**EMERGENCE OF 3D PRINTED FASHION:**
**NAVIGATING THE AMBIGUITY OF MATERIALITY THROUGH COLLECTIVE DESIGN**

*Research-in-Progress*

**Ning Su**
Ivey Business School  
Western University  
1255 Western Road  
London, Ontario, Canada  
nsu@ivey.ca

**Naqaash Pirani**
Ivey Business School  
Western University  
1255 Western Road  
London, Ontario, Canada  
npirani.phd@ivey.ca

**Abstract**

The emergence of 3D printing technology is being embraced by an increasing number of fashion designers. Due to the nascent and evolving nature of the technology, however, there is significant ambiguity around this technology’s implications for the practices of fashion design. Based on the theoretical perspective of sociomateriality and the concept of translation, and drawing on archives, interviews, and other forms of qualitative data, this study’s preliminary findings show that fashion designers navigate this ambiguity by pursuing a collective design process with diverse stakeholders to actively perceive and leverage the affordances and constraints of the technology. The ongoing interaction among a network of heterogeneous actors gives rise to innovative perceptions, practices, and products, which collectively shape the emergence of the field of 3D printed fashion.

**Keywords:** 3D printing, fashion design, design process, sociomateriality, innovation
Introduction

“As for the future, technology is what will move fashion forward.”

– Alexander McQueen, Fashion Designer

Technology has a defining role in fashion, as emphasized by the late Alexander McQueen, one of the most talented and revered designers of our times, whose work was paid tribute to by the Metropolitan Museum of Art in New York (Bolton et al. 2011). One of McQueen’s most memorable runway shows involved using computer-controlled robots to create a dress on the catwalk in real time, with the intention of expressing the interaction and tension between human and technology in the fashion industry (Fashion Institute of Technology 2013). In fashion, technology is broadly defined and includes both the materials of garments and the tools for design and production. Recently, an emerging technology, 3D printing, has shown the potential to reshape the fashion industry. The active adoption of 3D printing among fashion designers has given rise to many 3D-printed clothes and accessories being featured at the latest global fashion events such as the 2013 Paris Fashion Week (Brown 2013) and the 2013 Milan Design Week (ArchDaily 2013).

For fashion designers, 3D printing is not just a new means of fashioning textiles into products; it has been described as a reinterpretation of couture and a paradigm shift through which a new wave of fashion ideas is emerging as a result of technological innovation. As stated by one designer, “instead of us interacting with technology, the technology interacts with us (Brown 2013).” However, not originally tailored to the fashion industry, the material features of the 3D printing process and outcome do not immediately provide most designers with convenient tools for creating wearable garments. Instead, there is significant ambiguity around the properties of 3D printing which could present both opportunities and challenges.

A sociomaterial perspective (Orlikowski 2007) can be applied to better understand how designers respond when presented with such ambiguity around the materiality of the technology. Rather than accepting and accommodating the limitations of 3D printing, designers instead chose to collaborate with architects and software engineers to resolve the constraints and utilize the affordances of this innovative technology. The resulting collective design process involves translation and transformation of knowledge within a network of heterogeneous actors, both social and technical (Latour 1986; 1994). This entanglement of technology (Suchman 2007) within ongoing practices (Gherardi 2000; 2006) can lead to the creation of not just new design and manufacturing processes, but also entirely new products, market categories, and even business models. Such outcomes have been observed in a growing number of 3D printing collaborative projects.

The aim of this research project focuses on understanding how fashion designers navigate the ambiguity around the affordances and constraints of this innovative, IT-enabled technology, while reshaping the traditional practices of fashion design. Collected data consist of interviews with different stakeholders in the emerging 3D fashion industry, including fashion designers, software engineers, architects, 3D printer manufacturers and 3D printing service providers, supplemented by visits to companies and exhibitions, and compilation of press releases, catalogues, and news articles. To further analyze the dynamic process of fashion design, the study also seeks to videotape actual design activities and gather product prototypes. Based on diverse forms of data, this study applies qualitative research methods to conceptualize the social processes by which designers form collaborative relationships with different stakeholders to collectively explore and exploit the materiality of 3D printing and co-create the emerging field of 3D printed fashion.

