FASH STUDIES / ON

Custom Clothing Technology:
Diffusion of Luxury Practices in Fashion

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Abstract: The common understanding of the fashion industry is that it is rapidly changing and constantly on the cutting edge of what is new. Yet in reality the fashion industry does not adopt new practices or change its ways of doing business quite so easily. This article examines the successes and failures of 3D scanning as a new tool in the fashion industry. Through the analysis of three case studies it becomes clear that new technology is not an automatic guarantor of innovation or success. Analyzing the motivations behind the introduction of 3D scanning for made-to-measure clothing products is important to understanding where technology and the fashion practitioner do not necessarily communicate properly. Whereas 3D scanning promises to make made-to-measure clothing an easy and accessible service, made-to-measure and other custom clothing businesses are based upon traditional notions of luxury and craftsmanship. It is apparent through first-person interviews and observations that the current dichotomy between technology and craftsmanship has not been resolved. Creators of fashion-based technologies need to be working in tandem with traditional fashion practitioners, whose expertise is required if new technology is to reinvent the centuries-old processes of clothing production for the better. 3D scanners that have been introduced to date have yet to meet their full potential because they lack the nuanced understanding of the human body that comes from traditional clothes-making training and expertise. Researching the present status of this technology's integration within fashion is important in understanding how digital technology is best included in the design, production, and sale of clothing products more broadly.

Introduction:Technology vs. Tradition

The goal of this research is to parse the hype and expectation around digital technology and fashion to gain a better understanding of how 3D design tools are being introduced into the clothing supply chain. Increasingly seen as the "future of fashion," 3D technology is allegedly poised to revolutionize and transform how clothing is designed and produced ("The Future of Fashion"; Lay; Thomson). Yet through observation of and discussion with stakeholders implementing these tools now, there are clearly gaps in how the technology is integrated into the workflow and how it is perceived by customers. Despite the promise that scanning technology will revolutionize how clothing is made, it is clear upon further research that such a revolution is off to a slow start (Vialva et al.). After outlining the essential history and types of 3D scanners and fashion business models, made-to-measure suiting companies Alton Lane and Acustom Apparel will be examined, with a focus on how they use 3D scanners in their New York showrooms. A look at Rigby & Peller — a luxury lingerie retailer with a 3D scanner in one of their Manhattan storefronts — will help to demonstrate the ways in which 3D scanning falls short as a technology in its current form. Rather than give up on the technology, however, the second half of the paper will use the three case studies as a set of parameters for seeking lessons and solutions for future implementations of digital technology in clothes making and fit. Ultimately, it becomes clear that the integration of digital tools into the fashion system in a meaningful way will come only when those tools incorporate more knowledge of and support for traditional fashion techniques.

Definitions: 3D Scanning and the Fashion Industry

The history of 3D scanning is best described in terms of the various forms the technology has taken and through the technology's implementation. As documented in research published in Displays, a journal covering the various forms of digital interfaces, the first 3D scanners emerged at the turn of the 21st century in parallel with the continuous development of higher quality image resolutions (Daanen and Ter Haar 270). Scanning technology can today be broken into four groups: laser line, structured light, multi-view camera, and millimeter wave systems (270). Laser and light-based systems introduce either a single laser beam or flashes of light into the scanning area while cameras simultaneously analyze and record distortions that occur when these two-dimensional forms hit a 3D surface (271). Camera based systems, meanwhile, involve dozens of photographs that are compiled into a 3D form (271). In a camera system either the subject must rotate, the camera must move around the subject, or multiple cameras must collaborate within a rigging structure. All of these technologies differ from what is perhaps the most commonly experienced form of 3D scanning — the millimeter wave. Airport security screening involves these devices, whose millimeter waves are able to penetrate clothing to detect the form of the body without undressing (271). As noted in Displays, this would seem ideal for all scanning scenarios including fashion, but the technology is not designed to accurately record the dimensions of the 3D form, instead capturing just the initial distortions of the millimeter wave (273).

