



3D PRODUCT CUSTOMIZATION PLATFORM

End-to-End Customization

Executive Summary

In today's competitive market, customization is no longer a novelty—it's a strategic imperative. Consumers demand personalized products, and brands that deliver gain a direct channel to deepen customer loyalty, increase margins, and differentiate from third-party retailers. The global custom products market is growing with an annual growth rate of 4.6%, and brands that invest in customization outperform competitors in both sales and engagement.

However, customization is complex. It requires seamless integration across e-commerce, supply chain, and production workflows to be scalable and profitable. Spectrum's end-to-end platform automates these processes, enabling brands to offer mass customization without operational bottlenecks.

This white paper provides a roadmap for building a scalable customization program, covering:

Strategic Business Impact: How customization drives revenue, improves conversion rates, and reduces return rates.

Operational Execution: Key considerations for aligning supply chain capabilities with consumer demand.

Scalable Growth Strategies: A phased approach to expanding customization offerings while maintaining efficiency.

Technology & Automation: Leveraging AI-driven validation, 3D visualization, and seamless e-commerce integration.

Leading brands like Microsoft XBOX, Stanley, and ASICS have streamlined their customization programs and maximize profitability. This document outlines how your organization can do the same—turning the challenge of customization into a competitive advantage.



Introduction

Seamless Customization.

Users love personalizing products—there is no better expression of brand love than putting a piece of yourself into or onto a product. However, creating something truly unique like a customized product does involve extra steps and some additional work. But solving and executing these extra steps is clearly worth it, as consumers' demand for personalized products reaches over \$200 billion annually across hard and soft goods. Spectrum created an end-to-end software platform to automate many of these extra steps and, in doing so, developed a knowledge base that we are sharing to help bring customization to all brands.

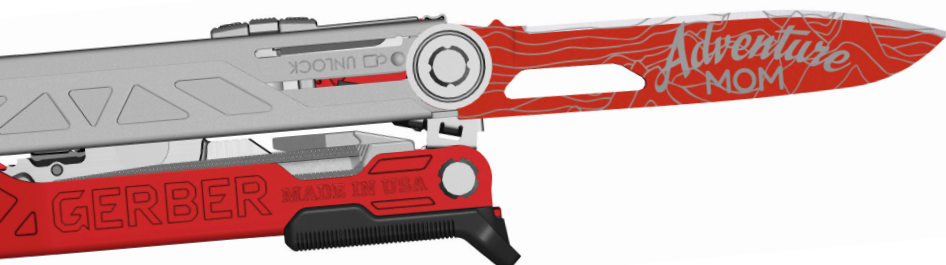


Why Spectrum?

We named our product Spectrum because we handle the full end-to-end process for customization. It's the only thing we do, and we've built unique and extensive experience handling custom programs for many Fortune 500 brands. Although this paper will include examples of what we do, its primary purpose is to explain the ins and outs of a custom program as a way of promoting customization in general, not simply selling our software.

Why Custom?

Customization isn't new or novel. Tailors and cobblers have been creating form fitting and purpose built articles of clothing and footwear as long as humans have been wearing clothes and shoes. As large scale manufacturing has come into play, this process has devolved into simply producing the adequate size for the average consumer. As online technology and improved manufacturing processes emerged, customization and personalization options have gone beyond size selection and evolved toward a blueprint that allows for manufacturing scale and product customization to co-exist.



Customization Versus Personalization

At Spectrum, we think about customization and personalization as two distinct offerings.

Customization

Altering a product in a way that yields a functional benefit.

- Using body measurements to create garments fitted exactly to a person's body.
- Adding a hammer loop to a pair of pants for a carpenter.
- Adding specific accessories to improve performance.
- Adding different shaped handles to a game controller to assist people with disabilities to play games.
- Ability to choose between different fabrics for performance of the product.

Personalization

Adding decorations that change the look of a product.

