Tech-Clarity

Driving Engineer-to-Order Differentiation and Profitability

Analyzing Trends and Best Practices in Product Configuration

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Executive Overview

Customized products are more compelling to customers and drive higher profitability. They can also create chaos in sales proposal and order fulfillment processes as engineers scramble to develop cost estimates, customized designs, and detailed manufacturing and sales documentation. This engineer-to-order (ETO) study finds that some companies have found better ways to design custom products, alleviating the engineering bottleneck created in most companies when quotes requests or orders roll in.

The manufacturing industry needs to adopt best practices and technology to accommodate the growth in customized products. Researchers for this report surveyed over 200 companies, finding that product customization is growing significantly. Why? For some companies, it helps them differentiate. For others, their industry doesn't give them a choice. It's just the nature of the business. Either way, growth in product customization drives increased complexity that leads to late deliveries, recalls / warranty work, and missed financial targets. The cause? Manual processes for custom products make Engineering a bottleneck to getting quotes and orders out of the door.

Manual processes for custom products make Engineering a bottleneck to getting quotes and orders out of the door.

Fortunately Tech-Clarity research[1] shows that companies taking more advanced ETO approaches to customize their products end up with better results. This report investigates trends in customization and digs deeper into these best practices. The analysis finds that manufacturers achieving the highest sales and profitability growth, The Top Performers, place more strategic emphasis on rapid quote and order turnaround. They also perform better when executing orders, experiencing significantly fewer errors.

This research concludes that customization performance can be improved with ETO best practices and technologies.

Our research shows that Top Performers adopt leading design practices including platform, modular, and rules-based design techniques[1]. Survey reports show they support these best practices with leading technologies, finding that they are:

- More than twice as likely to use **technical product configurators**
- 53% more likely to have **quote automation**
- 22% more likely to leverage **design automation**

This research concludes that customization performance can be improved with ETO best practices and technologies. These approaches help Top Performers relieve engineering bottlenecks, leading to better order performance and financial results.

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Product Customization is on the Rise

Survey participants indicate that product customization has grown over the last five years and will continue to grow over the next five (Figure 1). Over one-half of companies report growth, with only a very small number indicating a decrease. An even larger number (58%) say they expect the amount of product customization to continue to grow over the next five years. Researchers note that although these results could be somewhat self-selecting because respondents chose to take a survey on the topic, the level of customization is relatively consistent with other Tech-Clarity research including Best Practices in Developing Industrial Equipment.

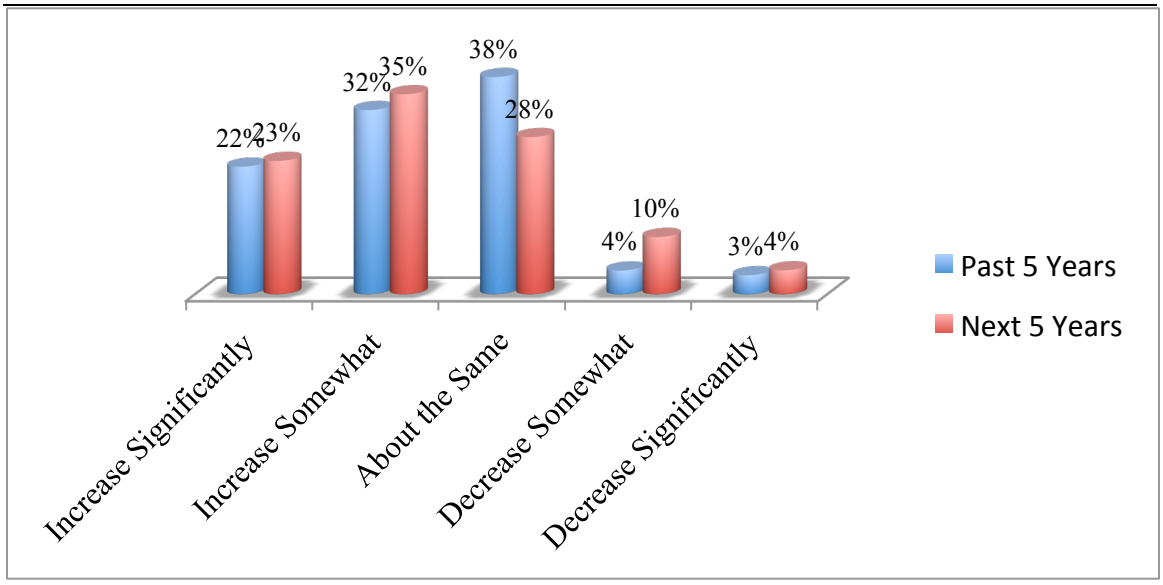

Figure 1: Growth in Product Customization

Customization growth is pervasive across manufacturing verticals.

Customization growth is pervasive across manufacturing verticals, although there are some variations. Some newer industries are expanding their use of the "to order" model, for example three-quarters of medical device and life sciences companies report growth in customization. Similarly, one-half of electronics and automotive industry companies indicate expansion. But even industrial equipment and machinery companies and those serving the energy and utilities industries, despite customization being the nature of their business and having embraced ETO for a long time, have seen noticeable growth. It appears that some industries such as the automotive industry are relatively early in their transformation to customized products, while others are expanding their ability to tailor products more closely to customer needs.

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Understanding Customization Business Drivers

Why is product customization growing? To understand this, it's important to step back to analyze why manufacturers sell customized products in the first place. Over one-half of survey respondents say their companies customize to differentiate from their competition (Figure 2). This supports findings and subsequent analysis from our Best Practices for Developing Industrial Equipment study indicating that 43% of industrial equipment companies and 46% serving the automotive and transportation industry have a strategy to differentiate based on customization. In fact, that analysis indicates that customization is a close second to innovation as the leading product differentiation strategy.

Customization is a close second to innovation as the leading product differentiation strategy.

