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Modes of Making:
Adaptable Zero Waste Patternmaking For Fashion Waste Management

May 23rd, 2023

AUT School of Art & Design, Fashion

A thesis submitted to Auckland University of Technology in partial
fulfilment of the requirements for the Degree of Master of Design

Abstract

This practice-led research examines the issue of material waste within fashion production systems by utilising craftsmanship making techniques and alternative design frameworks. A foundation of tacit knowledge, personal experience and craftsmanship skills guides this sustainable fashion design practice. The research explores zero waste patternmaking to reduce textile waste through a puzzling together of pattern pieces during the making process. Zero waste methods are investigated to create adaptive garments which offer additional design opportunities to designers and wearers. This research asks the question: How can zero waste patternmaking techniques be applied to generate an alternative approach to waste management in fashion practice?

Zero waste practitioners contextually map the field of this inquiry through their patternmaking approaches and acknowledgement of the holistic nature of the design process. Reflections-of-self become visible throughout this practice, building on personal making experiences, and guided by the feminist-artwork theory of femmage, incorporating artisanal handcraft to highlight the importance of materials in the creative process. This research builds upon existing zero waste patternmaking knowledge, while providing new approaches to an adaptive garment design mode of making, within an ongoing circular collection. The developed patterns and garments become vehicles through which to share tacit knowledge and showcase acquired zero waste skills.

Fashion Waste Management // Circular Collection
Zero Waste // Adaptability // Patternmaking

Attestation of Authorship

‘I hereby declare that this submission is my own work and that, to the best of my knowledge and belief, it contains no material previously published by another person (except where explicitly defined in the Acknowledgements), nor material which to a substantial extent has been submitted for the award of any other degree or diploma of a university or other higher learning.’

Signed: Tessa Wishart

22 May 2023

Acknowledgements

I would like to express most sincere gratitude to my supervisors, Leica Johnson and Dr Rachelle Moore, for their endless guidance, support, expertise and patience through the challenges of this project. Thank you for believing in my vision and helping to vitally refine the scope of my research.

Thank you to Master of Design Programme Director Dr Sue Gallagher for your creativity and support.

I would like to express my appreciation to AUT for their provision of a research scholarship, without which I could not have undertaken this practice.

I would like to thank my Master of Design peers Daniel and Te Rina, whose creativity inspires my own. Thank you for your time and expertise when accompanying me whilst I undertook this journey.

Lastly, a heartfelt thanks to my family and my incredible partner for their constant encouragement, endless patience, and support even through pandemics and natural disasters.

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1.0 Introduction

Women have always collected things and saved and recycled them because leftovers yielded nourishment in new forms.¹

This practice-led research builds on past textile handcraft experiences and zero waste patternmaking to inform a new working process, which allows skilled fashion audiences to reduce waste in their artisanal handcraft practices. My fashion design ethos and sense of identity are positioned alongside the concept of femmage, which is an appreciation for feminine domestic craftsmanship techniques and textile scrap reincorporation, developed by Melissa Meyer and Miriam Schapiro 1977.² Femmage acknowledges how the preservation and reincorporation of waste yield new outcomes to support ongoing practice. In this practice methods of contemporary femmage are realised through scrap collection and preservation, pattern configuration and the setting of design criteria. Equally, femmage supports personal designer identity embedded within the generated garments.

This research approaches zero waste management with a view of sequencing waste generation through incorporation of all material, while mapping a traceable journey of maker progression. Within this work, boundaries of pattern configuration are re-imagined as I investigate a maker's ability to control waste outcomes and craftsmanship techniques in garment making. In *Crafting Anatomies*, academics Dr Holly McQuillan and Dr Timo Rissanen articulate these patternmaking outcomes as a mind-body-garment-cloth relationship.³ This research explores the viability of crafting zero waste patterns that skilled fashion industry audiences – who I refer to as fashion practitioners – could follow and adapt to their own preferences. The outcome of this practice is to provide an ongoing mode of making that fashion practitioners could emulate to support their own zero waste practices.

1 Miriam Schapiro and Melissa Meyers, "Waste Not, Want Not: Femmage," *Heresies* 1:4 (Winter 1977-1978), Accessed January 28, 2023 from <https://www.in-terms-of.com/pdf/femme.pdf>.

2 *ibid.*

3 Holly McQuillan and Timo Rissanen, "Mind-Body-Garment-Cloth." In *Crafting Anatomies : Archives, Dialogues, Fabrications*, edited by Katherine Townsend, Rhian Solomon, and Amanda Briggs-Goode, 1st ed., 149-70, London: Bloomsbury Visual Arts, 2020, <http://www.bloomsburycollections.com/book/crafting-anatomies-archives-dialogues-fabrications/ch8-mind-body-garment-cloth/>.

1.1 Aims

The primary purpose of this research is to reduce waste created during production within the fashion industry. Working to craft a personal method for making collections of zero waste garments, I question: How can zero waste patternmaking techniques be applied to generate an alternative approach to waste management in fashion practice? This research aims:

- To articulate personal approaches to garment making using zero waste making methods and design criteria.
- To explore how a circular collection model can be employed to reach zero waste outcomes.
- To promote audience understanding of sustainable practices in the garment-making process.

1.2 Rationale

Drawn from a personal love for fashion craftsmanship, scrap preservation, and pushing the boundaries of zero waste pattern configuration, this research responds to the crisis of fabric waste in today's garment-making industry.⁴ Though a series of practice-led prototypes my practice challenges conventional levels of fashion waste production.⁵ Preserving the functionality of zero waste garments through applied craft techniques and adaptability considerations is a priority of this research (Figure 1), as zero waste designers recognise how the inflexibility of zero waste patterns make garment adaptability and functionality difficult.⁶ Therefore, this inquiry is viewed as relevant within a contemporary fashion context as my emergent mode of making offers an alternative to existing high waste fashion production methods. This research envisions a future where industry practitioners prioritise an artisanal approach to making which incorporates the directions and approaches developed in this thesis.

4 Holly McQuillan, J. Archer-Martin, G. Menzies, J. Bailey, K. Kane, and E. Fox Derwin, "Make/Use: A System for Open Source, User-Modifiable, Zero Waste Fashion Practice." *Fashion Practice* 10, no. 1 (January 2, 2018): 7-33. <https://doi.org/10.1080/17569370.2017.1400320>.

5 Conventionally, garment cutting produces 15% fabric waste from a fabric yield. Timo Rissanen, "Creating Fashion Without The Creation Of Fabric Waste," In *Sustainable Fashion: Why Now?: A Conversation Exploring Issues, Practices, and Possibilities*, edited by Ulasewicz, C., and J. Hethorn, 184-206, Bloomsbury Academic, 2008.

6 *ibid.*



Figure 1.
Initial zero waste experiment, encapsulating scrap waste within an adaptable lacing detail.

2.0 Contextual Review

2.1 Femmage

This contextual chapter highlights intersections of femmage, craftsmanship and zero waste. In the 1977 essay “Waste Not Want Not: An Inquiry into What Women Saved and Assembled”⁷, coauthors Miriam Schapiro and Melissa Meyer introduce coined phrase femmage, a fundamental concept in this design research. Contextualised by post-WWII ‘Waste Not Want Not’ textile preservation initiatives⁸, femmage defines textile saving, collecting and domestic crafting practices. Schapiro and Meyer provide fourteen criteria to determine whether a work can be called femmage. My research aligns mainly with femmage criteria 2,3,6 and 8 (Figure 2).

Figure 2.
Femme Criteria Chart,
as Applied Within my
Practice. Chart by the
author. Femmage criteria
from Miriam Schapiro
and Melissa Meyer,
“Waste Not, Want Not:
Femme,” *Heresies* 1:4
(Winter 1977–1978).

Chosen Femmage Criteria For Making	Adapted Femmage Criteria For My Practice
<i>2. The activities of saving and collecting are important ingredients.</i>	I am mindful of collecting all generated scraps, considering how to lower waste production and re-encapsulate scraps in ongoing work.
<i>3. Scraps are essential to the process and are recycled in the work.</i>	This criterion underpins an ongoing circular collection model, where I sequentially reincorporate scraps within my work during my processes of patternmaking discovery.
<i>6. The theme of the work addresses itself to an audience of intimates.</i>	My work is designed for an audience of intimates. I craft adaptable womenswear, intending that fashion practitioners could wear garments or reproduce the patterns, replicate a circular collection design model, or apply my findings to their practice.
<i>8. A diarist’s point of view is reflected in the work.</i>	Collecting and reincorporating scrap within new work is a method of personal diarising, tracing the progression of the previous garment-making and waste generation through the collection.

7 “Waste Not, Want Not: Femmage.”

8 Sunhyung Cho, and Jean Louise Parsons, “Evaluating Sustainability Through an Historical Lens: Clothing Conservation Efforts during WWII,” *International Textile and Apparel Association Annual Conference Proceedings* 73, no. 1 (November 9, 2016).

Schapiro and Meyer explain how femmage applies female-oriented domestic handcraft techniques (such as collage, assemblage, and stitchwork) to diarise the maker's personal experiences within the artwork. Femmage retains contemporary relevance as criteria setting, pattern configuring, scrap preservation and waste management are recognised within modern fashion craft to embed designer identity.⁹ Femmage artists present varying interpretations of the femmage concept. Schapiro's textile quilting methods (Figure 3) influence my textile waste management methods, emphasising the value of collecting material for future practice.

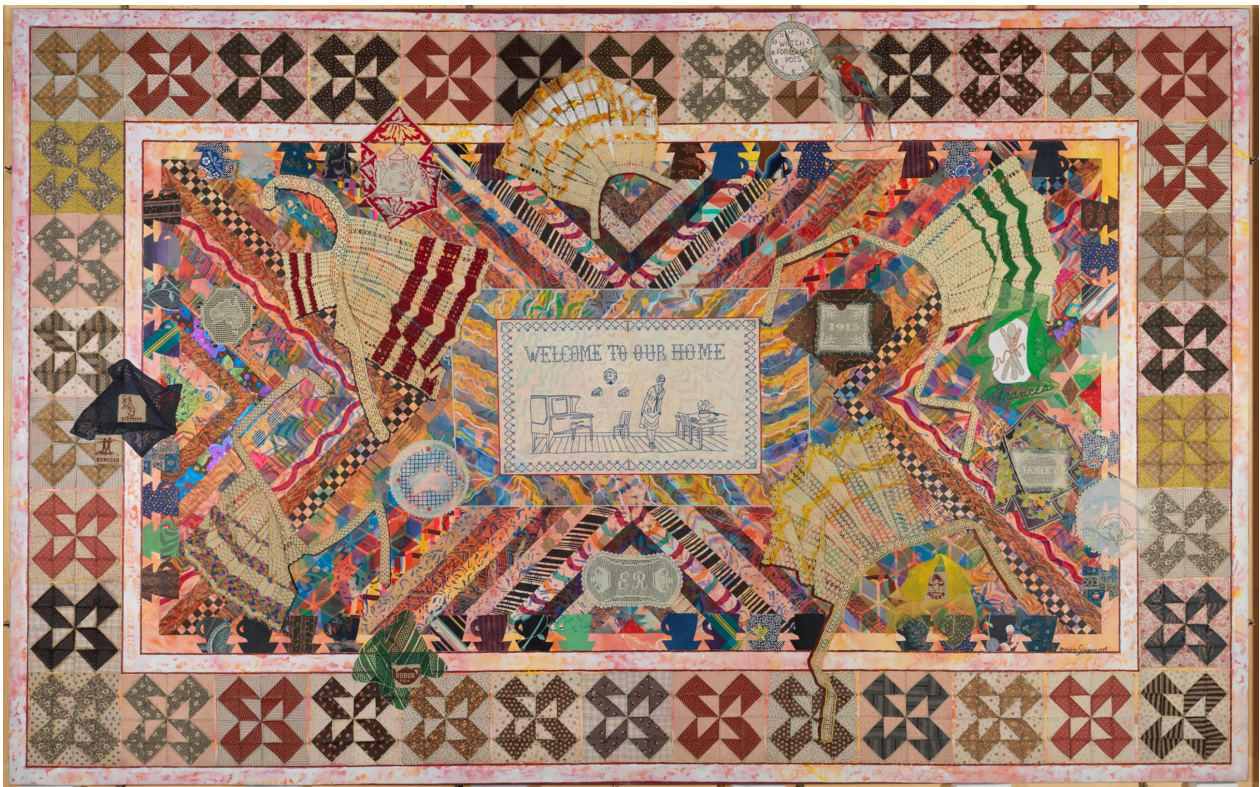


Figure 3.
Miriam Schapiro, *Wonderland*, 1983, acrylic, fabric and plastic beads on canvas,
Smithsonian American Art Museum, Washington D.C, <https://americanart.si.edu/artwork/wonderland-35394>.

⁹ "Make/Use: A System for Open Source, User-Modifiable, Zero Waste Fashion Practice."



Figure 4.
Stitch Diary. I preserve the
smallest scraps of textile.

Collected, saved and combined materials represented for such women acts of pride, desperation and necessity. Spiritual survival depended on the harbouring of memories. Each cherished scrap of percale, muslin or chintz, each bead, each letter, each photograph, was a reminder of its place in a woman's life, similar to an entry in a journal or a diary.¹⁰

Schapiro and Meyer connect the actions of material collection to diarising through handcraft. Historically, collecting materials for repurposing was particularly prevalent during the WWII era in Britain, when “Mend and Make Do” and “Waste Not Want Not” became governmental campaign slogans. During this time, fabric and scrap collection, preservation, and reincorporation occurred. Garment making with traditional handcraft techniques became an everyday practice, encouraged by financial and textile austerity.¹¹ Collecting materials, such as textiles, pictures and printed matter is identified as the first stage of *femme*. This collection facilitates a sustainable approach to my own fashion design practice. Within my research, scrap describes leftover pieces of cloth from stages of garment making or end-of-life garment waste.^{12 13} I preserve everything generated during the making process, striving to minimize textiles discarded through zero waste patternmaking (Figure 4).