There are at least a dozen companies today that offer 3D scanners for a variety of applications, including those mentioned by the researchers in Displays (Daanen and Ter Haar 272). In addition to airport screening, film and television, and medical analysis, a notable recent trend is the introduction of scanners to gyms and other fitness spaces ("Fit3D"; "Styku"). These devices are marketed as an alternative to the numerical scale. Rather than relying on an abstract number, the companies argue, customers can instead track their body shape systematically over time. In turn, the companies compile a vast array of body size data that can be anonymized and sold to apparel companies in order to inform their sizing standards, among other companies and purposes. According to an interview with Raj Sareen, the CEO of Styku and a conversation with a salesman at BodyBlock AI (an offshoot of Fit3D), using the scanner for any other purpose related to fashion is less economical because of a low volume of data — a stance decidedly at odds with the approach of the companies studied for this paper (Moore; Sareen). For Sareen in particular, a 3D scanner is ill placed in a design company because the number of people placed in front of it will never be large enough to justify the collection of such specific data.
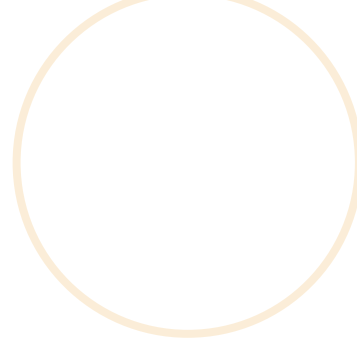
Meanwhile, it is important to note the subtle differences that can occur in the methods of different clothing companies (Bubonia; Ewing and Mackrell). Two business models are under analysis in this paper: "made-to-measure" (also sometimes known as "tailor-made" and often mislabeled as "custom") and "mass production" (also known as "ready-to-wear"). Within these two sectors of the fashion marketplace there are of course distinctions, but general dividing lines can be drawn in the industry between:

A) Clothing that is designed, sized, and produced in bulk before being made available to customers. These are mass produced items, referred to in the industry as "ready-to-wear" and, in an accelerated time frame, could be labeled "fast fashion."

B) Clothing that is at least partially but often fully designed and sized before being adjusted for a customer ahead of final production and/or delivery. Clothes that are "tailor-made" or "made-to-measure" fall into this category, as is clothing made through "mass customization," where styling features can be selected ahead of purchasing.

C) Clothing that a customer has full creative control over and that is hand made to the customer's size and preference. Haute couture and Savile Row are the organizations/historical associations governing the highest echelons of this sector, but small-scale designers, tailors, or dress makers may call themselves "custom", "couture", or "bespoke" while offering a similarly high level of flexibility in the design of their clothing.

Traditionally, type C is prized as the most luxurious. Couture and bespoke tailoring is performed by highly trained artisans, most famously working in exclusive French ateliers like Chanel or Dior, that offer their customers an unlimited array of options for the style, materiality, and fit of their garments (Anderson; De Marly). There may also be companies and individuals who perform the specialist, handmade techniques of type C without the full certification or distinction of being haute couture. Despite policing by the Fédération de la Haute Couture Et de la Mode, some businesses may use the word "couture" in marketing where "custom" might be more appropriate ("La Fédération"; "Savile Row Bespoke").

Type B forms the majority of this paper's analysis, but in turn is also typically fast and loose with its terminology by using "custom" where "made-to-measure" is more appropriate (see, for example, "Indochino"). These firms offer a range of style features that customers can select to create something unique, however the options are preordained by the company and cannot be deviated from. Rather, as exemplified by the companies Alton Lane and Acustom Apparel, every garment is designed and sized before the customer has any input, at which point the sizing of the garment is modified and a fabric is selected (Newcomb; Norcross and Sumner). Here type B firms are hewing closer to the practices of type A — ready-to-wear or mass production fashion firms — in their systematic design and development of garments. Some companies do take a half step back toward bespoke and allow controlled stylistic changes: Acustom Apparel and others may allow for collar styles, hem styles, button styles, and/or other elements to be toggled between multiple pre-designed options (Norcross and Sumner). As well, Alton Lane does create a new set of garment patterns for each customer (Newcomb). For the most part, selections of significant style changes are discouraged in favor of simply selecting another pre-designed option with more of the desired features (see, for example, "Indochino"). Type A firms, which offer fully completed garments for sale in retail storefronts, represent the clothing experience most people have experienced (see, for example, "Men's Wearhouse" and "Rigby & Peller"). The average American fashion consumer may stray from type A into type B territory in shopping for wedding clothes, for example (Mead).

Case Study: Alton Lane

The offices of made-to-measure suiting company Alton Lane are in a nondescript office building on 25th street in Manhattan. Occupying a full floor, the showroom is styled like a Victorian lounge ("Alton Lane"; Figure 1). Such décor is an extremely common trend across men's suiting companies: the Chesterfield sofa, dark color scheme, and mixture of wood, leather, and animal skin is meant to evoke a sense of exclusivity, comfort, and traditional masculinity (Barry). Around the room is an assortment of sample garments and swatch books. The sales desk doubles as a bar, mixing drinks and tie samples to create a relaxed atmosphere. Tucked away in a corner, however, is a device that breaks with the vintage aesthetic and serves as the focal point for this paper: a 3D body scanner. The presence of a scanner sets Alton Lane apart from its competitors, yet the hidden physical presence of the scanner is reflective of its place as merely a tool in Alton Lane's business practices.