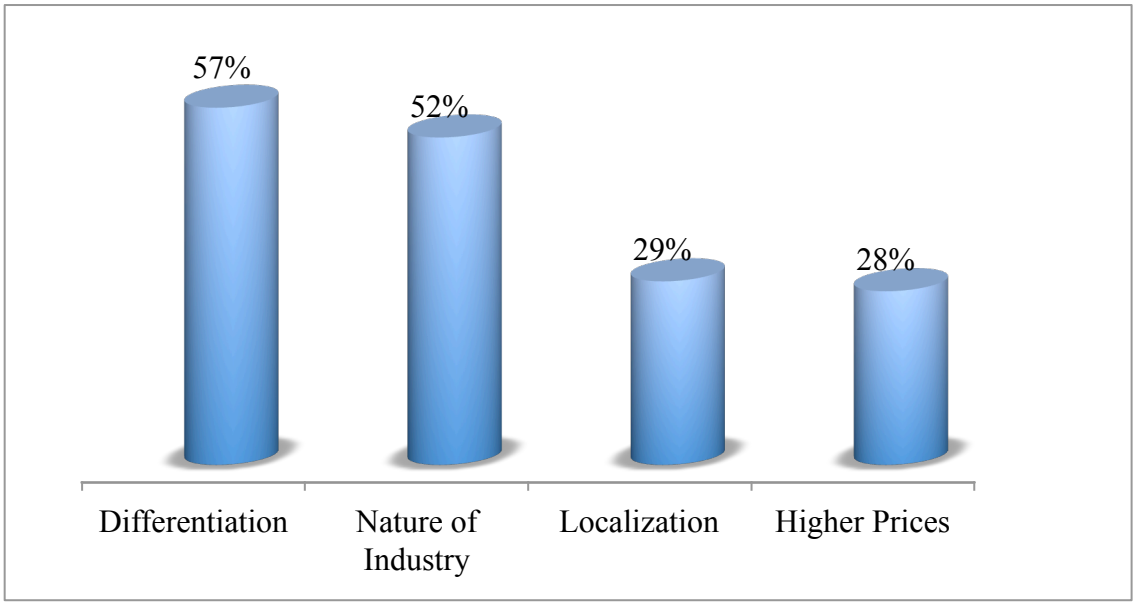

Figure 2: "To Order" Business Drivers

ETO is a way to compete in crowded, global markets because it helps manufacturers better meet their customers' needs. On the other hand, about one-half of respondents say it's simply the nature of their industry. For instance, a piece of equipment has to meet customer performance specifications and also conform to site-specific requirements such as footprint, wind loads, seismic conditions, local codes, or a host of other factors. Mark Rogers, Knowledge Based Engineering Manager for commercial HVAC manufacturer Price Mechanical, shares and example, "*We handle the custom market. Customers require customization because their needs are different. We have to fit units into spaces the architect created, deal with standards for fresh air, and meet the complexities of*

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having a properly air-conditioned building." But even the industries where customized products are the norm are expanding the level of customization offered to their customers.

While only about one-quarter of companies say they customize to command higher prices, this is likely understated because of industries that are compelled to customize and aren't able to charge a price premium. Other industries still target higher prices. Over one-half of consumer goods and medical device companies, for example, customize to grab higher prices by being a better fit with what customer needs.

Creating Differentiation in Customized Products

If companies adopt customization to differentiate, how do they differentiate their customized products? Surprisingly, the answer is deeper levels of customization (Figure 3). Of the companies surveyed, more differentiate themselves by the level of product customization and their ability to meet customer needs than anything else. Many also compete on reliability and service, the next two most frequently reported strategies.

Differentiation strategies vary by industry.

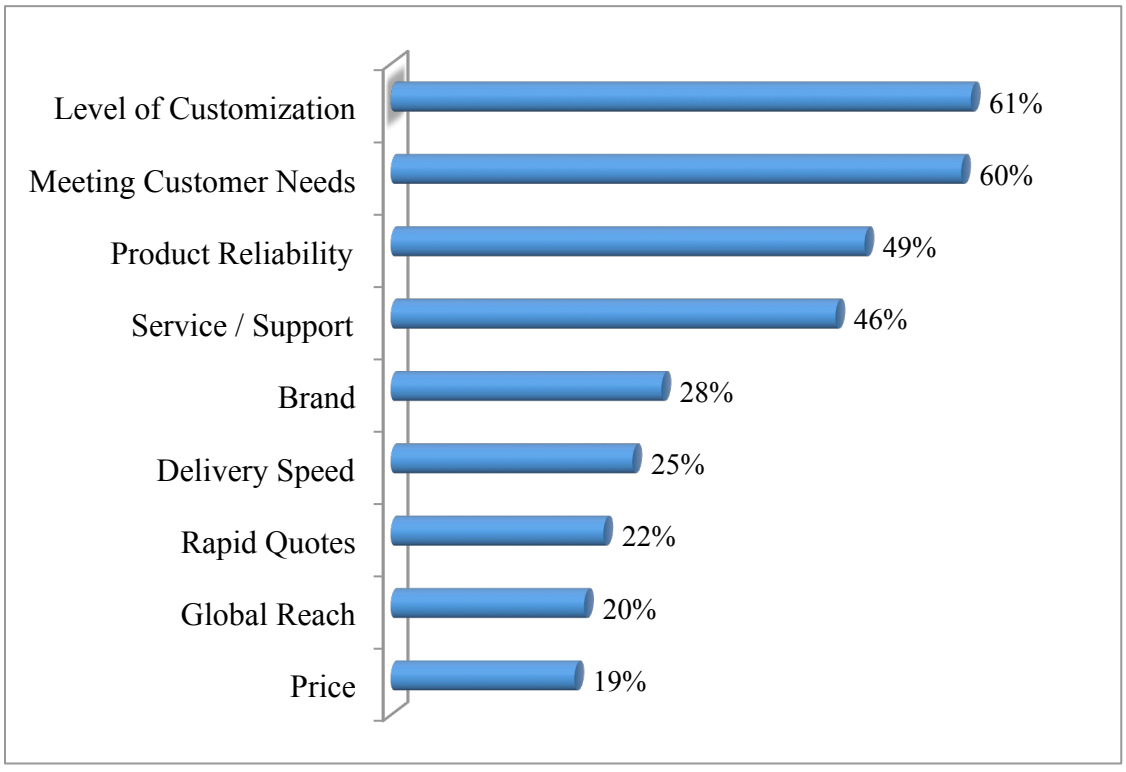

Figure 3: Product Differentiation Strategies for Customized Products

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Survey analysis shows that differentiation strategies vary by industry. Aerospace and defense companies lead the way in terms of differentiation by their level of customization and meeting customer needs, perhaps because a large part of their success is based on winning programs. Reliability is also more important to differentiate in these safety-critical industries. Electronics focuses more on price than others, but mostly only service excellence and reliability. Industrial machinery, where customer needs typically vary by location and usage, is more focused on meeting customer needs than most industries, while the medical device industry tends to compete much more on responsiveness (quote and delivery speeds) than others.

Strategy makes a big difference in terms of business results.

We'll see later that not everyone places the same strategic emphasis on some of these drivers (Figure 9). As our performance banding analysis shows, strategy makes a big difference in terms of business results.

Taking A Deeper Look at Customization

Before we go too much further, let's discuss what it means to customize a product. Manufacturers can adopt one (or more) manufacturing styles, ranging from making standard products that can be built and sold "off of the shelf" to purely custom items that leverage an array of manufacturing capabilities to produce a wide variety of items designed by their customers. For the survey, we used the following manufacturing style definitions (Figure 4):

Manufacturing Style	Attributes
Standard Products	Products that do not require additional definition when ordered or produced (just a part number).
Configure-to-Order (CTO)	Variable products that can be configured to customer needs using features and options (like size, engine type, material, etc.) All parts and their usage are designed and validated prior to taking the product to market. The primary job of the product configuration process is to select the right parts and assemble them into a valid product.
Engineer-to-Order (ETO)	Highly variable products that are designed to a customer specification. Frequently requires designing new parts to meet the customer's requirements. Significant engineering/design effort

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	may be needed in the proposal and/or order fulfillment processes.
Job Shop / Pure Custom	Products that require engineering and design to meet customer needs but are not repeatable in nature and don't follow logical, repeatable design rules.
Hybrid	Products that exhibit a mixture of CTO and ETO processes.