10 “Waste Not, Want Not: *Femme*.”

11 “Evaluating Sustainability Through an Historical Lens: Clothing Conservation Efforts during WWII.”

12 Susan Brown, *Scraps: Fashion, Textiles, and Creative Reuse*, Edited by Caroline Baumann, New York, NY: Cooper Hewitt, Smithsonian Design Museum, 2016.

13 This research discusses four main stages within the garment making process: design phase, make phase, wear phase and end-of-life phase. Generally, scrap waste is sourced from garment making and cutting in use phase, or from the garment itself when being disposed in end-of-life phase.

2.2 Craftsmanship

Craft is central to this fashion research. “Skilled making, or craftsmanship, is widely understood as ‘expertise in technique’, the result of learned repertoire or refined gestures informed by hand and mind, sustained through supplemental material-based practice.”¹⁴ Viewed by academic Glenn Adamson as a supplemental multidisciplinary motion-based process, craft is supported by material experience and skill.¹⁵ Adamson recognises a historical lack of serious appreciation for craft, traditionally disregarded as an art form by art critics.¹⁶ This connects with Schapiro and Meyer’s 1977 femmage recognitions of domestic handcraft and collage as being considered outside the periphery of high art by art historians.¹⁷ The term craftsmanship also connects the action of craft with the person performing it, as this is a deeply personal practice with capacity for collaboration.¹⁸ Craftsmanship within my work represents the varied application of handcraft methods, often referencing femmage collage-based techniques¹⁹ whilst infusing the outcomes with a personal reflection of self (Figure 5). I consider craft to be inherently sustainable in that new works preserve traditional knowledge-based techniques. Care about making, valuing labour, and consideration of resources make craftsmanship a praxis of positive change.²⁰



Figure 5.
Reflection of Self.
Personal ways of working and collected scraps are communicated through femmage-style crafting. Bodice with insertion stitch lacing and encapsulated scrap.

14 Katherine Townend, Rhian Solomon, and Amanda Briggs-Goode, *Crafting Anatomies: Archives, Dialogues, Fabrications*, London, UNITED KINGDOM: Bloomsbury Publishing USA, 2020. <http://ebookcentral.proquest.com/lib/aut/detail.action?docID=5995742>. (Referencing Adamson, 2007, and Sennett, 2008.)

15 Glenn Adamson, “Material,” *Thinking Through Craft*, 1st ed., 38–68, London: Bloomsbury Academic, 2007. <https://www.bloomsburyvisualarts.com/encyclopedia-chapter?docid=b-9781350036062&tocid=b-9781350036062-chapter2>.

16 *ibid.*

17 Elissa Auther, “Unapologetic Feminine Excess,” Museum of Arts and Design, Accessed May 19, 2022, <https://madmuseum.org/views/unapologetic-feminine-excess>.

18 “*Crafting Anatomies: Archives, Dialogues, Fabrications.*”

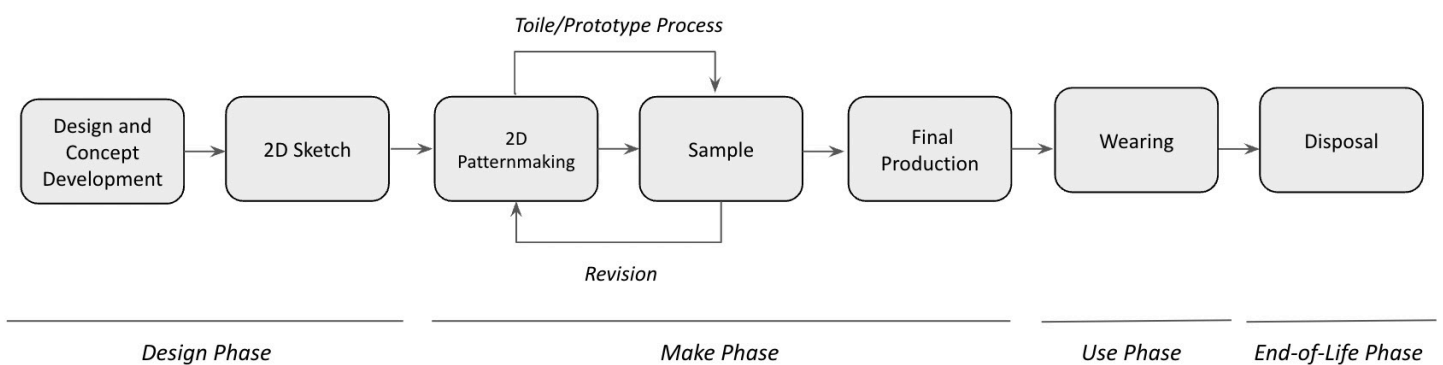
19 “Waste Not, Want Not: Femmae.”

20 D. Wood, *Craft Is Political*, London, UNITED KINGDOM: Bloomsbury Publishing USA, 2021, <http://ebookcentral.proquest.com/lib/aut/detail.action?docID=6522848>.

2.3 Zero Waste

Zero waste in this research is defined as a garment patternmaking process where no waste is produced. Within conventional fashion processes the lifecycle of a garment is mapped with linear stages of the design phase; the make phase (where testing and revision occur), the use phase and the end-of-life phase, as evidenced in Figure 6. Timo Rissanen identifies that an average of 15% of fabric surrounding the pattern pieces is wasted in conventional industry garment cutting.²¹ Recognising how current textile waste levels damage the environment, zero waste designers employ patternmaking practices to “create fashion without the creation of fabric waste.”²² By applying femmage scrap management methodologies, zero waste patternmaking can occur in the crafting process at varying garment lifecycle stages. Characterised by Rissanen as a “jigsaw puzzle methodology”²³, zero waste patternmaking is incorporated into my practice when I work at a two-dimensional patternmaking levels to generate a three-dimensional garment.²⁴ I take inspiration from a range of zero waste patternmaking techniques exercised by contemporary practitioners such as Dr Holly McQuillan, Pei-Wen Jin and Birgitta Helmersson to support my practice.

Figure 6.
Conventional Linear
Fashion Design Lifecycle.
Diagram by the author.



21 Timo Rissanen, “From 15% to 0: Investigating the Creation of Fashion without the Creation of Fabric Waste,” *Creativity: Designer Meets Technology Conference*, Copenhagen, September 1, 2005, https://www.academia.edu/3762020/From_15_to_0_Investigating_the_creation_of_fashion_without_the_creation_of_fabric_waste.

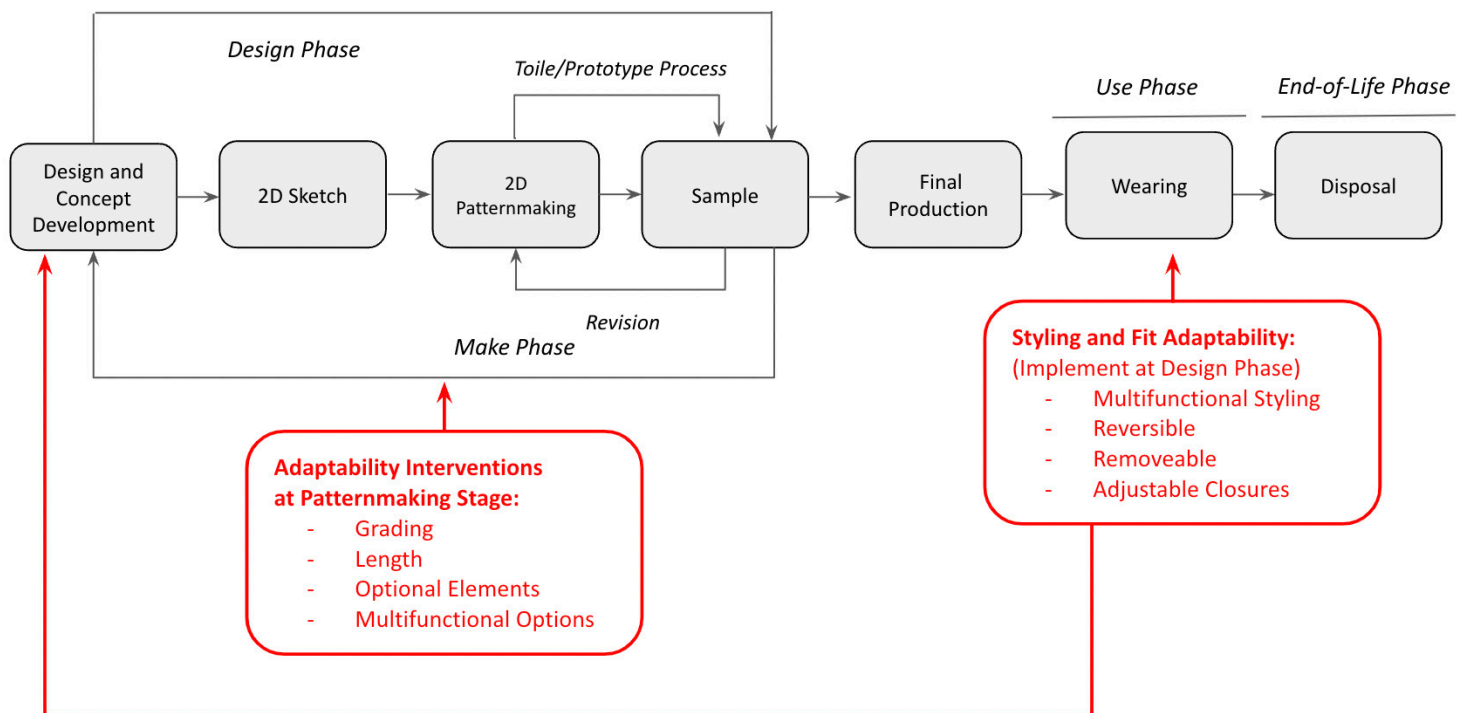
22 “Creating Fashion Without The Creation Of Fabric Waste.”

23 *ibid.*

24 *ibid.*

The zero waste patternmaking process requires continuous holistic conversation between garment design and making approaches²⁵ (Figure 7). Within my design practice, I recognise how complex pattern configurations involve designing, patternmaking, prototyping, and revising to occur back and forth during the lifecycle of a garment, which McQuillan identifies as a holistic approach.²⁶ Equally, this lifecycle can become cyclical if scraps are fed in at the beginning of the project or scraps generated throughout making are reincorporated into future garments. In this research, a complete circular collection is defined as garments designed to sequentially incorporate all textile waste before the end of the cycle. Zero waste designers often develop patterns that audiences can access and remake, and are sometimes designed to be modifiable.²⁷ To make a garment more transformable and therefore, more sustainable and wearable, my research considers stages in the production process where adaptability and/or reduced textile waste might occur.

Figure 7. The zero waste approach influences a garment lifecycle. Points of intervention for adding adaptability are indicated in the Making and Use phases. The lifecycle can become circular by incorporating scraps from past projects or reincorporating them. Diagram by the author.



25 A. M. James, B. M. Roberts, and A. Kuznia, "Transforming the Sequential Process of Fashion Production: Where Zero-Waste Pattern Cutting Takes the Lead in Creative Design," *International Journal of Fashion Design, Technology and Education* 9, no. 2 (May 3, 2016): 142-52, <https://doi.org/10.1080/17543266.2016.1167253>.

26 "Mind-Body-Garment-Cloth."

27 "Make/Use: A System for Open Source, User-Modifiable, Zero Waste Fashion Practice."

2.4 Zero Waste Practitioners

Contemporary fashion designers innovate zero waste patternmaking to create patterns for variable garment outcomes, such as variable sizes, lengths and styles. Dr Holly McQuillan's 2015 'Make/Use' collection presents a digital database of user-modifiable zero waste patterns.²⁸ McQuillan considers garment making, using and wearing to be intertwined, presenting zero waste "through the lens of use practice."²⁹ Inspired by linear historical silhouettes,³⁰ McQuillan's grid-configuration patterns facilitate easy modification and grading for users (Figures 8-10).

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Figure 8.

'Crop T-Shirt' grid pattern, inspired by a Danish Bronze Age coat.
McQuillan, Holly, Jen Archer-Martin, G. Menzies, J. Bailey, K. Kane, and E. Derwin.
'Make/Use: A System for Open Source, Waste Fashion Practice.' *Fashion Practice* 10 (January 29, 2018): 1–27.

Figure 9.
(Above) Constructing 'Crop T-Shirt'. "Make/Use: A System for Open Source, Waste Fashion Practice."

28 Holly McQuillan, Objectspace (Gallery), Massey University, and Creative New Zealand, "Make/Use: An Exhibition and Workshop Series Exploring User-Modifiable Zero Waste Fashion," 2015.

29 Holly McQuillan, "MakeUse V1 and Exhibition," October 14, 2014, <https://hollymcquillan.com/2014/10/14/makeuse-v1-and-exhibition/>.

30 Dorothy K. Burnham, (1973), *Cut My Cote (Illustrated)*, Royal Ontario Museum; Gerrit Rietveld Academie. Discussed in "Eight Cubic Meters by Line Arngaard and Rosita Kær: Bog Jacket," January 2021, <https://rietveldacademie.nl/nl/page/16779/eight-cubic-meters-by-line-arngaard-and-rosita-k%C3%A6r-bog-jacket>.

