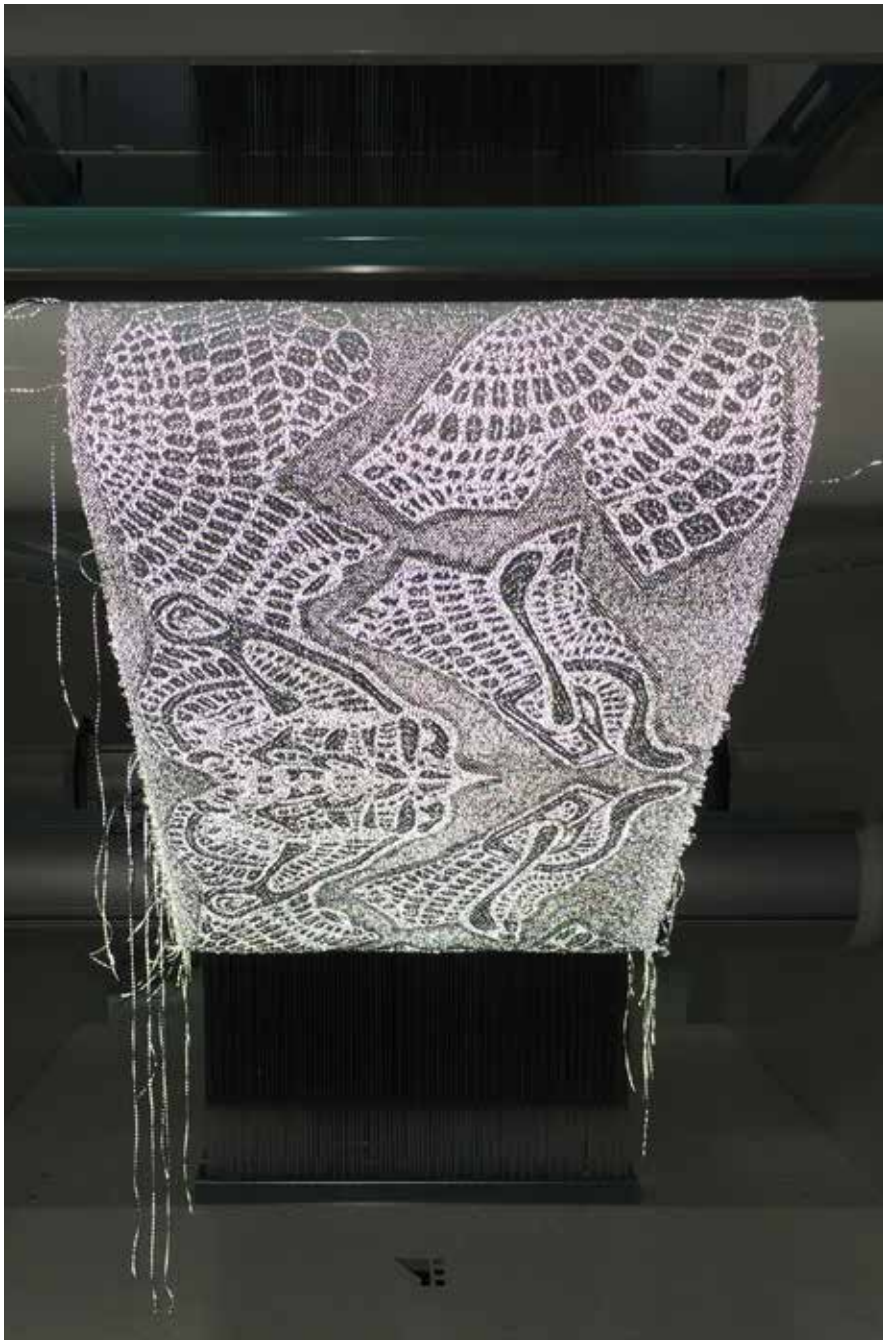

# Reflective Textiles:

## Garment Design, Space, and the Digital

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A critical & process documentation paper submitted in partial fulfillment of the requirements for the degree of

MASTER OF DESIGN

Emily Carr University of Art + Design
2019

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Special thanks to:

Hélène Day Fraser
Dr. Maria Lantin
Sean Bayntun
Brad Danyluk
Sean Bletcher
Meg Carscience
Ariel Helvetica
Sidney Hryciuk
Lyndsey Britten
Ruthe Ordare
Daniel Ruiz

The Material Matter's research Center
&
Kwantlen Polytechnic University

# Introduction

As a child who grew up in the later part of the 20th century much of my desire to learn how to sew stemmed from a fascination with identity and customization. Looking back, my first exposure to being taught to sew was inherently connected to shared traditional hand sewing techniques and values - it was quite meticulous and uncompromising. I have come to realize that this practice - a handed down lineage held in common by my mother, my aunts, and my grandmothers - is also one that was made accessible, encouraged and taught through early 20th century publications such as *The Mary Brooks Picken Method of Modern Dressmaking* (1925). As a teenager, I didn't realize that my maternal mentors were shaping my skills and philosophical values regarding quality, patience, and detail based on a perspective espoused and encouraged over half a century earlier. These women, who found passion in garment creation, inspired my career path.

A degree in fashion design was a focused path I dedicated all my energy towards as a young adult choosing a career goal. The idea of becoming a fashion designer in a professional business, possibly a high end fashion house, directed me to seek a university learning environment. While completing that degree, I was working in a variety of jobs as a workman (hemming seamstress) and communicator (material assistant), and upon graduation a junior designer (menswear). The complexity and attention to detail applied to visual garment-production files gravitated my interest to technical illustrations and production specification documents. Working in a communication rich environment, the head designer, product developer, and factory all impacted the prototyping process. As I explored my role as a designer, I found satisfaction in controlling the design fit and construction details, much like a pattern maker would do through translating an illustration. In 2009, as a way to explore other areas of making, I started to create burlesque costumes for my friends, learning about the neo-performance style.

I quit my fashion design job in 2010 and found inspiration in a new field that utilized my sewing skills as a workman: the theatre. Since making this shift almost ten years ago, I have had the opportunity to work in a new way. Removed from the garment industry I was no longer basing all garment construction and form ideation of an idealistic male body type. Increasingly my work involved satisfying specific needs and aspirations for theatre production. Through this design work I have been able to work with a large variety of body shapes and sizes, a wide range of textiles, and many different forms of garment construction. Over time and based on circumstance I have found myself applying new



methods of garment creation - adapting my approach to the context of clothing demands of each project that has come my way.

In addition to working for the theatre my move out of the fast-fashion industry context also led me to take on custom work. In response to demand and interest in body-positive, well-fitting garments, I started a personalized swimwear service. My work in swimwear soon morphed into an increasing number of commissions for burlesque costumes. Developing costumes for a burlesque performance requires each contributor (performer, costume designer, workman) to take part and ideate on how the costume can tell a message. This often involves learning how a performer might remove costume components in unexpected ways. When a performer is communicating their vision for a costume, it's not always apparent how the costume will be perceived from all angles. Because burlesque or cabaret-style performing reveals the human body, rotating and controlling what the audience will see impacts all angles of the costume being designed. The importance of how a garment looks on the inside may not be applicable for all areas of burlesque or even costume design, but keeping this in mind when designing costumes can complicate common methods of construction.

My work developing costumes for burlesque performers broadened my horizons as my understanding and affinity for the qualities of cloth flourished and grew. I began letting the textile dictate the placement of the grainline on the garment pattern pieces I was developing. I moved from limited, simple garment form and construction I had been trained in to developing increasingly complex 3D patterns for clothing. This shift

in approach to garment design and construction was significant. It afforded me a malleability that I had not encountered in the fashion industry. I found every reason to involve this new way of working into my design process. Nurturing this process, I inadvertently began to develop a type of co-designing. This was especially the case as I developed costumes for a local Vancouver burlesque troupe, Pandora and the Locksmiths. An adaptive, collaborative approach to garment design and construction is almost implicit in the context of burlesque as this type of garment development requires a much higher number of fittings compared to streetwear or lower valued clothing items. My work as a designer in both theatre and burlesque has broadened the way I approach my design process: rather than an isolated act I have come to see and acknowledge how my work can interact with a community of stage performers.

As a workman and a designer, the material-led research practices explored throughout this thesis informed each artifact through the building of new knowledge in digital and manual applications of textiles. Through costume design for a theatrical performance, the explorations documented use planning, prototyping, observing, and reflecting as a process of developing updates to inform each iteration (Collins, 2010). The research is intended for costume designers, fashion designers, and interdisciplinary designers.

As a big influence on the language and philosophy, David Pye outlines in *The Nature and Art of Workmanship*, the following quotations and definitions will help define the key language included in this thesis (2002).

> "In practice the designer hopes the workmanship will be good, but the workman decides where it shall be good or not. On the workman's decision depends a great part of the quality of our environment" (Pye, 2002, p. 17).

**Blocks/Slopers:** A basic pattern created for a specific body type that is used as a building block or foundation that can be manipulated or changed through pattern design and dart manipulation. The pattern pieces that make up a sloper usually consist of a front, back, side/arm, and top/bottom, depending on the complexity of the end garment type.

**Co-creation:** As described by Walmsley, "co-creation is ultimately messy, raw, incomplete, contingent and context-dependent. Successful co-creation involves trust, respect, collaboration, playfulness and exchange; it takes participants on an adventurous journey and deepens their engagement with theatre" (2013).

**Co-design:** Designers play a key role in the process of designing with a team of contributors; designers provide expert knowledge, prototyping, and facilitate production (Sanders & Stappers, 2016, p. 24).

**Draping:** Achieved by taking textiles and applying them directly to a three-dimensional form or body to create the components that get sewn together in a garment.

**Dress form:** A three dimensional form of a model used for fitting clothing.



**Grainlines:** The way a pattern piece is aligned on the warp threads, or selvage, determines the mechanical stretch the textile will endure when assuming a three-dimensional form. The rotation of a grainline can make a significant difference on some types of fabrics.

**Internal Structure:** An overall shape for a garment. This structure is not seen from the outside of the garment, and may be concealed inside a lining layer. The structure is commonly used in costume design technique to establish shaping.

**Muslin:** A lightweight, unbleached cotton textile that is used to make development patterns. This fabric can be sewn together to achieve a prototype design.

**Neo-Burlesque:** A form of striptease inspired by American Burlesque. The neo-burlesque movement values comedy, theatrical extravagance, and using stage performance to express storytelling through conception of dance, music, costumes and lighting.

**Pattern Piece:** A piece of paper that is the basis of a garment design. The shape of the pattern can be created from a variety of methods depending on the level of communication needed to execute the design.

**Warp + Weft:** In woven textiles, the horizontal and vertical thread structure are identified by these terms. Warp threads run lengthwise (the white 100% cotton thread seen in the weaving samples). Weft threads run horizontally (the reflective threads used in the weaving samples).

**Workman:** A person who creates, or builds a physical artifact. Instead of using the term seamstress, workman is used throughout this document.

How can engagement, visualization tools, and handworkmanship promote thinking beyond traditional modes of garment design?

Image 1: Muslin prototype of the Future Human shoulder structure, 2019

Traditional garment creation has a deep history of craft, quality workmanship, and culture. As the collective skills of weaving, sewing, and draping are being challenged through societal influences of consumerism and the roles of clothing, this research seeks to blend traditional garment design processes with emerging visualization tools to order to support manual making skills. Through seeing the final silhouette true to the 3-dimensional shape, a custom textile was created with both manual and digital applications on a digital jacquard loom. By bringing in other designers' perspectives, design philosophies, and digital visualization tools, a series of artifacts were created to support a proposed theatrical production, *Future Human*.

# Context

In my preliminary research for this thesis, I spoke with theatre designers, directors, and producers regarding alternative approaches to the design process. I found myself fixated on an interview I had with a highly accomplished Canadian costume designer, Susan Benson, who started her career and education in London, England. As I came to know more about her career and her contribution to Canadian costume design, I realized that her opinion on character illustrations were much different from my own. Everything she said about design theory, attention to detail, and textiles was consistent with my own practice, and yet her perspective and attitude towards the role and importance of illustration struck a discord. Primarily, this was because illustration (and my capacity to do so) had never played a fundamental role in my own work. This accomplished theatre designer's perspective worried me. While I am sure it was not intended, it made me feel less of a designer, and somehow inadequate. The contrast between our approaches to costume design made me think about how important traditional methods of communication, such as hand-painted illustrations, strongly reflect the common practices of the mid 20th century. Comparing my own process to this accomplished designer, I realized there were many funda-

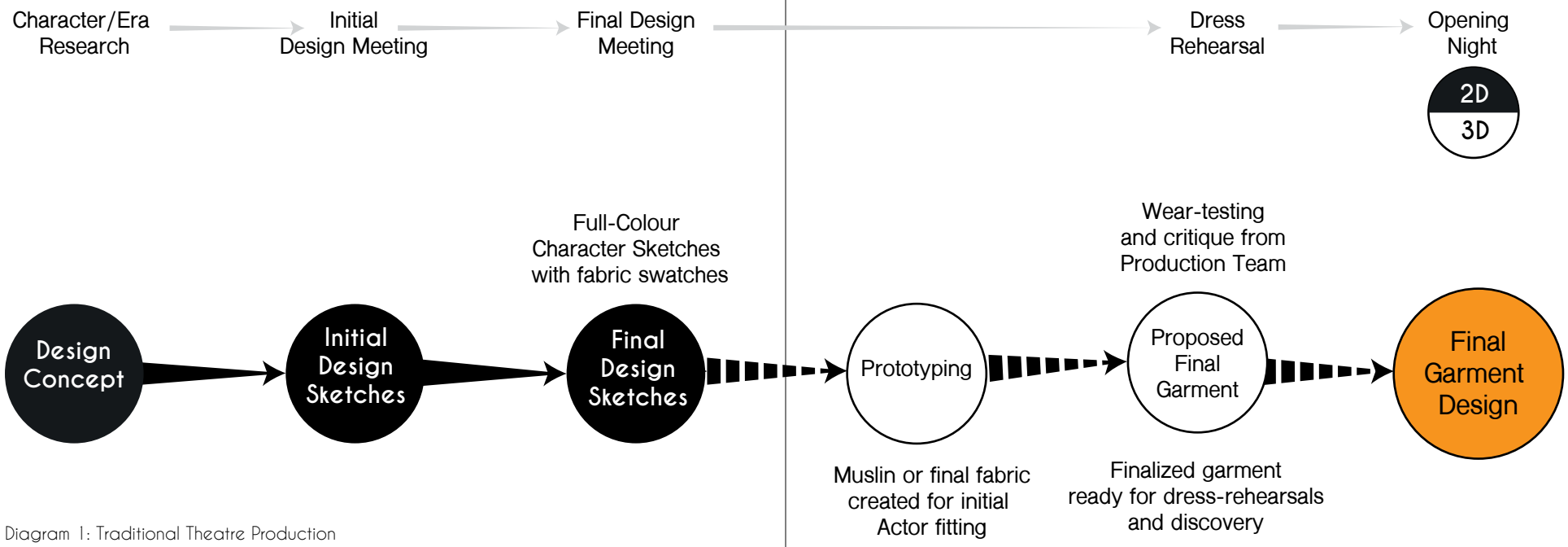



Diagram 1: Traditional Theatre Production

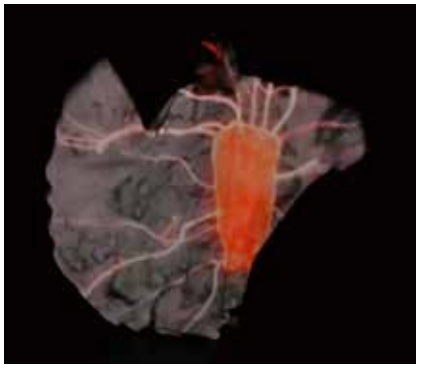
mental differences between the way we each took on costume design, which reflected our environments and lived experiences. At some point in our visit, she made the observation that it was obvious that I was not a graduate of a costume design program but rather that I had received a degree in fashion design where "technology-focused projects are found across all years" (KPU).