Figure 4: Manufacturing Style Definitions

The most confusing aspect of this is usually differentiating ETO from CTO. The biggest difference is that ETO orders require additional engineering to complete quotes and manufacturing instructions. "*If you're truly designing the product for an order, its ETO*," explains Bob Mattern, Engineering Services Team Leader for energy and environmental technologies producer Babcock & Wilcox Company, "*If you're just picking and choosing what part numbers go together, that's CTO*." ETO typically requires engineering calculations, heuristics, and decision-making that demands additional engineering effort and expertise (along with increased process complexity). Of course, many companies have products or product lines that incorporate elements of each manufacturing style.

Order-specific information is critical to developing cost and schedule estimates and giving manufacturing clear documentation for production.

So what's needed to fulfill custom orders? The requirements vary depending on the products being produced (Figure 5), and most companies will use a combination of these for any given order. This order-specific information is critical to developing cost and schedule estimates and giving manufacturing clear documentation for production. In addition, many customers request 3D CAD or visualization models to validate their order before manufacturing is authorized.

One interesting aspect investigated in this survey is based on the growth in "smart products." It might not be a surprise that 40% of products need custom mechanical components for their orders. But about one-third need custom electronics, and about the same number need custom embedded / product software. This indicates that many manufacturers face mechatronic complexity and the need to successfully develop customized smart, systems-oriented, mechatronic products.

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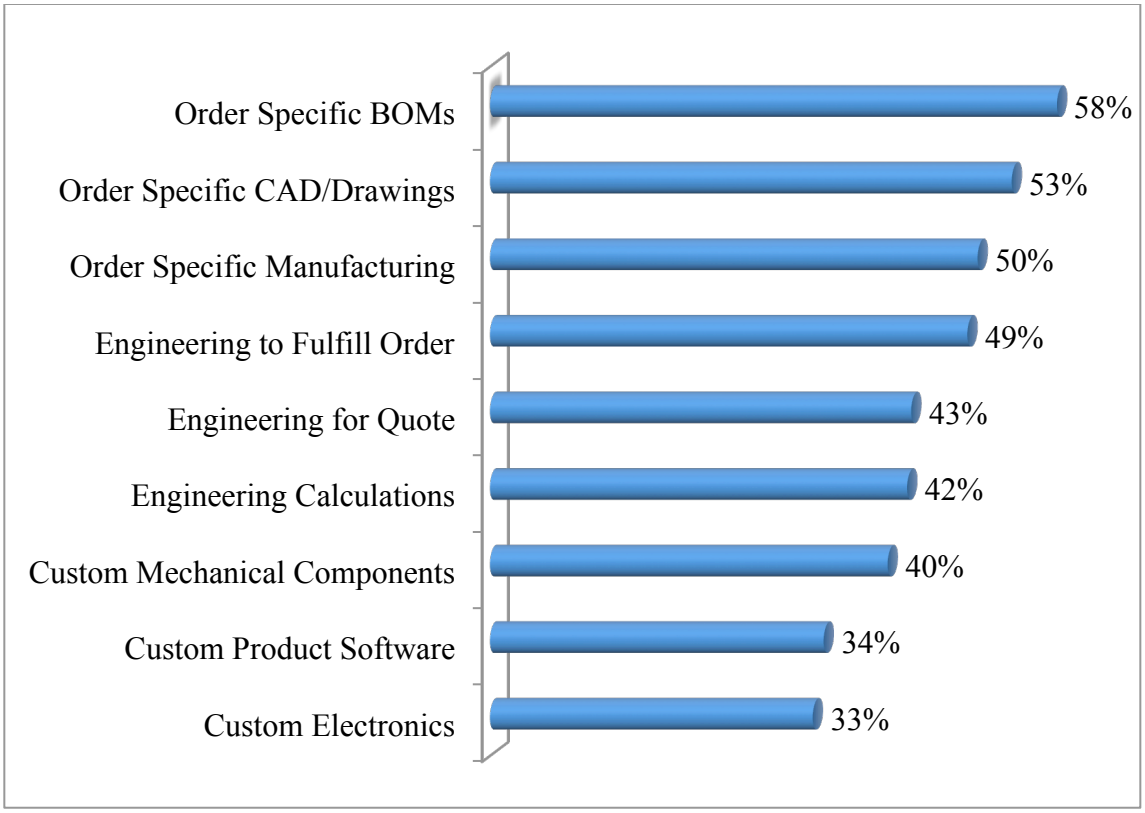

Figure 5: Order-Specific Requirements for Customized Products

Recognizing Customization Challenges

As The Five Dimensions of Product Complexity shares, complexity has increased because of the "*increase in 'mass customized' or tailored products*" because "*many manufacturers have introduced configurability into their products, requiring final engineering based on order specifications*." Our research helps provide more detail on the challenges and impacts of this complexity.

The top two challenges are related to sales quotes.

The top two challenges are related to sales quotes. Manufacturers have difficulty estimating costs and quoting rapidly (Figure 6). The most common challenge – and one that can significantly impact profitability – is developing accurate cost estimates. ETO orders require enough of a design to get accurate cost and schedule estimates. Although most companies can estimate costs based on a number of key drivers, a reliable estimate for ETO products needs a solid design and enough knowledge about materials, machines, work-center times, custom tooling, and labor to calculate a cost.

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The need for fast quotation response creates a conundrum because speed and accuracy are often at odds.

The second most common challenge is quote response time. The need for fast quotation response creates a conundrum because speed and accuracy are often at odds. Companies have to be able to quickly develop a quote and a price that is competitive without taking on unacceptable risk. "*Developing the confidence that we can deliver the product the customer wants was an issue with past (B&W) companies, the proposal time was so short you did your best to guess*," Rick Habel, Engineering Analyst of Babcock & Wilcox shares. "*With ETO tools you can confirm you can or can't do it, and gain the right price confidence*."