Figure 10.
'Crop T-Shirt'. "Make/Use:
A System for Open Source,
Waste Fashion Practice."

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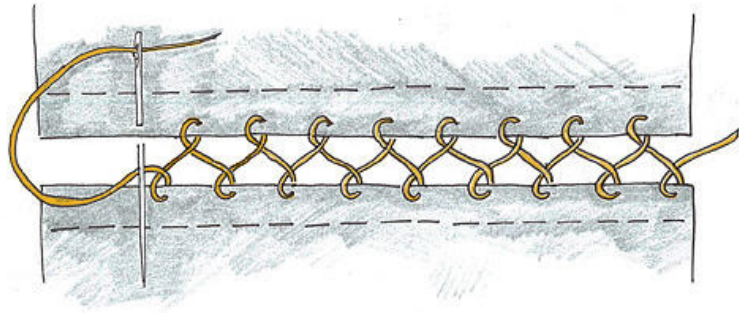


Figure 11.
 Make/Use Insertion Stitch 'Joining'. Holly McQuillan, "Joining", Make/Use - Zero Waste Fashion, ca. 2015, <https://makeuse.nz/make/joining/>.



Figure 12.
 Residuum Bodice. My insertion stitch lacing and neckline detailing encapsulates small silk scraps and provides an adaptable closure.

In addition to pattern modification, McQuillan presents garment construction and crafting techniques for developing varied aesthetic outcomes and future modification of garment details. Presenting user-friendly crafting methods, she suggests an "insertion stitch" embroidery joining which can be cut away later in the garment lifecycle, to rotate and re-join garment sections into new configurations³¹ (Figure 11). Alike McQuillan, I consider adaptability "through the lens of use practice"³² by providing adaptable patternmaking, construction and styling options (Figure 12).

Inspired by McQuillan's rotatable patterns (Figure 13), designer Pei-Wen Jin's pattern mimics a tangram (a traditional Chinese puzzle) to form multifunctional zero waste grid patterns (Figure 14). Similarly, Birgitta Helmersson's zero waste pattern book proposes endless possibilities, providing five initial grid-like blocks which can be mixed and matched to make 15 further projects.³³ These designers use modular grid patterns as a canvas for simple aesthetic or structural alterations to make easily audience-adaptable garments. I approach patternmaking with the same adaptability and audience considerations when I develop easily modified grid patterns for using linear waste. Additionally, my patternmaking explores complex shapes and curves, thereby offering a point of difference through increased design opportunities.

31 Holly McQuillan, Holly McQuillan, "Joining", Make/Use - Zero Waste Fashion, Accessed April 16, 2023. <https://makeuse.nz/make/joining/>.

32 "MakeUse V1 and Exhibition."

33 Birgitta Helmersson, "ZERO WASTE PATTERNS - BOOK," Accessed April 2, 2023, <https://www.birgittahelmersson.com/pages/book>.

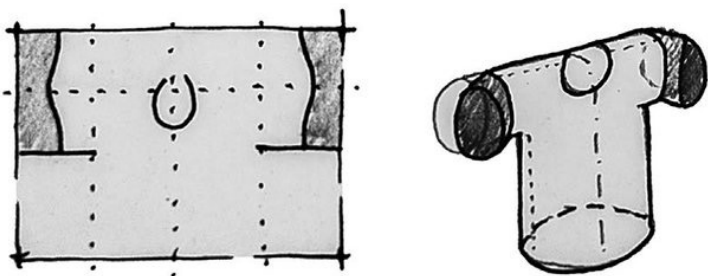
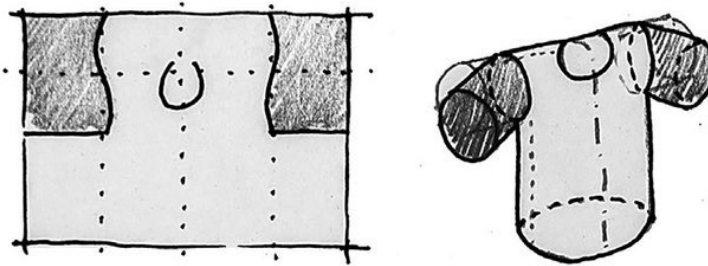
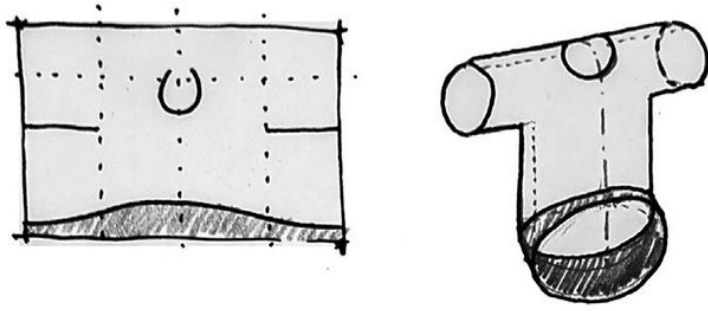


Figure 13.
 Holly McQuillan Make/
 Use rotation modifications.
 Holly McQuillan,
 "Modification", Make/Use
 - Zero Waste Fashion, ca.
 2015, <https://makeuse.nz/make/modification/>.

Figure 14.
 Pei-Wen Jin's Tangram
 Puzzle creates modifiable
 pattern configurations for
 a multitude of outcomes.
 Pei-Wen Jin, "Play zero-
 waste pattern as Tangram
 puzzle," January 17,
 2023. <https://peiwenjin.com/2023/01/17/play-zero-waste-pattern-as-tangram-puzzle/>.

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Designer Katie Roberts Wood practices waste management as a contemporary femmage designer. Her jackets and dresses encapsulate collected silk scraps to make “fully formed”³⁴ pattern pieces using embroidery techniques (Figures 15 & 16). The “reincarnated”³⁵ garments use strip ties instead of regular seams, supporting the adaptability of the garment through use of secondary waste. This adaptable method builds a relationship between waste strips and the garment’s size flexibility, while adding modification potential for sections like sleeves to be untied and removed. Roberts Wood pays homage to “the skill to create something almost out of thin air, with only your skilled hands and an idea”³⁶, exemplified in her use of scrap waste to join and tie garment seams together.³⁷ Recognising that the female maker is conventionally undervalued in a process she sees “as pure magic”³⁸ she performs handcraft to preserve the emotional value of making.³⁹ Roberts Wood’s concepts support my femmage practice where patternmaking and handcraft techniques reincorporate strip scraps within main garments.

Figure 15.
(Left & middle)
Reincarnated waste strips
bind seams. Katie Roberts
Wood, “Reincarnated Silk
Gown — Roberts Wood,”
Accessed January 3, 2023,
<https://www.roberts-wood.com/x-ray-and-vortex-dresses/reincarnated-silk-gown>.

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Figure 16.
(Right) Roberts Wood
‘Reincarnated Jackets’,
with open seams to be
joined by strips. Instagram,
“ROBERTS | WOOD on
Instagram. Reincarnated
Silk Jackets,” November
14, 2022, <https://www.instagram.com/p/Ck8ulRpN-2I/>.

34 Katie Roberts Wood, “Reincarnated Silk Gown — Roberts Wood,” Accessed April 16, 2023, <https://www.roberts-wood.com/x-ray-and-vortex-dresses/reincarnated-silk-gown>.

35 Instagram, “ROBERTS | WOOD on Instagram. Reincarnated Silk Jackets,” November 14, 2022, <https://www.instagram.com/p/Ck8ulRpN-2I/>.

36 Condé Nast, “With Stitchless Garments, Designer Katie Roberts-Wood Links Femininity to Strength,” *Vogue*, February 20, 2019, <https://www.vogue.com/article/katie-roberts-wood-london-fall-2019-collection-female-creatives>.

37 “Reincarnated Silk Gown.”

38 “With Stitchless Garments, Designer Katie Roberts-Wood Links Femininity to Strength.”

39 Katie Roberts Wood, “SS20 - SANCTUARY | A DIGITAL CRAFT — Roberts Wood,” Accessed April 5, 2023, <https://www.roberts-wood.com/ss20-sanctuary-a-digital-craft>.

3.0 Methodological Framework

A design methodology presents the systems and inquiries involved in creating new design research.⁴⁰ Practice-led research and action research are methodological frameworks within this research. Practice-led research describes a “knowing through making” inquiry process.⁴¹ This methodology is suitable for fashion practice as it allows physical making to inform the research and increase personal knowledge. The personal learning and tacit knowledge acquired from making are seen as essential outcomes from this research. Action research combines active practice and reflection to form a methodology, where the work continues in an ongoing manner based on response to ongoing practice.⁴² Academic David Hopkins (1993) presents action research as continuous stages of planning, acting, observing, and reflecting.⁴³ Alternatively, Ernest Stringer maps an iterative action research methodology as looking, thinking and acting⁴⁴ (Figure 17). I applied Stringer’s format to display the phases in my practice-led research, recognising how ongoing research findings in each cycle feed broaden the work (Figure 18).

Figure 17.
Ernest Stringer “Action
Research Interacting
Spiral”. Ernest T Stringer,
“Action Research”,
Thousand Oaks, UNITED
STATES: SAGE
Publications Inc, (US),
2007.

This content has been removed by the author
due to copyright issues.

40 Linda Candy, “Practice Based Research: A Guide,” *Creativity and Cognition Studios Report 1* (November 1, 2006).

41 Maarit Mäkelä, “Knowing Through Making: The Role of the Artefact in Practice-Led Research,” *Knowledge, Technology & Policy* 20, no. 3 (2007): 157–63.

42 Cal Swann, “Action Research and the Practice of Design,” *Design Issues* 18, no. 1 (2002): 49–61.

43 David Hopkins, *A Teacher’s Guide to Classroom Research*, Open University Press, 1993.

44 Ernest T Stringer, *Action Research*, Thousand Oaks, UNITED STATES: SAGE Publications Inc, (US), 2007.

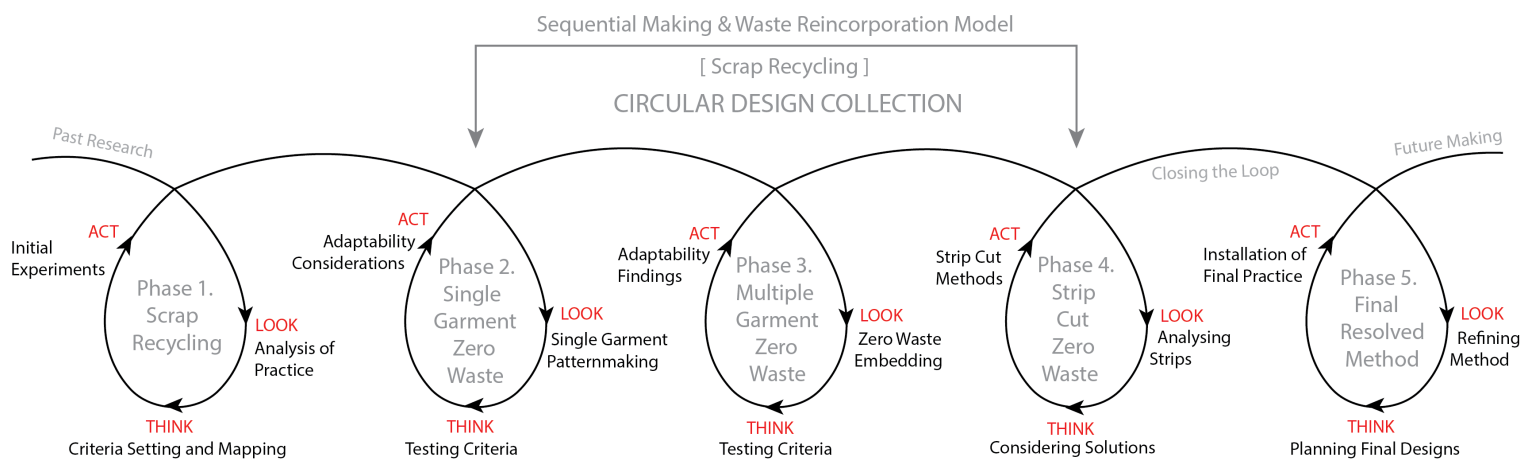


Figure 18. Action Research Spiral, structure of personal research. Diagram by the author.

3.1 Research Methods

3.1.1 Reflective Practice

This research draws on reflective practice⁴⁵ in two ways during development and making processes. Firstly, author Donald Schön in *The Reflective Practitioner*⁴⁶ discusses an intuitive personal basis of existing knowledge. Schön suggests a practitioner draws from personal experience to influence current design choices, exhibiting a “knowing in practice.”⁴⁷ Secondly, academics David Coghlan and Mary Brydon-Miller’s *Action Research* discusses reflection as cyclically responding to ongoing outcomes and tailoring the design aims.⁴⁸ During my creative process reflective practice occurs through self-reflection before designing; I use these findings to set design criteria, then continually reflect in action (during making) and on action (after making).⁴⁹ This research also embraces tacit knowledge, which is implicit intangible knowledge⁵⁰ used to guide reflective practice. Schön explains how tacit knowledge and reflective

45 Donald A Schön, *The Reflective Practitioner: How Professionals Think in Action*, London, England; New York, New York: Routledge, 2016.

46 *ibid.*

47 *ibid.*

48 David Coghlan and Mary Brydon-Miller, *The SAGE Encyclopedia of Action Research*, by pages 675-678, London: SAGE Publications Ltd, 2023, <https://doi.org/10.4135/9781446294406>.

