SOLIDWORKS

3DEXPERIENCE®

USING DESIGN AUTOMATION
TO REDUCE COSTS AND INCREASE PROFITABILITY
White Paper

OVERVIEW

By implementing design automation, engineer-to-order manufacturers can complete days of custom engineering in just minutes. Design automation also expedites and simplifies the creation of SOLIDWORKS® models, drawings, quote documents, and manufacturing data—virtually any requirement of the custom sales process.

SIMTEK
Real Time. Real Results

DASSAULT SYSTEMES

INTRODUCTION

Profit margins are narrow across most industries today and will continue to become even thinner. Even in segments where margins are relatively healthy, competition and global outsourcing mandate cost reduction. Historically, the high cost of engineering has significantly reduced profit margins, so numerous attempts have been made to cut process time or reduce the cost of engineering activities.

"Because we are always fire-fighting, I often have to use out-of-date drawings just to get the job moving. This can lead to huge mistakes."

Most of these approaches have been point solutions that can be highly important in their own right but are not applicable across the board. Design automation, on the other hand, stands out as an effective means of dramatically cutting costs for a well-defined, well-proven range of engineering activities. This is especially so where business needs demand rapid, accurate quoting; consistent engineering; and most importantly, minimum time to product delivery.

DRIVING DESIGN INNOVATION

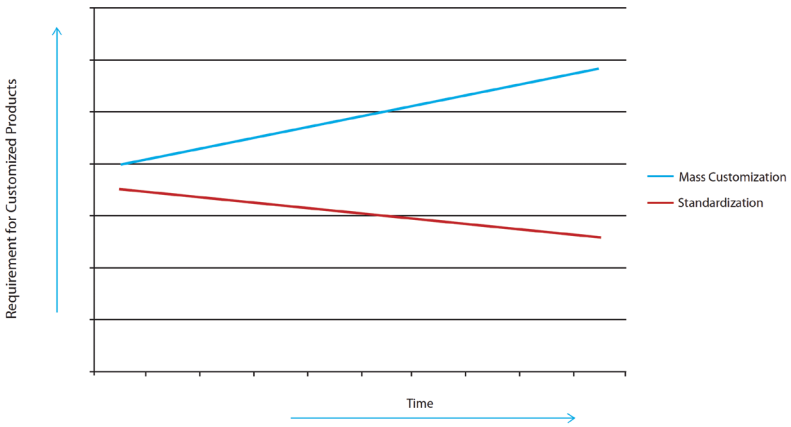
The majority of companies share a common goal of reducing design costs. Traditionally, there have been two options: (1) design less and standardize the product range, or (2) design faster.

"We cannot quote quickly enough."

If you want to limit your customers' choices, the first option is fine. However, the pressure to customize products has risen tremendously over the past few years. In a Cincom study, 73 percent of total respondents viewed product customization as critical for products valued over $100,000, while another 25 percent considered it crucial even for products valued under $1,000.

This trend will only grow.

The Cincom study also revealed that 63 percent of engineers had seen requests for customized products increase, and 26 percent anticipate a significant growth rate for customized products in the future.



If you want to keep customers happy and grow your profit margins, the second option—faster design—is ideal. Along with growth, however, come growing pains, especially if your custom design process is unmanaged.

MORE GROWTH, MORE PAIN

Typical complaints from companies that do not automate their design process include:

"Because we are always fire-fighting, I often have to use out-of-date drawings just to get the job moving. This can lead to huge mistakes. From receipt of the order, we usually have six weeks to get the job out the door. Unfortunately, we generally don't even get the drawings until after five weeks."

"We simply cannot quote quickly enough. In fact, we reject small inquiries—around 30 percent of possible orders. We also rule ourselves out of a further 30 percent of possible contracts by missing quote submission dates."

"Our salespeople are forever selling things we can't make … or they sell things that we can't make at the price they quote to the customer."

Design automation is the solution to the problems cited above: It provides rapid engineering as well as fast drawing and document production.

Another survey of CAD users asked key questions about users' design processes. All survey respondents were aware of design automation since they work in various industry segments that document paybacks from design automation. These include almost all engineer-to-order products and many customizable products; basically any enterprise in which a significant percentage of orders must be touched by engineering.

The single primary determinant of whether design automation will benefit a company or a designer is the extent to which new products are based on previous designs. Nearly two-thirds of respondents indicated that a significant portion of their products—from 20 to 100 percent—are retreads (Figure 1).

Two-thirds of companies using CAD derive all or part of their new designs from previous designs.