As I reflect on how alternative approaches to costume design can be tackled, it is clear that this conversation and perspective on my own training foreshadowed two important aspects of my Masters research: engagement with visualization tools. As an alternative mode of communication via a costume illustration, digital applications of video projection, 3D scanning, 3D printing,



and Photoshop for garment design helps shift towards thinking about computers and digital technologies as not just tools for designers to document our work towards, but "a place where they have become our creative partner in designing, making, and using what we produce" (Wujec, 2017). Not every designer can work fluidly between digital and physical worlds, but as technology advances, many designers are finding ways to integrate digital technology into their practice. The advances in visual technology, like computer-aided pattern drafting and vector graphics throughout the 20th and early 21st century have had a large impact on the clothing industry (Ramirez, 2014, p. 64). New computer-aided technology and innovation is evident in every phase of the production processes here in 2019. In garment trade software, such as Optitex,

virtually sewn garments are animated on custom-built 3D avatars, providing a useful means of garment visualization. By giving the designer and/or pattern maker a visual representation of a prototype garment before it is even cut, the understanding in relationship to a 3D form can be experienced much sooner in the production process. This visualization of the 3D product enables design teams to observe, reflect, and identify challenging grainline placements, construction complications, or unwanted fit issues before it is cut into a textile. While 3D tools (such as Optitex, Clo, Tuka 3D, Marvelous Designer, Bronzewear) strive to parallel reality and enable 3D rendering of form and textile drape, they usually only serve as limited representations of fit and material qualities. In reality, textiles vary tremendously in weight, and hand from one weave, knit, or dye lot to the next.  Programs have yet to tackle this effectively, but have gotten quite close to becoming a viable tool in the textile industry. The malleability of textiles makes visual technology challenging when catering to a wide range of designers, textiles, and functions (Wujec, 2017).  With these limitations in mind I have been interested in finding alternative ways to apply and use visual tools to bridge with traditional garment creation skills.



# Digital Tools for Costuming

Image 2: Ruthe and I testing space and projection angles in the Cultch Theatre, 2018

In the early stages of my Masters studies I began looking at and exploring costume design in relation to projection and light.

Theatre and live performances increasingly deploy video projections, wireless technology, and computerized follow spots. "The 'digital' is so embedded, it has become invisible" (Blake, p. viii). The drive to integrate emerging technology necessitates a closer look at how costumes work and function in a broader ecology that includes the set and projection design (Blake, 2014). For live performance, lighting and projection designers enrich the visual experience for the audience by using visual projections onto performers, performer's costumes, and the space inhabited by the performers and/or the audience (Freshwater, 2009, p. 14). As technology advances and changes the look of the performance space, the way a costume designer, like myself, can ideate potential garments for the stage does not necessarily support exclusivity to traditional modes used in the 20th century. Reviewing and analyzing previous work in wearable technology by designers like Jodi Sperling, Kaus Obermaier, Robert Lepage,and Mourad Merzouki inspired me to think of the human body as a canvas for projection design.

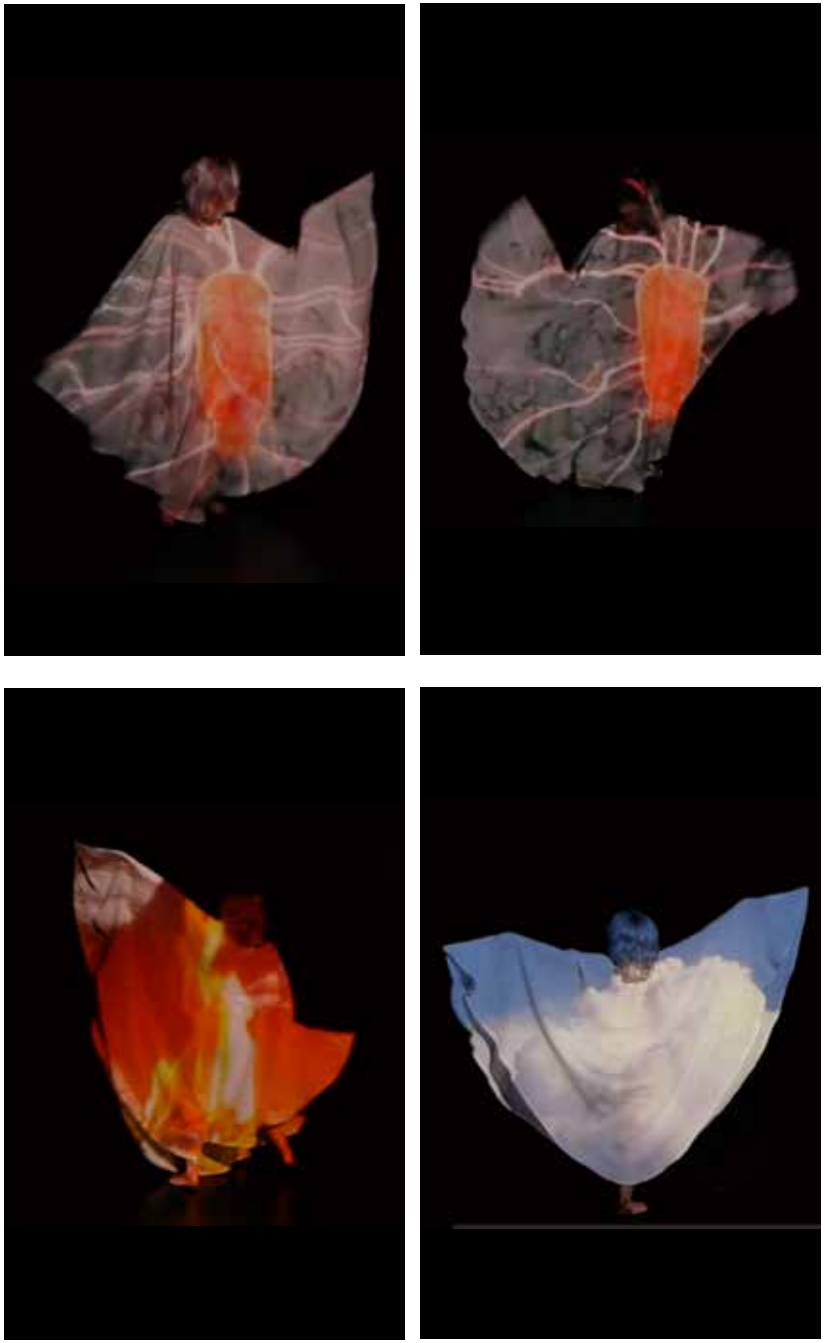


Image 3-6: Ruthe working with the cape at the Cultch Theatre, 2018

| Title | Projector | Projection | Costume | Performer | Space |
|---|---|---|---|---|---|
| Lotus Flower | 1- 1000 lumen short throw projector | 1- Radiohead Music Video | 1- White Cape | Me | White Walls, Grey floor |
| Bird in a Cage | 1- 2000 lumen projector<br>1- 1000 lumen projector | 1- Rotating still image<br>1- Bird Animation | 1-White tube skirt<br>1-Black overskirt<br>1-White blouse<br>1-Black shoulder wraps | Michelle | White Walls, Grey floor |
| Earth Spinning | 1- 2000 lumen projector<br>1- 1000 lumen projector | 1- Water video<br>1-Earth spinning animation | 1- Traditional Tutu<br>1- Cloud overskirt<br>1- Sleeveless top | Ariel | White Walls, Grey floor |
| Dreams | 1- 3500 lumen Projector | 1- Water ink/ | 1- Opaque Cape<br>1- Sheer Cape<br>1- 5M long wrap garment | Ruthe | Black Box Theatre |
| Future Human | 2- 200 lumen hand held projectors<br>1-1000 lumen projector | 2- Meg's custom Projections<br>1- Circular projection | 2- Black turtle-necks<br>2- Black tights<br>2- White fringe curtain prop | Sidney<br>Lindsey | Black Box Theatre |

Diagram 2: Projection Explorations

In my initial research, I decided to take on a series of theatre tests to help me identify preferable material requirements and technical parameters a garment specifically designed for lighting/projections might possess. These tests included one projector on white costume in a white room, two projectors on a black and white costume in a white room, two projectors on a structural costume in a white room, one projector on three different costumes in a black room, and three projectors on two dancers inside of white fringe set pieces in a black room. Each of these tests explored different aspects of technology, movement, projection design, and lighting to help inform the final textile development.

Image 7-8: Ruthe working with fabric at the Cultch Theatre, 2018.

Mimicking the flatness and expansiveness of a projector screen, the first garment prototype was a cape constructed of a draped semi-sheer material. The cape was designed so that the 'arms' of the performer extended past their natural arm span, thereby extending the silhouette. A long rod was stitched into the shoulder area of the cape. By holding on to this rod the performer is able to manipulate the material. When the arms and the rods are fully extended, a large projectable surface is created that is approximately 200 cm across by 145 cm tall. The garment uses the performer's body, pole extensions, and the textile to disguise the human form.

At this early stage, I was particularly interested in exploring visual elements projected onto the human body. A white cape prototype became my means of considering this. Earlier in my burlesque costume research I experimented with cape designs for performers in a variety of contexts. The cape construction is similar to performers like Loie Fuller's 1891 serpentine dance. More interestingly, Loie Fuller also used theatrical lighting effects in combination with her silk costume design as a performance technique (Magical Motion Museum, 2012). I spent my time ideating garment form possibilities that might play with the relationship between projections and the body. I found that projection design on material can be rapidly tested by getting a performer (sometimes myself) inside the costume and moving around in it. Rapid prototyping with my simple white garment, a video projector, and a video camera allowed me to consider a range of possibilities. From very early on I played with mimicking the flatness and expansiveness of a projector screen. The capes were an ideal simple garment for doing this; I was able to

Image 9: Cultch Theatre Technician and I discussing projection angles. 2018

make full use of the drape and hang of each textile I observed. I quickly realized that the performer's arm extensions, the textile qualities, and gravity all played a role on the projection design and visual mapping onto the cape-costume. The fluidity I achieved in these early projection tests provided me with a similar effect as Jodi Sperling's 'Book of Clouds' where she utilizes projection design, textiles, and a dancing performer (2017).

Drape, opacity, and range of movement within a theatre space were perimeters that helped direct how I began to test the garment design. In my second phase of projection and light explorations I moved to testing a range of powerful handheld projectors. Moving outside of my studio to a local theatre space enabled me to gain new perspective. I began to understand how the brightness, or lumens, can react to a performer, costume, and a black box theatre. My explorations of cape/projection interactions in Vancouver's Cultch Theatre helped illuminate my discoveries.

Thinking as both a projection designer and costume designer and working with the additional support of the Cultch's projector technician gave me new insights such as:

-In this larger space the brightness and visual quality of the imagery had a much bigger impact.

-The brightness of the projector defines what types of textiles are suitable for the saturation of the projection design.

Image 10: Me testing the projection at the Cultch Theatre, 2018

-When a textile is moving, it adds an improvisational rawness to the projection and in turn the performance.
-When the imagery projected is dark, the performer is less visible and merges with the projection, becoming almost invisible.
-The brightness and darkness of the projection space and how the projection reacts with the background surface is important to consider.

My explorations in this space and the unexpected help from others that it afforded suggested strong collaboration is a necessary component to visually understand how costumes interact with projection designs. This initial research into costume-projection interactions, and testing of different types of equipment, allowed me to realize that the detail I was seeking in a final costume concept would require a better understanding of a real world theatre context - a theatre production. It was clear that I would need to move away from my predominantly solo explorations and into a collaborative relationship. As a garment designer the complexity of projection visual literacy, modes of musical expression, and choreography were beyond my skill set.