Related Literature

This section first provides a brief overview of the fashion industry and the recent adoption of 3D printing by fashion designers. The role of 3D printing technologies and techniques in transforming fashion design practices can be conceptualized through the lens of sociomateriality. The sociomaterial perspective, as well as related research of technology-mediated translation, is then summarized in the rest of this section.

--

1 This paper does not hold any views on any of the quoted fashion designs, and only focuses on the process of creating these designs.
**Haute Couture and 3D Printing**

High fashion, or haute couture, began in Paris in 1858 with the arrival of Charles Frederick Worth. Before this time, private tailors and dress-makers were employed to dress the elite classes. Worth distinguished himself from his predecessors by choosing not to copy the designs created by others. Instead, he was an autonomous creator who designed unique and bespoke clothing and accessories for his clients (Crane 1997). The emergence of haute couture led to the designer being seen as an artist-craftsman, with little recognition of the materials and artisans who assisted in the realization of the designer’s ideas. However, just as an architect’s design cannot materialize without building materials and builders (Tanggaard 2013), a couturier’s fashion design relies on textiles and tailoring to bring it to life (Clarke and O’Mahony 2008).

While traditional fashion design has depended on sewing by hand and machine to create items of couture, the recent commercialization of 3D printing has introduced new possibilities for the industry. In contrast to traditional subtractive manufacturing in which designs are cut out from larger sheets of material, 3D printing uses additive technology to create objects layer by layer (Kessler 2013). The specific process used is called selective laser sintering (SLS), in which high-powered lasers fuse small particles of materials into a three-dimensional shape (e.g., Nike Inc. 2013; Park 2013; Wright 2013). As explained by one designer, “the printer lays down a fine layer of powdered material such as nylon and a laser solidifies the powder according to your design. Then another layer is deposited over the first and the laser hardens, or ‘sinters’ this layer, and subsequent layers are fused until the final form is built up (Kessler 2013).”

3D printing was initially restricted to a handful of manufacturing materials. However, the capabilities of 3D printers have since expanded to include working with softer materials like rubber, polyurethane and polyamide (CSC 2012; Sani 2013). This technology can now be used to create complex shapes and fabrics that can be fashioned into garments (Kessler 2013), a catalyst for the introduction of 3D printing into fashion. However, in fashion design, a major difficulty of 3D printing is creating flexible dresses with materials that are not malleable; designers thus need to systematically divide a design into a number of, sometimes thousands of, pieces and integrating the printed pieces (Frazier 2013). Despite the challenges, 3D printed creations have been extensively featured in major fashion shows, such as the 2010 Amsterdam International Fashion Week, 2011 Melbourne Spring Fashion Week and 2013 Paris Fashion Week (Brown 2013; Wright 2013), as well as major design events such as 2013 Milan Design Week (ArchDaily 2013).

**Technology and Sociomateriality**

The sociomaterial perspective (Orlikowski 2007) can be used to conceptualize how designers perceive and respond to an emerging technology, while entangling the technology within existing practices. Technology artifacts have certain properties that are inherent and enduring. This arrangement of physical or digital materials into particular forms that are important to users has been labeled materiality (Leonardi 2012). Technology artifacts, meanwhile, are seldom enacted in isolation; instead, they are always embedded in some time, place, discourse and community, and the meanings and effects that a technology produces can be different depending on the context in which it is enacted (Orlikowski and Iacono 2001; Pickering 1995).

When individuals encounter a technology, they form perceptions on how its materiality aligns with their own goals and desires. When a technology’s material properties are viewed as aligned with an individual’s goals, the technology is considered an affordance; when it is seen to restrict agentic desire, it is labeled a constraint (Leonardi 2011). Affordances and constraints are relationally constructed in the space between people and materiality, while materiality embeds multiple affordances and constraints (Fayard and Weeks 2007; Markus and Silver 2008). When confronted with a technology, individuals may decide how they either capitalize on it or come up with a workaround to achieve their goals (Leonardi and Barley 2008).

