ETO

Driving Engineering Innovation and Manufacturing Excellence

by Nancy Spurling Johnson

This article explains the engineered-to-order (ETO) approach to design and manufacturing, how it works, and how manufacturing companies are tapping it to increase sales volumes and shorten engineering time from weeks or days to hours or even minutes. The article also introduces the ETO services offered by IMAGINiT Technologies and explains how the company's team of experts can support your efforts to automate the design process, saving money and allowing designers and engineers to spend more time innovating and improving products.

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IMAGINiT Technologies works with manufacturers of all shapes and sizes to implement ETO (engineered-to-order) systems in Autodesk® Inventor®–based workflows. By automating the design of one-of-a-kind products, companies can virtually eliminate tedious engineering tasks while improving product quality, increasing productivity and profitability, and freeing up time for product innovation.

Customization is no longer the wave of the future in manufacturing — it's here now. From design-your-own athletic shoes to a one-off autoclave large enough to hold aircraft components, products that meet customers' unique preferences and requirements are becoming increasingly important to the business of design and manufacturing.

Customers are driving the trend toward customization, but technology is the key to delivering on it. Specifically, engineered-to-order (ETO) systems are capitalizing on the efficiency and accuracy of 3D modeling to automate design and engineering processes in ways that bring customization within reach of any manufacturer, large or small.

Even manufacturers that have been in the made-to-order business for years can benefit from the increased productivity, innovation, profits, and success afforded by ETO. By improving efficiency and accuracy, ETO can result in

- reduced design errors and costs,
- faster engineering times,
- improved quoting accuracy, and
- shorter sales cycles and increased sales volumes.

Perhaps most importantly, ETO solutions can eliminate tedious, non-value-added tasks from the day-to-day workflow so designers and engineers are free to spend more time innovating and improving products.

In short, ETO is fast becoming an opportunity that manufacturers can't afford to overlook.

WHAT IS ETO?

ETO automates the product design process to enable "engineering as little as possible," says Carl Smith, Manager, Manufacturing Solutions Division at IMAGINiT Technologies, a professional services and technology company and integrator of Autodesk 3D design and engineering software. Among its many offerings, IMAGINiT helps manufacturers automate Autodesk® Inventor®–based workflows. In addition to custom application and web development, IMAGINiT's approach uses iLogic, a rules-based add-on for Autodesk® Inventor®, to manage design parameters and capture design intelligence in templates that drive the automated engineering configurations. iLogic supports all types of Autodesk® Inventor® files, including parts, assemblies, and drawings; a few assembly templates developed with iLogic can drive hundreds of assembly configurations. The result is that 80%–95% of traditional engineering interaction is automated, so when a manufacturer initiates the design process, it's essentially hands-off for the engineer.

Given a set of product specifications, a rules-based ETO system will automatically create complex 3D assemblies, drawings, and finished designs. Incorporating best practices in engineering technology and materials properties, the system can prepopulate a CAD assembly with parts, dimensions, texture, and other information.

At its most basic level, ETO can be a personal productivity tool for the designer, using iLogic to automate repetitive, nonvalue-added tasks in Autodesk Inventor. At the top level, ETO can be a system that provides clients with an Amazon.com-like experience, Smith says, incorporating

iLogic as well as custom programming and web development. A customer could log into a manufacturer's web site and configure the desired product online, and subsequent processes take place automatically in the background — such as producing a price quote, design documents, or a product rendering — with virtually no engineering interaction.

"You can't really pigeon-hole ETO to say it's only for automatically generating product," Smith states. "It has a lot of other advantages as well."

ETO BENEFITS

Smith goes on to explain that when he consults with an ETO client, he's looking to achieve bottom-line as well as top-line benefits. When assessing bottom-line payoffs, Smith asks, "Where are your bottlenecks and how can we affect those" by eliminating engineering time and therefore reducing costs?

To achieve top-line benefits, Smith asks, "How can we make your product stronger, lighter, cheaper, faster, and be more innovative than your current process allows if we're not thinking about all the mundane, nonvalue-add tasks that engineers are often saddled with?" The bottom-line approach can improve profits while the top-line approach can result in new and improved products.

ETO systems allow manufacturers to respond more quickly and accurately to customer requests for proposals and enables sales teams and distributors to produce custom quotes that include a 3D model or image of the final product early in the sales process. Sales staff and distributors can order custom-configured products via an online form that captures all details needed to create a valid product configuration and quote the project. Automated configurators can provide bills of materials for accurate cost and price quotations with little or no engineering involvement. All this dramatically speeds sales and manufacturing cycles while significantly improving proposal response time, accuracy, and customer service.