Richard, a longtime employee at Alton Lane, reported that the body scanner that Alton Lane relies on is only sometimes effective ("Alton Lane"). In fact, it is not at all uncommon for salespeople to disregard the results of a scan. Rather than a fault of the equipment, the issue is that many of Alton Lane's patrons are uncomfortable with being scanned nude, as required by their laser-based scanning system. The scanning area is completely enclosed of course, but even then, nervousness on the customer's part will often result in 3D scans that are marred by a pair of boxer shorts or a t-shirt. The outline of a loose short or sleeve opening will read as a contiguous part of the body, distorting the measurements that come from the scanner (Newcomb).

Figure 1: Alton Lane's 25th street showroom features traditionally masculine decor. @altonlane, 30 April 2018, Instagram, https://www.instagram.com/p/BiM-vZv3Hhgz/.

A particularly instructive detail as to the nature of Alton Lane's relationship to their scanners is that it is easier for them to disregard such scans than ask the client to scan again. Such a response to difficulty with technology is aligned with Richard's characterization of the scanner as an aid or tool in the hands of a trained salesperson. Alton Lane showroom employees are, thanks to rigorous training, fully capable of assessing the fit and size of a suit for a customer with nothing more than a measuring tape. Yet most 3D scanners are proposed as faster and more objectively accurate replacements for that measuring tape ("Size Stream").[1] Size Stream, the manufacturer of the scanner in question, offers a suite of software to accompany their physical hardware ("Size Stream"; Figure 2). The software is customizable from one business customer to another, and outputs body measurements that are specific to each brand using the scanner. For Alton Lane this means that the standard set of tailoring measurements are included, such as the inseam, out seam, chest circumference, etc. (Newcomb).

Figure 2: The 3D scanner in the Alton Lane showroom. "SS20 'Classic' Edition," Size Stream, http://sizestream.com/ss20-classic/.

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[1] Size Stream could not be reached at the time of writing for an interview. The scanner pictured in Figure 2 is a more recent edition of the SS14 model used by Alton Lane and Acustom Apparel.

It is surprising to find out, however, that Alton Lane sales staff regularly supplement the scanner with measurements taken in physical space with a measuring tape. In particular, the scanner seems to have trouble with arm lengths and with correctly identifying certain focal points of the body. Richard connects the supplementation of the scanner's measurements back to the company's use of the scanner as a tool among more traditional tailoring techniques and methods. Throughout the hour-long interview, Richard most often repeats the notion that scanners do not confer perfection, and that it must instead be used to inform professional opinions and expertise. Such expertise around suiting and clothing fit is based upon a formal and luxurious heritage of fine tailoring (Blackman). The scanner is at best a supporting player in Alton Lane's push to offer a fine tailoring experience at a reasonable price. The technology creates friction, to use a bit of digital design jargon, between the brand's aesthetic and experiential vision and its business goals (Newcomb).

Richard was asked some questions about how the company manages their business and customers. Given that each client is ordering items that are always different in size, and often different stylistically between one order and the next, management of orders and inventory could presumably be highly complex. He replied that the company is fundamentally not looking for or attempting to predict trends in areas like fit data (this, as mentioned, is a stark contrast to Sareen's approach at Styku). Meanwhile, fabric and style selection in the made-to-measure context is not unlike any other fashion business outside of the fact that the selection tends to happen at a different point in the development pipeline, a shift that Alton Lane finds easy to manage. Richard reports that there is also a bell curve of sizes — the smallest and largest sizes being less popular than a median range — that is similar to one that might be seen in a ready-to-wear company (Christel and Dunn; Newcomb).
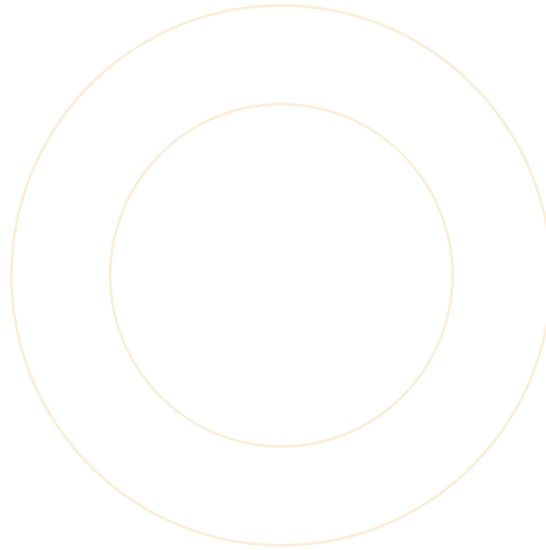
As a result, this means that Alton Lane's offer of made-to-measure garments is not attracting a clientele that is ill served by ready-to-wear, or that is otherwise not served by off-the-rack options. Richard says that some customers come in with concerns about their body shape or appearance, and that many customers stay within a narrow range of suit colors and styling features (think of perennial suit colors black, navy, and grey). 3D scanning, though used here in the context of custom clothing, is able to work in part because it is programmed with a standardized notion of the human body and body types (Brown and Rice), and as Richard notes the company rarely works with customers who fall outside these norms. Underwear and supplementary hand measurements notwithstanding, most customers do not encounter issues with being scanned (Newcomb).