While technology’s affordances and constraints have largely been treated as mutually exclusive categories (Leonardi 2011), it has been observed that materiality can simultaneously enable and constrain (Pollock 2012). When a technology is emerging, there can be significant ambiguity around its materiality and the embedded affordances and constraints. The ambiguity can encourage individuals to question traditional modes of thinking (Gioia and Chittipeddi 1991) and make changes to the domain to realize the affordances (Pollock 2012). Since affordance is a multifaceted, relational structure, where the same technology can be enacted by different stakeholder groups and exhibit different affordances or constraints (Faraj and Azad 2012), affordances may arise in exploration of different social configurations (Groreau and Demers 2012).
Collective Design and Translation

When individuals pursue new social configurations by engaging other parties, their action and interaction can lead to the co-creation of unique and innovative outcomes. A great deal of human creativity has been attributed to the interaction of people and artifacts within a social context (Csikszentmihalyi 1997). This is especially true in collective design (e.g., Stempfle and Badke-Schaub 2002; Ada 2008), where the final product often emerges from compromises between designers through negotiation and dialogue (ibid). The creation of 3D printed fashion represents such a collective design process. According to the sociomaterial perspective, technology functions as an integral part of this process (Doolin and McLeod 2012; Zammuto et al. 2007) by enabling the translation (Latour 1986; 1994) of knowledge and meaning, which produces outcomes that neither the humans had initially anticipated nor the artifacts were designed to facilitate.

Specially, in the heterogeneous actor network of people, technology, and other material forms (ibid; Law 1999), social order is produced and stabilized through translation (e.g., Gherardi and Perrotta 2011). The outcomes of translation include new technological systems, processes (Doorewaard and Van Bijsterveld 2001), and even institutional changes (Seo and Creed 2002), such as new market categories (e.g., Su 2011). In this interaction, the construct of practice (e.g., Gherardi 2000; 2010), broadly defined, in particular, has a foundational role in forming a variety of novel, emergent social, technological, and organizational phenomena (Feldman and Orlikowski 2011). Integrating the lens of sociomateriality with the construct of translation in practice-based theory, this study focuses on the dialectical relationship among individuals and technologies in social practices (Schegloff 1982; Suchman 2007; Tanggaard 2013), specifically, how actors collectively leverage the ambiguity of materiality as the technology reshapes the practice of design.

Research Methods

This study employs qualitative research methods (Miles and Huberman 1994; Strauss and Corbin 1997) in which the theory emerges through an organic analytical process (Suddaby 2006). This particular research approach is selected for its value in understanding the process by which actors construct meaning out of intersubjective experience (ibid): in this case, the perception of affordances and constraints of 3D printing. Collected data include published interviews with fashion designers, software engineers, architects, 3D printer manufacturers and printing service providers, visits to exhibitions, press releases accompanying 3D printed clothes and accessories featured at fashion shows, catalogues from major designers operating in the 3D fashion space, and news articles from major online sources such as Forbes and Wired. Since 3D printed fashion is still a new space with limited players, we searched for all designers involved in this field. Additionally, in April 2013, the first author attended “Inside 3D Printing Conference and Expo”, a major industry conference on 3D printing, held in New York. The founders and top-level managers of over ten pioneering firms in the 3D printing industry presented at the event. To acquire an intuitive understanding of the industry landscape, a series of informal interviews were conducted with representatives from six 3D printer manufacturers and service providers, and demonstrations of the printing processes of diverse 3D printers were observed. Since 2011, the first author has also studied several major fashion exhibitions in New York, including “Alexander McQueen: Savage Beauty” and “Schiaparelli and Prada: Impossible Conversations” at the Metropolitan Museum of Art, and “Fashion and Technology” and “Shoe Obsession”, both of which featured 3D printed items, at the New York Fashion Institute of Technology. The next phase of the project will include interviewing major stakeholders in the 3D printed fashion industry, visiting one or multiple studios in New York, videotaping and analyzing the actual design activities, and studying the created product prototypes in order to further elaborate the fluid and dynamic process of collective design.