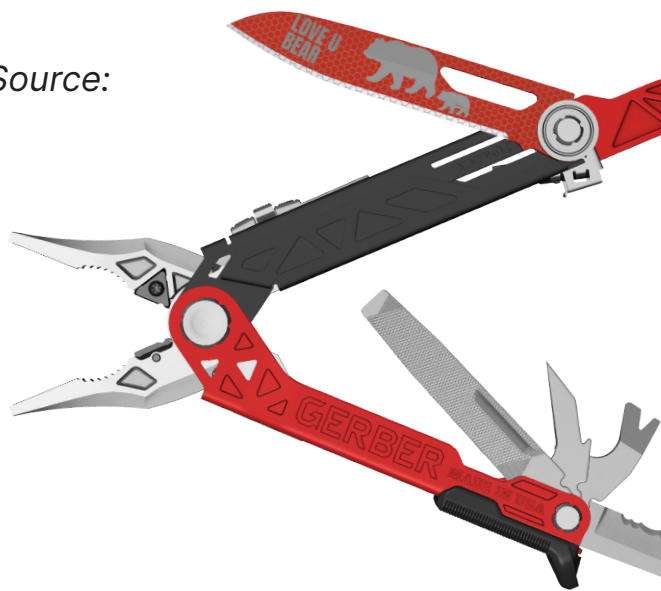
- Controlling colors and/or add unique marks to create a team uniform or company workwear.
- Placing monograms, names, or logos onto a finished product.
- Sublimating a photo of your family on the upper of a shoe.

Although the difference between customization and personalization may not be significant from a customer experience perspective, the difference matters a great deal when thinking about how the product is manufactured. Because of this, we always recommend starting with understanding where and how the product is altered when designing a customization program.



10 Reasons Why Customization is Important

1. It's not uncommon for Spectrum clients to see between 5-7X sales of custom vs. stock SKUs. *(Source: Spectrum Primary Data)*
2. 80% of consumers are more likely to purchase from a brand that offers personalized experiences. *(Source: Epsilon, Accenture)*
3. The global custom market is expected to grow to \$370 billion by 2025. *(Source: Zion Market and Business Market Research)*
4. 48% of customers are willing to wait longer for customized products, and 22% are willing to pay more for them. *(Source: Deloitte)*
5. 44% of consumers are likely to become repeat buyers after having a personalized shopping experience. *(Source: Segment)*
6. Customized products reduce return rates by 20% since they align better with customer expectations. *(Source: McKinsey)*
7. Personalized interactions can drive customer engagement by 20%, leading to longer browsing times and increased conversions. *(Source: Salesforce)*
8. 57% of companies that invest in personalization outperform their competitors in sales growth. *(Source: Forrester)*
9. The global market for mass customization is projected to reach \$36 billion by 2027, growing at a CAGR of 11.4%. *(Source: Grand View Research)*
10. Customization minimizes overproduction, contributing to up to 30% reduction in unsold inventory. *(Source: Boston Consulting Group)*



Creating a Customization Program

At Spectrum, one of the first questions we ask is whether a customization program is targeted to consumers (B2C), businesses (B2B), or both. While it might be true that the customization offering differs between the two, typically there are key logistical differences between B2B and B2C. We have highlighted some of the key considerations below:

B2B

- B2B customizers are often more complex on the front-end, offering more choices and flexibility on the customization offering.
- Minimum order quantities (MOQs) are often required. For example, you are not likely to digitize a custom logo for embroidery when buying just one garment.
- Custom pricing rules and discounts can differ by user account resulting in a Customize, Price, Quote (CPQ) offering.
- Fewer automated guardrails are placed on copyrighted or offensive content.
- B2B ecommerce systems often require more testing scenarios, making them more complex to integrate.



B2C

- Typically offered as a batch of one, whereby each product is customized uniquely.
- Customization experience is simplified, offering fewer choices in favor of increasing conversion rate.
- Custom text and imagery must go through automated guardrails to protect the brand from copyright infringement, offensive statements and adult content ([more on moderation later](#)).
- B2C ecommerce systems tend to be easier to integrate and test.



Back to Front: Supply-Chain First

A common trap, especially for new customization programs, is to put the primary focus on the front-end experience. It's an easy mistake to make since the amount of customization you can put into a web or mobile experience is limitless. However, it's more realistic to start with what is possible within the supply chain first, strategically limiting conversation and planning to what can be manufactured. This approach can bring up more questions than answers. Below are some of the most important questions to ask about your supply chain:

1. Where in the process can we introduce customization? At the point where the product is created or as a post-embellishment step?

This question is critical in determining whether the program focuses on customization, personalization, or both. For example, if a brand is sourcing a product from a third-party with little control over manufacturing, it is very difficult and expensive to physically change the product to a unique specification. But, if manufacturing control is present, many choose to enhance a sampling line to provide customization.