WHO CAN BENEFIT FROM ETO?

Typically, an ETO system addresses the challenges of manufacturers that produce products designed to customer specifications, where each product requires unique engineering or design customization. Companies that practice this style of manufacturing are present in markets across the board, and they can be any size and produce any number of products.

IMAGINiT works with one- or two-person shops all the way to Fortune 100 companies, Smith says,

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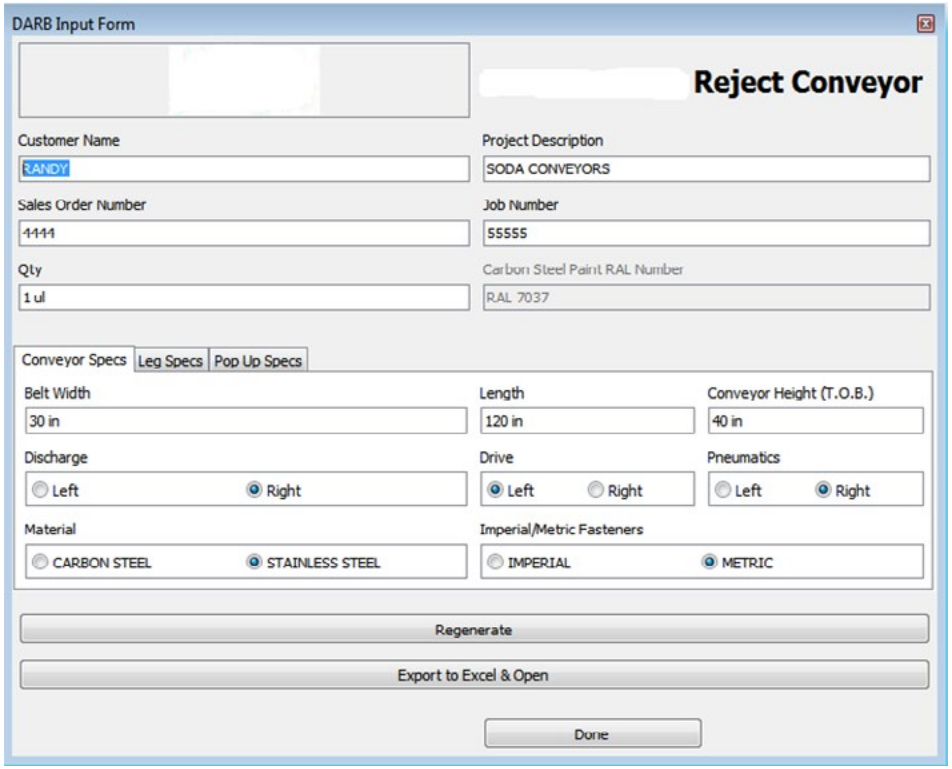
— Carl Smith
IMAGINiT Technologies

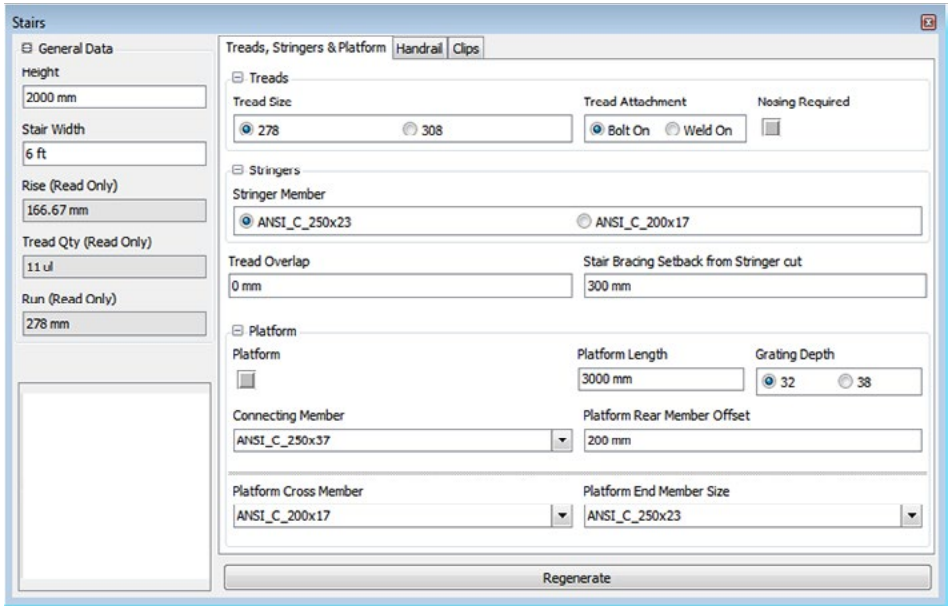
"but our sweet spot is with those companies that could use automation to gain the highest return." This is typically a small to medium-sized company that is experiencing design-related bottlenecks but doesn't have the resources to hire more staff, or has business that is cyclical, Smith explains. "We work with those companies to remove the bottlenecks and let them be more productive in what they do every day."