In the current stage of this research project, data collection and theoretical analysis have been approached as exploratory, interrelated processes. Qualitative research methods (Miles and Huberman 1994; Strauss and Corbin 1997) were applied to identify patterns from multiple data sources and construct preliminary conceptual models. Due to the highly publicized nature of the fashion industry, a rich set of published interviews with designers was especially helpful in this exploratory phase. Adopting the sociomaterial perspective, data analysis drew on the concepts of materiality and translation from the existing literature, while the aforementioned notions of ambiguity and collective design emerged from inductive analysis and were then linked to the broader literatures of information systems and management. Multiple iterations of data analysis were conducted until a preliminary model that fit most of the data was derived (Yin 2003).
A Sociomaterial Perspective on 3D Printed Fashion

The section presents a preliminary conceptualization of the emergence of 3D printed fashion. The analysis first explains the materiality of 3D printing and its perceived affordances and constraints, and then briefly outlines the mechanisms by which 3D printed fashion is co-created through collective design activities.

Materiality of 3D Printing

3D printing centers on a form of additive manufacturing in which a specific set of inputs can be used. Through the process of selective laser sintering (SLS), materials like rubber, polyamide and polyurethane are fused into a three-dimensional shape (e.g., Sani 2013; Wright 2013). For designers, the advantage of 3D printing over traditional cutting and sewing is that it allows for localized production, requires less labor, and compresses fabrication time from weeks into hours (Chua 2010). It also enables clothing to be tailored to an individual’s body (Scott 2013) and facilitates experimentation with the dynamics between form and function in design (Park 2013). As designers explained, “exploiting computational boundaries in combination with emergent technology selective laser sintering, of a new flexible material, lead to enticing and enigmatic effects within fashion design. New possibilities arise such as eliminating seams and cuts where they are usually placed in couture (Materialise 2013),” while “the ability to vary softness and elasticity inspired us ... to design not only the garment’s form but also its motion (MacManus 2013).”

3D printing relies on Computer Aided Design (CAD) to generate models that can guide the manufacturing process. CAD is also said to have revolutionized the design process and provided an entirely new approach to materiality by introducing a sense of three-dimensional space into two-dimensional design, allowing for complex designs to be conceptualized, modeled, and visualized in a relatively short period of time and enabling alterations of design with the click of a mouse (Clarke and O’Mahony 2008). As one designer noted, “[using 3D modeling program Rhino] I developed the necessary skills to design upon an avatar of a size 8 model which I 3D scanned, granting me the ability to produce stand alone pieces as well as items customized to the body. The terra-flat function of the program has also enabled me to design garments digitally upon the avatar and unfold these garments to create flat patterns (Fagg 2011).”

While 3D printing and CAD afford many new possibilities, they require significant technical knowledge to operate. In addition to understanding the mechanics of the printer itself, users must be able to generate algorithmic scripts to create the structure of the 3D printed fabric (Shapeways 2013). For example, the first fully articulated 3D printed dress was generated using an adaptation of the Fibonacci sequence (Kessler 2013; Scott 2013), and another well-known designer relied on genetic algorithms to create fractal patterns, which were then incorporated into the garments (Clarke and O’Mahony 2008). Far from being simple recursive algorithms, these scripts must take into the delicate and highly variable shapes used, the highly deformable and malleable nature of cloth and the intricate anisotropic and nonlinear mechanical behavior of garments (Magnenat-Thalmann and Volino 2005). Additionally, to create bespoke clothing like the Fibonacci gown, one must be able to operate 3D body scanning facilities (3D Systems Inc. 2013).

In a testament to the highly technical and complex 3D printing process in fashion design, one collection was described as follows: “Complex processes for digital surface manipulation have been investigated... The notion of hyper magnification leads to investigation of three dimensional fractal forms through the amalgamation of various algorithms. Highly specialized medical image processing software ... has been used to collate a voxelstack into a usable mesh object. This mesh object was then able to be manipulated into the desired shape within a data preparation software and then printed. 3D scanning provides the facility to work upon the same form both digitally and physically. A restrained colour palette eliminates distraction and allows focus to remain upon method, process and surface texture (Fagg 2013).”