With the [embellishment methods](#) we'll discuss later, it is possible to introduce personalization without direct manufacturing control. This is most commonly performed as a final step before shipping from the brand's distribution center or logistics provider. For new programs, Spectrum will often provide a build vs rent analysis and provide matchmaking services for third-party providers.

2. What and how products will be customized?

Determining current and future products that will be offered is a critical step to program planning. The desire to introduce customization options to top selling products is a common first consideration. But in reality, some products' physical attributes make them better suited for customization from a manufacturing standpoint (*see inset*). Finding the sweet spot between ease of manufacturing and customers' demand often leads to the initial list of customized products.

How the products are customized is the other question that must be answered, informing what

Physical Properties to Consider for Customization

- Types of materials available
- Availability of suitable surfaces and spacing
- Product shape
- Amount of (pre) assembly needed for the product

is shown online and determining what can and cannot be customized. Ultimately, these rules form the core of a logic document that lists the rules of customization to be translated online. Many “can vs should” conversations pop up at this point since there are typically a lot of options that you “can” do, but “should” you offer them to a user? Sometimes, these decisions are based on the audience and an evaluation of cost and popularity. See [Creating a Customization Program](#).

As customization becomes more core to business, we often see brands designing and developing new products with customization in mind. This is often done to meet customer demand, reduce costs, and increase margin and scale.

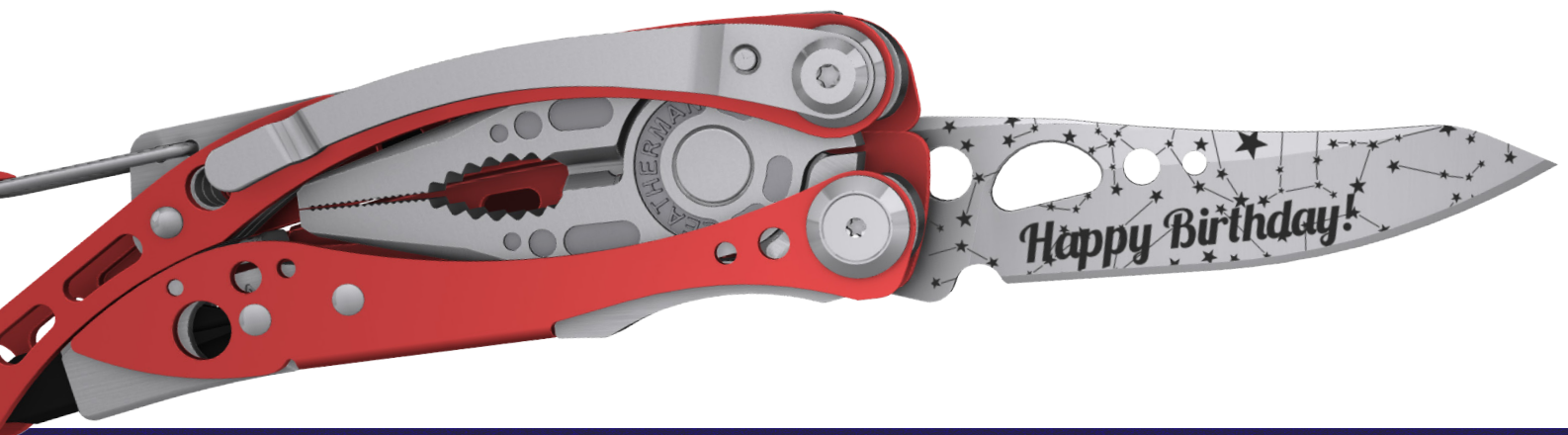
3. How much time and costs are added to provide customization?

With any customization program, there are added material and labor costs to calculate with the supply chain. Spectrum helps our clients determine and project these costs, providing the following deliverables:

- Upcharge pricing strategy
- Throughput: maximum capacity measured by customized units per hour
- Lead time expectation
- Program profitability projections

4. How is inventory allocated and managed?

This never-fun and often-overlooked question has the potential to negatively impact the business if not properly planned. Typically, customization can fit into an existing SKU management strategy with the addition of value-added services, but determining how inventory is allocated and reported upfront leads to better cohesion with the whole business. More specifically, for the customization offered to customers, real-time inventory positions must be communicated from the supply chain through ecommerce then to the online customization front-end experience.