The natural follow-up question to the lack of wide variety in Alton Lane's clientele is why Alton Lane bothers with customization at all. Richard notes that even within a narrow range there can still be quite a bit of variation where body type is concerned. Richard also says that two people with the same body type do not necessarily perceive the fit of their clothing in the same way. The range of preferences between a slim and relaxed fitting garment is vast, as evidenced by the proliferation of consumer guides for clothing fit online (Babcock; Ismanalijev; Peterson). It is in this service of individual preferences that Alton Lane outperforms the ready-to-wear alternative in the eyes of their clientele. While their body types alone do not necessarily fall outside the norms of ready-to-wear sizing, a combination of body type, posture and fit preference drives many customers toward Alton Lane because ready-to-wear options are rare. Furthermore, even within terms such as slim fit, traditional fit, and loose fit there are wide variances of opinion. The definition of these terms in relation to measurements on the body may not match the definition that a customer has. For example, Richard shared that when helping his father get a suit from Alton Lane his own definition of a relaxed fit was a slim fit in his father's eyes (Newcomb).

Case Study: Acustom Apparel

Acustom Apparel, in comparison to Alton Lane, is a company with a bit more of a modern edge. In their West Broadway showroom, there are fewer traditional furnishings and more graphic art on the walls. There are leather jackets as well as velvet tuxedos alongside more traditional suits, which are similarly priced to Alton Lane's at around one thousand dollars. Further illustrating the differences between the posturing of the two companies are the competitors that each named during the interview. Whereas Richard at Alton Lane mentions Brioni, a fine luxury suiting company, Dan at Acustom Apparel mentions online made-to-measure suiting retailers like Studio Suits and Indochino ("Brioni"; "Indochino"; "Studio Suits").

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Dan, a founder of Acustom Apparel, is quick to share his opinion of their body scanner, the same Size Stream model as the machine found at Alton Lane. He says that as a company, Acustom would prefer to be hardware and software agnostic, by which he means that technology for apparel tend to have good software or hardware but never both. As the head of the company Dan feels that there is value in scanning, but most of the process is not yet "clean" and it is difficult to dedicate time to a device that is not fully streamlined in its use (Norcross and Sumner).

Dan immediately echoes the sentiment gleaned from Alton Lane: that body scanning is a tool best used in the hands of someone who has expertise in traditional forms of tailoring and clothes making. Alex, an expert in the Soho showroom (the company's only location), says that the scanner is a tool to get the process started. He will 3D scan a customer in order to ascertain the general size range that the fitting appointment should start at. Acustom's clothing, like Alton Lane's, is based on pattern blocks, which contain interchangeable garment component patterns (linings, collars, sleeves, etc.) that are known to work across a number of styles (Fasanella). From this starting point the garments are then tailored to the individual customer — a process that can go faster when a body scanner can immediately say which size is the best to work off of for any given individual (Norcross and Sumner).

Alex went on to report many of the same experiences and opinions found at Alton Lane, in particular the concept that "tailoring is more of an art than a science." Alex, in his practice as a tailor, seeks to balance the technology that is at his disposal with the artisan craftsmanship in which he is trained. He is largely looking to the client to understand their preferences and needs, noting that "measurements are not the garment." The Acustom Apparel customer is, by Dan and Alex's estimation, perhaps slightly heavier set than the typical person, but only 5% of their customers are truly outside the norms of ready-to-wear sizing. Alex reports that he notices more of a variation in body types across customers than strict size differences. By contrast, posture and weight distribution are the most important aspects for Alex to consider in ensuring a quality fit (Norcross and Sumner).