The materiality of 3D printing is perceived as embedding both affordances and constraints for designers. On the one hand, it presents new possibilities for creating innovative styles and artifacts. On the other hand, it requires complex and detailed architectural design, which in turn relies on extensive technical knowledge to operate; the materials used in 3D printing are also somewhat limited. Meanwhile, at times, the affordances and constraints are intricately connected and even mutually constructed. For example, the technical complexity of 3D printing itself translates into significant meaning in the design outcome. Data analysis shows that designers respond to this ambiguity around materiality by participating in a collective design process involving different stakeholders with different knowledge structures and interpretations.
Navigating Ambiguity Through Collective Design

Almost all fashion designers partnered with subject matter experts in related fields and pursued design as a collective activity. This approach has been observed in each of the aforementioned global runway shows featuring 3D printed garments. The Engineered Distortion line at Melbourne Spring Fashion Week was a collaboration between designers Amelia Agosta and Natasha Fagg, and 3D manufacturing consultant Chris Murray; the Escapism collection previewed at Amsterdam International Fashion Week was a partnership between designer Iris van Herpen and architect Daniel Widrig; the Voltage collection shown at Paris Fashion Week was joint work between designer Iris Van Herpen and the MIT Media Lab (Brown 2013; Wright 2013). Collective design also enabled the creation of the first fully articulated 3D dress and the first ready-to-wear 3D printed article of clothing (Frazier 2013; Scott 2013; Shapeways 2013). The collective design process allowed fashion designers to make sense of the materiality of the technology, identify and leverage the affordances while resolving the constraints. The outcome of this process proved that knowledge of fashion and computers is a “potent combination” (Clarke and O’Mahony 2008, p. 9).

Specifically, the collective design process was initiated by the perception of the technology’s affordances. For example, the Engineered Distortion line by Amelia Agosta was created based on 3D printing’s ability to experiment and prototype in 3D, enabling the designer to steer away from traditional fabrics and break free of model making techniques (Johnson 2012). However, meanwhile, the constraints of the technology became salient and eventually led to collaboration. In Engineered Distortion, the piece was complex and time-consuming to draw up; the assembly of the garment also presented engineering challenges (ibid). For this reason, Amelia Agosta collaborated with Natasha Fagg and Chris Murray to design and produce the line. As explained by Fagg, “I was approached by Amelia Agosta to produce two supporting items for her graduating collection... Amelia invited me to use my knowledge of the program to design the second piece... through consultation I was able to produce the file using my 3D avatar and Rhino knowledge (Fagg 2011).” Once the design had been coded, Agosta contacted Chris Murray of 3D Systems to convert the CAD files into a 3D printable format and resolve any fabrication issues in the process (Johnson 2012).

The perceived constraints and the resulting collective problem solving activities, in turn, led designers to revise their practices to realize their visions in an innovative manner. In this reflexive and exploratory process, translation and transformation of knowledge occurred, which potentially led to the perception of further affordances and the creation of novel perceptions, products, and processes. For example, when the tacitness of tailoring was replaced by the articulation of highly detailed, computerized models, fashion designers’ traditional mindsets and practices were disrupted; as a result, a much more research-intensive process was practiced than in traditional fashion design. Natasha Fagg described this transformation as the following: “This research lead me to investigate complex processes for digital surface manipulation. I have undertaken extensive self-directed research to expand upon my current knowledge of 3D development software... The acquirement of knowledge within this unfamiliar realm formed a condition of my self implicated contract for the year, I wanted to develop the technical understanding and comprehension of these programs in order to be the designer and producer of these pieces (Fagg 2012).”

It should be noted that the interaction between fashion designers and other stakeholders was not a simple sequential dependency. The collaboration was a highly collective and interactive process that required different parties to learn from each other’s work practices and make adjustments in their own perceptions and activities (Clarke and O’Mahony 2008). Collective design was also a highly emergent process. Similar to the “Trukese navigator” in sea navigation (Suchman 1987; 2007; Orlikowski and Hofman 1997), the designer had an initial vision of what she or he wanted to create but the final product was contingent on circumstances that arose from the designer’s ongoing interaction with subject matter experts and the translation and transformation facilitated by the technology. In describing the final product that emerged from the collective design process, Agosta commented: “Engineered Distortion fuses together craft and technology... 3D body scanning and 3D printing technologies are instrumental in articulating sculpted forms composed of repetitive lines and geometries that wrap around the female body... The clean and engineered finish of the 3D printed pieces also reflects back into the garments in the collection. Every seam is bound, lined or neatly finished, which also transports back to the futurist look (Collie 2012)”. As shown in Engineered Distortion, collective design involves the ongoing perception of affordances and constraints of technology, and iterative translation and transformation of knowledge and practices. Table 1 uses four other collections that pioneered 3D printed fashion to summarize and illustrate this process.
**Table 1. Collective Design in Pioneering 3D-Printed Fashion Collections**