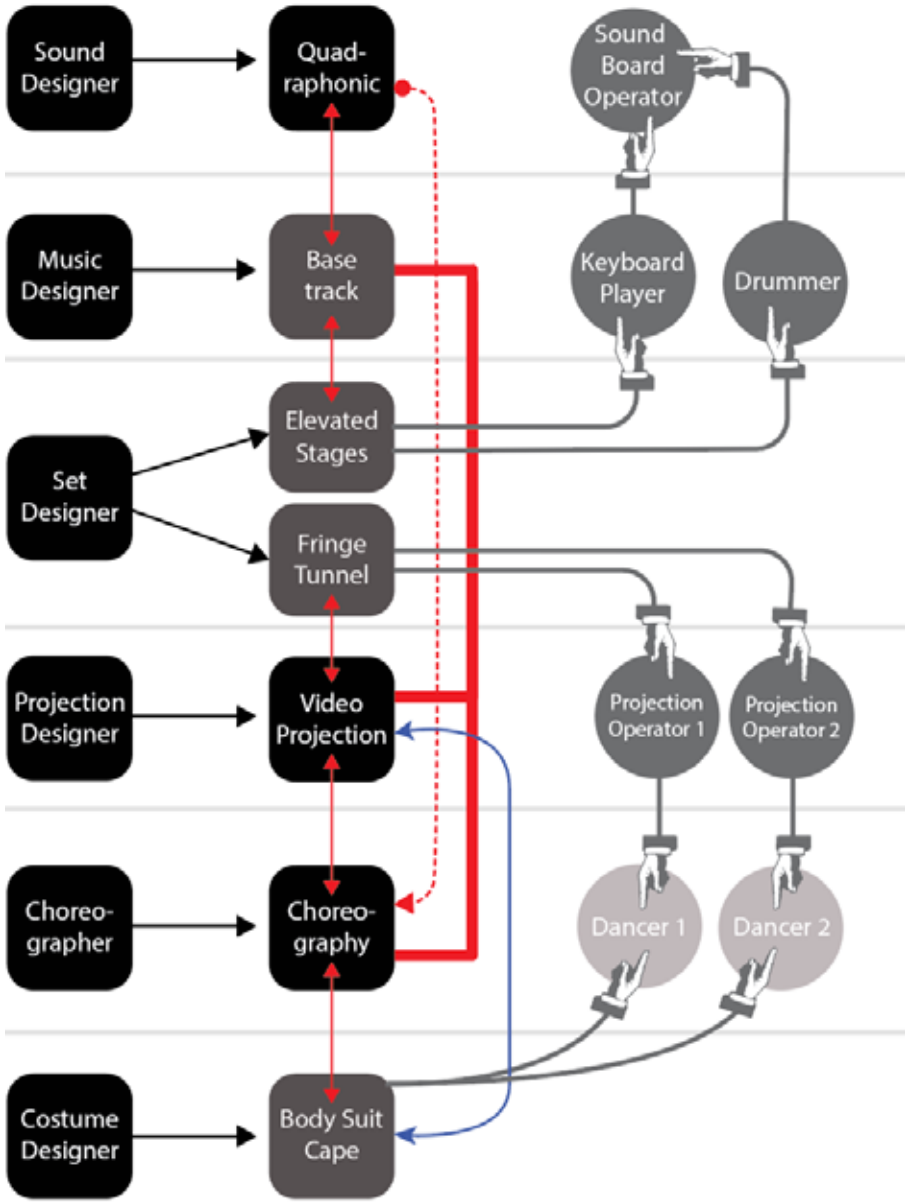



Diagram 3: Roles & Contributions through the prototyping process.

# Collaboration:

> "Successful co-creation involves trust, respect, collaboration, playfulness and exchange; it takes participants on an adventurous journey" (Walmsey, 2013).

Performative networks are made up of individuals on stage and behind, as well as the entire audience, all of which are part of a larger social network (McConachie, 2013, p. 69).

> "Whatever their size, networks are relatively stable groupings of similar kinds of people, with varying dynamics of inclusion and exclusion, that constrain and enable sociality, identity, construction, and other social practices before, during, and after a performance" (McConachie, 2013, p. 70).

The energy and creativity of my initial thesis work had sparked the interest of a group of local theatre designers, producers, and performers with whom I shared discussions of philosophy and projection design. Reciprocally, my projection-light explorations also made me notice how much I enjoyed working with others and how, in many senses, I have been gravitating towards design work that involves collaboration or even co-creation rather than working solo for quite some time. I wondered how I might enable this more frequently. I decided to team up with other theatre designers to

Image 11: Setup, inside of the performance space. 2018

help conceptualize and test ideas for an original theatre production: Sean Bayntun (Composer/Keyboard Player), Sean Bletcher (Sound Operator), Lyndsey Britten (Dancer/Choreographer), Meg Carscience (Projection Designer/Operator), Brad Danyluk (Sound Designer), Sidney Hryciuk (Dancer), Daniel Ruiz (Drummer/Percussion).

> "Good collaboration is getting on the same page; speaking the same language, creating touchstones in the ideas of the play and finding a common vocabulary all help us create a new and complete world onstage" (Robin, 2011).

I already knew that working with others impacts my own design process, often allowing me to be more focused on the visual language and the bigger picture. This perspective aligns with educator and author of Visual Literacy for Theatre Ming Chen's observations of semiotic functionality that exist in collective theatre making (2015). By using this concept of a co-designing working environment, this can be achieved by working with a group of theatre designers on a collective performance. Also referred to as Polyphonic Dynamics, this process involves collaboration and the applications of non-traditional theatre production (Chen, et all, 2010, p. 115). To begin this process I created an interconnected production schedule see diagra 3. My intent was to enable space for each designer to work directly in the performance space while outlining a prototyping and testing process. Each design segment within the creative team was to have an opportunity for both individual reflective revisions as well as collaborative

Image 12: Sound and set design breakout session, 2018

Image 13: Dance and set design breakout session, 2018

Image 14: Building the stage design, 2018

Image 15: Stages installed in the space, 2018

Image 16: Second sound and set breakout session, 2018

Image 17: Aodin Hand-held projector used for test performances. 2018

Image 18: Second Dance and set design breakout session, 2018.

critiquing across design responsibilities and expertise (lighting, sound, movement, set, projections).

Enabling different members of the production team to contribute to the development of a costume design expands the traditional approach of the singular costume designer working primarily through an illustration process to something arguably far more dynamic and risky. The more I investigated theatre design, the more I realized the impact a live performance can have on an audience. I began to think about the relation between the stage and the audience. Traditional theatre tends to use seating and stage layouts that facilitate large gatherings of people and also inherently privilege the separation of the audience and the performer (Freshwater, 2009, p.18).

Through an initial design meeting, the inspiration for the production didn't have a definitive theme, but rather was based on ideas from author Yuval Noah Harari's books *Sapiens, Homo Deus, and 21 Questions for the 21st Century*. A historical overview of humankind, projected possibilities of the future of humanity, consumption, mortality, and physical appearance inspired all segments of the design team. When building out a theatre production, many aspects of the performance are defined by the format of the stage. Based on past experience I surmised that this was the first thing that the sound designer, musician, set designer and costume designers in my production could collaboratively explore. Interestingly, the first things came to the fore was an interest in working with a theatre in a round stage formation. The opportunity to work in the round and ideally a small space sparked the interest of the entire design team I had collected. With this in mind, I sought out a theatre space in a local community center, the

Image 19: Stage set-up for test performance. Aug 31, 2018

Image 20: Stage set-up for test performance, Aug 31, 2018

Moberly Center for Arts and Culture. This became the site for our production meetings, rehearsal space, and the shared meals before each rehearsal or gathering.

The experience provided me with opportunity to think about the role of costume design as an element of a collaborative process. Working with a group of designers helped me expand my assumptions of projections on a costume design by thinking about an entire production, choreography, music, set, and lighting. Rather than applying the usual conventions and ways of developing and communicating costume design through illustration or photos, I found myself conceiving and sharing my ideas in more messy, raw, and incomplete ways. I used physical prototypes. My work was contingent on the other members of the group and context-dependent. Our individual expertise and the places we gathered to work together had an effect on how we worked.

The design team worked together to rehearse and test ideas in a performance space. After a series of brainstorming sessions each segment came together to test their intentions through a collaborative dress rehearsal-style prototyping session.

The music design was created with a quadraphonic sound setup, complicating the sound set up for the space. Conventional sound design divides the music into two channels, left and right. The composition created for the test performance used five channels: front, back, left, right, and subwoofer. This collective decision to shape the space with music affected the design team's collaborative vision.

Image 21: Projection testing with dancers and set design. 2018.

In the collaborative setting I had established, I realized that visual cues and spoken ways of communicating were not always commonly understood the same from designer to designer. The way each of us approached producing our initial prototypes of set pieces, musical sketches, choreography, and videos for the test performance necessitated smaller breakout brainstorming sessions. I learned that the choreographer and I had very similar ways of developing ideas through the use of raw designs that gradually helped us develop an overall concept. The music designer in contrast needed an overall concept first, which they then developed into more finite details through storyboarding and developing a timeline.

Aspects that motivated each of us creatively was also interesting. By increasing the complexity of the musical composition and the sound performance, the sound designer and composer became more engaged with the physical space. This in turn impacted the work of the choreographer. The sound designer and composer were interested in how the quadraphonic sound design could be used to attract an audience's attention. The ability to have sound travel around the room impacted the rest of the creative team. Each of us had to move from seat to seat in order to understand the audience perspective and consider how to design for this, whether that be via light, costume, gesture. The creative team became an audience. We sat, reflected, and considered how to work with this new unanticipated sound element - how might our collective work jointly respond with our individual work.

Image 22/23: Photos from the Test performance on Aug 31, 2018.

The experience of working collaboratively in a theatre space, with a team of designers to create prototypes, was incredibly inspiring. The reality of analyzing my own work with a collective's deep considerations is something that could be part of a theatrical production process. This type of exploring was a great way to utilize rapid prototyping and test overall concepts. In my case, as costume designer, I realized that the white material I had been working with was not bright or reflective enough regardless of the theatre space. This detail highlighted the need for more material exploration. The success of bringing a team of designers together to create an initial design concept in a theatre space led me to my next stage of material research using a range of visualization tools.

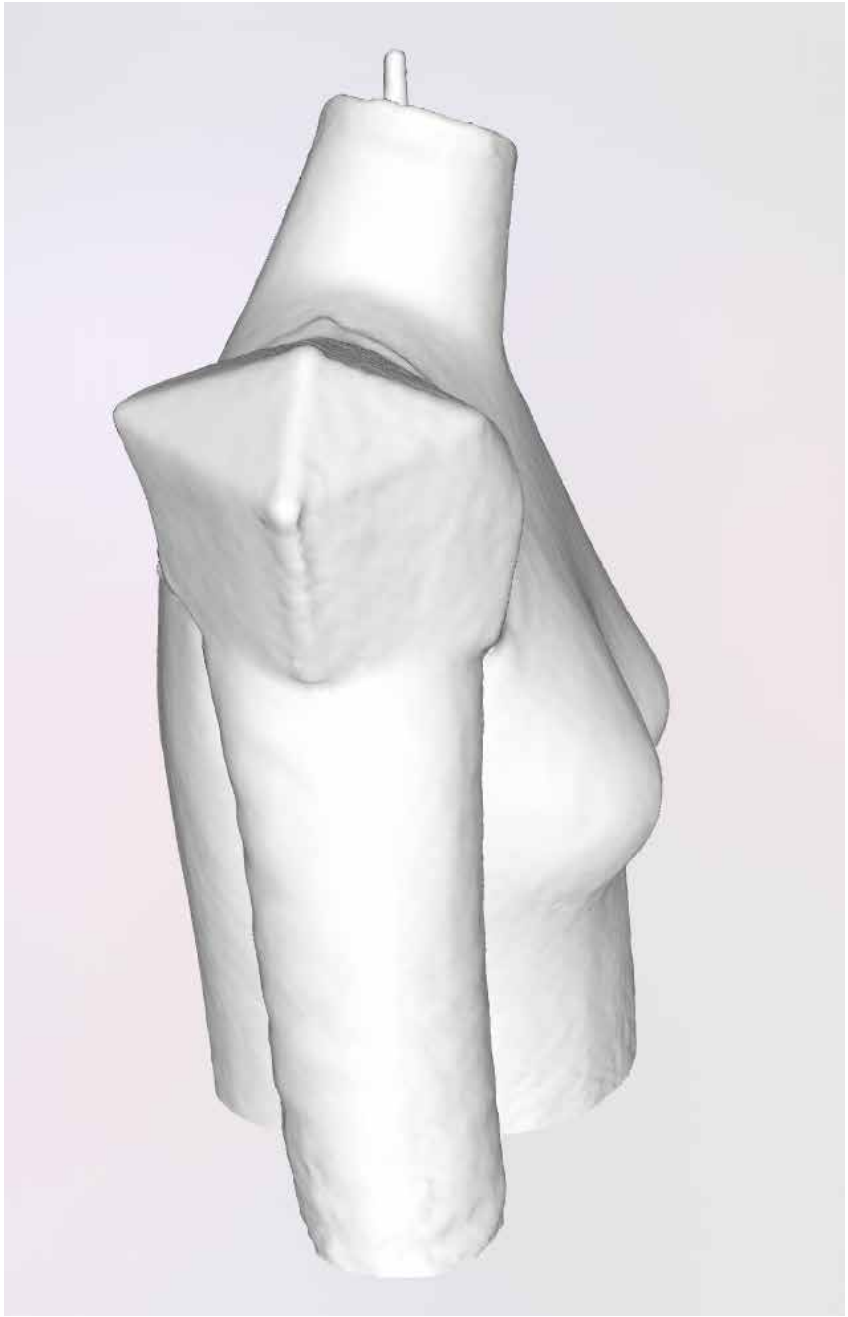


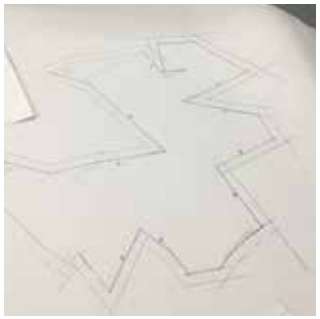
Image 24: 3D scan of Shoulder Structure. 2019

# Digital Tools for Costuming

In my final explorations I sought to investigate diverse textile possibilities through the construction of a single design element for burlesque performance: a detachable shoulder extension accessory/unit/module. This section describes and discusses this body of work.

The lack of visibility of projected imagery in the performance made me realize that there was opportunity to consider and develop more detailed costume elements. The rapid pace of the prototyping process resulted in low complexity garment design. The body being more visible defined a need to expand my knowledge of alternate textiles, which subsequently necessitated adaptations in workmanship; for example, considering weave and yarn structures in garment design.

Image 25: Process photo: shoulder structure design. 2018



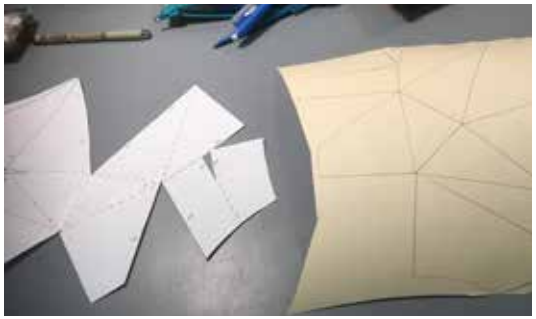


Image 26-27: Process photos: flat pattern pieces, 2018

Earlier projection explorations with handheld projectors made it clear to me that the distinction between light and dark can be enhanced with textile development like 3M Scotchlite Reflective Material Fabric, or reflective yarns. Reflective textiles like 3M Scotchlite Reflective Material are commonly seen in safety and athletic wear garments, but not frequently in costume design. At this time, this material is still quite scarce and not readily available in small quantities. The proximity and quality of the light source is also a large factor when utilizing this technology (Kemp, 2016).