Scalability: Crawl, Walk, Run

With new customization programs, we advise our clients to employ a measured approach to analyze, learn, and scale. This allows the business to absorb the overall impact of system and supply chain changes, setting the baseline infrastructure on which to scale the program. There are a multiple ways to scale a customization program:

- **Scale Out Products:** Increasing the number of products to be customized over time. For example, starting with top sellers and gradually adding in new and existing products.
- **Scale Out Offering:** Increasing the capabilities of customization by adding more features to alter or embellish the products. This can be as simple as adding new artwork choices or as complicated as adding a physical alteration to the product.
- **Scale Out Markets:** Brands will typically start in one market and expand to others in priority order. This often means localizing additional content and integrating customization features to other platforms. Scaling to other markets often entails integration with more systems such as different distribution centers and logistics providers.

Our customers will often do a combination of these items to scale after the initial program has met critical business objectives. This allows for key learnings and ecommerce experimentation to be done through the supply chain at a smaller scale, before undertaking a full-scale effort.



Embellishments

All personalized items use some embellishment technique to add detail to a product. A critical function of the Spectrum platform is creating the unique specification and artwork for each of these embellishment types along with any manufacturer specific requirements. This enables us to translate online designs to factory-ready files in near real time. There are many methods to do this, but the below list represents the most common approaches.

- **Laser Engraving:** Laser engraving involves using a high-powered laser beam to remove material from the surface of an object, creating a design that is precise, permanent, and often textured. This method works well on materials like metal, wood, glass, leather, and certain plastics. The laser's precision allows for detailed patterns, logos, or text. It does not involve color, as it etches directly into the material, but it provides a professional and elegant finish. Laser engraving is commonly used for products like water bottles, jewelry, cutting boards, and multi-tools.
- **Embroidery:** Renowned for its durability and professional appearance, embroidery is popular for logos and text on polos, hats, jackets, and other clothing. While embroidery is best for solid, simple designs, modern machines can handle multicolored and slightly intricate designs. Embroidery can be the most difficult embellishment since it requires a design be digitized into a format that can be read by an embroidery machine, while also requiring an artist to perform the action. Fortunately, Spectrum has helped automate this workflow by visualizing the embroidery and determining appropriate stitch count.
- **Direct-to-Garment (DTG) Printing:** DTG printing uses a specialized inkjet printer to apply water-based inks directly onto fabric. The ink soaks into the fibers of the material, resulting in a soft, breathable finish. This method allows for high-resolution, full-color designs with intricate details, including gradients and photographic imagery. DTG works best on cotton or cotton-blend fabrics and is ideal for small



production runs or one-off customizations. However, it requires pre-treatment for dark fabrics and is less effective on materials like polyester or heavily textured surfaces.

- **Direct-to-Film (DTF) Printing:** Direct-to-film printing involves printing a design onto a specialized film, applying an adhesive powder, and then heat-transferring the design onto the product. This method works best on materials such as cotton, polyester, blends, and even leather. DTF allows for vibrant, durable prints with sharp details, making it versatile for various garments and hard goods. Unlike DTG, DTF does not require pre-treatment and can be applied to darker fabrics with ease. The resulting print is slightly raised, providing a more durable finish compared to standard heat transfer techniques.
- **Screen Printing:** Screen printing is a traditional technique that involves pushing ink through a mesh stencil (screen) onto the material below. Each color in the design requires a separate screen, making it ideal for simple designs with few colors. Known for its vibrant and durable results, screen printing is well-suited for large production runs and a variety of materials, including fabrics, plastics, and wood. It provides a bold, opaque finish that resists fading or cracking over time, but setup costs can make it less economical for small orders or complex, multicolor designs.
- **Sublimation:** Sublimation printing uses heat and pressure to transfer dye into polyester-based materials or polymer-coated surfaces. The process transforms the dye into gas, which bonds permanently with the material, resulting in a vivid, long-lasting print that won't crack, peel, or fade. Sublimation works best on light-colored products and is ideal for creating photo-realistic images, complex patterns, and designs with gradients. Popular items for sublimation include custom apparel, mugs, phone cases, and signage. However, this method is limited to polyester fabrics or polymer-coated substrates.



Building The Customizer

Bringing a customizer online is the most creative aspect of a customization project. Customizers should adhere to common web and mobile best practices such as load speed, accessibility, and search engine optimization. What sets product customizers apart, however, is they are designed to be both exploratory and transactional, serving audiences that want to experiment and those that know what they want immediately. So there are wide latitudes to create unique experiences, but there are two principles all customizers should adhere to:

1. **No Dead Ends:** never let a user create something that is not possible to manufacture.
2. **What You See is What You Get (WYSIWYG):** show the user exactly what they are going to get. Many customization programs do not allow returns so setting the expectation immediately online is very important.