<table>
<thead>
<tr>
<th>Perception of Affordances</th>
<th>Perception of Constraints</th>
<th>Process of Translation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimentation with new materials and design techniques</td>
<td>Skills of both software modeling and fashion design</td>
<td>Formation of technology-driven, exploratory design process</td>
</tr>
<tr>
<td>“It really is a new process with new materials; this appeals to me. When I was asked to take on this new technique, I did it. I was curious about this new type of production.” – Iris Van Herpen (Wiegman 2011)</td>
<td>“I am not technical myself and it involves quite a lot of software aptitude, which really requires the aid of a specialist. I collaborated with Daniel Widrig, a 3D software architect.” – Iris Van Herpen (Wiegman 2011)</td>
<td>“Before I started on this project I didn’t like computers and technology. I have learned to appreciate it more, though, and now I see the possibilities for the future are enormous... The inspiration doesn’t come from fashion itself necessarily. It is through cooperation and experimenting that vibes and inspiration materialize.” – Iris Van Herpen (Wiegman 2011)</td>
</tr>
<tr>
<td>“Escapism attempted to further investigate possibilities and potentiality of advanced digital design techniques and computer aided manufacturing in the realm of haute couture fashion design... Escapism pushes the limits of 3D printing in order to increase the wearability of the pieces.” – Daniel Widrig (Wakefield 2011)</td>
<td>“Compared to regular fashion design there’s a major difference in production time. Normally the manual labour, the design, goes quickly and the production takes a long time. Here, especially in the beginning, this was reversed. The design process took longer.” – Iris Van Herpen (Wiegman 2011)</td>
<td>“Daniel had never designed around a human body. It was a big surprise. It was exciting, we had little control.” – Iris Van Herpen (Wiegman 2011)</td>
</tr>
<tr>
<td>Reinvention of the process of conceiving and producing artifacts</td>
<td>Reliance on highly complex and detailed models</td>
<td>Inspiration from collaboration across disciplinary boundaries</td>
</tr>
<tr>
<td>“It lets me think in total three-dimensionality, instead of first imagining something in 3D, then drawing it on paper in 2D and then creating it for the body in 3D again. For me, it’s a dream.” – Iris Van Herpen (Madsen 2013)</td>
<td>“3D printing is an entirely different language. The complexity and detailing of it almost resembles old historic crafts...” – Iris Van Herpen (Madsen 2013)</td>
<td>“It inspired us to design algorithms that could map physical movement and material behaviour to geometrical form and morphological variation in a seamless and continuous wearable surface.” – Neri Oxman (Materialise 2013)</td>
</tr>
<tr>
<td>Creation of garments highly customized for individual bodies</td>
<td>Knowledge of diverse activities in design and production</td>
<td>Transformation of design into a process of continuous variation</td>
</tr>
<tr>
<td>“This process allows for the creation of complex shapes and even ‘fabrics’ that were previously unattainable through conventional means. Its very nature lends itself to pushing the boundaries of fashion. It may eventually become possible to input your measurements and have a printer create a garment specifically tailored to your body.” – Michael Schmidt (Kessler 2013)</td>
<td>“This piece was uniquely engaging in that a great deal of the making of the gown was not only out of my control, it was out of my scope of comprehension.” – Michael Schmidt (Kessler 2013)</td>
<td>“It’s that continuous variation — managing the complexity of the subtle adjustments in form to respond to curvature of the body, how things tighten or narrow, where we need more flexibility or less flexibility of the mesh, all that was able to be tuned to a really high level.” – Francis Bitoni (Hurst 2013)</td>
</tr>
</tbody>
</table>