Material like 3M Scotchlite textiles diffuse light differently than mirrors, sequins, and crystals. From my experience as a costume designer, shiny surfaces like watch faces, eyeglass lenses, and metallic buttons can act as distractions on stage as they can reflect a bright beam of light back into the audience and away from the stage. In a burlesques design context, however, the refraction of light and "sparkle" is used as a key visual tool. By using a complex surface texture of Swarovski rhinestones, sequin fabric, or lamé, each surface utilizes the reflection of light in relation to movements. By using reflection of light as a way to draw attention to the specific performer or action on stage, this type of performance inspired each of the artifacts detailed below.

I found the desire to alter the shoulder silhouette as a means to represent a form that was neither male nor female by researching fashion designer like Thierry Mugler, Helmut Lang, and Serkan Cura. I decided to use a garment reference that I could dismantle and adjust as a means to understand each individual component needed for the final artifact. The garment reference was created not from an illustration, but was constructed much like a sculptor.

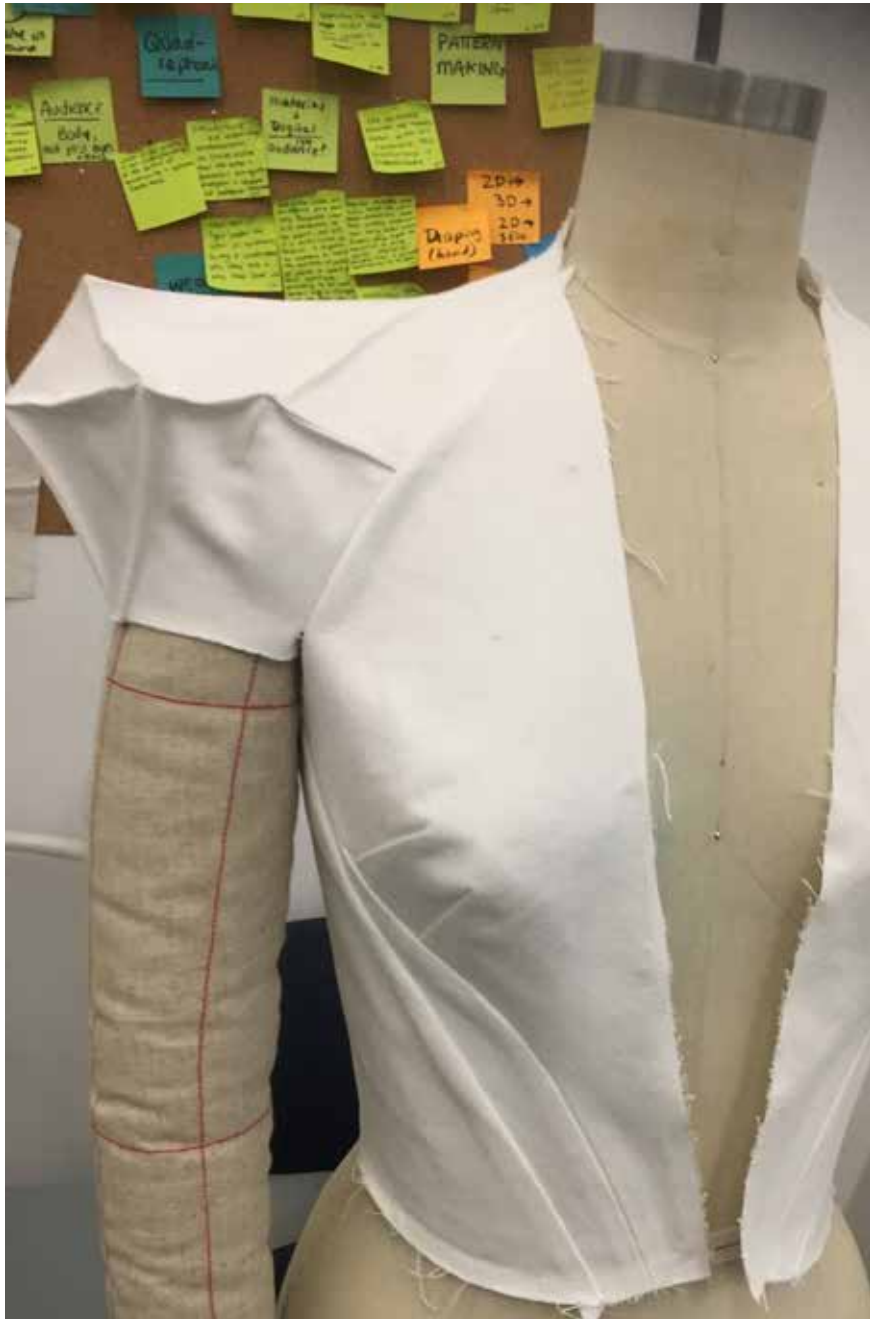



Image 28: Heavy cotton prototype, 2018

As a starting point for Future Human I created a set of criteria that was created from working with the burlesque performer Ariel Helvetica. The use of the Future Human shoulder design concept needed to be rigid but lightweight for Ariel's intended use and storage of the costume. It needed to be an independent structure that sat on but was not dependent on the human body to create shape and depth. From the inception of my idea for this costume silhouette, how the final costume execution was achieved involved co-design fittings which provided an opportunity for both designer/maker and performer to inform limitations.

The process of creating a shoulder structure that sits up and away from the body started with paper, masking tape, and a dress form. The stiffness of my first paper prototype provided a silhouette that accomplished a visual presence and effect which was much more interesting and effective than anything I had previously sketched by hand. I have found my ability to think about abstract shapes adapted to the body a challenge. Considering a design that wraps around the front body, the back body, and the arm in a two dimensional space does not come easily. This, interestingly, is linked to the typical format of pattern making/manipulation that I frequently use and teach. This method, which dominates the fast fashion garment trade, involves the separation of components that make up a body: the front of the body, the back of the body, and the arms are all treated as independent unique shapes which are then merged together through the sewing process. It was only when I cut up the sculptural 3d shape into a flattened pattern piece I could then identified where the seams or structure could be reproduced.

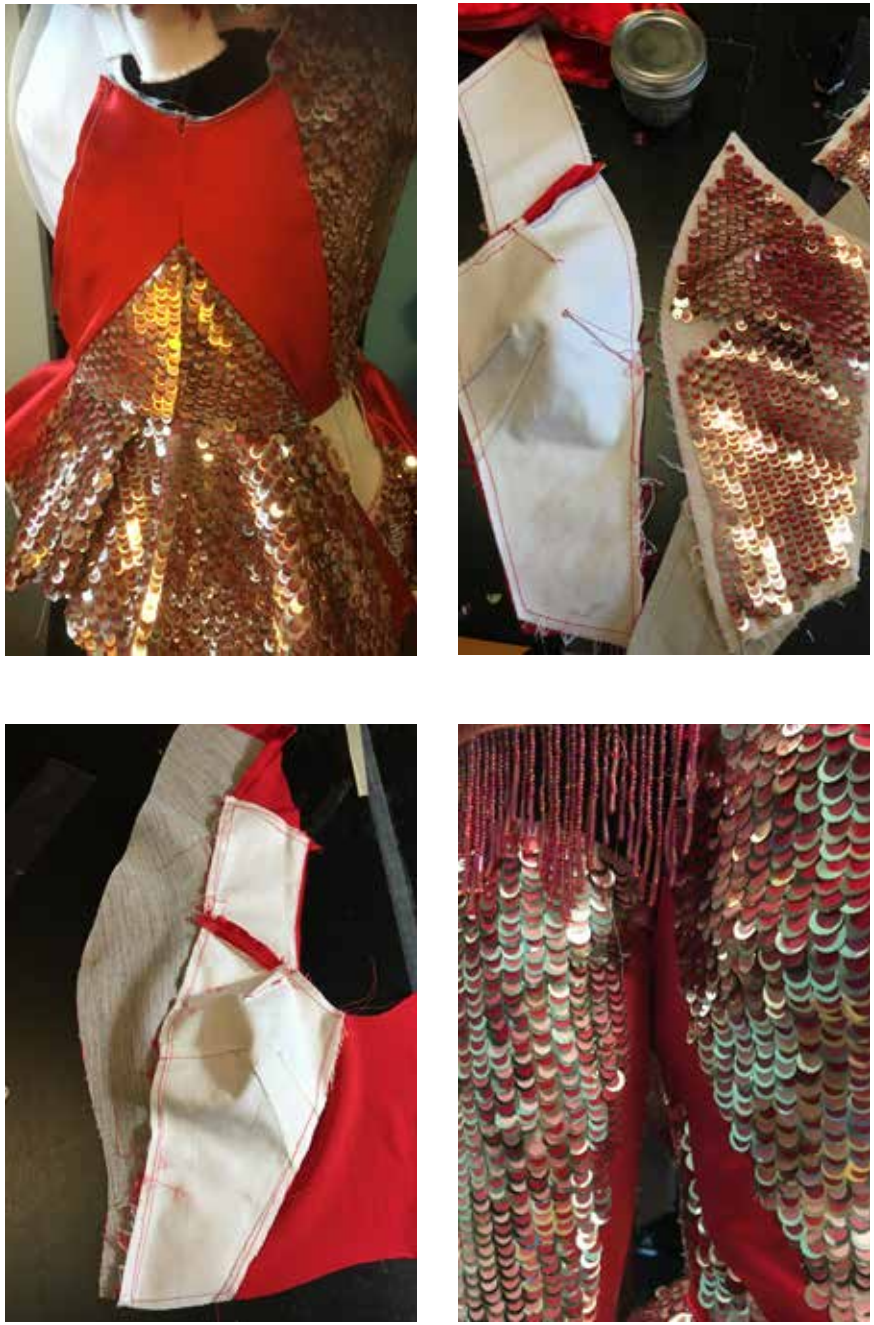


Image 29-32: Work-in-progress photos for sequin costume. 2018

Once my final pattern piece was 'draped', then flattened, I manually traced the form onto a copy made in paper. I used this paper copy to trace a replica pattern in muslin. I later scanned this draped pattern piece into Adobe Illustrator. In this format as a digital representation the shape was used to parallel my manual/analogue pattern development on a digital platform. There were noticeable differences between the manual paper pattern and the plotted results of the digitized scan. Ideally there would not have been errors or inconsistencies, but as each mode was tested for accuracy against the original paper pattern, the manual pattern techniques proved to be much more accurate. Using an iterative back and forth process I was able to get both the digital and paper pattern to match in every specification. This back and forth process took four updates to check the digital scan against the paper pattern, as the object was much larger than the scanning surface and some of the points of measure were out of spec when reviewing. Once this was done the form was tested using five different types of textiles (buckram, PVC, muslin, sequins, Scotchlite) and also support structures (3D printed supports, balsa wood supports, manila paper, Duralar) which helped guide the scale and proportions of the constructed three dimensional form.

Image 32: Work-in-progress photo of sequin costume, 2018

# Neo-Burlesque:

Neo-burlesque costumes often apply couture techniques in order to assure durability of garments in acts which are performed numerous times, possibly for years. When silhouettes require body modification via corseted waistlines or exaggerated shoulders, the modifications are better understood if the same human form can be referenced for all points of measure. By using a 3D scan, a model, or a dress form, design lines can be visualized directly onto the body being designed for. To create clothing design with specific visual language and performance functions the Future Human shoulder design explores different design contexts through the same design. Ariel Helvetica was immediately inspired by the context of a Future Human that I was researching and wanted to include this idea in her own costume commission I was creating for her. As my client already had a textile in mind for the co-design project - tear drop style sequins - this material challenged my assumptions of what would be suitable to execute my Future Human design concept.

As I started to work with the sequin fabric, I immediately learned that I needed to slow down my typical process of building, because the sequins were too large to be machine stitched. While the sequin surface provided excellent light reflection, the soft base textile they were connected to provided no structural shape capacity. While working with the sequined fabric, the fabric required hand removal of each unneeded sequin to be able to machine stitch for the final shape. This process was laborious, but as I carefully removed each sequin I felt confident in the accuracy of the cut fabric. As both the workman as well as the designer, I had tested the shapes and proportions of the final pattern pieces in

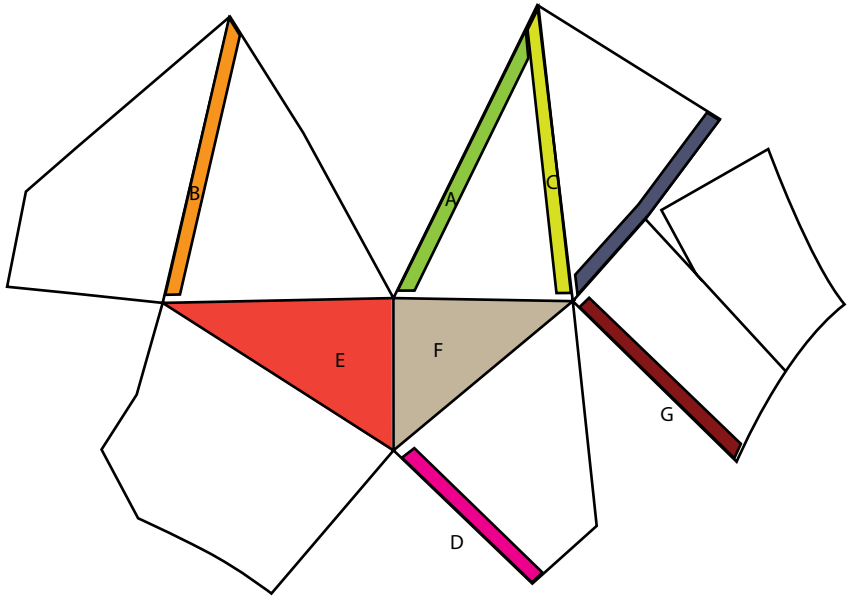



Image 33: Adobe Illustrator file of the skeleton structure, 2018

Image 34: Buckram inter-lining, 2018

Image 35: Skeleton Framework, 2018

manila and three weights of muslin before it was cut in the final sequin fabric. While I worked at creating this shoulder structure, I started to think of the alternative applications and construction techniques that this design could offer to another type of theatrical performance.