Some companies have what Smith describes as "easily automated products" that can be configured 100% by an ETO system, while others focus on addressing specific aspects of a process that are causing significant delay. Those that experience the best return on investment in ETO are the companies that produce high-volume, highly configurable products, Smith says, but "it doesn't have to be a large company or produce thousands of products. We see a lot of clients who don't have high-volume sales but their design process is a bottleneck."

An ETO system is not the answer for every manufacturing workflow, Smith notes. For example, it isn't practical for job shops where each order has little in common with the next. "That's not to say they might not benefit from automating some subset of the process," Smith adds, such as archiving drawings or designing the crate to ship a product.

Smith shares his experience with one client — Belvac Production Machines, a developer of machinery for can manufacturing — that used ETO to capture the knowledge of an employee so it could be accessed by coworkers.





Here are examples of forms that IMAGINiT has built to help clients define a configuration for a product line. Based on that information, the system can automatically create the custom design.

"Belvac had one person on staff who retained all of the internal knowledge regarding their process. He was the guy that everything had to run through before anything could happen, and it was a bottleneck when things got busy. So they asked us to capture everything he knew about their product and process and get everyone involved." IMAGINiT was able to automate Autodesk® Inventor® so any user could input the information required to generate a design. The system automatically created a digital prototype and produced the required results.

"The design validated much quicker and they could make faster decisions on how to proceed," Smith recalls. "They turned their CAD models into technical knowledge assets rather than relying solely on individual know-how."

ETO IMPLEMENTATION, START TO FINISH

Step one of an ETO implementation is the discovery process, Smith explains — that is, gathering information and intelligence, identifying bottlenecks, and strategically reviewing the company's engineering processes. "It's a deep-dive study of how the company works, in-the-weeds details" that can involve engineers, engineering managers, sales staff, and even those who dictate post-engineering workflow. "It's important that the key people are involved because we want buy-in from everyone. The more input we get, the more buy-in we get (from those who will ultimately use the system)."

IMAGINiT records the collected details and passes the documentation to the company in multiple rounds of revisions "until everyone is happy," Smith says.

Then IMAGINiT develops a statement of work (SOW) to outline project scope and schedule, deliverables, and system performance targets, incorporating solutions it has developed over decades of working with best-in-class manufacturers. The SOW keeps client expectations in check and helps avoid "scope creep" that can

arise when a company identifies something new to address midway through implementation, Smith adds.

With the groundwork laid, IMAGINiT gets to work on the development phase. This stage tackles all the working pieces of the ETO system, from iLogic configuration to custom software development to designing web interfaces. IMAGINiT carries out this work independently, with minimal time and effort required of the customer, but involves a project manager to serve as a liaison when needed.

Once system development is largely complete, testing begins — "a sandbox, if you will," Smith says. "We run the [new ETO] process through beta testing involving key people at the manufacturer. We validate and test and fix until everything is ready." Then the new system can be rolled out — to a specific department at first or to the entire company, depending on its wishes.

The entire programming and testing process takes a minimum of four to five weeks, Smith says, and could stretch to six months or a year for a high-level, high-volume company, so IMAGINiT often recommends starting with a pilot project to automate configuration for a single product. Once that's in place, a customer can actually automate additional products on its own.

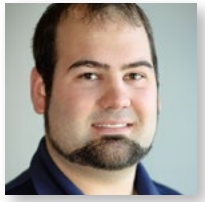
BENEFITS WITHIN REACH

"A common perception is that an engineer-to-order system is out of reach of a small- to medium-sized business because of cost," Smith says — but that simply isn't the case.