---

**Fuoriacqua Gown - Schmidt and Bitoni**

**Voltage - Van Herpen and Widrig**

**Perception of Affordances**

**Perception of Constraints**

**Process of Translation**

---

Su & Pirani / Emergence of 3D Printed Fashion
Table 1. Collective Design in Pioneering 3D-Printed Fashion Collections

<table>
<thead>
<tr>
<th>Perceived Affordances</th>
<th>Perceived Constraints</th>
<th>Process of Translation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Realization of highly complex forms of design</td>
<td>Understanding of both fashion design and computer algorithms</td>
<td>Amalgamation of designer vision and materiality of technology</td>
</tr>
<tr>
<td>“We wanted to be able to make garments in one piece, closures included, where no sewing is required. 3D printing offers possibilities of complex forms without constraint.” – Huang and Fizel (Core77 2012)</td>
<td>“Neither of us studied fashion design specifically, so our method of working with fashion comes from our own individual backgrounds in interaction and computational design.” – Huang and Fizel (O’Connor 2011)</td>
<td>“The bikini’s design fundamentally reflects the beautiful intricacy possible with 3D printing, as well as the technical challenges of creating a flexible surface out of the solid nylon. In this way, the aesthetic design is completely derived from the structural design.” – Mary Huang (Shapeways 2013)</td>
</tr>
<tr>
<td>“The freedom of 3D printing is that you can create and control the physical properties of your material through form. And since designs for 3D printing are entirely digital, we could approach the task with computational methods that would be impossible by hand.” – Huang and Fizel (Core77 2012)</td>
<td>“Designing the bikini was an endeavor of pushing the capabilities of the machine as well as working with constraints.” – Huang and Fizel (Continuum Fashion 2013)</td>
<td>“Instead of a traditionally optimized algorithm that tries for maximum coverage, minimum size variation or similar metrics, we were looking for something quite different.” – Huang and Fizel (Continuum Fashion 2013)</td>
</tr>
</tbody>
</table>

Expected Contributions and Future Research

This study takes a first step to understand the emergence of 3D printing and its role in shaping the fashion industry. Drawing on the lens of sociomateriality and the concept of translation in the context of practice-based theory, preliminary data analysis shows that facing the ambiguity around the emerging technology, fashion designers pursue a collective design process with different stakeholders to actively perceive and leverage the affordances and constraints of 3D printing; this process leads to ongoing translation and transformation of knowledge and practices, which reshapes the traditional field of fashion design. This research project is expected to contribute to the information systems and management literatures in several ways. First, at a micro level, it seeks to develop a fine-grained conceptualization of materiality, affordance, constraint, and the relationship between these constructs in the context of dynamic practices. Second, at an intermediate level, it seeks to elaborate the strategic processes by which different actors, both individuals and collectives, leverage the materiality of technology to achieve their goals. Third, at a macro level, it seeks to reveal how new technology translates into field-level phenomena, including design trends, genre systems, business models, and even industry hierarchies and structures (Kawamura 2005). Finally, this research sheds light on 3D printing, an emerging and potentially transformative technology.

This research project is ongoing, and both the empirical and theoretical components of the study will be systematically expanded. Future data collection will encompass a broad set of in-depth, semi-structured interviews with key stakeholders in the collective design process, including major fashion designers in this space and their collaborators such as 3D printer manufacturers and printing service providers, software engineers, and architects. Given the rapidly-changing nature of the industry, the evolution of the products, practices, and perceptions of different stakeholders will be tracked over time. The next phase of the study will also seek to record the actual design activities at one or multiple studios and apply video analysis to identify the fluid and dynamic details of the design process. Product prototypes will also be gathered and analyzed to provide further insights into both the design process and outcome. Based on the enriched and deepened dataset, future theoretical analysis will focus on elaborating the process by which technologies, individuals, groups, organizations, and industry fields interact with one another and co-evolve over time.

Acknowledgments

We thank the track chairs, the associate editor, and the two anonymous reviewers for their feedback. This research was supported by the Social Sciences and Humanities Research Council (SSHRC) of Canada.
References