## Internal Structure:

As noted earlier the sequin fabric I was working with was soft and had no structure. The shoulder form I had developed for Future Human sits away from the body of the performer, resulting in the need to find a means to hold the fabric up. Allowing revisions and modifications throughout the building process gave the costume components an opportunity to work together in an unexpected way. I decided to use 3D printing as a means to build the skeleton-like structure, this rigidness allowed movements and extensions to be considered. As the learning curve of working from 2D to 3D on a digital platform was a difficult shift, tactile props proved a vital learning tool. This 3D application to the design process provided an alternative shift in workflow, providing me with the idea of creating separate parts which are hand sewn to the final garment.

Image 36: Buckram inter-lining and sequins, 2018

Building a file that can be 3D printed requires the designer to consider the suitability of the equipment and functionality of the result. In my case I chose to do most of my designing of the structure I wanted to build in a program of preference, Adobe Illustrator. It is easy to become frustrated with adopting new technology or workflows to an existing structure. Patience applied to this part of the garment design process is important as it enables the workman to identify smaller discrepancies. While I am familiar and adept at using Illustrator this choice still provided many obstacles when I began to shift my drawn files to other applications - communicating between software is not an easy process, and this slowed me down allowing me an opportunity to understand the 3D software as it pertained to my design problem. My familiar skills, detailed traditional pattern drafting, supported my workflow in this unfamiliar territory. My manual building strategies helped support my work using a range of digital applications.

I first tested a 'skeleton support structure' which is hand stitched inside of the shoulder structure out of craft-grade balsa wood strips. Once the areas that needed support were identified, I created a paper pattern of each final shape. Once cut and then sewn to the updated shoulder structure, the balsa wood structure material proved to be quite adaptable and easy to build, providing adequate support to my shoulder form. Once I re-created the wood structures into adobe Illustrator, I started to recreate the support structure in Cinema4D, a 3D drawing software,. I was interested in comparing processes of working with a wood structure and the 3D printing process as this was a new workflow and consideration. Because I had created a physical example of the 3D print, it became an important tool

Image 37: Skeleton Framework: Internal view, 2018

by allowing me to be able to analyze the form I was working on in a physical space.

I then moved to 3D printing the form in conjunction with a Research Assistantship with Researcher Aaron Oussoren in the Material Matters research facility. The development of my 3D printed structure was further inspired by conversations and problem solving that these similar but different perspective to add to my own workflow. The involvement of other makers through the learning curve of working from 2D to 3D on a digital platform was overcome with the refinement of how I, as an individual with my own set of skills, could use the program. This 3D application to the design process provided an alternative shift in workflow and sparked further explorations. It enabled me to conceive and achieve sculptural design concepts that I was not able to execute before this introduction.

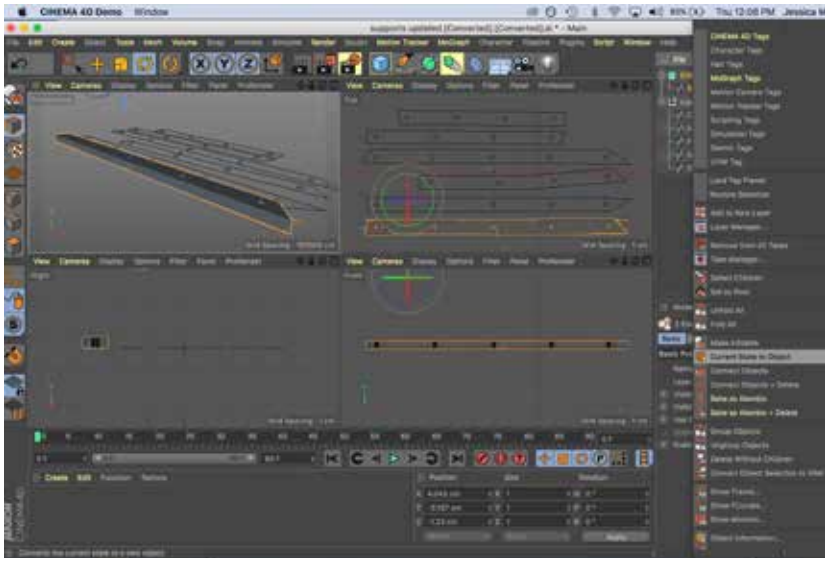


Image 38: Process of 3D Printing Skeleton Structure, 2018

Image 40: 3M Scotchlite Textile, photo with flash, 2018

# Reflective Fabric:

The 3m Scotchlite bonded reflective textile was purchased through Mood Textiles, a retailer in Los Angeles. Through my experience in athletic wear, I worked with textile mills that created this reflective surface in a variety of colours. As Arial was visiting Mood Textiles, she asked if I wanted anything I couldn't get in Vancouver. Instantly I thought of reflective fabric, and to my delight they had an extensive selection where I picked out a brown colour, something that reminded me of a skin colour. This cotton backed material is easy to cut, sew, and press. The accuracy of the cutting, sewing, and shaping around an internal structure framework required no adjustments or negative surface space as the material is flat and thin. The colour is uncommon as a reflective material yet the brightness of this material under a flash of light is still quite bright.

Image 41: Projection on a dressform, 2019.

Image 42: Transferring projection lines onto fabric, 2019.

Image 43: Transferred lines on fabric, 2019.

Image 44: Re-drawn textile design, 2019.

# Textile Design:

Prototyping the Future Human shoulder structure in a range of textiles and construction techniques, as detailed in the sections above, lead me to develop a textile design concept. Moving from earlier rough sketches on a muslin prototype I gradually developed a refined pattern. I transposed my work from an analogue muslin structure and hand drawn pattern to a digital format. These final explorations that employ digital tools for the creation of fabric have inspired a new workflow for myself as costume designer.

Many costume designers are faced with minimal choices when choosing local or durable materials/textiles to create costumes. To overcome frequent scarcity of reflective materials, I decided to take a closer look at the production of the textile. Inspired by an available tool (a TC2 digital jacquard loom), I was interested in adapting weaving into an integral aspect of 3D costume ideation and production process. Drawing on collective long standing knowledge connected to weaving cloth, traditional skills are needed to weave a textile on a digital jacquard loom. The loom required working with a technician, as well as learning how my specific yarn would interact with the warp threads on the loom. As the warp threads are made of a white 100% cotton fiber, I was curious to explore the possibility of working with natural fibers in combination with a reflective thread structure as the ability to over-dye the final fabric allowed more adjustability of the textile for a garment context.

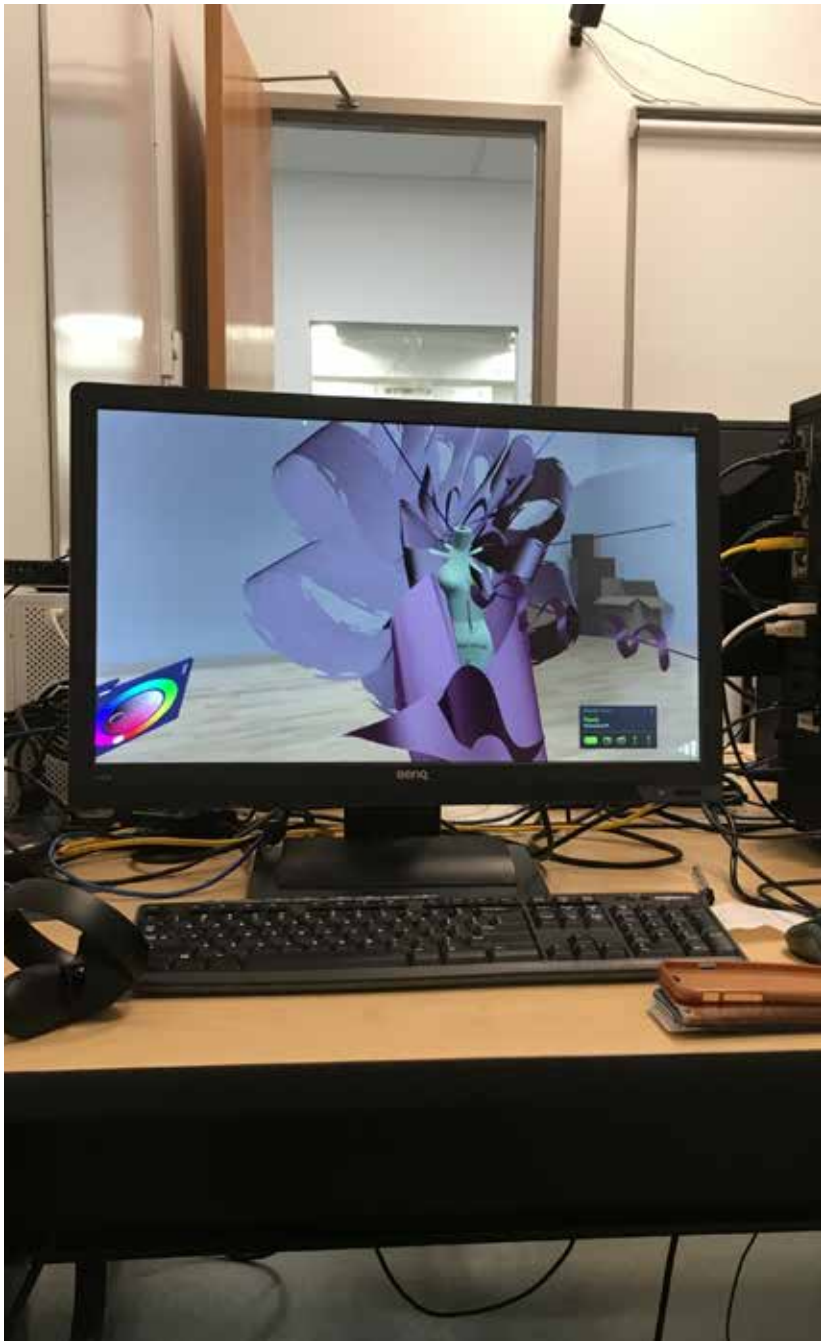


Image 45: Masterpiece VR screenshot, Emily Carr Campus, 2019

A sense of flatness created from computer files can be limiting when only looking at a typical screen-based workspaces. As a first attempt towards achieving a custom textile design, I chose to explore virtual reality as a way of working in the digital third dimension. My first experience wearing a virtual reality headset, Oculus Rift, was quite unique and oddly familiar. My intentions going into the experience were far too idealistic; I assumed drawing on a 3D scan of my base structure seemed achievable through the tutorial videos I was watching. The concept of eliminating the step of having to physically draw on the surface of a garment design didn't feel as accurate when working with the hand joysticks. While experiencing virtual space, I changed my expectations and started to think of other applications that supported the costume designer. I initially 3D scanned the shoulder structure created for the Future Human concept on a dress form, then downloaded it into the SketchFab program that is linked to Masterpiece VR. After troubleshooting and getting to understand the option menus, I successfully downloaded a dress form into the virtual space. Once I realized I could physically move my body around the dress form in virtual space, it felt familiar but not quite fully in my control. When I began to draw design lines directly to the dress form I imported, I felt the need to focus on silhouettes and bigger perspectives rather than small details. I found it harder to focus on the fine details the shoulder structure could produce. Preferring to understand how this garment might be perceived in a large theatre space with the possibility of true lighting or even projections, much of the textile design changed to a manual method of textile design, reserving this virtual space as a focus for future research.

Image 46: Hand drawn textile design, back, 2019

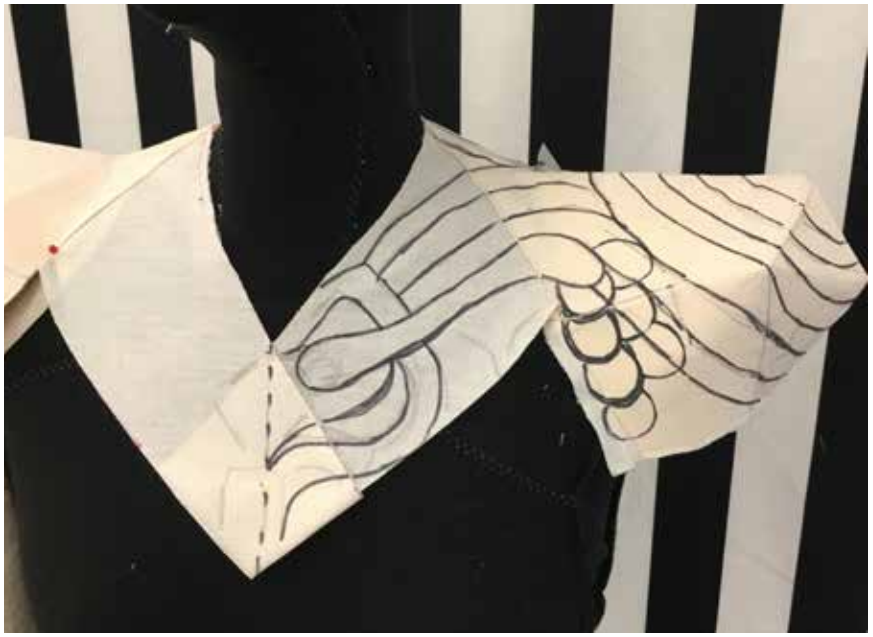


Image 47: Hand drawn textile design, front, 2019

As Image 41 shows, the use of a video projector can be used not only as a performable tool for garment design, but a tool in textile design. The reference images and proportions I was wanting to recreate for the textile design are based on the skeletal structure of the human body. A handheld or short throw projector can be used to identify scale, ordainment proportion, colour, or even test moving pictures against a light coloured prototype. As both designer and pattern builder, I was able to conceptualize ideas with this tool immediately. By referencing proportion and scale to the accurate actor - in my case a dress form adjusted to the correct height - the video projector and hand drawing was visually understood sooner, making transferring the general proportions faster.