Below are some key features of effective customizers, why they are important, and how we adhere to these best practices.

BUILDING THE CUSTOMIZER: 3D VISUALIZATION

3D visualization plays a crucial role in online product customization by offering customers an immersive and interactive experience. Unlike static images or flat 2D previews, 3D models allow users to view their customized products from all angles, providing a realistic representation of the final product down to a thread in the fabric. This interactive element bridges the gap between the customer's imagination and the physical product, instilling confidence in their purchase decision. For example, customers can rotate a custom shoe design to see the stitching, material texture, and color combinations in detail, ensuring their chosen features align with their expectations.

The precision and detail enabled by 3D visualization helps reduce misunderstandings and errors during the design and production process. Customers can make real-time adjustments, such as changing colors, adding engravings, or modifying layouts, while instantly seeing the impact of these changes. This immediate feedback ensures designs are finalized correctly the first time, minimizing the need for costly revisions or returns. It also streamlines the workflow for manufacturers, as they receive precise, customer-approved designs ready for production.

In addition to improving accuracy, 3D visualization enhances the overall user experience, making the customization process engaging and enjoyable. The ability to manipulate and personalize a product in a virtual environment empowers customers and fosters a sense of creativity. This interaction not only builds an emotional connection to the product but also increases the

likelihood of a purchase. This translates to higher conversion rates and customer satisfaction, as buyers feel confident and excited about their unique creations

Lastly, 3D visualization supports emerging technologies like augmented reality (AR) and virtual reality (VR), further elevating the customization experience. Customers can use AR to “place” virtual products in their real-world environment, such as seeing how a customized chair would look in their living room. Additionally, 3D models can be used to generate marketing images and animations for online and offline marketing uses. This level of realism and context makes 3D visualization an indispensable tool for businesses looking to offer cutting-edge, personalized shopping experiences in an increasingly competitive market.

BUILDING THE CUSTOMIZER: LOGIC AND VALIDATION

Earlier we discussed the back-to-front approach where we first understand the capabilities and embellishment methods that can be realistically performed within the existing supply chain. This effort pays dividends when constructing the logic for front-end customization. The logic is displayed as customer choices, sometimes varying by audience (B2B vs B2C). Clearly defined customization logic strikes a balance between offering seemingly limitless options and not overwhelming the user. The goal is to always lead the user down a path of what is possible. One effective way to accomplish this is to show users pre-made designs, and allow those to serve as inspiration.

Once a user uploads text or imagery, it’s critical to validate that content for the benefit of the user, the factory, and the brand. User-uploaded content should be moderated to ensure there is no offensive content or copyright violations included in a user’s design. Below is a list of validations that Spectrum routinely performs:

- Adult image detection
- Copyright logo detection
- Offensive text as type or within image
- Minimum image resolution
- Color count analysis
- Vector file quality and color analysis
- Image complexity



BUILDING THE CUSTOMIZER: ECOMMERCE INTEGRATION

Most customizers need to be integrated into an ecommerce platform to be able to support cart, checkout, and payment processing. A customizer can be integrated into any system, but the level of effort can vary from platform to platform. For example, integrating into Shopify, the leading B2C ecommerce provider, is relatively low effort, typically measured in days to complete. On the other hand, a B2B implementation might be larger given the likelihood of more complex pricing or business rules in play. Regardless of the context and platform, the items to integrate are typically the same:

- **Pricing and inventory:** customizers will typically have variable pricing based on selections or embellishments that a user chooses. To accomplish this, pricing and inventory data (often at a component level) must be communicated to the customizer to show updated pricing and availability as the user customizes the product. At Spectrum, we believe custom pricing and inventory should always come from the same system that stores this data for stock products, which is often the ecommerce platform. Integrating these systems enables product and marketing teams to manage pricing and inventory in a way that is familiar and consistent.
- **Cart and checkout integration:** A customized item can almost always sit side by side with stock items within a cart, becoming part of the same checkout process. While the process may vary depending on the ecommerce vendor used, ultimately the cart will need to be able to identify a customized item, and calculate the price based on data provided to the cart while also showing an image of the customized product.

Spectrum does this by providing a unique identifier to the cart, signifying a customized item. Using this identifier, all the details of the item can be retrieved including customized images at any angle. With minimal custom development and styling, Spectrum is able to ensure that each brand is able to retain its unique cart presentation.