Just as with Alton Lane, though, the variety of body shapes is not reflected in the variety of items purchased: style selections at Acustom Apparel tend to be fairly traditional and unsurprising despite the range of options available. In the same vein as Richard's response, though, Alex speaks to how addressing personal preference is the key selling point of made-to-measure, not variety of styles. Both Richard and Alex expand upon these positive effects to speak of the empowerment that comes from well-fitted clothing. The fulfillment of an individual's ideal vision of their appearance or style through made-to-measure is a luxury that their customers are keen to experience. However, just as at Alton Lane, the 3D body scanner is a minor if not nonessential part of providing that experience (Newcomb; Norcross and Sumner). .

Case Study: Rigby & Peller

Perhaps nowhere across the different types of garments in the clothing industry is there a more acute need for quality fitting than in lingerie (Chodosh). Intimate apparel is at its best when it fits the body perfectly — body conscious in industry jargon — something that is very difficult to achieve when shopping for even the basic bra. While a sharp divergence from the domain of suiting, there would seem to be high potential for 3D body scanning to aid in the fit of clothing for a part of the body that varies widely from person to person. It is for this reason that lingerie retailer Rigby & Peller is worth considering as a contrast to the variances of suit fit.

A British lingerie retailer with multiple stores in North America, Europe, and Asia, Rigby & Peller specialize in and highlight their ability to fit the perfect bra to any body type ("Rigby & Peller"). Shoppers can choose from over ninety available bra sizes and are guided through each by a trained salesperson who doubles as a fit technician. While there is an assortment of sizes available, it is important to note that Rigby & Peller, along with virtually all other lingerie companies, do not customize or custom fit their bras. Rather, the wide array of bra sizes is prefabricated and produced in quantity to be purchased off-the-rack (Anderson et. al). The fitting specialists at Rigby & Peller are helping customers to find an existing size that fits them well rather than tailoring the lingerie. In addition, Rigby & Peller does not design or produce its own line of lingerie.

Rigby & Peller fit specialists go through a six-month training process to become experts in lingerie fitting, according to one of the salespeople and technicians at their downtown Manhattan location. According to this specialist, Rigby & Peller employees are able to serve customers in a matter of minutes in order to determine what sizes are best for their body types. This is a very intimate appointment between customer and specialist, held within a private and spacious dressing area. Perhaps unexpectedly for some, two of Rigby & Peller's dressing rooms in the 5th Avenue location have 3D body scanners, designed to help customers find the right bra for them and to display different options on them virtually without having to try lingerie on in physical space.

The 3D scanner at Rigby & Peller is significantly different from the Size Stream scanner discussed previously (Paganelli; Figure 3). Colloquially referred to by Rigby & Peller staff as a 3D fit mirror, the device seems to offer a more minimalist appearance, particularly where the client-facing user experience is concerned. Clients are asked to turn, arms outstretched, in a 360-degree circle in order for the camera, which is behind a single panel of mirrored glass, to capture an accurate visual representation of the client's body. Once complete, the bra styles that are preloaded into the computer can be displayed on the virtual model. This could be used as a try-on feature or a comparison tool between select styles. With the inclusion of such virtual reality features, technology like the 3D mirror would ideally make comparison shopping easier and more informed (Gomes). A graphic interface on the mirror itself displays a virtual avatar of the customer, and will also display and recommend sizes for the bras in its product catalogue. It is important to note that the scanner's product catalogue is smaller than the full store's inventory and limited to brands that have partnered with the scanner company to upload their garment sizing data. The entire scanning process is aided by the fit specialist both in person and through the use of an app developed by the scanner company for store employees to use on an iPad, a process which takes about twenty to thirty minutes to complete.[2]

Figure 3: The 3D fit mirror at Rigby & Peller's 5th Avenue & 16th Street location. Nicholas Paganelli, October 2018.

[2] Source is a personal interview, conducted in person at Rigby & Peller 5th Avenue location by Nicholas Paganelli on October 24th, 2018.

The Rigby & Peller fit specialist notes that the use of the 3D mirror is regularly complicated by bugs in the system. Similar to the friction points identified by Dan at Acustom Apparel, there are often issues with the scanner app or with the quality of the scan. These delays on their own can often take as long as it would take the specialist to fit a bra without using digital technology at all. As a result, the specialist says that the majority of the staff at the store, which is the only one in North America that has the 3D fit mirror, do not use the mirror and do not generally mention it to customers. By their estimation one in ten customers at the most asks about the mirror and requests to use it. Among the customers who do use the 3D mirror, on which all of the store's fit specialists are trained, there are often concerns over privacy given that the fit mirror is using photography rather than infrared, and as a result takes and saves photorealistic images of the customers.