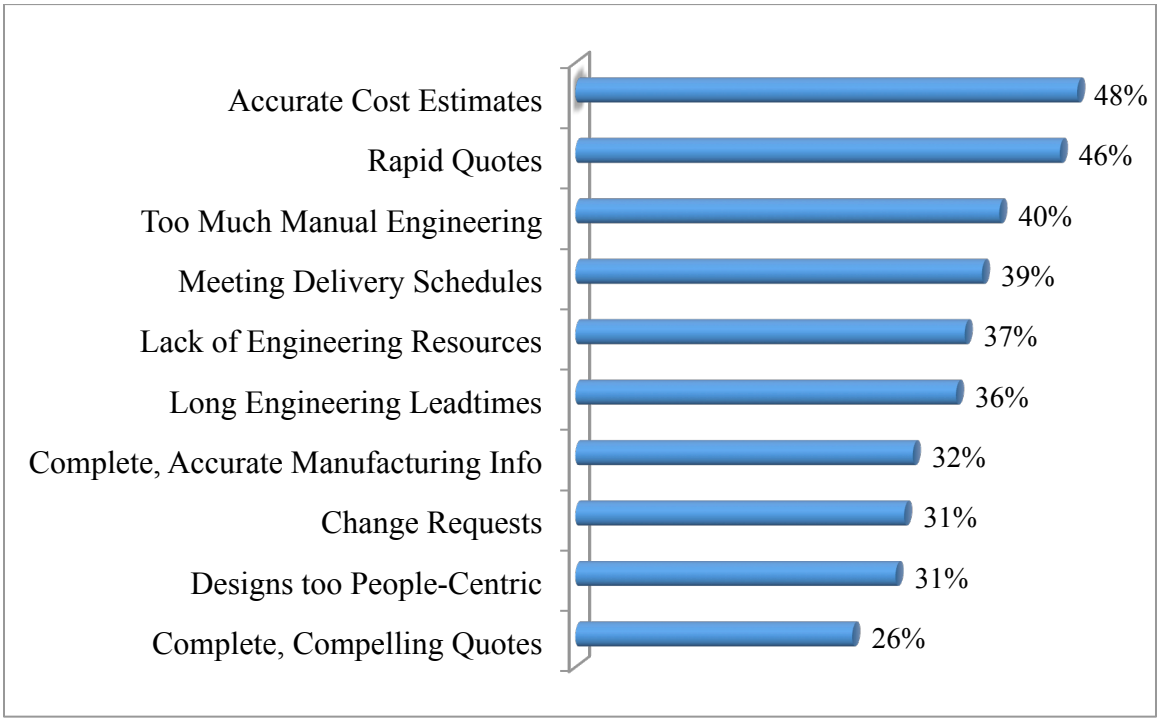

Figure 6: Challenges in Selling Customized Products

If companies aren't able to estimate well, they have to either add on too much cushion (which may price them out of the job) or err on the other side and price too aggressively (and risk losing money on the order). Neither are good options. "*Many companies find they don't have enough time to make proposals accurate, compelling*," offers Scott Heide, President of engineering services firm Engineering Intent Corporation, "*They end up missing business because they don't have time to develop the quote or create the quote without capturing the true cost and get 'killed' on the margins*."

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Quotes for ETO products require more than just price. They require rich product content like 3D visualizations, detailed technical descriptions, and sales level drawings so that customers can understand how the solution being proposed meets their requirements. "*We develop a fully parameterized 3D model. Our customers also want 2D drawings with dimensions*," says Mark Zeinstra, Manager of Product Design Department for Siemens Hengelo, a business unit of Siemens Energy, "*It helps that we have a professional way of presenting the proposal, with accurate and uniform bids. It means we can win more*."

Companies that require too much manual engineering effort will suffer from long quotation and order lead times.

The fourth most commonly reported challenge is also time-related. Over one-third of companies say they have trouble meeting their promised delivery schedules. We believe this is related to some of the other challenges listed, including long engineering leadtimes and lack of engineering resources. But the third item is likely the root cause of a lot of this. A lot of order engineering is done manually, resulting in significant delays in developing the manufacturing documentation required to produce these products.

For ETO, most companies spend the bulk of their time documenting and engineering as opposed to manufacturing.
Scott Heide, President, Engineering Intent Corporation

Manual processes are also the likely cause for the long quote leadtimes common to many ETO products. Companies that require too much manual engineering effort will suffer from long quotation and order lead times. "*For ETO, most companies spend the bulk of their time documenting and engineering as opposed to manufacturing*," explains Heide, "*For example, one company we worked with had automated their factory floor and 12 of their 13 week leadtime was getting everything ready for manufacturing. Engineering configuration was their limiting factor in throughput. This can cause companies to lose orders*."

Recognizing Potential Negative Impacts of Customization

The challenges above are frustrating, but more importantly lead to significant, negative business consequences (Figure 7). The research shows that manufacturers that produce custom products suffer from frequent order errors. On average, one out of five custom orders is delivered late and one out of six miss margin targets. About the same number have manufacturing documentation errors, end up with recalls or warranty work, or result in rework. And one ten results in fines / damages from customers!

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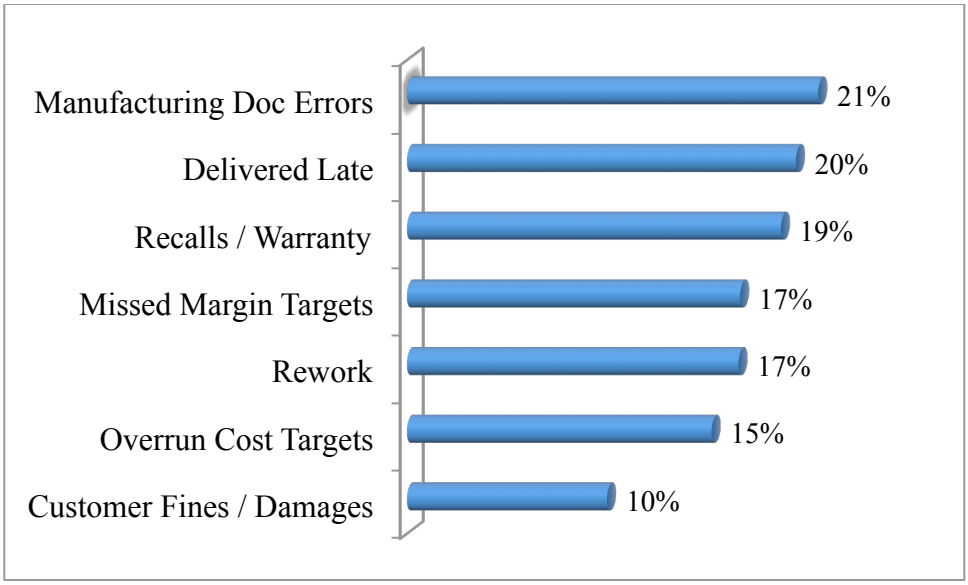

Figure 7: % of Customized Orders with Errors

These are tangible business issues that impact profitability, customer relationships, and reputation. And it's important to note that these errors aren't exclusive of one another, meaning that many customized orders likely suffer from a combination of errors, compounding the problem.

On average, one out of five custom orders is delivered late and one out of six miss margin targets.

Identifying the Top Performers

Given the common challenges and impacts, there appears to be a lot of room for improvement in customizing products. To understand what can be done to improve performance, researchers used performance banding to understand which approaches and enablers help companies improve performance in selling, engineering, and producing custom products.