- **Product detail page:** The simplest and often first front-end step is to create a place where the customizer exists. For consistency and simplicity of integrations, taking an existing product page for stock items and replacing product photo and product description with the customizer is a good starting point.

At Spectrum, we use a low-code integration method using JavaScript to load all visuals, logic, and user controls from our centralized platform.

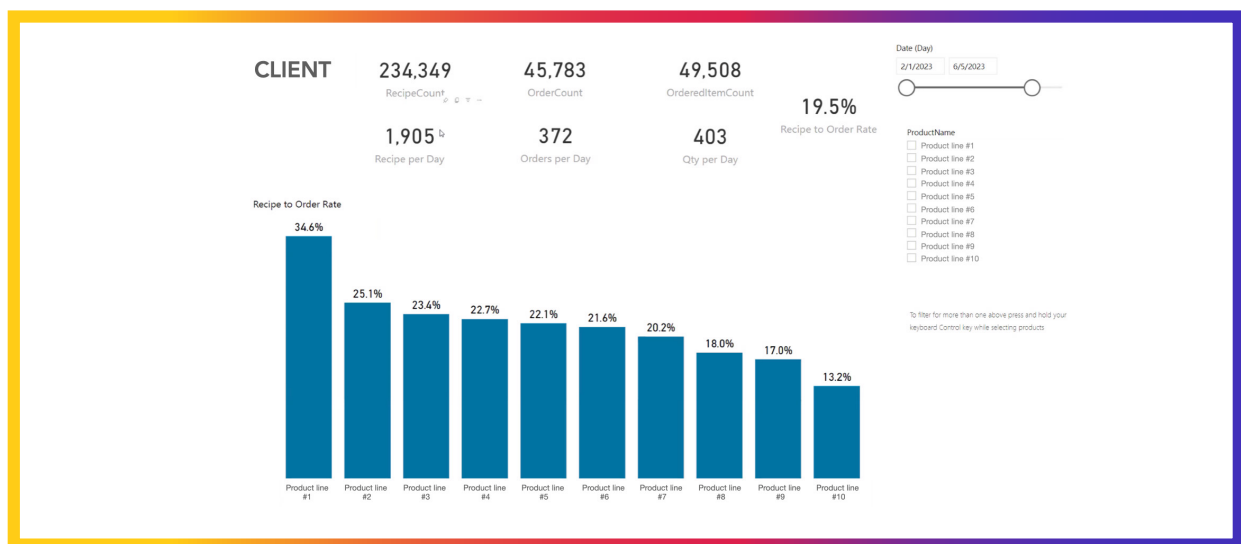
- **Inspiration:** Getting users to the product page is similar to other user engagement best practices. However, with customized items, displaying pre-existing customized items is a proven way to show diverse options, engage interest, and inspire users. These can be shown in a variety of places, including custom product landing pages, marketing campaigns, home pages or stock product detail pages.



Key Metrics

Overall, conversion goals for custom products are the same as stock items, as you always want to optimize for purchase. Here are 5 of the top metrics that are important to watch:

1. **Load speed:** Customizers are doing more than a normal product page, but initial page load is still hugely important. It's critical to load page content first and then progressively load larger content. 3D assets are typically larger than 2D images so extra care is critical. However, one benefit of 3D is once it's loaded, a customer's choices are visualized instantaneously.
2. **Time on page/site:** Increased time on site or the customized page should be viewed as engagement. For stock products, increased time is often viewed as user confusion, but typically higher time for custom products leads to increased conversion. In fact, some Spectrum clients see up to 2X increase in time on site when comparing custom vs. stock SKUs.
3. **Design to Order Ratio:** This metric is simply the number of designs that users make relative to the order. This is also known as the Recipe to Order ratio and if it is too high it means that users may have choice paralysis.
4. **Bounce rate:** The bounce rate on customization pages should be some of the lowest on the site. If not, the funnel is not optimized, or the page is poorly designed for conversion.
5. **Conversion:** One of the reasons for implementing a custom program is the expectation that conversion rates of custom products are higher than stock items and average orders.