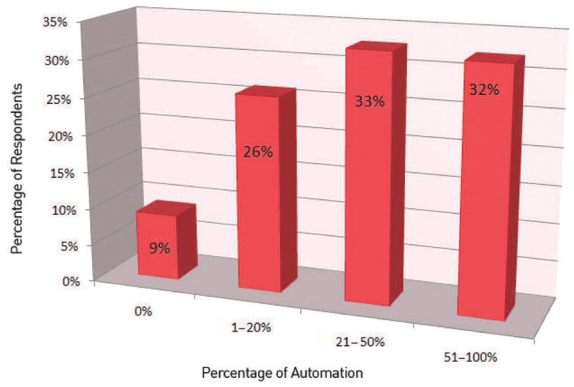


Figure 1: Many designs are based on previous designs: These are good candidates for design automation.

The survey concentrated on areas where design automation can contribute significantly and prioritized its results into the following wish list for automating engineering activities:

- **Automated creation of SOLIDWORKS parts, assemblies, and drawings based on variations of existing products (88.8%)**
- **Automatic generation of manufacturing documents (75.9%)**
- **Automatic retrieval and incorporation of existing product data and calculations (61.8%)**
- **Automatic generation of sales proposals, quotes, and documents (51.8%)**
- **Automated product specification by non-technical associates, such as sales (45.3%)**
- **Automated, web-based product specification, such as remote sales or customers (30.6%)**

Clearly everyone wants some sort of design automation but the definition of design automation differs from company to company. Exactly what is design automation?

A variety of companies across a multitude of industries are searching for ways to save time and lower costs in the engineering process. As a result, vendors refer to different features or utilities as "design automation." Unfortunately, most of these features are not useful mechanisms for automation because they cannot handle an entire job.

For companies that offer engineer-to-order products, design automation is defined as a system that captures and more or less automatically applies that engineering activity to product variants to create finished designs in minimum time.

- **System: a controller, rather than a random assortment of features, that provides an overarching workflow. Design automation systems often drive CAD systems and interact automatically with product lifecycle management (PLM), as well as with other engineering and office applications.**
- **Engineering activity: all the calculations, rules of thumb, engineering precepts, and product lore that go into a product variant.**
- **More or less automatic: intelligent design automation systems automate repetitive work and leave assessments of design requirements and rapidly needed creative solutions to experienced engineers.**
- **Product variants: families of products derived from a central or standard design that must be significantly engineered before products are fully functional.**

Engineers can overcome the difficulties in customizing a product with design automation software. Design automation software evolved with CAD technology as a way to streamline customized product development. It captures a company's in-house design rules to simplify the process of creating variations.

Design automation addresses the "points of pain."

DESIGN AUTOMATION QUICKLY EXECUTES REPETITIVE ENGINEERING TASKS, REDUCES COSTS FOR ACCURATE BIDS, AND ENFORCES ENGINEERING DECISIONS THAT PREVENT SALES FROM SPECIFYING NONCOMPLIANT OR UNMANUFACTURABLE PRODUCTS

Consider a typical conveyor design: space constraints; the weight, size, and spacing of products to be conveyed; the belt or link type; and the drive system, all affect the design.

Nontechnical people may assume it is easy to rework a few details of a base conveyor design into a new conveyor for the next customer. Engineers know better, however. If product weight and size differ from the original design, many calculations will be required to create a new system with its specified speeds and throughputs. For example, if an original conveyor is for laundry detergents and the new one is for food products, different materials and contamination control safeguards will be necessary. A wider conveyor carrying heavier products will need more power, while a narrower one, with a smaller motor and gear train, will likely be more cost-effective. If more power is needed, engineers must make significant changes in the geometry of the drive and motor installation. Guards, fences, and sensors must be altered, possibly with corresponding changes in frames, mounts, and metal gauges. An average conveyor vendor's engineering department requires four to eight weeks to manually configure such changes into a new conveyor system.

IS DESIGN AUTOMATION EFFECTIVE AND EFFICIENT?

Design automation systems have been helping companies to save time and money since the early 1980s. By implementing design automation, a machine that once required 80 hours can now be engineered in less than one hour. An elevator manufacturer can now create quotes and drawings, including engineering and documentation, within 24 hours as opposed to the weeks required with manual methods. A lifting-beam company can respond to customer inquiries in less than an hour—including general arrangement drawings and a quote; deliverables that previously took 16 hours.

Even small products benefit; component brackets that take 45 minutes to configure manually can be done in under a minute.

Clearly design automation is both effective and efficient, and it's available within SOLIDWORKS.

DO CONFIGURATORS PERFORM DESIGN AUTOMATION?

Many configurators perform design automation tasks; however, most are an afterthought rather than the core competency of a system. Design automation is best served via programming-based customization.

Configurators typically mix and match rather than engineer. As a result, most configurators cannot handle engineer-to-order designs. For example, they can add and remove items on bills of materials (BOMs) but cannot understand the calculations or workflows required for engineering.

Design engineers require a system that will drive a CAD package in a coherent and controlled manner. Moreover, every point of automation must be done consistently, with nothing forgotten, nothing fudged, and everything completed.