Image 48: Hand drawn textile design, scales, back, 2019

Image 49: Hand drawn textile design, scales, front, 2019

Image 50: Flattened version of the textile design, 2019

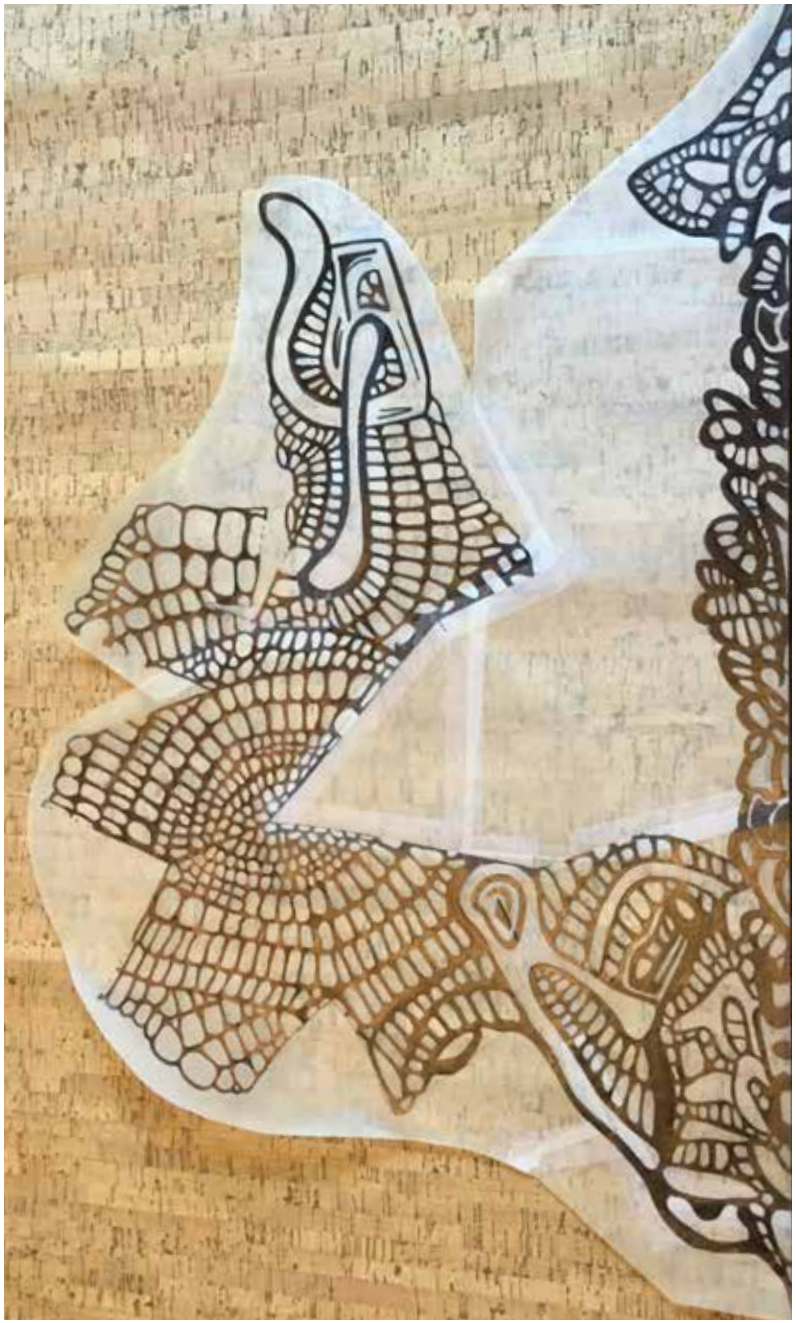


Image 51: Final textile design template, 2019

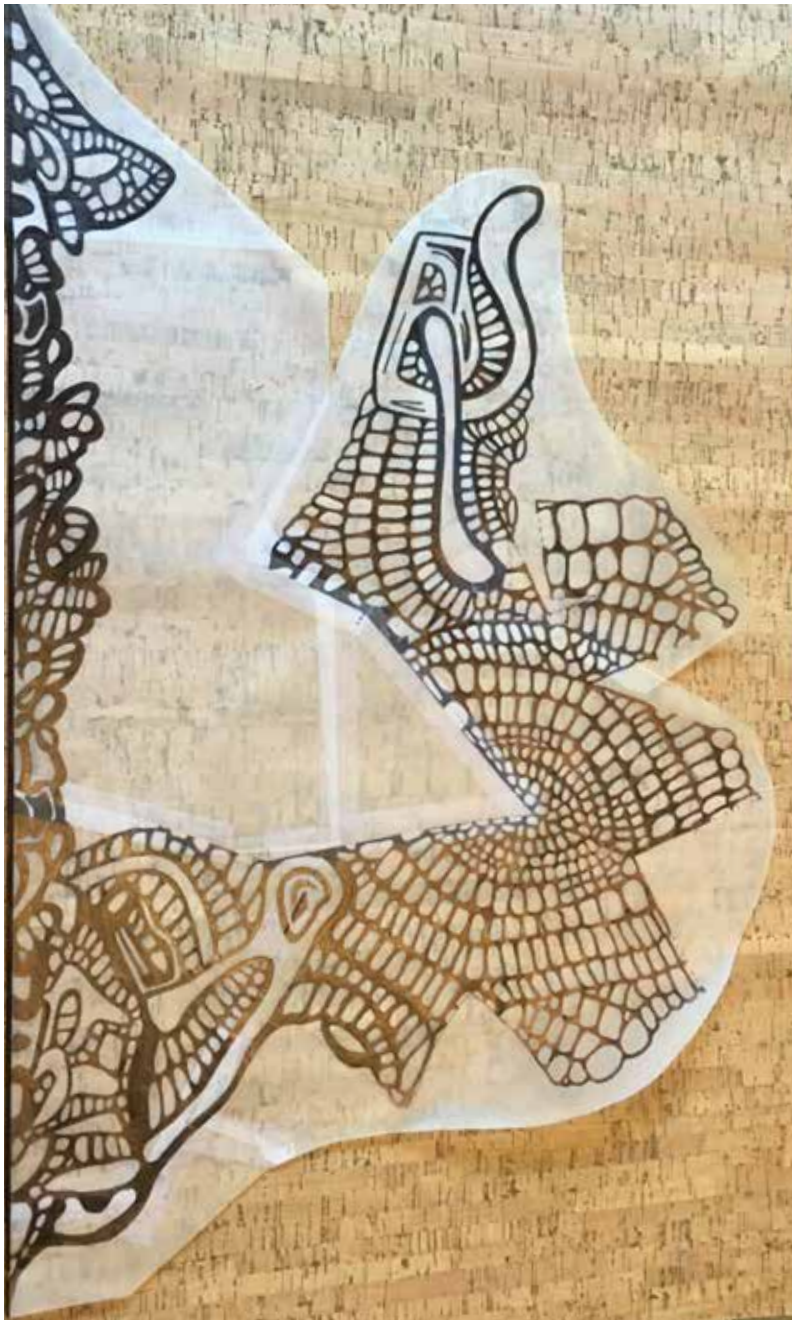


Image 52-54: Dissecting the textile design into smaller components, 2019

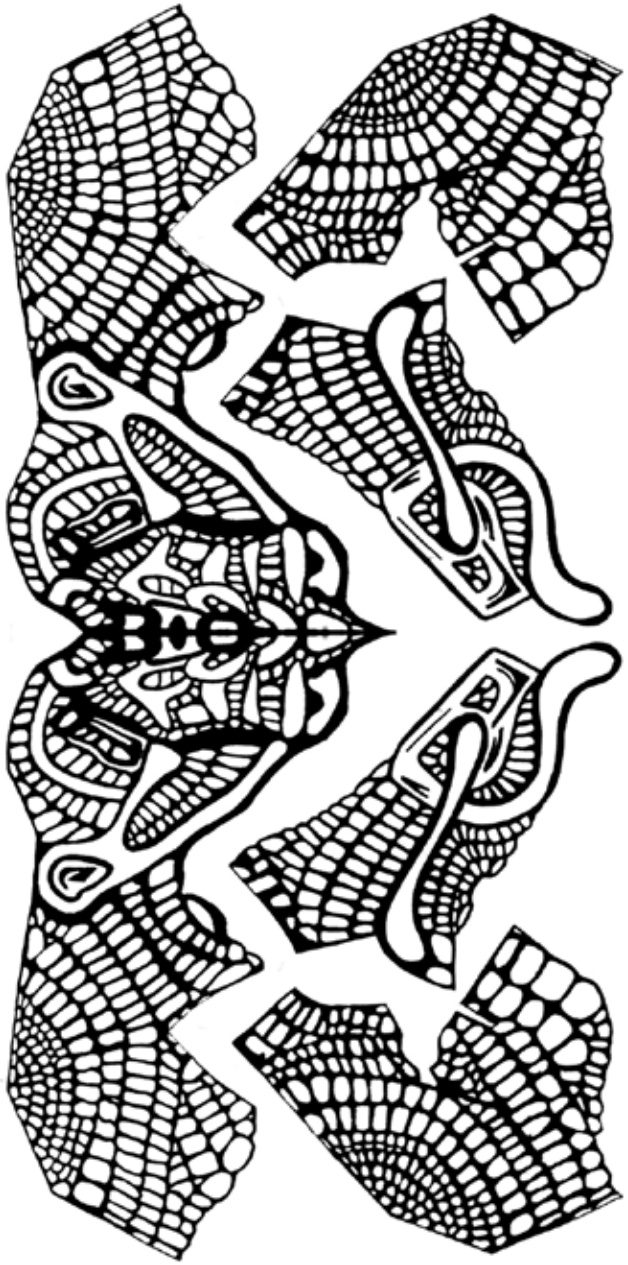


Image 55: Scanned and digitized version of the textile design, 2019

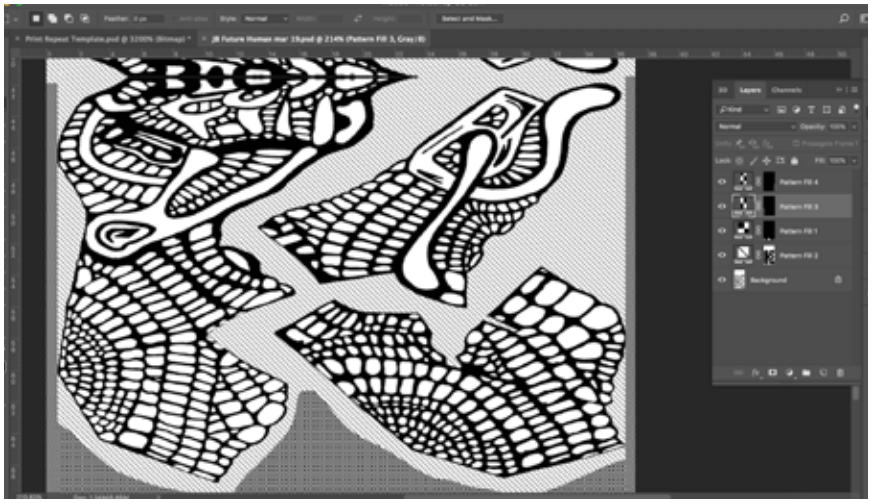


Image 56: Photoshop file of textile design, 2019

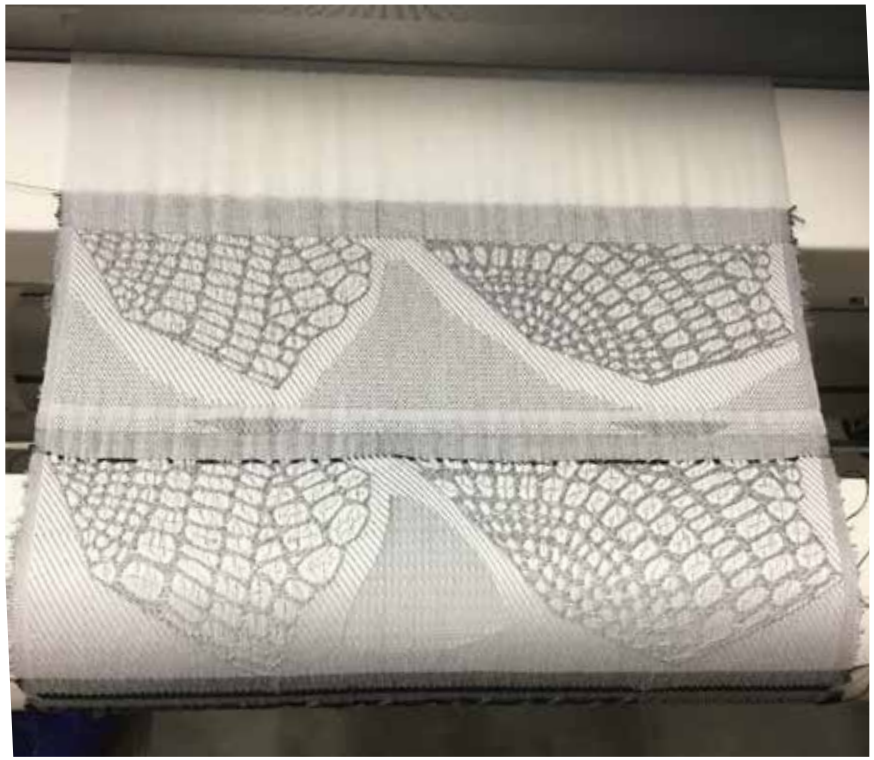


Image 57: Weave testing, TC2 Loom, 2019

# Weave Testing:

While I was able to easily control and manipulate the texture and surface of the textile, the scale and sizing was more of a challenge when transferring the digital file to a manual process. Each time I approached the digital jacquard loom with a file, there seemed to be a disconnect between the shape and proportions of the threads woven, and the shape and proportions of the square pixels.

A digital file has the potential to appear accurate to size proportions of each thread visually represented in artwork suitable for a digital jacquard loom. The TC2 loom's software translates data from a black and white image, which can be imported from a variety of different digital programs. In my case I found Photoshop was the most successful in communicating the weave structure I was creating. The ability to achieve photorealism is often a barrier when designing costumes. I was able to conduct a series of tests to better understand the performance and malleability of a reflective polyester thread. The software controls the TC2 loom threddles and air compressor, and a manual operator completes the production process. The blend of manual and digital application forced me to consider every square centimeter of material as each row of weaving indicated improvements and techniques to further develop.

When weaving a custom textile with the TC2 digital jacquard loom, the artwork creation can make the largest impact on how the structure will be translated into a cloth. The proportions are based on one pixel representing one single thread (880 total warp threads). By creating a prototype, drawing a design

Image 58: Weave tests: Checking the original design, 2019

Image 59: Weave tests: Unbalanced, 2019

concept, then transposing the artwork into a black and white image, the original artwork of the textile posed a problem in size, as it did not fit in the width of the 880 threads. Rather than adding more threads as a width to the machine, the artwork was cut up into smaller segments and re-arranged to efficiently use the final width of the weaving area (Image 70). Because I am using reflective thread for my final design, each test done without this thread type resulted in a different scale or ratio from the original graphic design imported into the program. The final textile's specifications in both width and depth did not transfer true to the original artwork. To correct the modifications of the artwork imported into the loom software, I reduced the warp length by 87% and stretched the weft width by 105%. The adaption of scale, combined with an angular textile structure, required a large range of tests to explore different weave structures to achieve a continuous textile, and true portions. Each alteration to the weave structure, yarn choice, and observation of machine changed the result.