Researchers reviewed respondents' assessment of their business performance to identify those that are operating at the highest levels. Analysts chose to measure the direct financial impacts of customized products as benchmarking metrics, specifically revenue and profitability growth of "to order" products over the last three years. Researchers selected approximately the top one-third of the respondents and identified them as "Top Performers." These were the respondents that reported they were "above average" or "significantly above average" compared to their competitors in both metrics. The remaining, poorer performing companies were identified as "Others."

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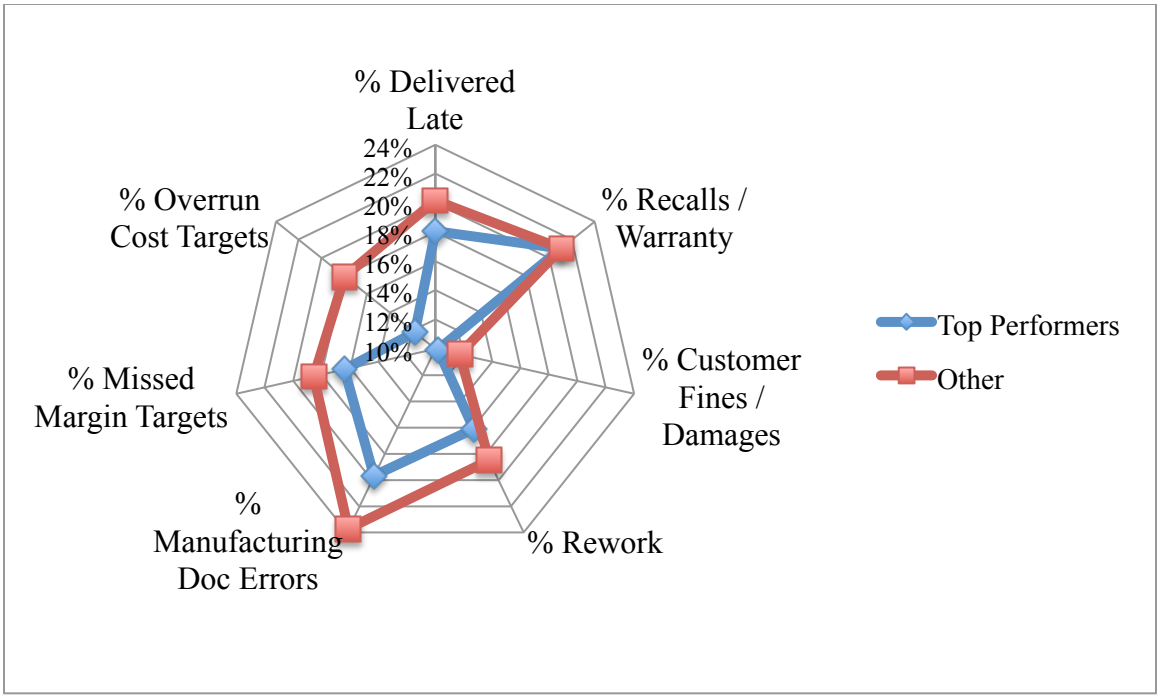

Figure 8: Order Errors by Performance Band

Researchers also analyzed the order-based metrics in the report to validate and quantify the better results of the Top Performers. In addition to (or perhaps as a contributor to) their enhanced financial performance, Top Performers have fewer issues with their orders (Figure 8).

Specifically, Top Performers are:

- 34% less likely to have cost overruns
- 17% less likely to have manufacturing documentation errors
- More than 10% less likely to have fines/damages, rework, and missed margin targets
- 10% less likely to deliver orders late

In addition to (or perhaps as a contributor to) their enhanced financial performance, Top Performers have fewer issues with their orders.

"*We've had ETO automation projects completely justified based on cost of quality and reducing upfront mistakes that ripple through*," recalls Heide of Engineering Intent.

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Analyzing what Top Performers do Differently

Separating respondents into performance bands helps provide a different perspective when we look at what companies do differently, and allows researchers to make improvement suggestions to companies that aren't performing as well. Notice what happens, for example when we look at differentiation and sort by the most *differentiating* strategies (Figure 9) as opposed to looking at the most *common* ones (Figure 3).

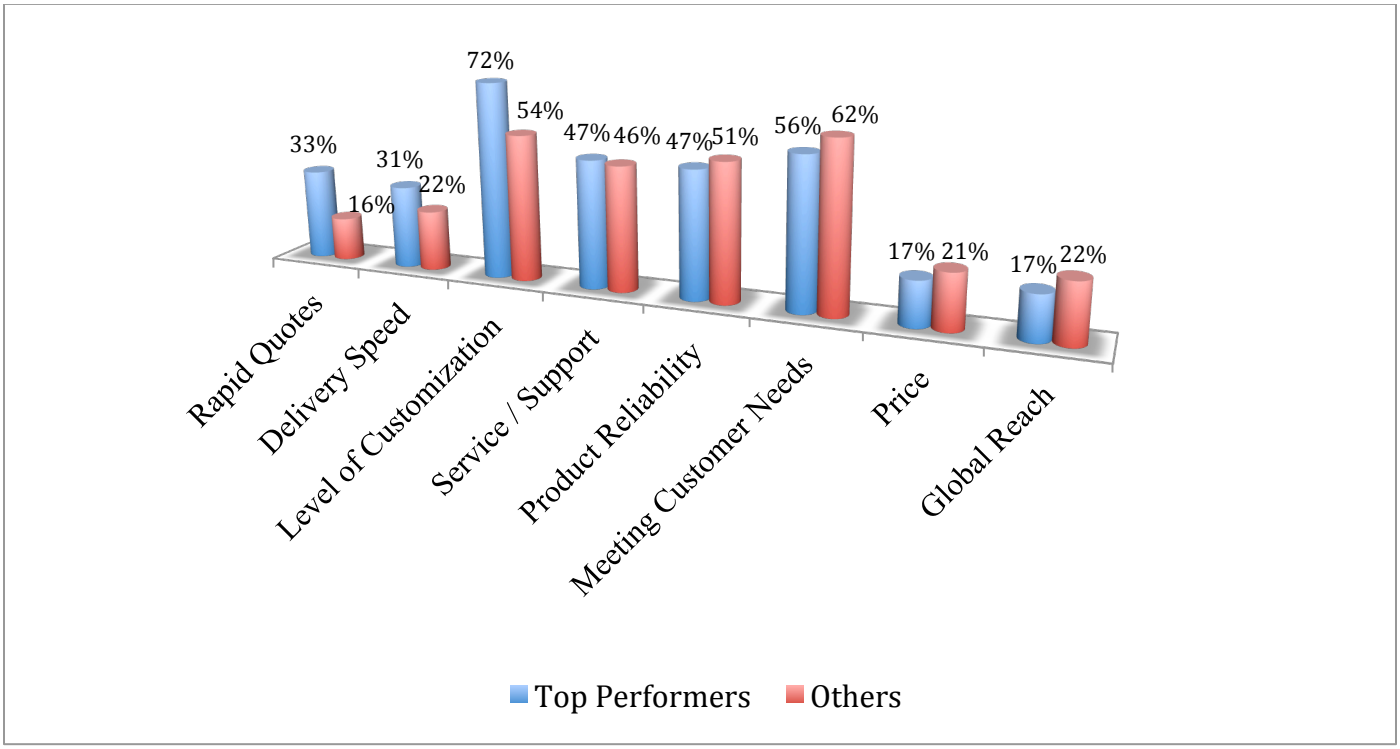

Figure 9: Differentiation Strategies by Performance Band

In the list of what is most *common*, developing rapid quotes and delivering products rapidly are toward the middle of the pack. But when sorted by what *differentiates* Top Performers compared to Others, these approaches show up at the top. They are found more frequently in Top Performers than Others. This is noteworthy because they are what set Top Performers apart from the rest of the pack.