THE BENEFITS OF DESIGN AUTOMATION

In the table below, the key benefits of design automation are listed by organizational level.

Organizational Level	Benefit
Engineer	• Greatly reduces sales support requirements • Dramatically reduces repetitive tasks
Engineering Department	• Significantly increases departmental productivity and throughput • Greatly improves consistency, especially with junior engineers
Company	• Quickly enables first-to-bid on quotes • Easily helps to ensure accurate bid and product costing for predictable margins • Dramatically shortens time-to-delivery after order is signed • Readily helps develop true teamwork between engineering and sales

Table 1: Design automation frees up engineering time formerly taken by repetitive tasks, recalculation, and specification changes. The resulting benefits apply across the organization, from the individual engineer to the company as a whole

DESIGN AUTOMATION IN PRACTICE

Design automation should be viewed as a new way of working, not as a single project with a beginning and an end that is done only once. With design automation, you can literally treat every part of an assembly as a variable design that can be modified automatically by inputs. Doing so, however, would be a mistake. Your first step is to determine which variable parts require engineering while they are being varied and will generally be a subset of a given assembly. Then select the best candidate from among these to tackle the first design, which is typically a redesign that literally takes more time than it is worth.

Consider the conveyor design example. Most conveyors consist of a frame, legs, rollers or bearings, and links or belts. One or more sides require guards and fences. Some consist of straight sections with minimum change in elevation, whereas others spiral up or down significant vertical distances. Control and sensor needs, drive and gearing considerations, and various other components must be modified to meet a specific custom requirement.

Design automation is a new way of working. It is not a one-off. Start small and adopt existing SOLIDWORKS models.

It would be naive to imagine that you could put all the details about all of these parts into a rules-based system in one go with numerous variables. Where would you start? What route would you follow? Answer that, and you have the answer to the initially under-constrained task. The key, of course, is to build the automated activities one step at a time.

BUILDING ONE ELEMENT AT A TIME

Start by automating individual elements. You do not have to start from scratch since you can adopt existing assemblies and then add rules and make them intelligent with design automation tools. With a conveyor system, for example, you could begin with a single series of drive and gear designs. In design automation, you can easily create a system whose outputs include dramatically different geometries and configurations based on such specifications as product weight, pitch, and conveyor width. You could then create a rule that takes a specified number of drive systems for a given conveyor length. From there, you can build rules that will automate the design of idle rollers, then frame components, and so on.

Before long, you will achieve a conveyor-generating system that performs design automation. After you specify the size and weight of the product along with the system dimensions, design automation tools can calculate the frame design, populate it with drives and idlers, and automatically generate the chains or belts. From there, you can add capabilities to create the drawings, documents, and data for conveyor systems that will be useful first in sales quotations and later in manufacturing documents.

CREATING THE RULES

Attaching rules to a basic design is a straightforward way to select the SOLIDWORKS model. Design automation tools will walk you through the process in a consistent workflow, allowing you to easily attach variables and parameters, engineering rules, and myriad engineering-related activities to the design. In the background, the design automation tools manage all the relationships between rules and assemblies, as well as the necessary interconnectivity between the design automation software's model and the entities within SOLIDWORKS.

As you add rules for the conveyor's legs, beam, and motor, it becomes a step-by-step process. Eventually, you will build a complete model; by doing it in steps, however, you can gain benefits every step of the way. For many projects, you will find it best to maintain a top-down view while working in a bottom-up manner. A little thought will allow you to reinvest a good deal of the time spent building one model when creating the next one.

Clearly, rules-based design automation systems capture the way you engineer, enabling the computer to do many of the recalculations and the remodeling that take up so much time. These systems can also manage and retrieve a broad range of design methods and criteria built up by your company, including important engineering rules, rules of thumb, and product lore that, if forgotten or ignored, can lead to product problems and unhappy customers.

KEY EVALUATION CRITERIA

Engineers choose SOLIDWORKS software for its powerful modeling and revolutionary interface. When you are searching for the ideal design automation model, you want the same dynamic combination. Unfortunately, it is not included in all design automation packages.

Look for a 21st-century system—not one saddled with implementation models from the 1980s.

In fact, you will find that design automation business models range from ones that dictate buying software and consulting to models that are easily installable software that allows you to quickly build your own rules, calculations, and models. Since you bring product knowledge and expertise to the table, you should retain complete control over that intellectual property.

Solutions that require consulting hearken back to the first days of design automation. In the early 1980s, engineering design was more rudimentary. Affordable CAD software that ran on small computers was 2D and not graphical in its interface. Serious 3D design required minicomputers and high-end CAD and generally mandated specialized consulting for installation and startup. A CAD system that cost $40,000 per seat in 1985 dollars for basic 3D capability could easily demand $100,000 in consulting—and $140,000 in 1985 is the equivalent of nearly $275,000 today. Then and now, that is an investment only large companies could make.