For those whose fears are allayed by Rigby & Peller's policy of deleting photos after each appointment, they may still encounter quality issues when the scanner cannot create an accurate virtual model from those photos. A customer whose bust is not in the position that the scanner expects or who have a stomach that protrudes forward are not likely to get an accurate scan. These mistakes on the scanner's part are entirely due to the standardized body type and proportion that is programmed into the scanning software, similar to the standards released by ASTM International (ASTM D5585-11e1). Some of the quality issues may also be related to the lower resolution of a camera-based scanner versus laser-based (Daanen and Ter Haar). Over-all, it would appear that the 3D mirror is offering services of a poorer quality than the equivalent service from the lingerie fit specialists. Indeed, the commitment to a months-long training process for Rigby & Peller employ-ees in non-digital fitting is an emphatic sign of the importance of the human expert in apparel sizing.

How to Assess the Merits of 3D Scanning

At the heart of the fit specialist's centrality is their understanding of the fact that human bodies are not uniform (for more on this history, see Fields). Where the scanner is seeking to measure and analyze against a standardized notion of shape and proportion, the trained expert is able to appreciate and address the subtle nuances that exist between any two bodies and between their various opinions on how best to dress that body. If one of the fundamental features and ideas behind made-to-measure and custom-fit clothing is the ability to capture personal preference, then it is perhaps particularly problematic in terms of normativity and body image in the industry to see a body scanner used as a tool when its express purpose and function is to capture a person's size with objective accuracy.

Richard's comments echo the author David Bohm in speaking of how the scanner is a scientific tool reinterpreting the art of clothes making. Bohm's philosophical writing in *On Creativity* seeks in part to point out that the commonly perceived dichotomy between science and art is not in fact present. Rather, Bohm performs an analysis of the scientific method and of an artist's method in order to point to how much similarity there is between the two. In that analysis he finds that the scientifically minded person must be creative in their search for answers and tests for useful theories. The artist may be a creative practitioner, but artists must also be scientific in their study and use of methods and materials to inform and create their art (Bohm 33-49).

Rather than relying on cold scientific method, Alton Lane is instead using 3D body scanning as a tool to guide the custom clothing experience. In doing so, a rigid scientific tool is able to inform the artisan — in this case the tailor — as to how they might go about executing the artistic craft of clothes making. Despite the relatively unsuccessful application of body scanning in all three case studies, there remains a certain potential for harmony to exist between two radically different approaches to analyzing the human body.

In seeking that potential, 3D scanning is best assessed across three areas of the made-to-measure experience: its impact on the production and fitting methods used, its impact on the client's in-store experience, and finally its potential to democratize the luxurious business practices of personalized fit. By looking at these three areas it will be possible to define gaps in the effective implementation of the technology and how those gaps may be overcome. Knowing where the technology is successful or unsuccessful in its application, it will then be helpful to assess and debate the underlying motivations for the implementation of 3D scanning in a fashion context.

Production and Fitting Methods

The ways in which clothing is designed and produced has largely gone unchanged for decades (Richards). With the intervention of 3D scanning, there is potential for these methods to be radically altered by the presence of a technology that can analyze a human body so precisely and rapidly. For both Alton Lane and Acustom Apparel, however, it is clear that the 3D scanner is a tool that could be included or not included in their business models without much of an impact on their day-to-day operations. Where the human expert needs to do the vast majority of the work and have the expert eye, the scanner is playing a bit part by comparison. Most importantly none of the interviewees reported a higher rate of successful fit because of their scanners.

Additionally, it appears that digital measurements are not directly included in garment specifications or production. Rather, as corroborated by Alex at Acustom Apparel, it is easier to use a scanner's output to place a customer within the range of one or two clothing sizes which have already been developed without the use of a scanner. As a result, a scanner is actually used more like a search engine to find the correct result for the individual faster (Norcross and Sumner). Whether the clothing item is ultimately sized to match the 3D scanner's output is irrelevant, because once the nearest size garment is found that is the reference for the custom fit. Here is where the approach of BodyBlock AI — the data company tied to Fit3D body scanners — comes back into play, where they seek to gather data about body dimensions to better inform those garment sizes ahead of production ("Fit3D"; Moore). Perhaps this approach would allow for better fitting ready-to-wear garments, but certainly such efforts would not replace made-to-measure as a source for personalized fit.

The Client Experience

3D scanners are also typically not presented in a way that features them as a tool in the hands of a person, but rather as a device that is the guarantor of a successful product ("Apparel"). The underlying tone of such promotion, as on the websites of companies using and making scanners alike, is that scanners will allow the custom clothing process to become fully mechanized (see, for example, "3D Body Scanning"). Such an approach goes against recent moves elsewhere to feature more production and artisan craftsmanship in fashion marketing (Kawamura).