Top Performers use speed as a competitive weapon.

Top Performers are more likely than Others to compete on speed, suggesting that Top Performers use speed as a competitive weapon. They are more than twice as likely to differentiate by the speed at which they can deliver a quote and over 1/3 more likely to compete on delivery speed. "*We use ETO applications at the proposal phase to*

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participate in proposal design as quickly as possible and so that when it gets to a contract we can pull the trigger much faster," says Bob Mattern of Babcock & Wilcox. "*Timespan is extremely important, especially when we're competing for work*."

The other differentiation strategies might still play an important role. For example there wasn't a lot of differentiation between Top Performers and Others in competing via reliability or support excellence, but they may still be important areas for differentiation. In fact, the level of customization is not only more common across the board, but Top Performers are even 50% more likely to differentiate that way. We will see that in addition to having different strategies, Top Performers also employ different processes and enabling technology to achieve their superior performance.

Evaluating Top Performers' Process Advantages

How do Top Performers achieve these better results? Tech-Clarity research[1] shows that Top Performers take different design approaches. Top Performers are more likely to put in place:

- Platform design approaches (58% Top Performers, 39% Others)
- Modular design approaches (54% compared to 39% Others)

Platform and modular design approaches allow order engineers to more readily reconfigure products. Modules developed with standard interfaces can be replaced more easily to address specific customer needs, for example by substituting a more powerful motor or higher torque gear assembly.

Platform and modular design approaches allow order engineers to more readily reconfigure products.

Researchers also analyzed performance related to important customization capabilities and discovered that Top Performers have better processes in many different aspects of quoting, engineering, and manufacturing custom products (Figure 10).

Top Performers are much more likely to perform "Very Well" on "to order" related tasks. Top Performers report they perform "Very Well":

- 3.5 times as frequently related to engineering leadtimes
- 2.5 times as frequently on meeting cost targets
- 2.2 times as frequently on meeting promised delivery
- 2.2 time as frequently on having accurate manufacturing documentation
- About twice as often on having accurate quotes

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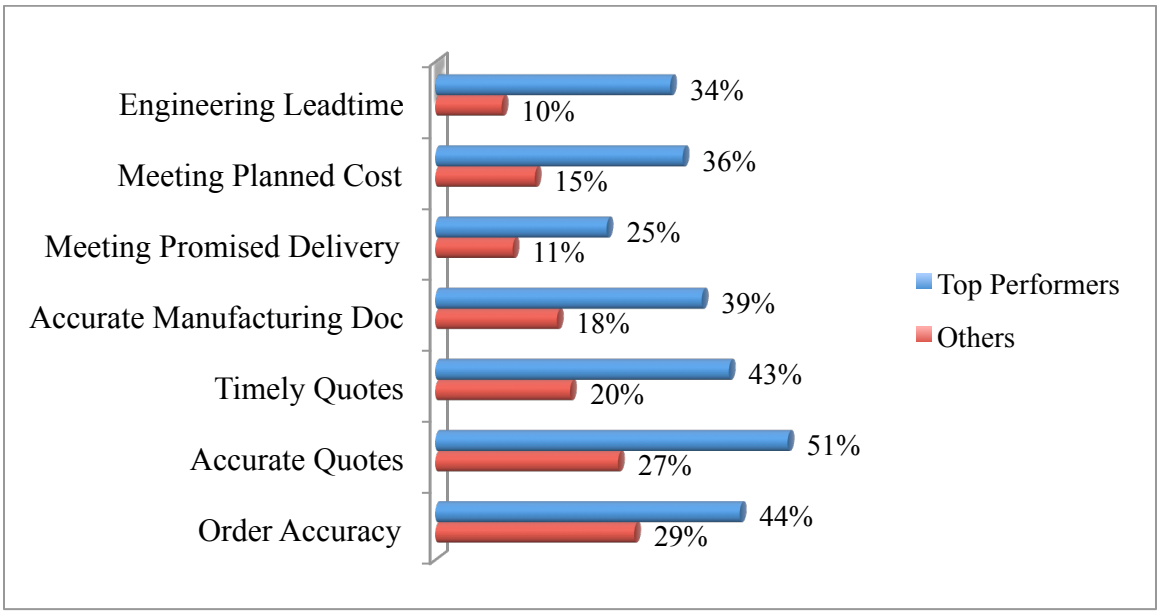

Figure 10: Customization Capability by Performance Class

It appears that Top Performers operate at a higher level of performance related to custom orders, and that the advantage is pervasive across processes. This also confirms prior findings[1] that indicate Top Performers have better abilities to develop timely, accurate quotes. Specifically, Top Performers:

- Are much more able to develop accurate price quotes
- Reported they were faster at developing quotes

Top Performers can quote, on average, within 7% accuracy compared to 13% accuracy for Others.

The research shows that Top Performers can quote, on average, within 7% accuracy compared to 13% accuracy for Others, giving them a 6% margin advantage to price orders more aggressively without incurring additional risk. "*We're very confident that with a few inputs we're going to get a very accurate design and confidence in the price in a very short time*," says Babcock and Wilcox's Mattern.

Analyzing the Technical Enablers of Top Performers

How do the Top Performers achieve their pervasive performance advantages? Our prior research[1] identified some interesting facts.

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Top Performers are:

- Four times more likely to use a rules-based design approach
- 47% more likely to use configurators / design automation technology

Top Performers are 47% more likely to use configurators / design automation technology.

These tools help capture knowledge and automate engineering tasks, improving engineering efficiency, shortening leadtimes, reducing errors, and creating a way to improve over time. This research looks a little deeper to understand what types of configurators and design automation solutions they utilize, and uncovers differences in the technology Top Performers use to support configuration and customization (Figure 11).