"We always take into consideration that smaller companies have budget constraints. When we encounter a situation where cost is of the highest concern, then we start taking a look at the Pareto Principle," Smith explains, referring to the rule that states that 80% of consequences stem from 20% of the causes. "Solving 100% of your problems through ETO, yes, that's expensive," Smith says, "so maybe we take a look at addressing 80% of your issues — the issues that are causing the most problems — and get over that hurdle. ... That gets you to a point where you can address the last 20% much more effectively."

ONE SUCCESS STORY

At Infinity Machine & Engineering, a manufacturer of made-to-order machinery for paper goods packaging, the ordering process was broken. Machinery orders passed from sales to engineering were plagued with incomplete and invalid information. Engineers and sales staff would go back and forth to clarify specifications and engineers would manually rearrange the assembly and modify model parameters, often several times for each order, until the customer signed off — delaying progress by several days. Even then, discrepancies could arise downstream, leading to further rework and delays. The haphazard process also made it very difficult to train new engineers.



In response to increased sales, **Infinity has hired more shop personnel** but not engineers. "If we hadn't done something like this ETO system, we would have just had to push schedules back or possibly turn away business."

— Steven Clark
Infinity Machine & Engineering

Fortunately, explains Steven Clark, a mechanical engineer at Infinity, this story has a happy ending. The manufacturer worked with IMAGINiT Technologies to integrate ETO in its Autodesk® Inventor® workflow and now has a solution that not only has eliminated the old bottlenecks, but also has freed engineers to innovate and has allowed the company to respond to growing sales without adding engineering staff.

THE JOURNEY

Previously, Clark says, Infinity began to implement lean manufacturing, and during that time discovered ETO. Management was convinced of the potential of ETO, but wasn't sure exactly what the company needed, Clark recalls. "We needed something to work with Inventor®, so I introduced iLogic. IMAGINiT was our [Autodesk] reseller, so we started there."

Infinity staff met with IMAGINiT consultants for several days to create what Clark refers to as a map for configuring the Infinity C-10 automatic case packer. "The C-10 is our oldest, most popular machine, and it has hundreds of different options," Clark says. From there,

"IMAGINiT did everything behind the scenes to program the system. We had to compile all the options and part numbers for IMAGINiT," Clark recalls, but overall development "had very little impact on our company."

IMAGINiT created an ETO system that incorporates a user-friendly dialog box that collects full system configuration details and eliminates guesswork. The system presents a complete list of all machine parameters and identifies missing details, which helps Infinity address problems immediately and helps customers focus on the decisions that still need to be made. The system validates the final order, which in turn drives the rest of the automated ordering process, including generation of a bill of materials that is submitted to purchasing.

According to Clark the first version of the new ETO system was ready to test in just two or three weeks. "It was pretty quick. It worked very smoothly and didn't require a lot of tweaking, and basically we trusted (IMAGINiT's work)," says Clark.

Once the system was deployed, IMAGINiT returned to the Infinity office for a few days to train staff how to use the new system and teach engineers how to use iLogic to configure additional models. "They were very thorough in helping us understand and use it," Clark says. The entire implementation, from planning through training, lasted approximately six weeks. The ETO system has been very stable, Clark adds, requiring no fixes or changes aside from updates and maintenance.

Regarding the accuracy of the models generated by the ETO system, Clark says, "Everything is pretty seamless. Once the subassemblies are created, it's just a matter of getting them in the right position in the top level." All told, Infinity engineering staff can accurately configure a new system in just a few minutes and engineering involvement has been reduced from four or five days to one day.

FOUNDATION FOR SUCCESS

Infinity's sales staff is bringing in a lot of repeat business as well as major new customers, Clark says, which is leading to a lot more orders. "We're scheduled to do just as much business in the next six months as we did all last year" — a total of 50 machines for the year. The company has hired more shop personnel as a result, but not engineers, Clark says. "If we hadn't done something like this (ETO system), we would have just had to push schedules back or possibly turn away business."

Younger engineers now are able to tackle system configuration to learn how machines go together, freeing the experienced engineers to focus on how to improve machines — "everything they always wished they could do, but didn't have the time to do," Clark says. "With the rate that we're growing right now, to actually be innovative on top of that is so great for the company."

The Infinity sales team appreciates the new system for its ability to improve order accuracy as well as the customer experience overall, Clark says. Management loves the system too, Clark adds — so much so that it has already assembled a team to configure the remaining 12 machines. ◆

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