If the customer's perception of 3D body scanning is as a stand-alone transformation of the made-to-measure clothing process, then the example of Alton Lane's customers being too nervous to disrobe is instructive. Perhaps the 3D scanner is perceived as an intruder upon a process that is otherwise intimate and personable. Alex notes that some customers at Acustom simply forget about what the scanner said after they are fully involved in the process of working with him directly, a process that is mostly about trying on sample garments and discussing fit (Norcross and Sumner). Meanwhile Rigby & Peller's customers are shopping for garments that have a highly personal context, and based on the fit specialist's assessment therefore greatly prefer a person-to-person interaction. The nature of custom-fit clothing and the fitting experience is that they are unique. The scanner, if it were able to be used to its full advertised potential, would remove the intimacy from the experience of being fitted for a garment.

Diffusion of Luxury Practices

If the 3D scanner is a tool that is not successful in its implementation as a tool for production or an appealing experience for customers, a third and final potential benefit could theoretically be the ability to help ready-to-wear clothing design firms introduce a modicum of personal service to a non-luxury customer (Istook and Hwang). While all three case studies sell products at premium price point (hundreds of dollars for lingerie, one thousand plus dollars for a suit), Alton Lane and Acustom Apparel in particular provide a luxurious service in that their product could be perceived as one-of-a-kind (or at least few-of-a-kind).

Here Mead's documentation of the wedding dress industry is informative despite being a departure into yet another sector of the fashion industry. That sector's ability to mass produce garments that are then perceived as one-of-a-kind by brides is an example of how companies like those in this case study are able to present luxuries to wider audience through their service models (Mead 75-106). The labour of the craftsperson or salesperson in the studio is what the customer sees, not the unglamorous labourer assembling the garment in a factory as ready-to-wear (Mead 175-196). The labour and effort that goes into the creation of that luxury experience and its companion luxury product are obfuscated by the presence of the 3D scanner.

Perhaps Marx would recognize the ways in which the made-to-measure business model features one set of practitioners and camouflages another (Tucker). The value of the product is the result of the labour that goes into it, and a successful implementation of 3D scanning would further conceal that labour. Operating a piece of equipment is a very different kind of labour than applying specialist knowledge. The goal of the implementation of 3D digital tools should therefore be to mix automation and expertise, satisfying Marx's demand for appreciation of labour while also aiding the execution of it (Tucker).

However, for the artisan practitioner, who is trained on the traditions of how to craft and create clothing around the body, the scanner is seemingly poised to replace them ("Can the Promise of Perfect Fit Disrupt Fashion?"). A device that promises a perfect fit through digital analysis of the body misses one of the principal points of custom tailoring: the ability to refine a garment based upon an individual's preferences as much as their shape. Tailoring expertise goes beyond measurements, and therefore the scanner is in the end unlikely to overwhelm the fashion industry with automation. Yet the presence, research, and testing of 3D scanning for custom fit points to the inability of its benefits to reach a greater number of customers. The desire to diffuse the luxury practices of made-to-measure across the fashion industry by way of digital technology is a compelling reason to continue such testing in spite of the negative results of the three case studies included here.

Packaging Luxury

In three approaches thus far, the 3D scanner has been unable to claim an unqualified success or clear path forward toward greater use. Practitioners of the case study companies are all unable to implement 3D scanning in a truly meaningful way. Yet it might still be hoped that 3D scanning could one day make the made-to-measure and custom fitting process faster ("3D Scan"; "Can the Promise of Perfect Fit Disrupt Fashion?"). The 3D scanner could then be poised to help package luxurious experiences around clothing for a larger audience. Luxury in fashion can at least be partly defined by the experience in procuring the clothing. It could be argued that one of the most luxurious things a clothing consumer can do is to purchase something that has to be produced and won't be ready for a number of weeks, therefore signifying a lack of immediate need. Put another way, it is safe to say that the made-to-measure suiting customer is someone who has the financial and temporal luxury of not having to settle for clothing that is instantly available off-the-rack (BOF, "Finding the Luxury").

The distilling of the tailor's luxurious labour practices for a larger audience is a process that could improve the ways in which clothing is sold and experienced, as well as the emotional durability of the product in question, which in turn could improve sustainability of fashion. Customers who are able to shop at Alton Lane, Acustom Apparel, and other companies are doing so because the custom fitted product is superior to the potentially complex, confusing, or unsatisfactory system, style, and fit of off-the-rack clothing (Fasanella). If the superior quality of personalized fit can be delivered to the off-the-rack customer, then many more would experience the benefits.