49 *The Reflective Practitioner: How Professionals Think in Action.*

50 Kylie Budge, “Teaching Art and Design: Communicating Creative Practice through Embodied and Tacit Knowledge,” *Arts and Humanities in Higher Education* 15, no. 3-4 (July 1, 2016): 432-45.

practice can inform the early stages of a project structure, but should be controlled so an overapplication of past knowledge does not overshadow the new research directions and outcomes.⁵¹ I find that the processes I have reflected upon in my past practices to inform and guide current practices, but am aware that over use will dilute new design directions.

3.1.2 Criteria Setting

I implement criteria to define the scope and boundaries of my design practice.⁵² This supports the research by refining specified methods, approaches and outcomes. Contextualised by Shapiro and Meyer's set of femmage criteria,⁵³ my own criteria dictate the methods of approach and limitations for patternmaking and textile repurposing. Setting criteria applies Schön's reflective practice,⁵⁴ drawing from personal design experience of what works or potentially causes a point of resistance. In this research, framing practice through criteria often occurs before the design process. Garment lifecycle mapping and analysis of the design processes are required to identify possible design intervention points for waste management. Early in my practice, criteria such as the width of fabric, were applied by designing a circular collection process. Criteria are the rules set within this design inquiry to explore aims such as the ability to adapt garments whilst eliminating waste. These criteria were tested in practice and reflectively refined.

51 *"The Reflective Practitioner: How Professionals Think in Action."*

52 Kate Fletcher, "Towards a Future Framework for Fashion - Kate Fletcher," Accessed May 17, 2023, <https://katefletcher.com/towards-a-future-framework-for-fashion/>.

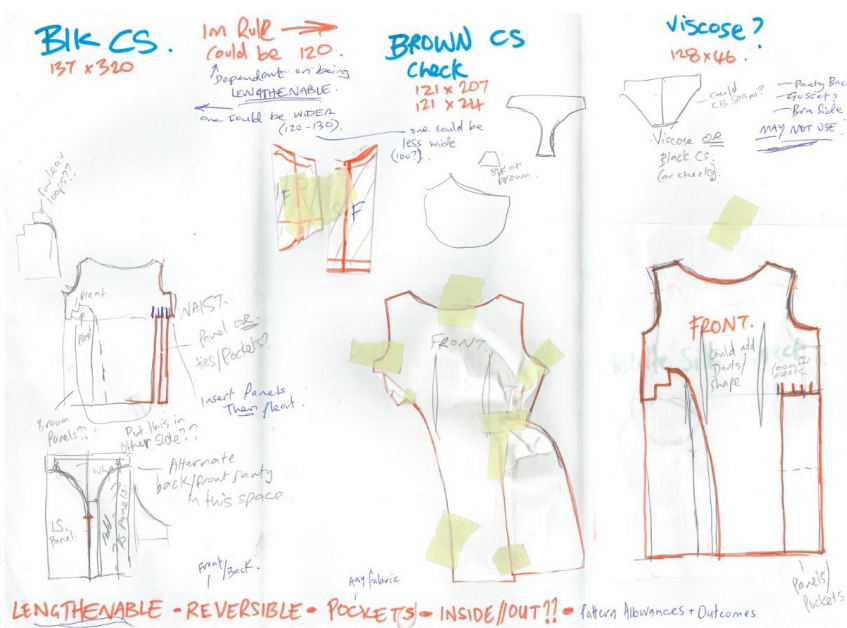
53 "Waste Not, Want Not: Femmage."

54 *"The Reflective Practitioner: How Professionals Think in Action."*

3.1.3 Prototyping

Prototyping is the iterative practice of testing, making, and refining, using materials to develop idea engagement.⁵⁵ It yields new methods and visual outcomes as a problem-solving, idea-based design process.⁵⁶ Prototyping involves ongoing making, reflection, and trial and error. “For design, these are everyday acts of design practice that the designer takes from project to project, accumulating a body of expertise throughout the duration of their exercise.”⁵⁷ Within fashion, I make toiles, which are garment prototypes sewn from low-cost fabrics. My prototyping techniques include design and sketching, developing zero waste patternmaking approaches, fit testing, and refining colour, fabric and craft techniques (Figures 19 & 20). Garment prototyping is used to refine fit, functionality, ease of use, and sustainability approaches during making. Prototyping reveals new and ongoing findings, developing intrinsic links between garment design and patternmaking within my zero-waste practice.

Figures 19 & 20.
Encapsulation Jacket
Prototyping.



55 Carey Jewitt, Kerstin Leder Mackley, Douglas Atkinson, and Sara Price, "The SAGE Handbook of Visual Research Methods", by pages 534-550, Second, 55 City Road: SAGE Publications, Inc., 2023, <https://doi.org/10.4135/9781526417015>.

56 Ibid. Referencing Deborah Lupton, *Towards Design Sociology*, *Sociology Compass* 12, no. 1 (2018): e12546, <https://doi.org/10.1111/soc4.12546>.

57 Laurene Vaughan, "Practice-Based Design Research", London, UNITED KINGDOM: Bloomsbury Publishing USA, 2017, <http://ebookcentral.proquest.com/lib/aut/detail.action?docID=4773817>.

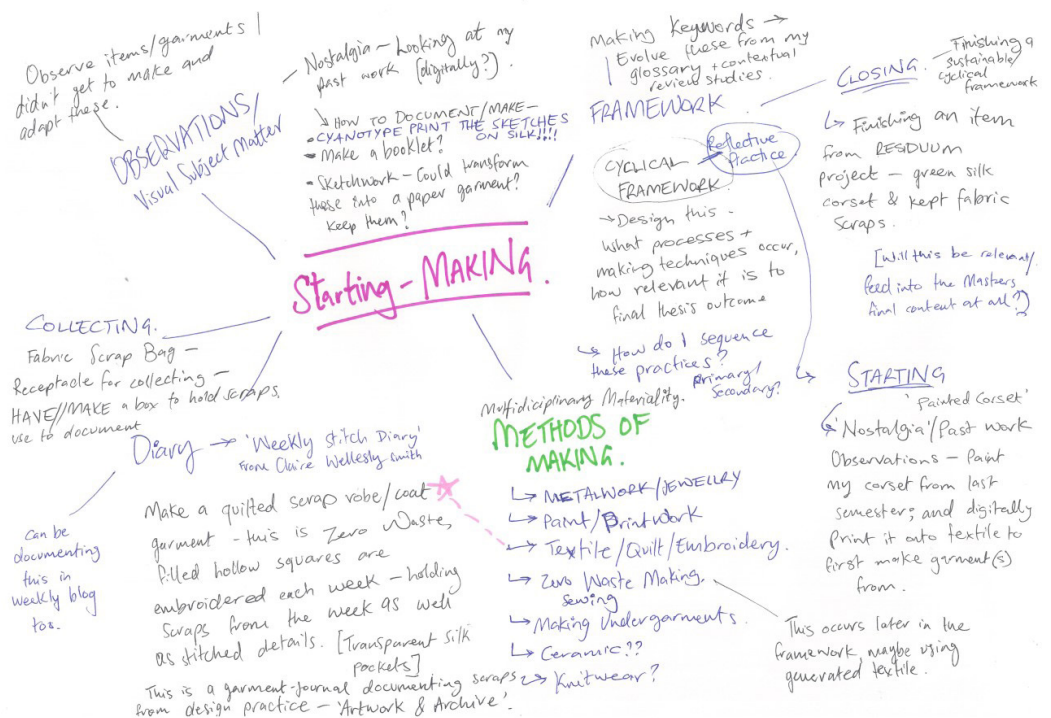
3.1.4 Diarising

As used in femmage, design diarising is a method of recording processes and self-evaluation, documenting personal perspective and creating a narrative when analysing practice. Through this method I become both the research subject and subjective narrator.⁵⁸ Constructive conversations with self are made possible through the reflection of practice, recounting successes and failures within the process so I might improve as a practitioner-researcher.⁵⁹ I diarise through crafting with femmage-style scrap reincorporation, and by keeping physical workbooks, digital records, and photo diaries which contain sketches, discussion of making approaches, and responses to outcomes (Figures 21 & 22). Waste management frequently occurs in this practice, subsequently diarising facilitates the preservation of both physical and thought-based output. Documenting my reflective practice through all making stages, captures my “knowing-in-practice”.⁶⁰



Figure 21. (Above) Diarising through crafting. Ongoing weekly scrap collecting, encapsulating waste within new work.

Figure 22. (Right) Diarising through writing. Workbook recordings of initial making ideas.



58 Elizabeth Chaplin, "The SAGE Handbook of Visual Research Methods, SAGE Publications" Ltd, 2011, <https://doi.org/10.4135/9781446268278>.

59 Carole Gray, "Visualizing Research: A Guide to the Research Process in Art and Design", Edited by Julian Malins, Aldershot, Hants, England; Burlington, VT: Ashgate, 2004.

60 "The Reflective Practitioner: How Professionals Think in Action."

4.0 Making

4.1 Phase 1. Scrap Recycling

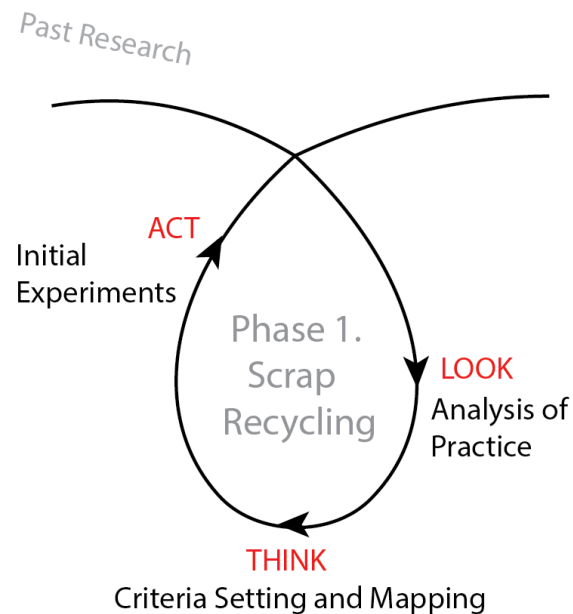


Figure 23.
Phase 1 Scrap Recycling.

4.1.1 Analysis of Practice

Phase 1 analyses past practices where my 'reflection of personal practice' allows me to examine scrap recycling in past works. This reflective analysis informs the design research trajectory. Reflective practice⁶¹ and tacit knowledge were applied to identify successes, points of resistance, unfinished works, and concepts to revisit in current practices (Figure 23). Methods involving femmage handcraft, craftsmanship and zero waste recurred as I explored relationships between the body, maker, wearer, and fabric. Two past garment collections were identified as most significant to this research: 'Residuum' and 'In Light of the Body in Cloth'.

61 *"The Reflective Practitioner: How Professionals Think in Action."*

The 'Residuum Collection' (2021)⁶² crafted multiple garments within zero waste patterns (Figure 24). McQuillan also practices this productive multiple-garment patternmaking approach, naming it embedding.⁶³ The term sequence is used to describe the process where leftover waste from the primary garment designs informed the secondary undergarment designs. A point of resistance was reached when I was unable to design secondary undergarments until the primary garments were configured within the pattern. This highlighted a need to inclusively design all secondary garments in my practice at the initial stages, requiring the prediction of waste outcomes before beginning patternmaking. This collection inspired me to develop multiple-garment patternmaking, scrap waste considerations and garment sequencing approaches further in this research.

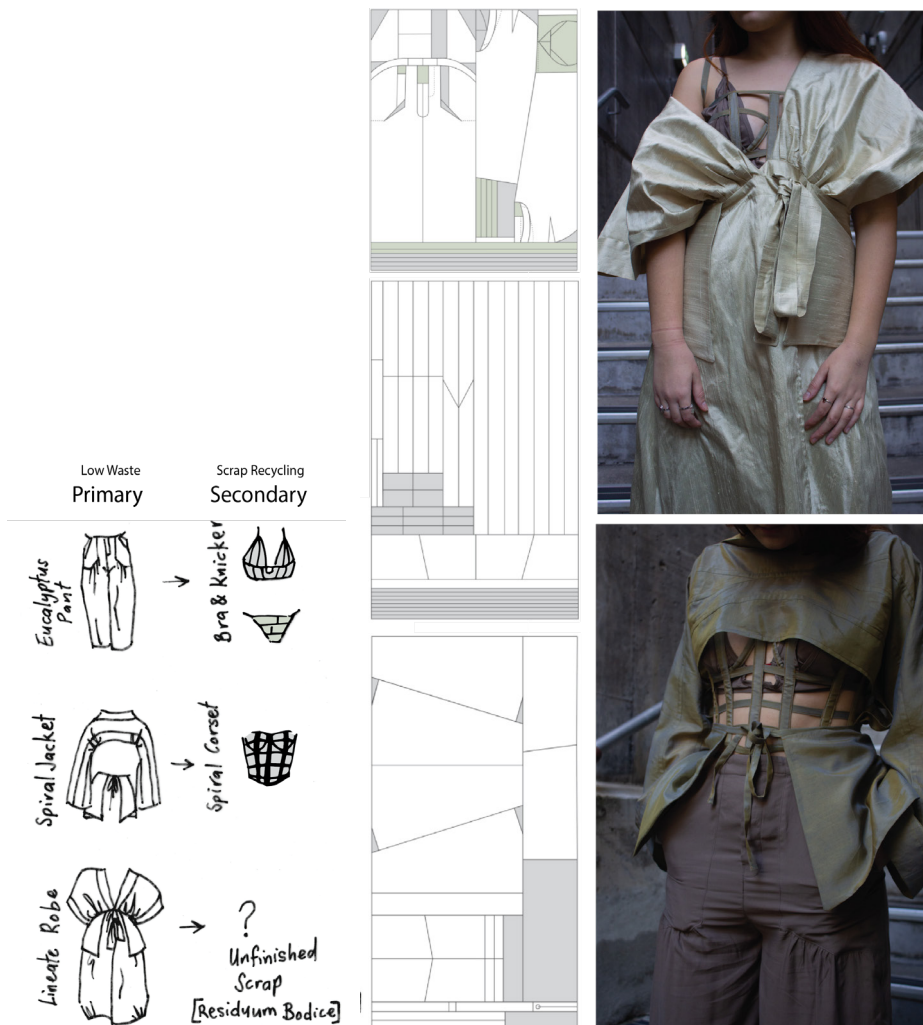


Figure 24. Residuum Collection. Primary and Secondary garments identified in patterns.