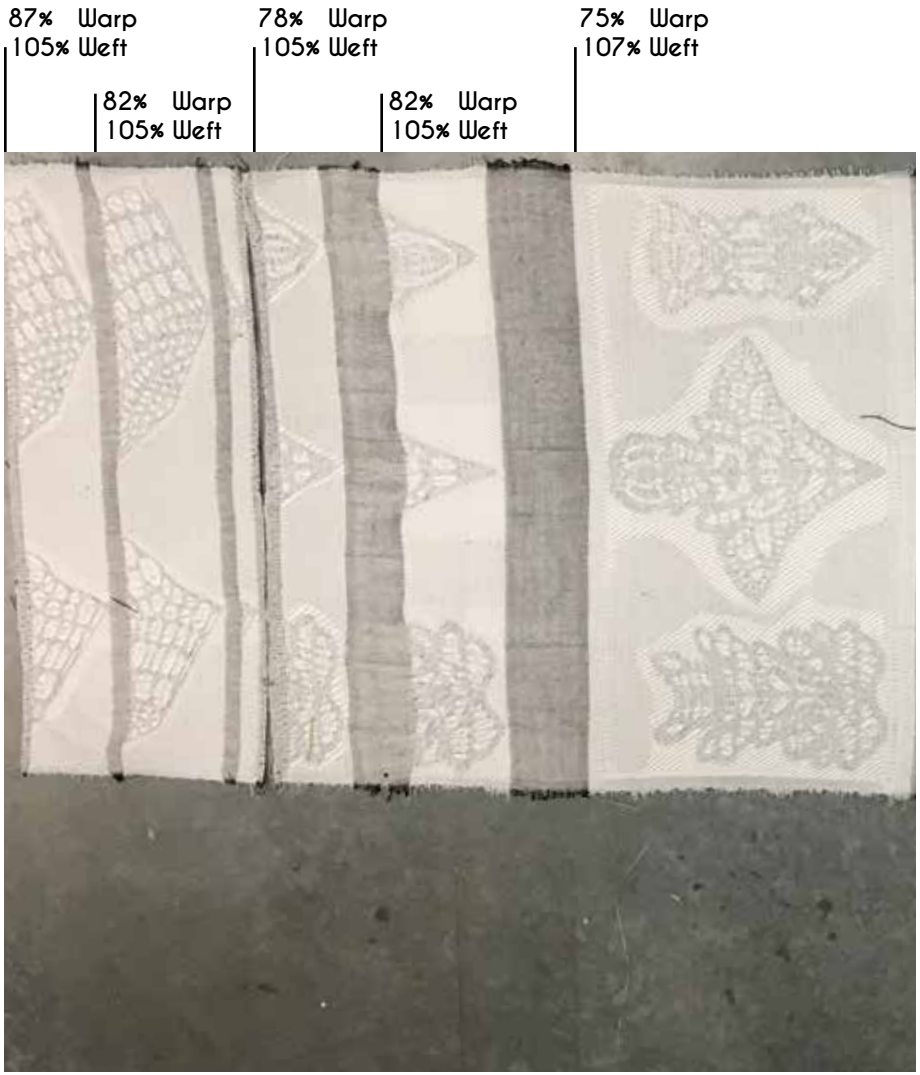



Image 60: Weave testing yardage, 2019

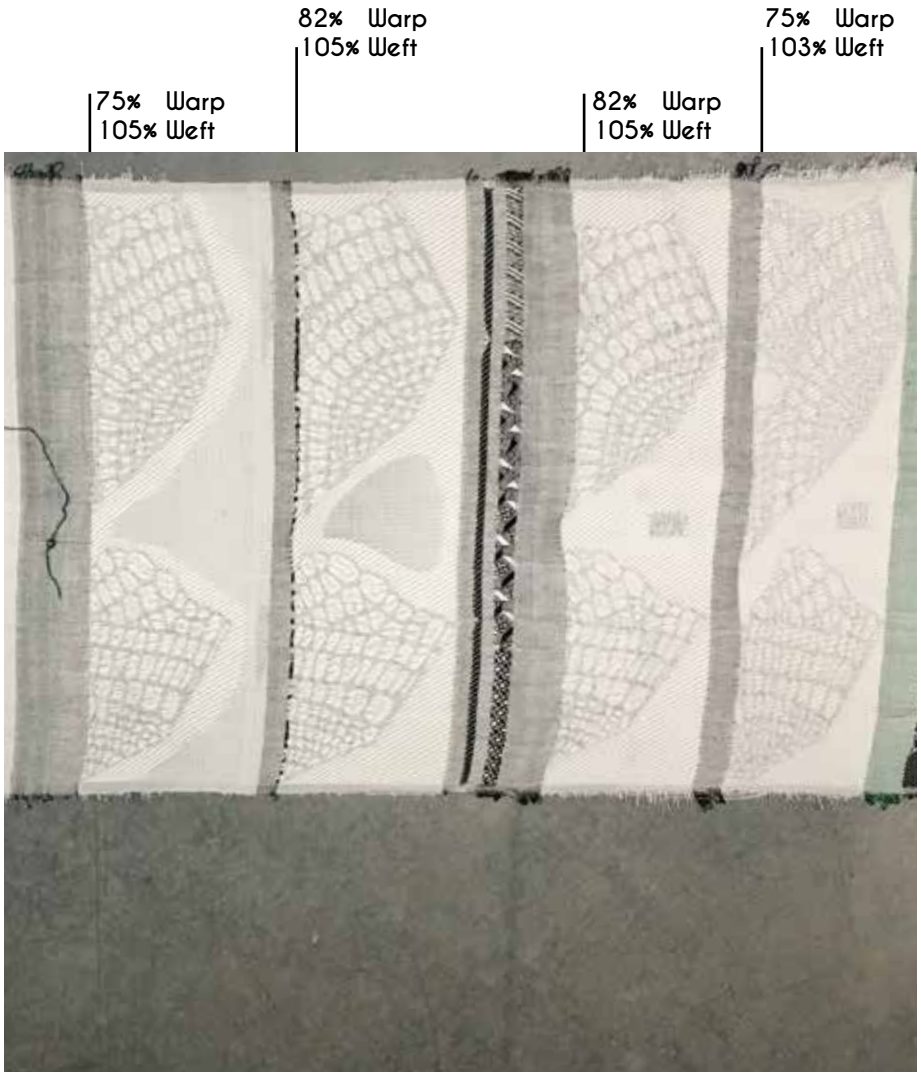


Image 61-63: Constructing the textile components, 2019

Image 64: Internal view of final garment, 2019

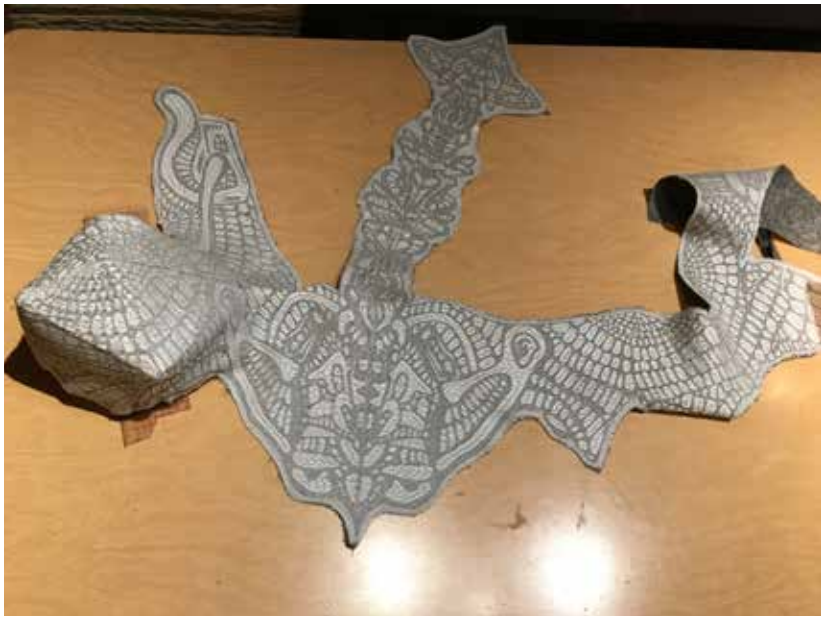


Image 65: Work-in process, constructing the final textile, 2019

Image 66: Final garment design, photo without flash, 2019

Image 67: Final garment design, photo with flash, 2019

Image 68: Final garment design, photo with flash, 2019

Image 69: Digital Jacquard Loom, Material Matters Research Center, 2019

# Conclusion:

> "In the context of providing material services with less material production, visionary rather than practical responses to materials and processes should not be ignored. The activities and experimental designers can offer alternative value systems and new ways of approaching sustainability and material efficiency" (Harrod, 2013).

The explorations documented and reflected on in the sections above seek to blend a range of experiences, research, and workmanship. My investment in this work has been a means to think beyond the traditional modes of communication and making within a costume design context.

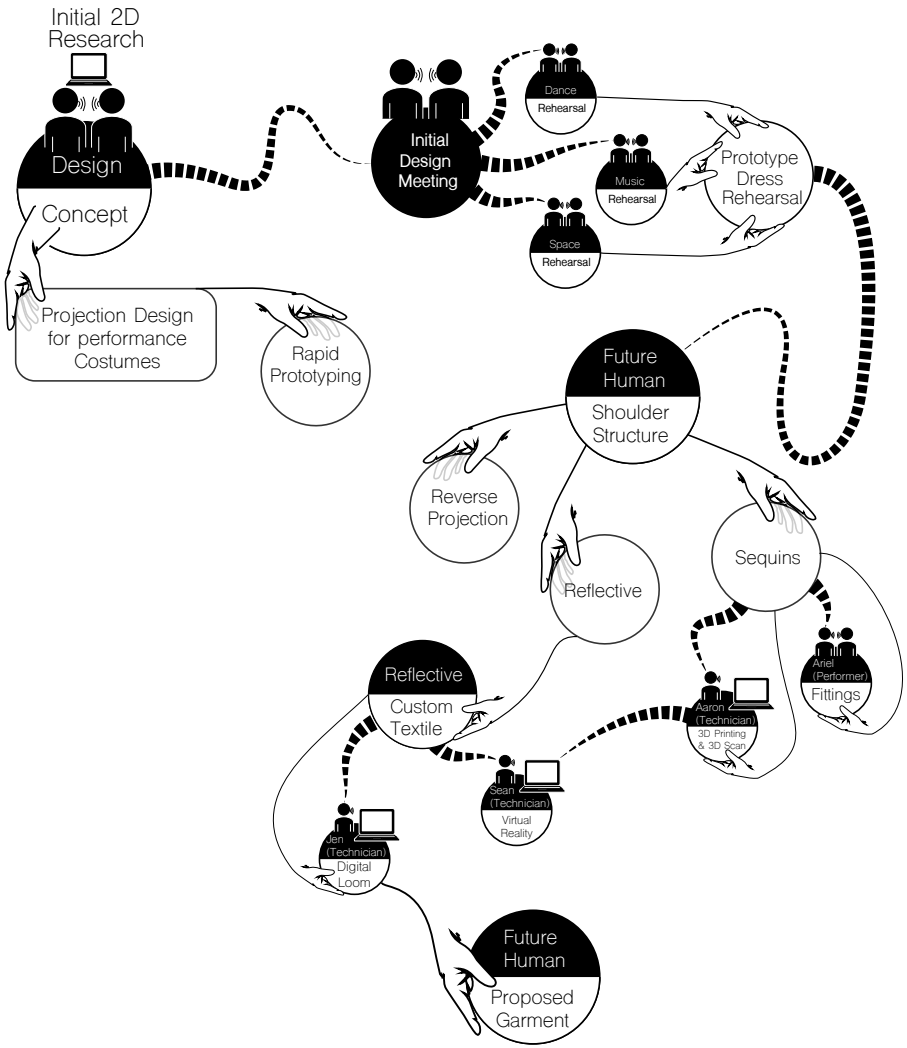



Diagram 4: Thesis Research Process Map.

Visualization tools and manual methods of making were key to my dialogical engagement with digital technology. Adopting this iterative approach to costume development allowed me to consider projection design possibilities in relation to the reflective capacity and build of cloth (sequin, reflective, specially woven). Another significant part of my work that allowed me to reconsider my approach to the build of garment prototypes came through collaboration with others in both theatre and research lab contexts. In the case of the theatre scenario where I worked with a projection designer, choreographer, music designer, sound designer, dancers, and musicians, I began to consider the needs of the audience as an integral part of my prototyping. In the research lab insight and work of others around me led to consider the collaborators not just limited to the design team, but the value in the interactions between technicians and workman.

This mixed modal approach (analogue, digital) and work with others has enabled me to step beyond traditional visualization techniques and challenge my skills as both a maker and a designer. In The Nature and Art of Workmanship David Pye described "designers have only been able to exist by exploiting what workmen have evolved or invented" (2002, p. 17). In the costume work I have taken on since 2010 I have consistently taken on both roles: that of a workman and that of a designer. This is a fundamental part of my design process. Applying my own values of quality, patience, and detail continuously brings my work back to my foundation by research old and new ways of making. My design process has allowed me to challenge my assumptions about the technical and manual differences in both experience and tacit knowledge.