As it stands, none of the 3D scanners studied have proven themselves able to support any great increase in scale. Yet scaling up small fashion businesses in a healthy way is something the fashion industry often struggles to do, as documented by McRobbie. Her analysis of young designers in Britain who have been brought low by the pressures of the fashion industry to perform at a certain speed and scale is instructive as tailors and custom clothes makers face very similar headwinds (McRobbie). 3D scanning technology, if introduced in collaboration with creative practitioners instead of in opposition or in parallel to them, could eventually be the key to expanding the positive impact these practitioners can have. While the creative practitioners in the companies studied are more stable financially than McRobbie's young upstarts, the technologies used to support the efforts of new fashion design firms could be potentially helpful to both.

Regardless of how successful 3D scanning has been for fashion, digital technology is going to be a major source of change for the industry in the near future (BOF, "When it Comes"). As digital technology is considered, however, those like the creative practitioners interviewed in this paper must be given a larger consideration than it would appear they have had to date. Where the scanner is most economically successful today is to help quantify rather than standardize the variations of these customer's bodies (Moore; Sareen).

Digitization of the fashion industry is something that should be done primarily to reform its business practices. The quantification model for 3D scanning, by contrast, only feeds into the existing mindset in fashion favoring high volume and quick satisfaction at the expense of quality. Such a model falls into the divide between consumerism and consumption, where unthinking and wasteful consumption overwhelms quality consumer centric business models (Bauman). Alton Lane, Acustom Apparel, and Rigby & Peller stand out among their peers in the industry when they go beyond the impersonal and imperfect ready-to-wear business model; such an approach should be supported, not muddled by digital innovation.

Conclusion: The Next Wave of Digital Innovation

By studying the experiences and practices of three businesses, their employees, and their customers in using 3D body scanning as a clothing fit and design tool, this paper has sought to understand how the made-to-measure clothing sector is impacted by new technology. Additionally, technology's impacts on the luxury experience and on creative practitioners are important subjects in order to come to productive and useful conclusions about how technology might be better integrated into the clothing supply chain. Based on the case studies of Alton Lane, Acustom Apparel, and Rigby & Peller, it is clear that the way in which 3D scanning technology has been introduced to the fashion sector is inefficient if not ineffective. The potential for 3D scanning to "revolutionize" how clothing is made is what most likely led each of the case study companies to adopt 3D scanning (Thomson). Where their efforts to date have not been successful overall, the hyper-precise quantitative nature of the technology is to blame. There is a clear disconnect between what the technology is designed for and what fashion practitioners would like to use it for.

In an industry that last overhauled its production technology in the nineteenth century — with the invention of flat pattern drafting, geometric tailoring systems, the sewing machine and jacquard loom — a new crop of technological change is coming with the adoption of 3D scanning ("Can the Promise of Perfect Fit Disrupt Fashion?"; Breward; Charpy; Matthews David; Tortora). Whereas the fabric loom could be considered one of the first computers ever, the computerization that is happening today is different in that it does not come from fashion practitioners themselves (Delve). The outsider nature of this technology creates a divergence between computer scientists and designers. Echoing Bohm's writing on the nature of the arts and sciences, there is a language barrier where one side sees the other's practices as incomprehensible and complex. Only with the recent push into new technology has the fashion industry begun to embrace technologists (Chitrakorn), although tailors were historically technologists through their own inventions. Ultimately this schism in perspectives is the primary source of friction between the fashion industry and the technology it is seeking to adapt to its practices.

Technologists working on 3D scanning and other fashion technologies should inform their work with the knowledge of how clothing is made. Fashion designers need to be better versed in the capabilities of digital technology in order to better influence its development. A closer working relationship between technologists and designers might then lead to a more meaningful modernization of the fashion industry's practices. New digital tools will enter and disrupt the fashion marketplace whether or not such a relationship can be established. The imperative is on fashion practitioners to look beyond their existing business models and actively seek innovative solutions that can harness the rich history and techniques of clothes making to create change in the industry.

Author Biography

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Nicholas Paganelli is a clothing designer and production manager turned creative technologist, exploring how to update clothing production technology for the twenty-first century. Nicholas' primary interest lie in the future of how we make clothes, with a focus on apparel production technology and systems design. Nicholas enjoys logistical challenges and strategic planning, but Nicholas also loves to design and create beautiful things. Between these two extremes is Nicholas' passion for social justice. That is why Nicholas' recent efforts as an MFA candidate in the Design and Technology department of Parsons School of Design have centered on how new technologies can help to create accessible clothing for people with disabilities, among others with non-standard body types.

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