Pattern 1. Eucalyptus Pant and Patchwork Bra and Knicker.

Pattern 2. Spiral Jacket and Corset.

Pattern 3. Lineate Robe and incomplete secondary scrap waste.

62 Digital Portfolio by the author. <https://tessiewishart.wixsite.com/defineandrefine/post/final-collection>

63 Holly McQuillan, "TwinSet", February 1, 2011, <https://hollymcquillan.com/portfolio/twinset/>.

The second collection 'In Light of The Body in Cloth' (2022)⁶⁴ references my undergraduate collection of zero waste patterns.⁶⁵ Silk textile collage panels are filled with scrap produced during making, then crafted into a silk corset (Figure 25). This scrap recycling practice is a method of diarising, allowing the work to become 'both artwork and archive'.⁶⁶ The scraps generated while cutting the corset were then reincorporated into the subsequent mesh dress design as twisted silk twine, to style with the corset (Figure 26). Integration and inclusion of all offcuts guides this research, demonstrating how the sequential processes of scrap reincorporation informs design outcomes as zero waste designing and patternmaking influence each other.⁶⁷



64 Digital Portfolio by the author. <https://tessiewishart.wixsite.com/masters/blog/categories/design-one>

65 Digital Portfolio by the author. <https://tessiewishart.wixsite.com/portfolio>

66 Warwick Freeman, *Dust*, (2012), "Mark Work", Objectspace, Auckland, Accessed 12 April 2022.

67 "Mind-Body-Garment-Cloth."

Figure 25. In Light of The Body in Cloth corset references a past collection by encasing the scrap within collage.

Figure 26.
Journey of Progression. Corset scraps
become silk twine dress.



4.1.2 Criteria Setting and Mapping

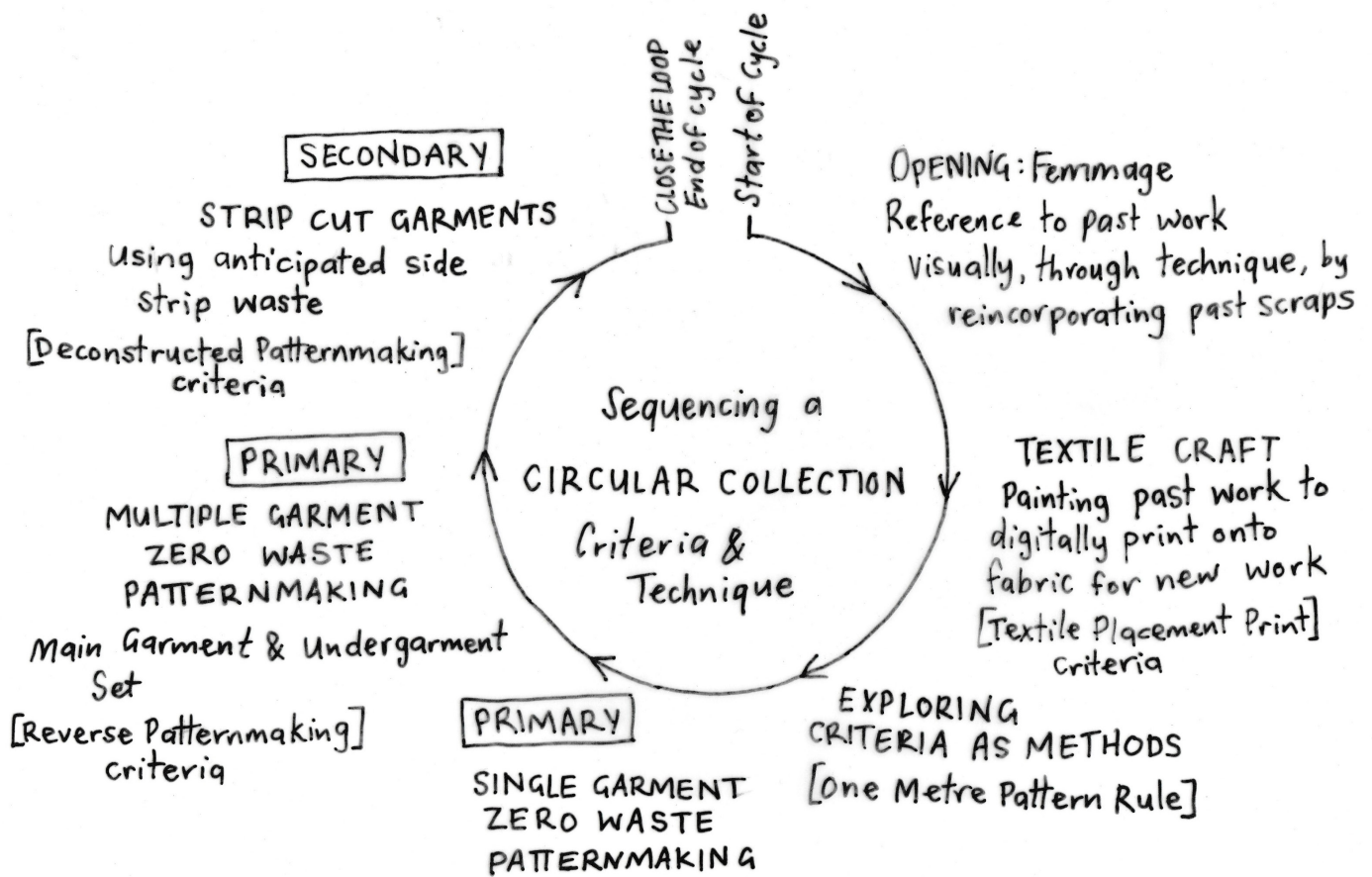
When working with the concept of scrap recycling, I aim to reincorporate scrap waste into ongoing garment production. Inspired by femmage criteria and my personal making processes, I formed a set of design and patternmaking criteria. The key criteria that emerged to provide a framework for the first phases of making are listed in Figure 27. These criteria emerged from observations of previous successes, points of resistance or slowness, and design outcomes. In particular I considered how the set criteria could support the design of easily replicated patterns and therefore increase accessibility for other designers. I intend to test and reflectively refine these criteria throughout ongoing making.

Figure 27.
Criteria Chart. Initial criteria for sustainable design and patternmaking approach.

Criteria	Definition and Reason for Criteria
Garment and Pattern Sequencing	I might 'sequence' garments or patterns. For example, in past practice when embedding more than one garment in a pattern I sequence them based on design order, e.g., 'Residuum' sequenced Primary main garments, then Secondary undergarments made from waste. Alternately, this practice considers a full zero waste pattern to be primary and the next garment made from leftover primary waste (side strips) to be secondary.
One Metre Pattern Rule	Zero waste patterns are not easy to replicate as the 'maker' needs to source the same width of fabric as the pattern to avoid waste. The one metre rule proposes making patterns in narrower (e.g., 1 metre) widths, then providing solutions for using up the side strips generated from different fabric widths. This is inspired by 'Residuum', where I couldn't undertake patternmaking until finalising fabric choices to inform pattern widths.
Strip Cut Garment	Garment-making with linear waste such as side strips. This is practiced in Residuum's 'spiral jacket' and 'spiral corset'.
Reverse Patternmaking	Prioritising the fit of undergarments in an embedded pattern before main garments, so both can have excellent fit. Inspired to avoid the point of resistance in the 'Residuum' collection where undergarments were made last from small scraps.
Deconstructing Pattern Pieces	Working backwards while zero waste patternmaking. This involves refining a final garment shape then working backwards to make the fabric pieces fit. Alternatively, refining the fit of separate pattern pieces before fitting them into the zero waste pattern configuration.
Material Considerations	Using natural textiles and avoiding or justifying synthetics like interfacing and elastic.
Fabric Shaping Techniques	Craft techniques like gathers, pleats, pintucks and darts can be interchangeable.

During this research a circular mode emerges - a mode of making designed to sequentially reincorporate scrap into each garment and use it up completely by the end of the cycle. To decide exact garment design to begin my practice, I considered the identified making approaches and criteria such as garment and pattern sequencing, one metre pattern rule, and strip cut garments (Figure 28). My criteria supported the garment design process that aimed to anticipate the fabric waste that would be produced and need to be reincorporated. During this research practice these initial design criteria and processes for generating zero-waste garments continually evolved.

Figure 28.
Initial crafting approaches planned within a circular collection model.



4.1.3 Initial Experiment

An initial experiment combined prototyping and reflective practice to test the circular framework by ‘closing the loop’ on the Residuum collection. I define closing the loop as concluding a circular collection once reincorporating all generated waste, and practiced it by crafting leftover Residuum fabric waste into a secondary garment. Testing criteria allowed me to adapt the existing fabric dimensions to an intended shape by using deconstructed patternmaking to lay the strip waste across a grid pattern (Figure 29) and applying fabric shaping techniques to make a strip cut garment. Diarising occurred through crafting by encapsulating the smallest scraps within binding whilst practicing McQuillan’s adaptable insertion stitch⁶⁸ (Figures 30 & 31). Considering how the strip garment could be remade without creating new waste, I reformatted pattern pieces into a rectangular single garment zero waste configuration (Figure 32). This pattern directly informed my Phase 2 practice, where I explored simplistic and accessible single garment zero waste outcomes. Overall, this experiment validated the emergent idea of a circular collection model and design criteria, causing me to visualise a complete first circular collection iteration (Figure 33).

Figure 30.
Residuum Bodice sketches.

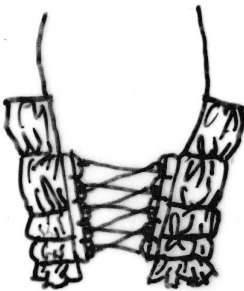
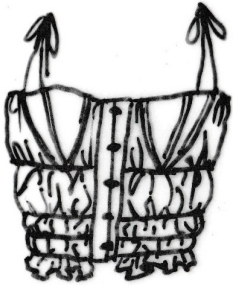
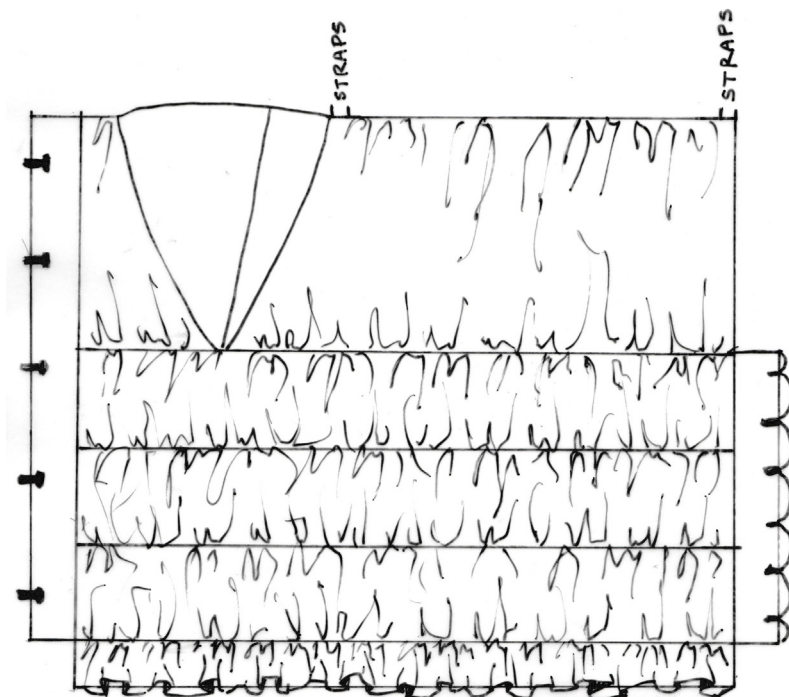


Figure 29.

Criteria Testing: Residuum grid pattern. As a deconstructed patternmaking criteria, strips of varied widths can be applied to fit the grid pattern’s final garment measurements using fabric shaping techniques.



68 "Joining."



Figure 31.
Residuum Bodice uses up secondary waste and incorporates McQuillan's insertion stitch adjustable joining method. Smallest scraps are embroidered on the front and encapsulated within neckline and lacing silk binding.

Figure 32.
Translating: Residuum Bodice strip waste pattern can be reconfigured into a rectangular single garment zero waste pattern.