Early design automation products presented two major obstacles: their price, easily $1 million ($1.9 million today), and their inability to interoperate with the CAD systems of the day. The geometry and spatial relationships of every part, no matter how complete in a given company's CAD system, had to be completely rebuilt in the design automation system. Furthermore, the process required mastery of an arcane coding language. No wonder consultants were needed.

In the same way that 3D CAD has become mainstream, modern design automation also offers a mainstream choice. Unfortunately, several design automation systems still follow the old model because it still appeals to system designers. If you are considering a system that requires third-party coding and handholding (an outdated modality that SOLIDWORKS moved beyond a long time ago), consider moving beyond it as well.

Aside from the business model, consider the following criteria when selecting a design automation system:

1. **Ease of use**
2. **Maintainability**
3. **Scalability**
4. **System integration**
5. **Return on investment**

EASE OF USE

When companies consider whether to adopt design automation, ease of use is the number one concern. After all, who wants to invest time and money in a system that is so difficult to set up and implement that no one will use it? Engineers need a system that runs on hardware everyone can understand and is built on a development platform with a proven track record. A system equipped with user interface and integration capabilities also allows you to interoperate with other software systems.

To capture engineering rules, your system must use current engineering skills rather than require engineers to become programmers, system integrators, or IT specialists.

MAINTAINABILITY

At most companies, the introduction of a design automation system is generally driven by one or more champions who can see the personal and company benefits of adopting this technology. However, every successful implementation includes moving the system beyond the original champions. A system must be understood by many and easily maintained by everyone.

When choosing a system, consider the following questions:

- **What will happen when a key member of your design team joins another company, or if a highly experienced and valuable team member retires?**
- **When your organization introduces a new operating system, what will take place?**
- **What will happen when you introduce new hardware?**
- **Will the design automation system always work with the latest CAD version, or will there be a time lag?**
- **When your design teams want to communicate and collaborate across continents, what will be the result?**

SCALABILITY

Is the solution scalable? That is, can you start small and easily ramp up to a complete system? Can you expand small automation projects based on highly constrained assemblies into more comprehensive systems?

Prepare for growth—make it scalable.

In practice, the implementation of design automation has no beginning or end. A successful system depends on an approach that allows you to create and refine a process that evolves over time; one that automates more and more aspects of your design and engineering while delivering more and more benefits to your organization.

If the company's design automation system provides no easy path to the next component for automation, life becomes difficult. You must be assured that all future steps can be easily married to the original project.

SYSTEM INTEGRATION

Design automation generally begins in the engineering department. However, every company function that interfaces with engineering can eventually benefit from design automation. To take advantage of all the benefits, your design automation system must be capable of integrating with other business systems.

In an ideal world, many companies look for seamless integration among all their systems to avoid duplication of efforts and the pain of maintaining several separate customer databases run by different departments. Therefore, make sure to specify a design automation system that can interoperate with broader business systems.

RETURN ON INVESTMENT

No software purchase is complete without considering return on investment (ROI). The ROI of a design automation system depends on several factors, including some of the criteria discussed above. Clearly, a key consideration is the length of the learning curve before using design automation in production.

With generic software, the critical element is ease of installation and use. With a design automation system, you must factor in the training and the skill sets required by the people who will be using it. A system that never reaches beyond a few outstanding, highly trained engineers will never provide the highest possible ROI. Likewise, a system that requires a dedicated programmer or ongoing support from consultants is unlikely to reach mainstream paybacks.

Finally, you must consider how soon you will begin realizing returns. To a large extent, this depends on how you set your objectives and measure success. It can take many months before product specifications can be entered into the system and outputs automatically generated from a custom or consultant-based solution. Further, companies often make the mistake of striving for a total solution right from the start. Having to complete every aspect of a design automation project before putting it to real work is highly detrimental to ROI.

CONCLUSION

Consider again a conveyor system. It might take two days to input the rules that automate the selection of motors and gears, as well as the subsequent geometry of the assembly, into design automation software. However, you could automate the design of all future conveyor systems within a week, automatically generating manufacturing data, drawings, and BOMs, each based on inputs that reflect the requirements of each respective customer. So even if it takes twice as long to capture the process in design automation software as it does to create a single custom design, you will start to reap tangible benefits by the third new order.

Choose to design faster. Take your inspiration from the many companies that have successfully implemented design automation. It is a perfect means to raise your visibility, increase your company's profitability on custom sales, and allow you to do what you do best—design innovative new products.

IF YOU HAVE FURTHER QUESTIONS REGARDING IMPLEMENTING DESIGN AUTOMATION SOLUTIONS IN YOUR PROCESS, **CONTACT YOUR LOCAL RESELLER.**