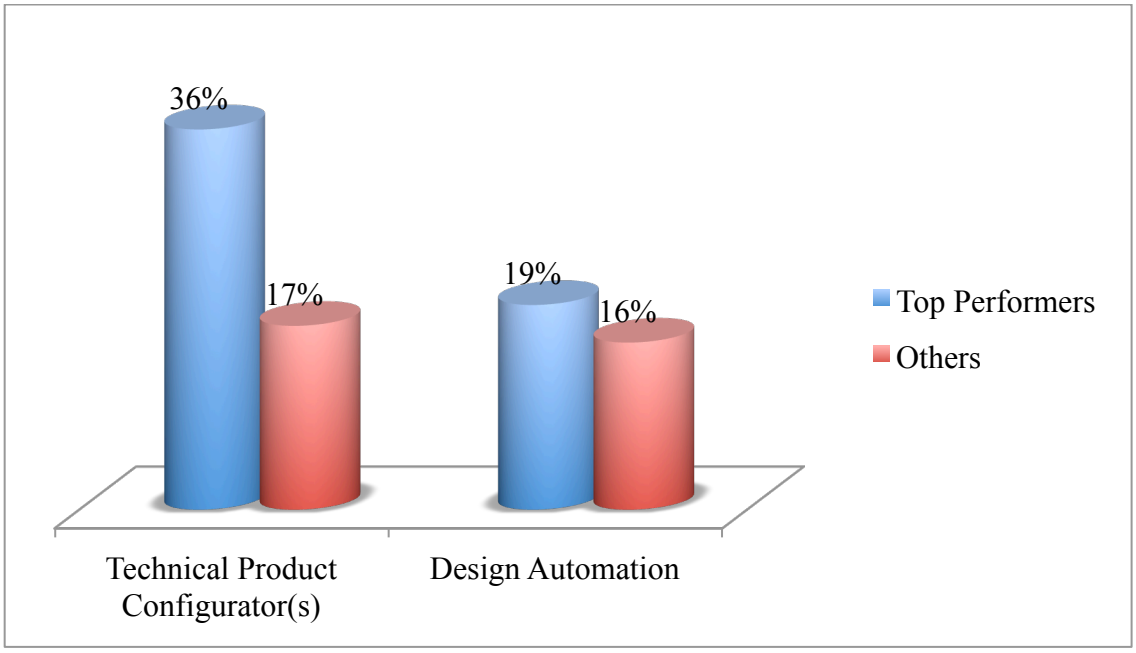

Figure 11: Enabling Technology by Performance Class

Two of the primary technologies researched are the primary categories of configurators used by manufacturers:

- **Sales Configurator (CPQ)** – Software that guides the user to a valid product configuration that is sufficient enough to generate customer pricing and quotations. This software typically generates the product configuration using rules captured within the system and automates the quotation. It may also offer quote

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lifecycle management and workflow capabilities. It is typically integrated into CRM and ERP software.

- **Technical Product Configurator** – Software that automates the detailed, technical product configuration in sufficient detail to manufacture the product. This software typically generates the product configuration based on rules captured within the system and automates the generation of order specific Bills of Material and work instructions. Product configurators may also generate order specific product content such as CAD models, drawings, and technical specifications.

The two different types of configurators are distinct tools and many companies use both independently.

Sales configurators typically handle order level product configuration based on product features and options, resulting in a configuration, price, and quote. This is why these configurators are sometimes known as "CPQ" configurators. Technical configuration includes analysis and decision-making for order-specific engineering, both of which are commonly required during the sales quotation process for ETO products.

Many companies face both of these different needs, but today the two different types of configurators are distinct tools and many companies use both independently. "*Typically the front office has selection software for customers to select options and validate high-level engineering like overall size and get to a price*," explains Price Mechanicals' Rogers, "*It would be ideal if it could be one and the same tool*." While technical product configurators set Top Performers apart, surprisingly, the use of sales configuration didn't differentiate that much.

Another category of solutions identified in the prior research[1] is design automation:

- **Design Automation** – Software that automates the design process for new parts. This software typically automates engineering and design calculations and integrates with CAD and CAE applications to automate their outputs. Technical product configurators for ETO processes often incorporate strong design automation capabilities.

Technical product configurators for ETO processes often incorporate strong design automation capabilities.

Top Performers across industries are 22% more likely to be using design automation. The resulting efficiency improvement can be dramatic. As Price Mechanical's Rogers shares, "*Our time study to manually create all manufacturing document for an average unit*

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comes to 72 man-hours per unit. We predict the design and drafting process will drop to 15 hours." That's almost a 400% productivity improvement!

Again, there are some significant differences between the most *common* approaches and the most *differentiating* ones. The most common technologies used to support developing orders and quotes are ERP (51%), spreadsheets (43%), and CAD (43%). About one-half of companies use each of these, including the Top Performers. But they didn't show any significant differentiation between Top Performers and Others. The most common software used to support order engineering are CAD (84%) and spreadsheets (over 1/3). These were not the most differentiating, either. The most differentiating enabler Top Performers use are technical product configurators. They are more than twice as commonly used by Top Performers.

The most differentiating enabler Top Performers use are technical product configurators.

Why do technical product configurators provide such a distinct advantage when other, more common technologies don't? Technical product configurators that incorporate design automation can automate manual engineering processes that are a bottleneck in sales proposal and order fulfillment processes. This is likely what allows Top Performers to provide more configuration while simultaneously competing on rapid quotes and order delivery, because automation speeds order execution, reduces rework from errors, and provides more accurate manufacturing documentation. "*Through a rule-based system we know we will design things the same way and get similar output*," shares Rick Habel of Babcock & Wilcox Company "*We know we're going to get a quality product that we can build. It's not ambiguous, we have consistent products and constant quality*."

Technical product configurators that incorporate design automation can automate manual engineering processes that are a bottleneck in sales proposal and order fulfillment processes.

On the other hand, CPQ solutions (while very effective for CTO), typically do not have the design automation capabilities required to eliminate the manual engineering bottleneck in ETO sales and order engineering processes. "*Most features/options configurators have learned their lesson*," cautions Heide of Engineering Intent, "*Just because a configurator talks to the CAD system doesn't mean it will work for ETO. Driving a 150% BOM and CAD assembly and setting some CAD parameters is not enough for ETO and probably not going to help you long term*."