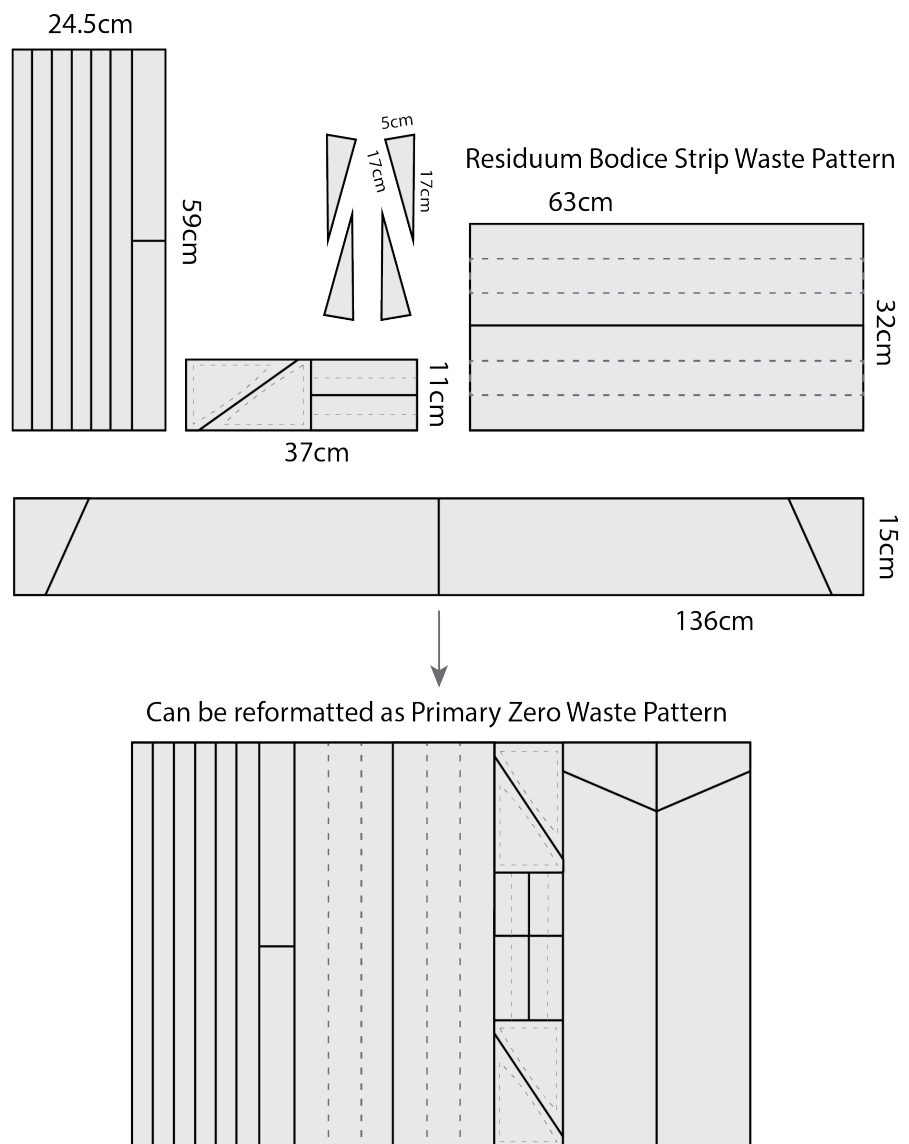


Figure 33.
Initial circular collection test sketch, with diagram journey of scrap recycling. Informed by initial experiment.



4.2 Phase 2. Single Garment Zero Waste

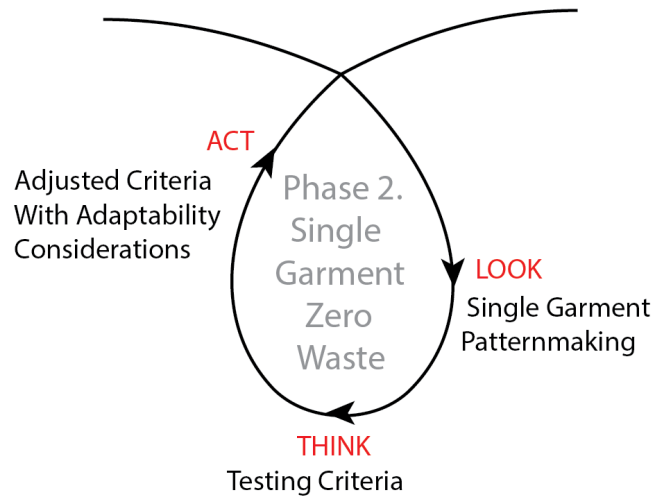


Figure 34.

Phase 2 Single Garment Zero Waste

4.2.1 Single Garment Patternmaking

Phase 2 aimed to explore single garment patternmaking to extend the testing of initial criteria (Figure 34). Single zero waste garment making means ‘puzzling’ an individual garment’s pattern pieces together so no waste is created. Based on the points of resistance analysed in my Residuum collection – where I was left with irregular waste – I learned to anticipate some of the waste produced, during the design process. This knowledge allowed me to plan in advance towards a circular design collection using waste reincorporation methods. I formulated the physical pattern by drawing upon tacit knowledge and prior patternmaking skills, fitting the larger pattern pieces simultaneously before adding smaller sections, like strips, later. Testing the evolving patternmaking method on a single garment allowed me to further expand my knowledge of zero waste creative practices before moving into more complex multiple garment designs.



Figure 35.
In Light of The Body in
Cloth Corset Painting.
Acrylic on paper.

4.2.2 Testing Initial Criteria

The single garment zero waste prototype Trace Corset-Dress investigated fabric shaping techniques and the one metre pattern rule criteria. I implemented a new material criteria, allowing me to factor in a textile placement print which informed and altered the patternmaking outcomes. In a femmage-style reference to past practices and to communicate how scraps are essential to the design process⁶⁹, I digitally printed an image of a previously made corset⁷⁰ onto cotton poplin (Figures 35 & 36). Another designer could remake this pattern without the textile print, or alternatively could apply femmage techniques to paint or fabric collage their own image into the design.

Figure 36.
Testing digital print on habotai silk, crumpled.



69 "Waste Not, Want Not: Femmage."

70 'In Light of The Body in Cloth' 2022 collage corset.



Figure 37.
Trace Corset-Dress Half Scale Toile.

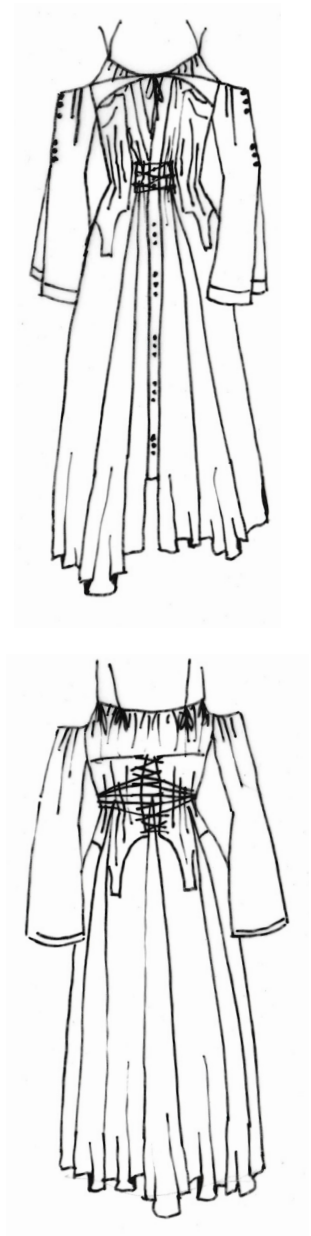


Figure 38.
Trace Corset-Dress front
and back sketch.

The print placement and dimensions influenced design details and patternmaking processes in that I had to cater for the way the print would sit against the body, whilst working back and forth between patterns and prototypes in half- and full-scale (Figures 37 & 38). Prototyping identified how adding specifications such as textile prints or fabric constraints inform and influence design processes and outcomes. The fabric shaping techniques criteria was applied to convert the flat pattern to a three-dimensional form; adding pintucks and a belt cinched the corset print to mimic natural shaping. Shaping techniques increase pattern adaptability as they could be exchanged at making stages. By changing the pintucks to pleats, darts, gathering, or lacing within the pattern, the garment's visual aesthetic alters without affecting the zero waste outcome.



Figure 39.
Final Trace Corset-Dress

The Trace Corset-Dress pattern applies the one metre pattern rule — this criteria recognises that a narrow zero waste pattern should yield side strip waste for a secondary garment at a later date. When testing this rule, I found the pattern needed to be wider than one metre to comfortably fit around the body (Figure 39). In editing the rule to become a *pattern width rule* criteria, I acknowledged the inclusion of a variable strip waste solution to be more important than the exact 1m width specification. This intuitive in-action and on-action reflective practice⁷¹ and my developing tacit knowledge lead to editing of the initial design and patternmaking approach criteria, guiding the course of the ongoing practice.⁷² This practice demonstrated how strips can be used as an additional adaptability resource within the zero waste model. The Trace Corset-Dress pattern has many strips drafted into the main pattern, which were used for a belt, ties and facings (Figure 40). This deliberate inclusion of strip pattern pieces with the initial garment design is discussed in detail in Phase 4.

71 “The Reflective Practitioner: How Professionals Think in Action.”

72 Stephen Scrivener, “Reflection in and on Action and Practice in Creative-Production Doctoral Projects in Art and Design”, Working Papers in Art & Design, January 1, 2000.



Figure 40. Labeled Trace Corset-Dress pattern. Strips (bottom) are patternmaking solutions.

Reviewed in Figure 41 are the outcomes of the criteria tested during this practice. Testing these criteria demonstrates ways designers can begin to use the fabric waste generated in the design stages of making within their own circular design collection. Testing too many criteria at one time could create a point of slowness, confusing the outcomes. Therefore, as the practice evolved I decided to focus on the exploration of complex zero waste multiple garment patternmaking instead of continuing with existing surface design and fabric prints. The inclusion of textile prints is a research trajectory for future personal research or for other zero waste designers to continue to develop.

Figure 41.
Tested and revised criteria during Phase 2.

New and Tested Criteria	Explained
Fabric Shaping Techniques	Pintucks and belt cinching were used to successfully shape the garment to the body. Altering the fabric shaping technique would visually alter the garment without affecting waste; it could be swapped for pleats, darts, gathering, lacing.
Existing Surface Design	The specification of the corset textile print and its dimensions informed the garment design and patternmaking process.
One Metre Pattern Rule (Renamed: Pattern Width Rule)	This rule proved successful – in design stages a designer can anticipate the only waste from the pattern being side strips (of variable lengths based on the chosen fabric width). Testing this rule proved that the exact dimension was not as important as providing a solution to use up the strips, explored in Phase 4.

4.2.3 Adaptability Considerations

During pattern development and criteria testing of Phase 2, I considered how a garment could be developed to be more adaptable so it might be worn by a greater audience range. In my practice, design and patternmaking became interlinked as I explored ways to achieve pattern and styling adaptability to alter the garment fit. The inclusion of styling adaptability is intended to offer opportunities to produce an adjustable garment which is more sustainable as people's bodies change over time. This builds on McQuillan's research which explores how "the encoding of navigational clues and markers into a garment or product might aid in its facility for creation and modification, enhancing emotional investment and connection, and extending its functional and desirable lifespan."⁷³

To improve and extend size options I considered grading the single garment zero waste pattern. Grading is the process of increasing or decreasing a garment size by altering length and width within the pattern. Rissanen identified how grading width up or down sizes in a zero waste pattern is not without its challenges, as the conventional grading process adds width to all sides which expands the pattern piece beyond the other pieces within the configuration.⁷⁴ I address this through a hybridised approach⁷⁵ by adding 'widen' and 'lengthen' lines at identified points on the pattern (Figure 42). These lines enable the pattern to be lengthened or widened by evenly adding in space without affecting the integrity of the zero waste pattern configuration. This forms the basis for a new design criteria; pattern alignment for gradeability. This developed new design criteria means both front and back body panels of the corset-dress garment can be shortened and sleeves removed through simplified pattern adjustments.

73 *Make/Use: An Exhibition and Workshop Series Exploring User-Modifiable Zero Waste Fashion.*

74 Timo Rissanen, "Zero-Waste Fashion Design: A Study at the Intersection of Cloth, Fashion Design and Pattern Cutting", 2013, <https://opus.lib.uts.edu.au/handle/10453/23384>.