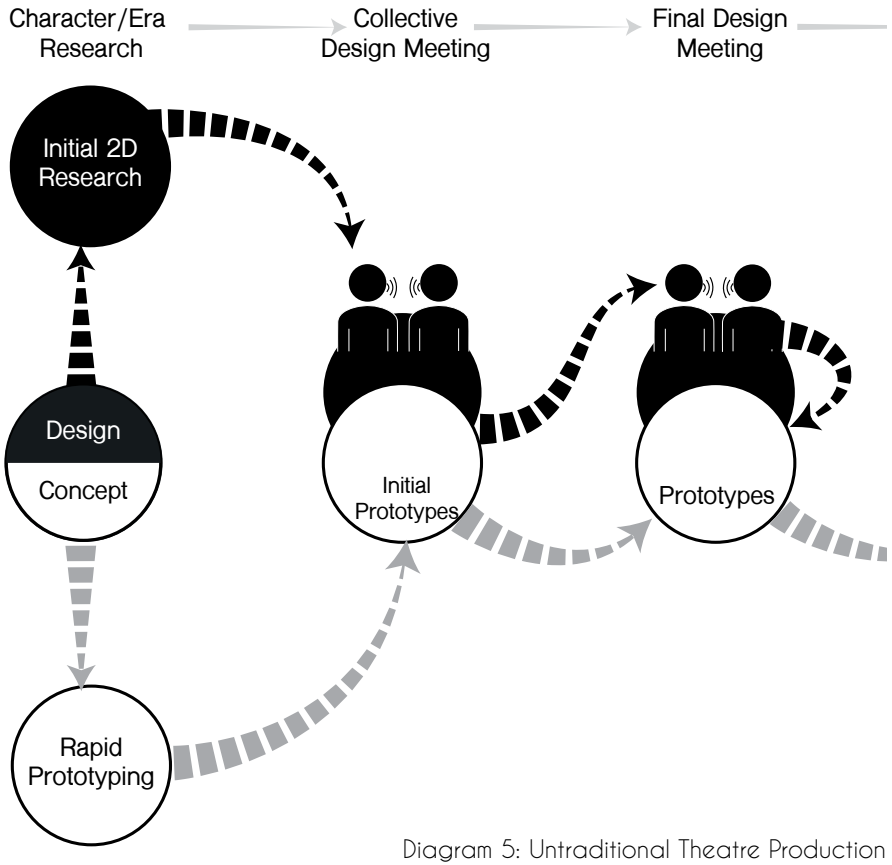
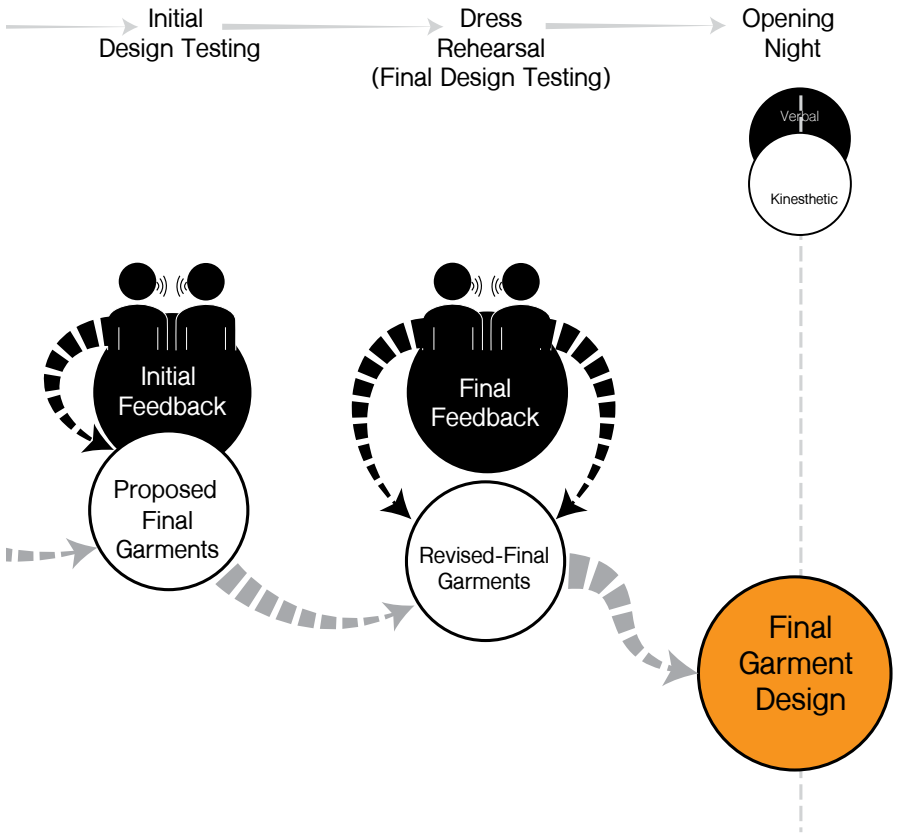



Diagram 5: Untraditional Theatre Production




## A Revised Design Process:

The community of designers and mentors made a larger impact on my design process than anticipated. Upon reflecting on the production process, the revised design process as seen above seeks to capture more of the nuances or verbal conversations that help guide final outcomes.

Through my research, I found that collaboration in a theatre design context is composed of good working relationships that acknowledge and respect the opinions and perspectives of everyone involved. Many of the collaborative conversations I tracked were informal ones. The excitement and investment that each mentor, designer, or technician offered up inspired my work. The drive for me to create something that the other collective designers wanted to experience through a performance made the interactions between each other that much more important. As my research concludes, the possibilities for exploring reflective textile design in a theatrical performance context has much more to offer beyond this thesis research. This drive to look beyond my typical role, how I create, or who I ask for advice has inspired myself as a workman and a designer.

## A Local Context:

Being a designer in Vancouver, a city with a limited number of local fabric retailers and fabric options, has forced me to contend with constraints that on one hand limit my options while also driving me to take up new approaches to making unique non-traditional textiles/textile applications.

Developing a custom textile shifted my approach to my Future Human shoulder structure. The digital technology and the community that uses it became my creative partner. I began to use and adapt a variety of digital visualization explorations to find my preferred workflow. As I worked with the textile design through a more detailed prototyping process I became fascinated with how the textile design itself impacts my work as a costume designer. The ability to create complex, unique textiles on a digital jacquard loom was an opportunity for myself as a costume designer who designs for stage performance and light applications. It enabled me to reconsider the 3-dimensional design possibilities by using reflective surfaces to achieve more visibility of a performer in a dark room. This discovery was not a result from strictly self-reflective analysis, but was shaped by the conversations and co-creation designing I was doing all throughout my thesis.

The ability to create textiles on a digital jacquard loom is a rare opportunity.. The fact that I could weave a custom textile which achieved every technical requirement changed how I thought about the design process, moreover, I was able to change absolutely every aspect of the cloth with this tool. The TC2 Loom is not designed to create large amounts of material; rather it is considered a prototyping machine. The production output through a prototyping machine could



be considered in local small productions where small fabric yields are common. The complexity in design should not just be limited to production processes that de-skill or replace hand-workmanship, but can provide workmanship that bridges historical practice with future thinking.

## Communicating & Developing Ideas with others:

"She is very receptive to my creative vision for this piece, and worked with me to achieve and innovate. Being a performer I am always wanting to see new and unique reveals on stage and we really executed that with this costume" (Ariel Helvetica, 2019).

Working in a non-traditional design process has given me the perspective of a new type of workflow in a collaborative setting. Starting from conversations early in the production process, finding ways my team of designers seek to work, and what visualizations or details are important can all help find ways of co-creating. Much of the research and development created in this thesis follows a non-traditional path. As I bridge my work back into a conventional context, I realize that the way I have come to communicate can still be achieved through a revised design process. Finding ways to work with other designers outside of the constraints of the traditional production schedule has meant that I have been able to bring in the entire team as co-creators. My intention was not to find ways of making things work faster, or yield efficiency, but rather to uncover new ways of developing ideas from other perspectives. Slowing down my own workflow has helped me reconsider how I work and relate to other designers.

Image 70: Weave testing, Reflective Thread. 2019

# Works Cited:


Blake, Bill (2014). *Theatre and the Digital.* Palgrave McMillan. Red Globe Press.

Benson, Susan (2018, June). Personal Interview.

Brooks Picken, Mary. (1925). *The Mary Brooks Picken Method of Modern Dressmaking.* New York City, The Pictorial Review Company.

Chen, M., Pulinkala, I., & Robinson, K. (2010). *Polyphonic Dynamics as Educational Practice.* Theatre Topics, 20(2), 113.

Collins, Hilary (2010). *Creative Research: The Theory and Practice of Research for the Creative Industries.* Lausanne, Switzerland: AVA Pub. SA

Freshwater, Helen (2009). *Theatre & Audience.* Palgrave Macmillian.

Fuad-Luke, A. (2009). *Design Activism: Beautiful Strangeness for a Sustainable World.* Earthscan, International Institute for Environment and Development.

Fuller, Loie (2012). *Serpentine Dance.* Magical Motion Museum, Retrieved from: https://www.youtube.com/watch?v=B-ZcbntA4bVY

Harari, Yuval N. (2015). *Sapiens: A Brief History of Humankind.* New York: Harper.

Harari, Yuval N. (2017). *Homo Deus: A Brief History of Tomorrow.* New York: Harper.

Harari, Yuval N. (2018). *21 Lessons for the 21st Century.* New York: Spiegel & Grau.

Harrod,Tanya (2013). *Visionary Rather than Practical: Craft, Art and Material Efficiency.* The Royal Society of Publishing.

Helvetica, Ariel (2019, March). Personal Interview.

Kamps, Haje Jan (2016). *This is how anti-paparazzi clothing works.* Tech Crunch, Verizon Media. Retrieved from: https://techcrunch.com/2016/06/29/now-you-see-me-now-you-dont/

Kpu. (2018). KPU. Fashion Design and Technology Program Overview. Retrieved from: http://www.kpu.ca/design/fashion

McConachie, Bruce. (2013). *Theatre and Mind.* Palgrave Macmillian.

Pye, D. (2002). *The Nature and Art of Workmanship.* In: Cambridge University Press 1968; Reprinted by Cambium Press, pp.17-29.

Ramirez, Stefanie Ann. (2014). *Slow Fashion: Developing a Conceptual Apparel Design Process.* Louisiana State Univeristy and Agricultural and Mechanical College.

Robin, N. (2012). *Putting it All on the Table.* Stage Directions, 25(3), 20.

Sanders, E. B-N., & Stappers, P. J. (2012). *Convivial toolbox: generative research for the front end of design.* BIS

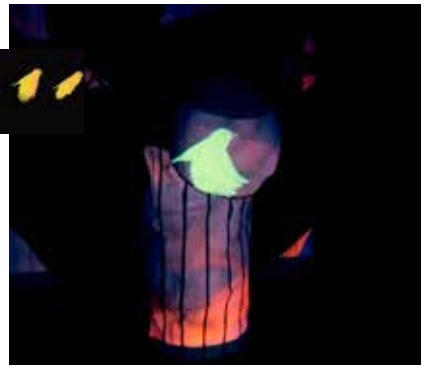
Sperling, Jodi (2017). *Book of Clouds: Time Lapse Dance.* Retrieved from: http://timelapsedance.com/videos/

Walmsley, B. (2013). *Co-creating theatre: authentic engagement or inter-legitimation?* Cultural Trends, 22(2), pp 108-118.

Wujec, Tom. (2017). *The Future of Making.* Melcher Media Inc.

# Appendix 1: Studio Explorations

Dancer: Michelle Chia



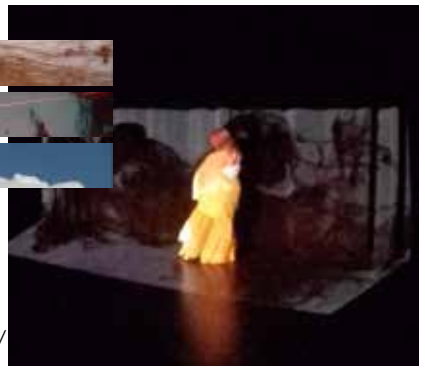
Projection Design: Birds flying- created with illustrator and photoshop.

Dancer: Ariel Helvetica

Projection Design: Earth Spinning created in photoshop

Video: https://www.youtube.com/watch?v=EOC6o3aZ7Mk&t=1s

Dancer: Ruthe Ordare

Projection Design: Created by blending multiple projection's together from copyright free videos.

Video: https://www.youtube.com/watch?v=mmhoUQt9q70&t=3s

Garment Design:

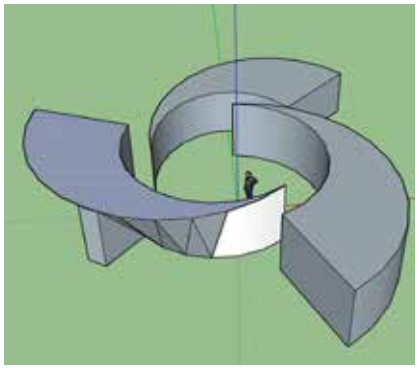
Wrap blouse
Wrap Skirt
Kids Play tube altered to become a hoop skirt
Oversized hat, painted white

Garment Design:

Traditional tutu (9layers)
Tutu overskirt with shapes

Garment Design:

5M x 1M wide wraping textiles



Set design concepts: Theatre in the round with projection design, 2018

Custom built stages for test performance, 2018

Modular design is easy to transport

Fringe curtain set design, 2018

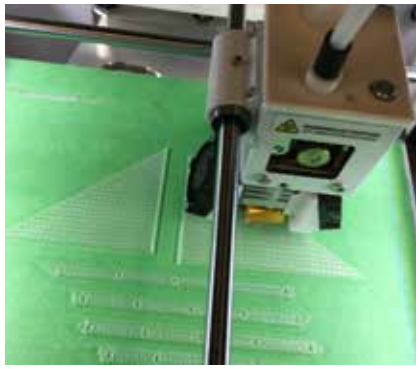
https://demolition-draftshop.wordpress.com/2018/11/30/fringe-tunnel/

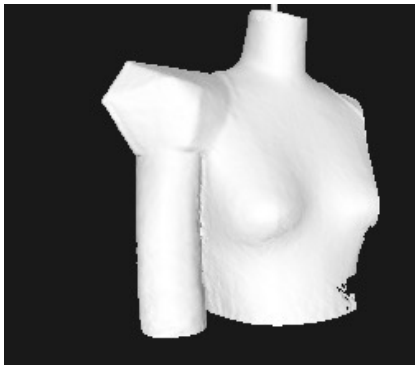
Unrestricted (Greater Vancouver Professional Theatre Alliance and the BC Alliance for Arts + Culture) collaboration Vancouver Theatre Conference: June 2018


Live Performance Jornal:

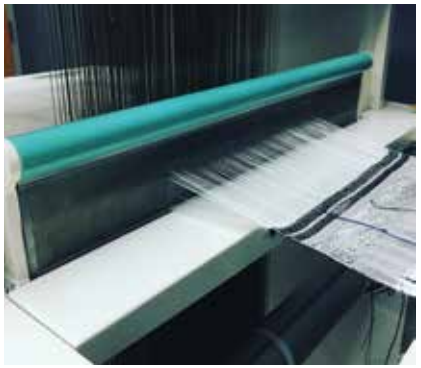
Bard on the Beach
Arts Club
Musical Concerts

3D Printing with Cinema4D, 2018





3D scanning, 2018



Digital Jacquard Loom, 2019

Sequins
Hand sewing + buckram
form. 2018

Reverse projector material +
Clear Plastic Sheeting, 2018

3M Scotchlite Reflective Ma-
terial , 2018