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Identifying the Technical Capabilities of Top Performers

Researchers also looked at a variety of features of both technical and sales configurators to determine which are more commonly used, and which appear to provide differentiated capabilities for the Top Performers. Of these, a few stood out as differentiators (Figure 12). Analysis of the capabilities shows that Top Performers are:

- 1/3 more likely to automatically generate order specific MBOMs
- Over 50% more likely to automatically generate quotes

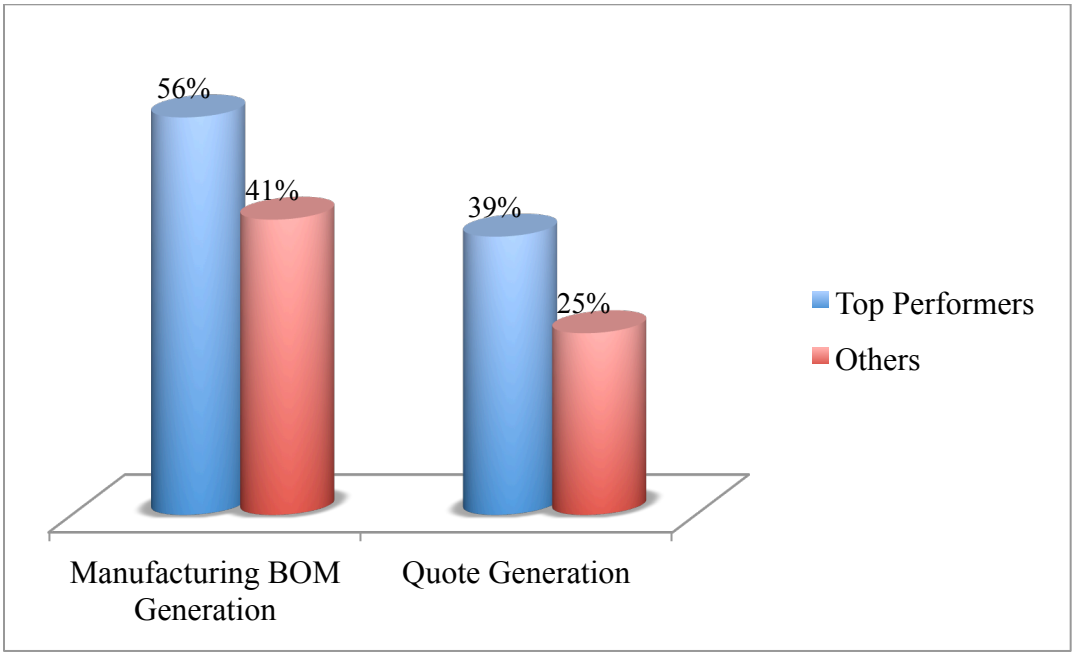

Figure 12: Differentiated Configurator Features by Performance Class

Instead of taking five days for one bid it is only four hours, maybe less.
Mark Zeinstra, Manager of Product Design Department, Siemens Energy

Automating manufacturing bill of material (MBOM) creation likely helps reduce the most common issue, manufacturing documentation errors. Also, if the MBOM and labor requirements are developed automatically, companies can calculate a more accurate, bottoms-up cost roll-up. Quote generation helps by eliminating costly, distracting, time-consuming effort developing quotes, and provides the opportunity to leverage custom engineering information such as 3D CAD models to develop more visual, compelling quotes. "*Our proposals are now fully generated without any CAD expertise. They are very accurate and look professional, and now instead of taking five days for one bid it is only four hours, maybe less*," offers Siemens Energy's Zeinstra.

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Top performers leverage more ETO automation capabilities.

Top performers leverage more ETO automation capabilities. These features incorporate automation and validation that are likely strong sources of the Top Performers' ability to compete on speed without creating additional errors that would result in order issues. "*There are two primary time savers from ETO configurators, automating the creation of the bill of material and the CAD information*," shares Price Mechanical's Rogers.

Conclusion

Product customization is growing and is expected to continue to grow. Customization provides significant business value, but also brings significant challenges. These challenges result in a large percentage of orders with costly and time-consuming mistakes. Top Performers, however, have fewer order errors than others. One of the key differences between their approaches and the Others' is that they have adopted more engineering automation. ETO automation helps eliminate engineering bottlenecks and manual processes that lead to delays and errors. "*If it's done right, engineering becomes a nonfactor for leadtimes*," explains Price Mechanical's Rogers.

ETO automation helps eliminate engineering bottlenecks and manual processes that lead to delays and errors.

Some of the key enablers that Top Performers employ more than Others are technical product configurators, design automation, MBOM generation, quote generation, and CAD automation. "*The whole idea is to automate a process to allow someone to do something more value-added for the business*," explains Mark Rogers of Price Mechanical. "*Automation allows engineers to design new things or cost-down products instead of processing orders*." These technologies help relieve the engineering bottleneck for customized orders and are likely the source of Top Performers enhanced order execution and higher financial performance. Other commonly used technologies including CAD, sales (CPQ) configurators, ERP, and spreadsheets also provide value, but they aren't correlated with the Top Performers' better performance.

Automation allows engineers to design new things or cost-down products instead of processing orders.
Mark Rogers, Knowledge Based Engineering Manager, Price Mechanical

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Recommendations

Based on industry experience and research for this report, Tech-Clarity offers the following recommendations:

- Focus on speed as a differentiator for customized products
- Adopt modular and platform design approaches to streamline customization
- Recognize the different capabilities of Technical Product Configurators and Sales (CPQ) Configurators, using each for their strengths (and possibly in combination)
- Leverage technical product configurators and design automation to remove manual engineering effort that creates bottlenecks and results in errors in sales and order engineering processes
- Adopt MBOM and quote generation capabilities to improve custom order performance

About the Author

Jim Brown is the President of Tech-Clarity, an independent research and consulting firm that specializes in analyzing the business value of software technology and services. Jim has over 20 years of experience in software for the manufacturing industries. He has a broad background including roles in industry, management consulting, the software industry, and research. His experience spans enterprise applications including PLM, ERP, quality management, service lifecycle management, manufacturing, supply chain management, and more. Jim is passionate about improving product innovation, product development, and engineering performance through the use of software technology.

Jim is an experienced researcher, author, and public speaker and enjoys the opportunity to speak at conferences or anywhere he can engage with people with a passion to improve business performance through software technology.

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About the Research

Tech-Clarity gathered and analyzed just over 200 responses to a web-based survey on Product Configuration and "To Order" Manufacturing. Survey respondents were invited by direct e-mail, social media, and online postings by Tech-Clarity, Engineering.com, and Siemens PLM.

The responding companies were a good representation of the manufacturing industries, including Industrial Equipment / Machinery (45%), Automotive / Transportation (18%), Consumer Packaged Goods (18%), Energy / Utilities (14%), Building Products / Fabrication (14%), Electronics / High-tech (13%), Aerospace / Defense (11%) and others including Life Sciences, Marine, and more. Note that these numbers add up to greater than 100% because some companies indicated that they are active in more than one industry.

The respondents represented a mix of company sizes, including 34% from smaller companies (less than $100 million), 31% between $100 million and $1 billion, 23% between $1 billion and $5 billion, and 12% greater than $5billion. All company sizes were reported in US dollar equivalent.

The respondents were comprised of employees holding various roles. About one-half (49%) were manager or director level. About one-third (32%) were individual contributors, 13% were VP or "C-level," and the remainder included internal consultants and others.

Respondents included manufacturers as well as service providers and software companies, but responses from those determined not to be directly involved in designing software-intensive products (including software vendors and consultants) were not included in the analysis. The majority of companies were considered to have direct involvement in designing and developing software-intensive products and the report reflects their experience.

Footnote

[1]Researchers quoted findings from Tech-Clarity's Best Practices in Developing Industrial Products because of the high prevalence of customized, to-order products in that industry and it serves as a good source of information for other industries.

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