75 *ibid.*

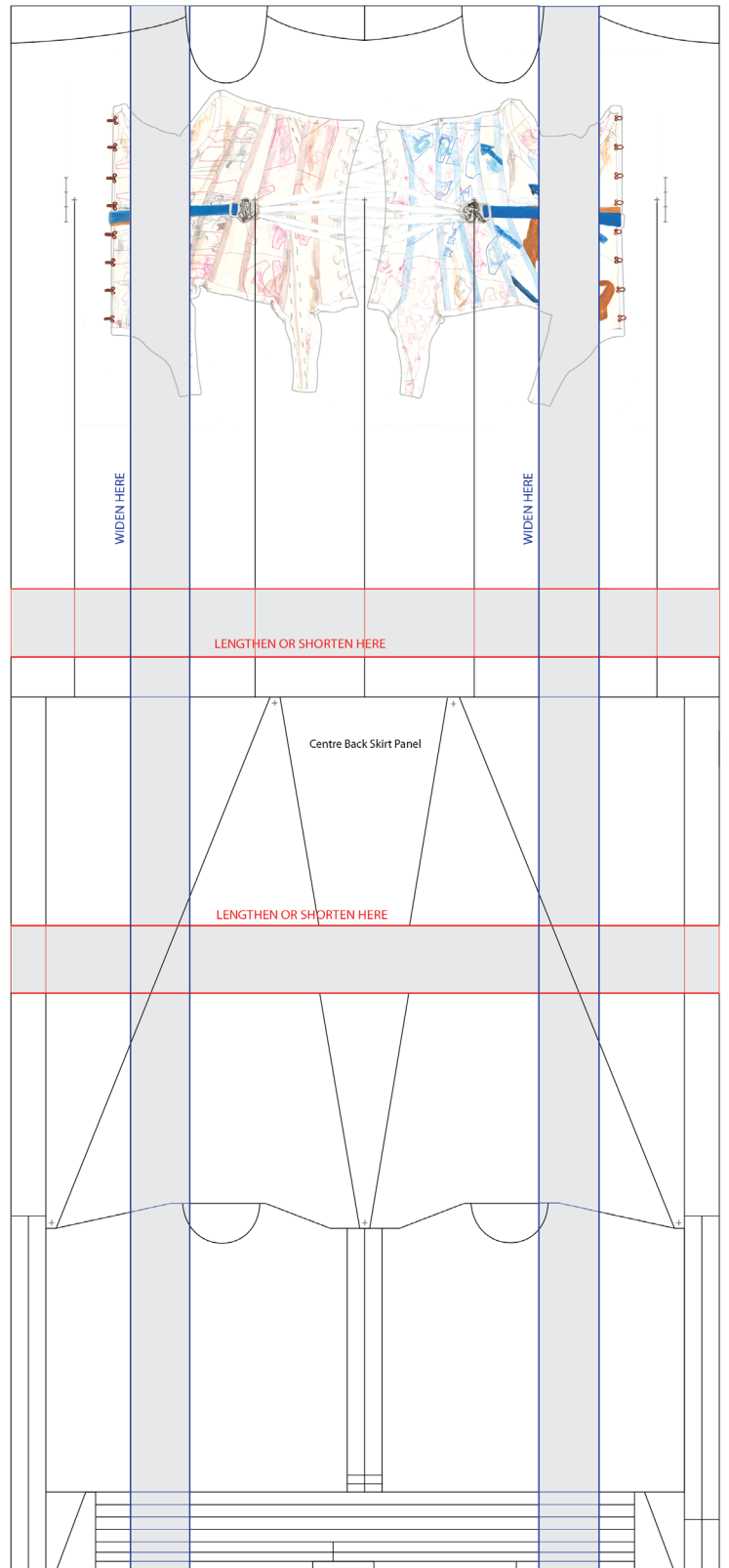
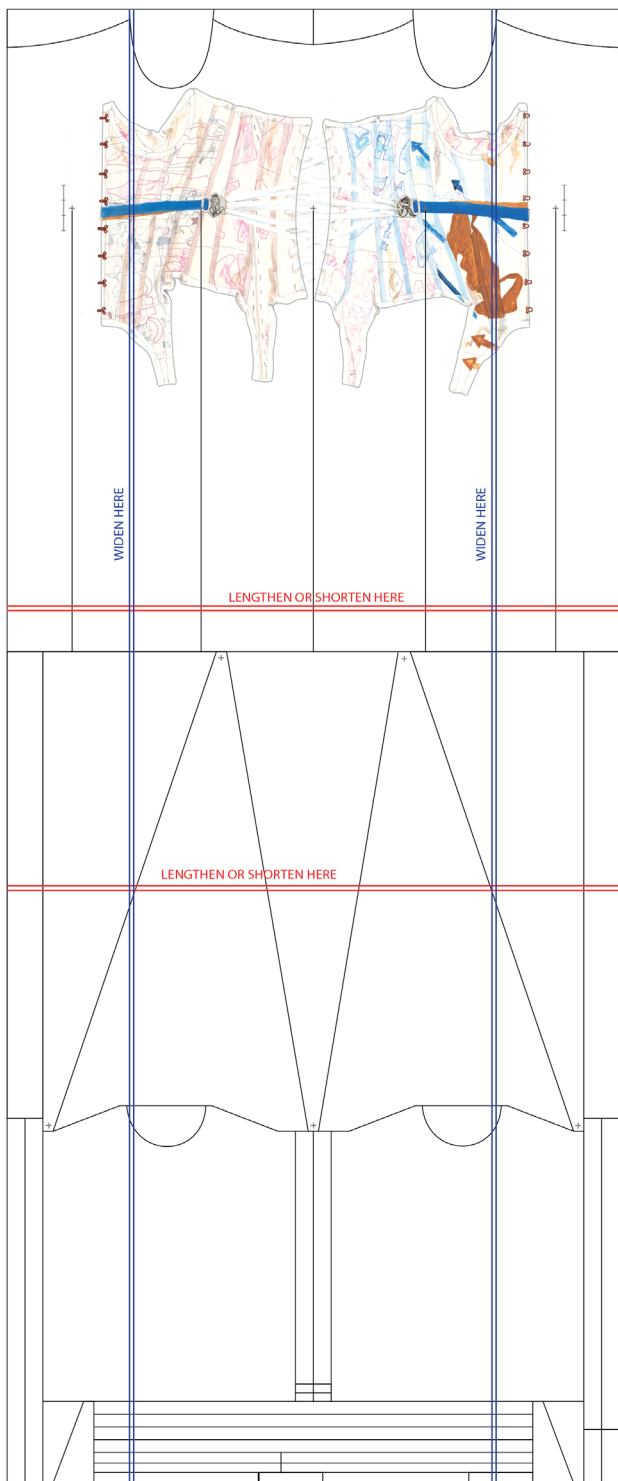


Figure 42.
 Final Trace Corset-Dress Pattern with corset
 print shows grading lines for size flexibility
 (left), pattern can be widened and lengthened
 (right). Furthering, sleeves could be edited out
 of the pattern if needed.

4.3. Multiple Garment Zero Waste

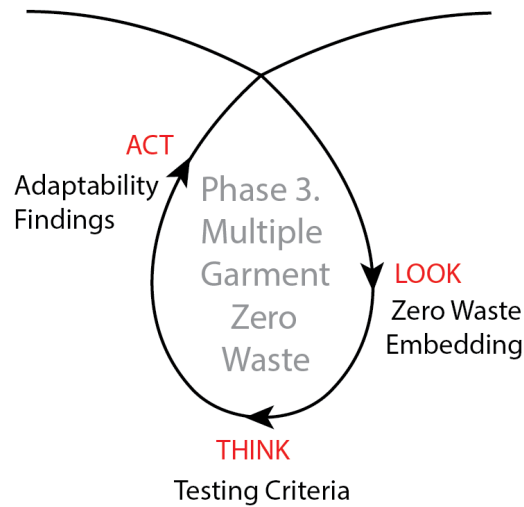


Figure 43.
Phase 3 Multiple Garment Zero Waste

4.3.1 Zero Waste Embedding

Phase 3 explores configuring multiple garments within a zero waste pattern to discover new patternmaking forms (Figure 43). Rissanen and McQuillan discuss how “zero waste fashion design addresses inefficiency in fabric use by reframing fabric waste as an opportunity to explore the magic of fashion; just like all fashion zero waste fashion celebrates experimentation and the discovery of new forms.”⁷⁶ To improve fabric efficiency this practice progressed into multiple garment patternmaking, using a method coined by McQuillan as embedding. Embedding is interlinking pattern pieces within a single zero waste pattern to yield multiple garments, which I explore by including smaller undergarments amongst main garments. This patternmaking approach allows for a variety of garment fits that cannot be achieved when using single garment zero waste patternmaking methods, therefore expanding the potential of what can be designed within a circular collection model.

76 Timo Rissanen and Holly McQuillan, *Zero Waste Fashion Design*, (London: Bloomsbury), 2016, 2.

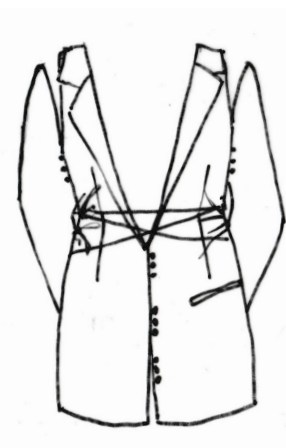
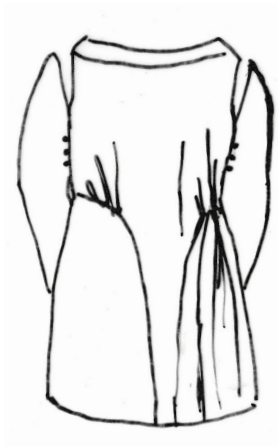


Figure 45.
Encapsulation Jacket
reversible front and back
design.



Figure 46.
Encapsulation Bra and
Knicker design.

To explore this embedded patternmaking approach I developed a three-garment pattern combination, Encapsulation Jacket and Undergarment Set, utilising several garments and fabrics within one pattern. Akin to the Trace Corset-Dress, this design took inspiration from personal past practice to guide the physical patternmaking outcomes (Figures 44-46). Residuum taught me to place garment and undergarment pieces within a pattern layout simultaneously, so the fit of both garments can be prioritised. Through the embedded zero waste process I worked with the challenges generated by multiple pattern configurations and waste output rather than against them (Figure 47).

Figure 44.
Confinement and Isolation, 2020. Personal past practices inspire the design of embedded jacket and undergarment set.

*Civilisation. Photography.
Fashion. Now.*

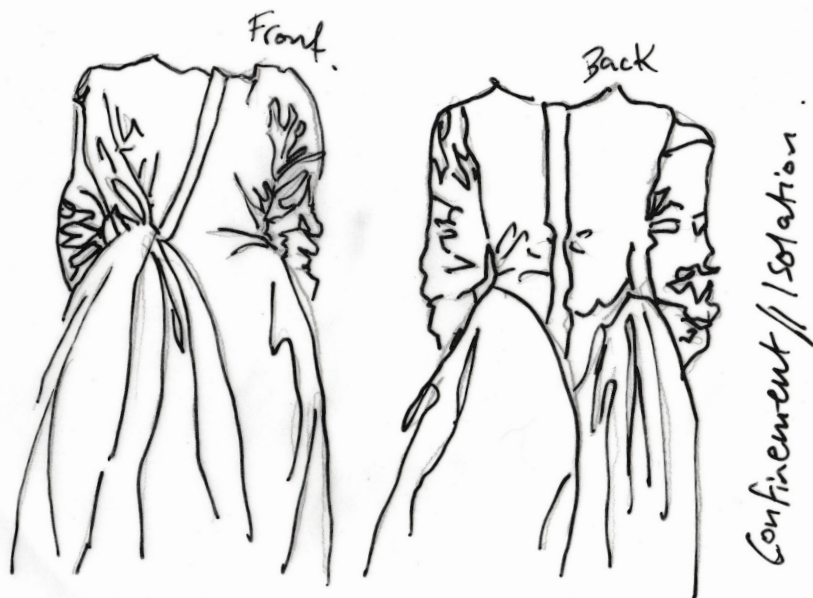




Figure 47.
Encapsulation Jacket and
Undergarment set toile
cutting.

4.3.2 Testing Criteria

The Encapsulation Jacket and Undergarment Set is made up of a reversible jacket, bra and knickers. Testing the embedded patternmaking technique on the four Encapsulation pattern prototypes allowed me to discover the best ways of working when configuring the patterns and taking garment adaptability into account. The intention of these prototypes was to develop a garment set using multiple deadstock fabrics. This required a new pattern for each fabric type to make up the jacket main, lining, and contrast bra lining cups. I developed a reversible garment, with styling adaptability increased through the inclusion of a lowered lapel, removeable sleeve options and adjustable belt. The multiple garment patternmaking criteria chart articulates these decisions (Figure 48).

Garment embedding yields new challenges, as pattern formatting generates leftover secondary waste which must be reused within the garment set. Phase 3 investigated zero waste approaches through multiple fabrics, irregular shapes within a pattern, strips as embedded design waste solutions, and considering how the inclusion of an optional lining impacts these factors (Figures 49 & 50). When designing with multiple fabrics in different pattern layers such as main and lining, “treating fabrics hierarchically is a useful strategy; this means that fabric waste as a design criterion is most significant with designing the pattern layout of the main fabric.”⁷⁷ This meant drafting the main pattern and then mirroring the lining pattern with minor adjustments for best fabric usage. During the zero waste process I craft removeable pattern sections such as the lining layer or sleeves so that the pattern’s zero waste effectiveness is not affected.

⁷⁷ *Zero-Waste Fashion Design: A Study at the Intersection of Cloth, Fashion Design and Pattern Cutting.*

Figure 48.
Multiple Garment Patternmaking Criteria Chart. Articulating the criteria applied during practice-led inquiry.

Criteria Used	Explaining Criteria in Practice
Garment and Pattern Sequencing	The Encapsulation set sequences blazer jacket, bra and panty combination together within a zero waste pattern. This allows irregular shaped pattern pieces to be fitted – these garments are not easily made in single garment zero waste patternmaking.
Pattern Width Rule	I make the pattern narrow enough to generate side strips to use up in the ongoing garments within the cyclical collection. Therefore I can cut from fabric wider than the pattern when solutions are given for using up side strips to facilitate scrap reincorporation within the collection.
Multiple Fabric Considerations	I pattern-make to fit multiple fabrics within a single design, understanding that each fabric has its own specifications and requires a separate zero waste pattern (e.g. lining pattern, main pattern, bra cup pattern). I find I can mirror the main jacket pattern to make the lining pattern with only small adjustments. I develop options within the pattern to accommodate adaptability (such as the ability to omit a layer like the lining without creating waste).
Deconstructed Patternmaking	Responding to the limitations of Residuum where the undergarments had to be designed last based on generated scrap, I refine undergarment and jacket non-zero-waste pattern pieces to have excellent fit before refitting them into the pattern configuration.
Reverse Patternmaking	Having separately refined undergarment and jacket pattern fit, I prioritise fitting the undergarments into the pattern before the main garment, as their fit must be more precise. In this process I find all pattern pieces tend to fit together simultaneously, holistically working back and forth between design and patternmaking. Then I work to solve sections of secondary waste in the pattern, using them to make ties or pockets.
Pattern Alignment for Gradeability	I factor in the size-flexibility considerations from the Trace Corset-Dress process, configuring pattern pieces together to allow me to draft lengthen and widen lines for simple grading. I configure the pattern to have separate sleeve and facing pieces for increased adaptability, with removeable elements.

