect high-quality, low-cost products to suit their needs, and these manufacturers are delivering more, profitably.

An Italian manufacturer of agricultural machines including combine harvesters for grass, hay, wheat, and corn, Cicoria s.r.l. wanted to take advantage of 3D modeling without sacrificing a wealth of insight and success reflected in its legacy 2D drawings created in AutoCAD® DWG format. As the format of choice for communicating with Cicoria's suppliers, 2D compatibility was doubly important – and one of the main percent, and reduced development costs by 25 percent.

By migrating to Autodesk 3D design technology, Boon Edam has reduced production errors 80 percent and now makes one-quarter the number of assemblies it once had to produce. But the real return on investment is in costs saved after a sale. Better design translates to better product function, and that's virtually eliminated the door manufacturer's former and frequent shipments of replacement parts to customers.