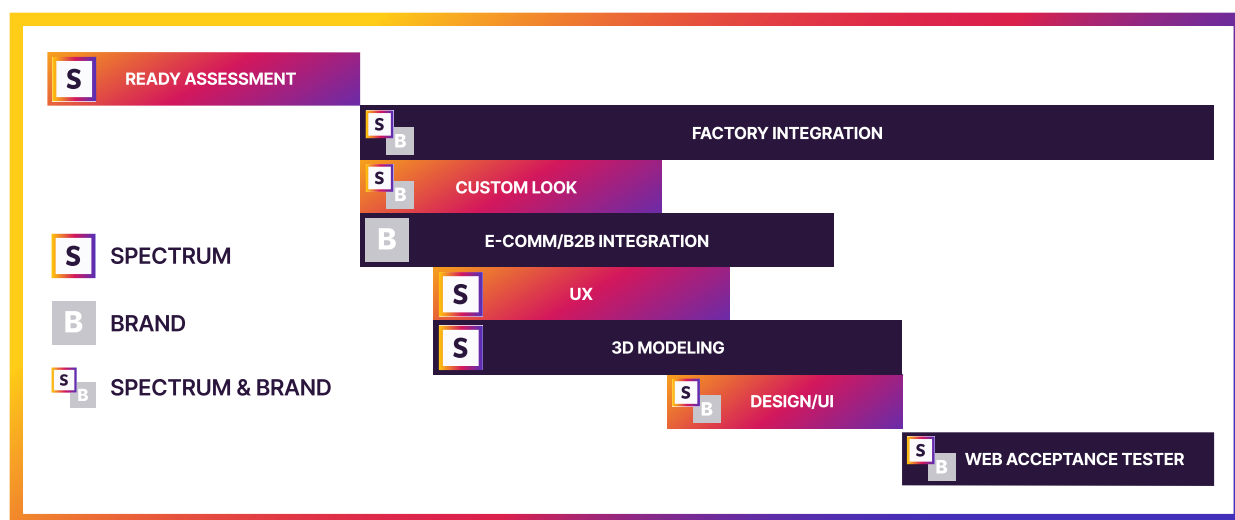


Spectrum Admin Reporting Tool

Typical Production Schedule

Over dozens of integrations, Spectrum's team has refined our process to optimize our production schedule. The chart below shows a typical production schedule to roll out a customization program. In our experience, the criteria that can impact the schedule include:

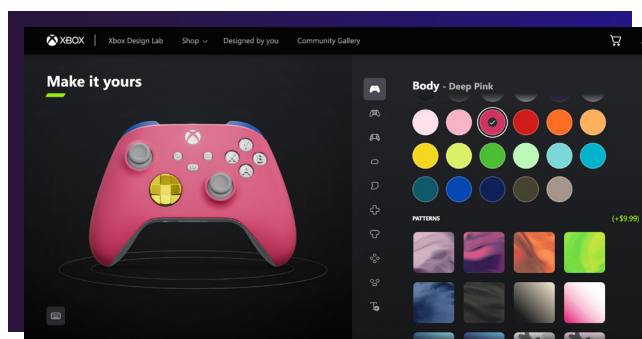
- Number of products
- Complexity of embellishments
- Capabilities of existing production



Typical Spectrum Production Schedule

The Spectrum Platform

The information in this white paper has been based on the experience of building and growing the [Spectrum Customization Platform](#) over the last decade. Not all brands need an external platform, but for those who do, Spectrum's white label solution delivers on the recommendations listed in this document. High-value brands like Microsoft XBOX, Stanley, and ASICS trust Spectrum for their 3D customization programs, from the interactive user interface and ecommerce integration, through the supply chain and ultimately to the factory floor.



Sources

The clothing customization industry has experienced significant growth in recent years, driven by increasing consumer demand for personalized apparel. In 2023, the global custom clothing market was valued at approximately USD 50.2 billion and is projected to reach around USD 131.6 billion by 2032, exhibiting a compound annual growth rate (CAGR) of 10.9% during the forecast period.

Link: [Business Research Insights](#)

The custom apparel segment, which includes personalized t-shirts, hoodies, and other garments, is also expanding. For instance, the custom t-shirt printing market was valued at USD 4.31 billion globally in 2022 and is projected to grow at a CAGR of 11.1% from 2023 to 2030.

Link: [Customcy](#)

Regarding hard goods customization, specific market size data is less readily available. However, the broader hard luxury goods market, encompassing items like watches and jewelry, was valued at USD 164.59 billion in 2023 and is expected to reach USD 244.59 billion by 2032, with a CAGR of 4.5%.

Link: [Zion Market Research](#)