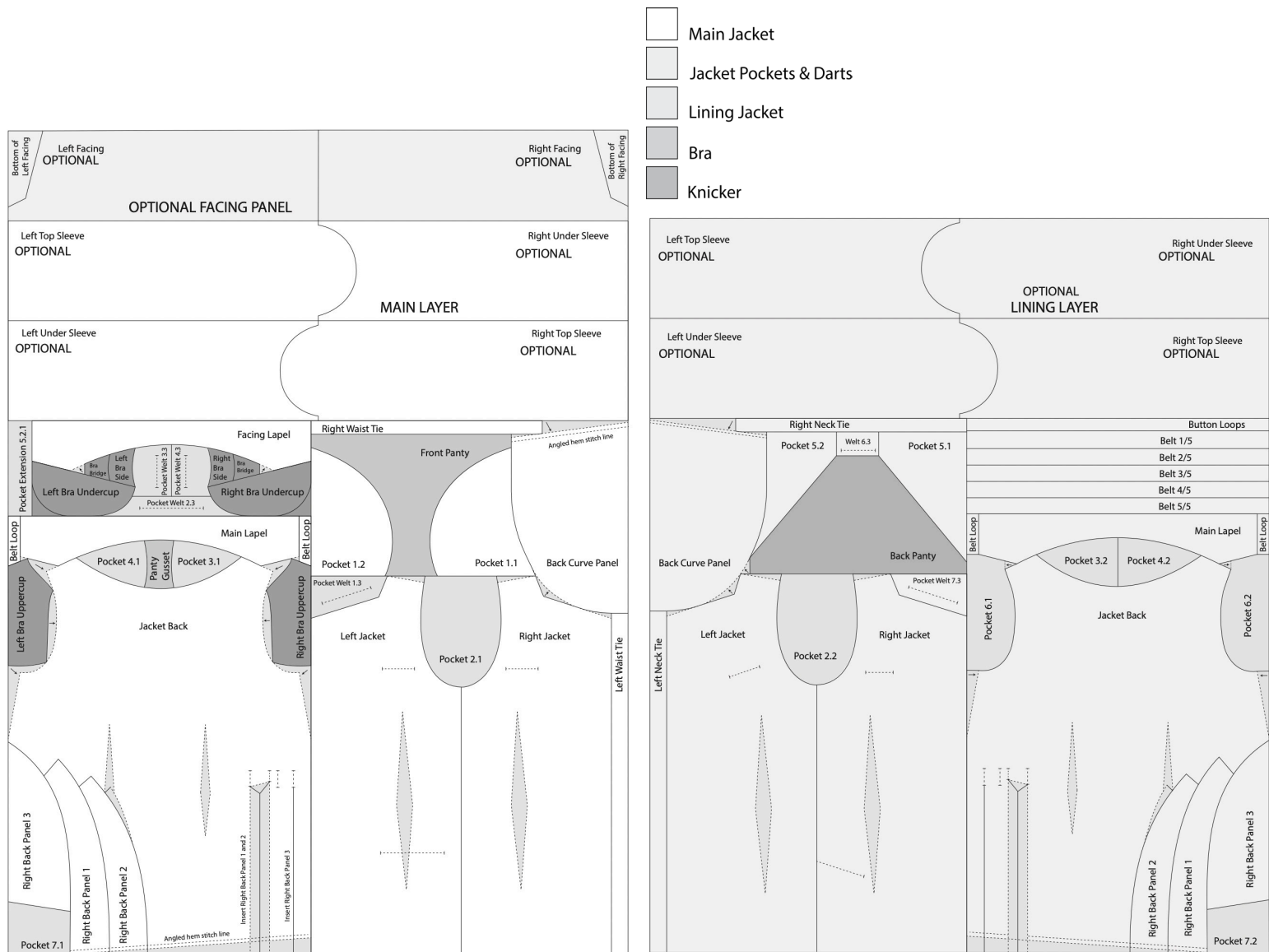


Figure 49.
 Encapsulation Jacket and Undergarment Set. Labelled Embedded Pattern.
 Separate main and lining patterns with colour key.



Figure 50.
Encapsulation Jacket toile
styled three ways. Jacket
is reversible front-to-back
and inside-out.

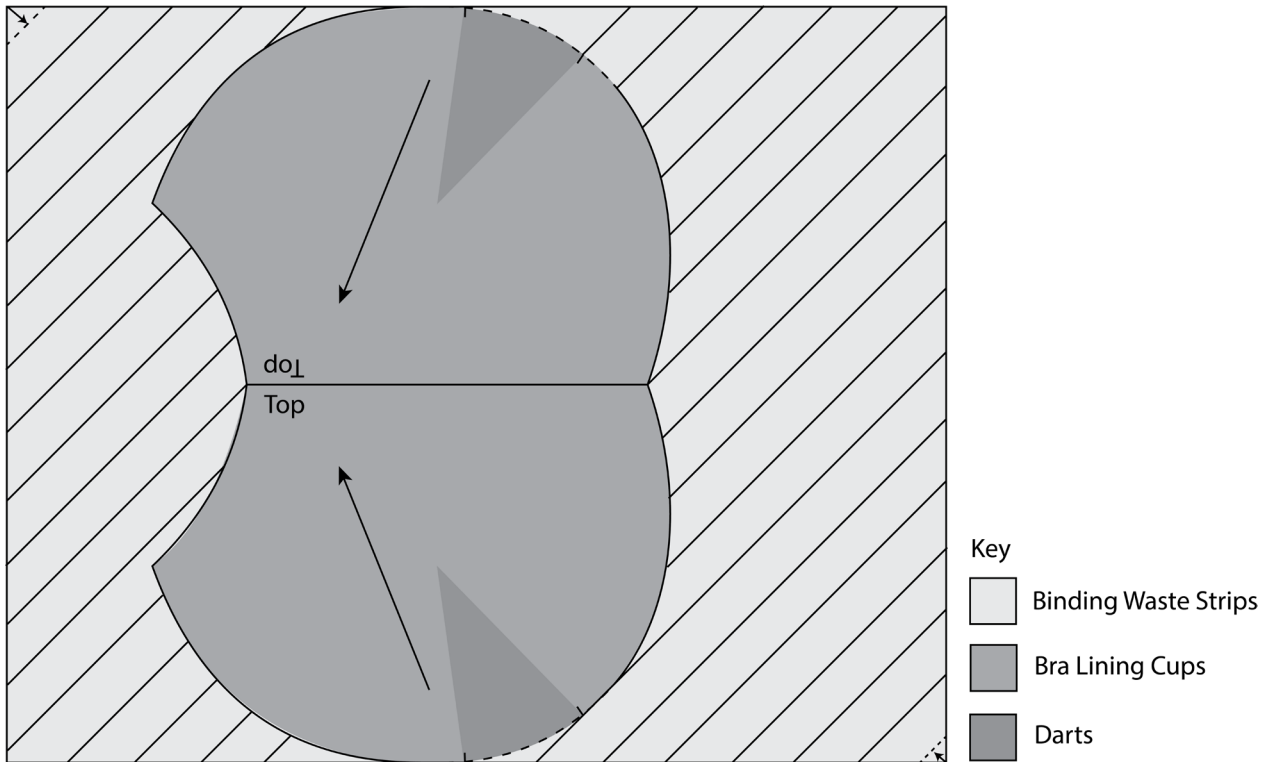


Figure 51.

Encapsulation bra cup lining pattern, to be cut from separate silk. Strips become embedded solutions throughout patternmaking. Irregular waste sections become continuous binding to use later during the circular collection.



Figure 52.

Secondary waste silk binding generated from irregular waste when cutting silk bra cup lining. To be reincorporated within strip cut garment.

Pattern pieces may be configured to minimise irregular shapes by situating smaller pieces, such as undergarment patterns, alongside larger waste sections which become jacket pockets. I found strips to be an embedded solution to the issue of irregular or excess waste. The strips could be included in the garment design as loops, facings, straps, ties and belts. This strip waste solution is applied when making a contrast bra lining cup, dividing the surrounding waste, which can be joined to make continuous binding to design into secondary strip cut garments within the circular collection (Figures 51-54). As a deliberate solution to the problem of irregular shapes created when patternmaking for complex garments, I feed the strips into future works within the cyclical collection.

Figure 53.
(Right) Encapsulation Bra lining.

Figure 54.
(Below) Encapsulation Bra and Knicker.



4.3.3 Adaptability Findings

McQuillan and Pei-Wen Jin’s simplistic pattern modifications prioritise audience accessibility, proving the importance of considering who might actually make or wear the garments. These practitioners identify a grid-composition zero waste pattern to be a successful vehicle for adaptability interventions and simple reconfigurations, inspiring my ongoing considerations of pattern shapes and methods to communicate adaptability. These decisions are made continuously before pattern making occurs, during pattern making and making stages, and when fitting the garment.

The potential stages for adaptability details are identified in Stages for Adaptability Intervention Chart (Figure 55). It is here at the nexus of femmage, craftsmanship and zero waste pattern making that this practice is positioned. This embedded patternmaking approach is supported by my criteria and evolving considerations of garment adaptability. Figure 56 demonstrates the stage of patternmaking adaptability in practice through lengthen lines and widen lines in the Encapsulation pattern, and Figure 57 demonstrates assorted styling options. These additions communicate how the integration of adaptability considerations increase the potential for a multitude of functional outcomes when designing and making.

Figure 55.
Stages for Adaptability
Intervention Chart.

Stages for Adaptability Interventions	Adaptability Intervention Stages Explained
Before patternmaking & Design Stage	Supported by practice, implicit tacit knowledge, and knowledge imparted in this research, the designer knows where and how to implement adaptability.
Patternmaking Adaptability	A maker has the ability to change, grade, exchange or remove pattern sections and details without affecting waste production. (Or gives solutions for waste generated from adaptations.)
Making Stage	<ul style="list-style-type: none"> • Crafting supports adaptability, as making approaches can be exchanged or combined to yield different aesthetic outcomes and support end-of-life adaptability. (Such as how McQuillan’s insertion stitch seams could be cut away to rotate a garment section.) • Varied scrap and side strip waste generated during production can be used to enhance adaptability of main garments. (Such as reincorporating strip waste for adjustability, e.g. Roberts Wood.)
Fit and Styling Adaptability	<p>This is an engineered ability to style, change and remove elements of the design to alter garment aesthetic and function.</p> <p>Garments are engineered for styling with other garments within the embedded pattern or circular collection.</p>

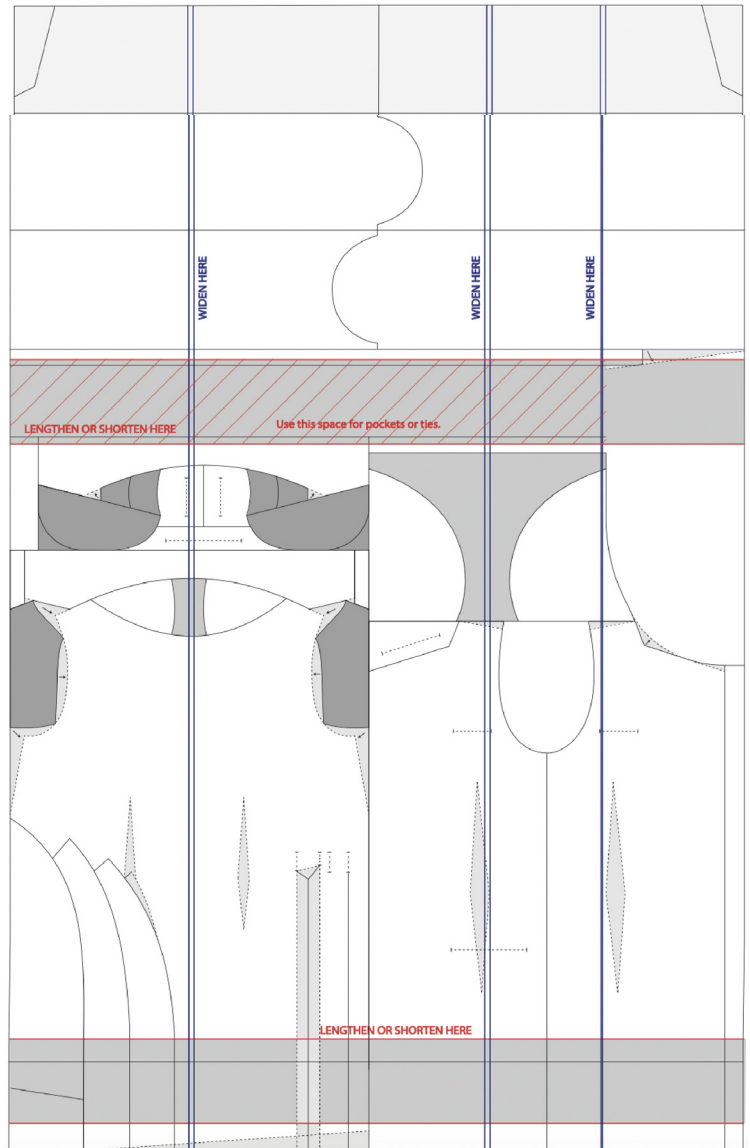
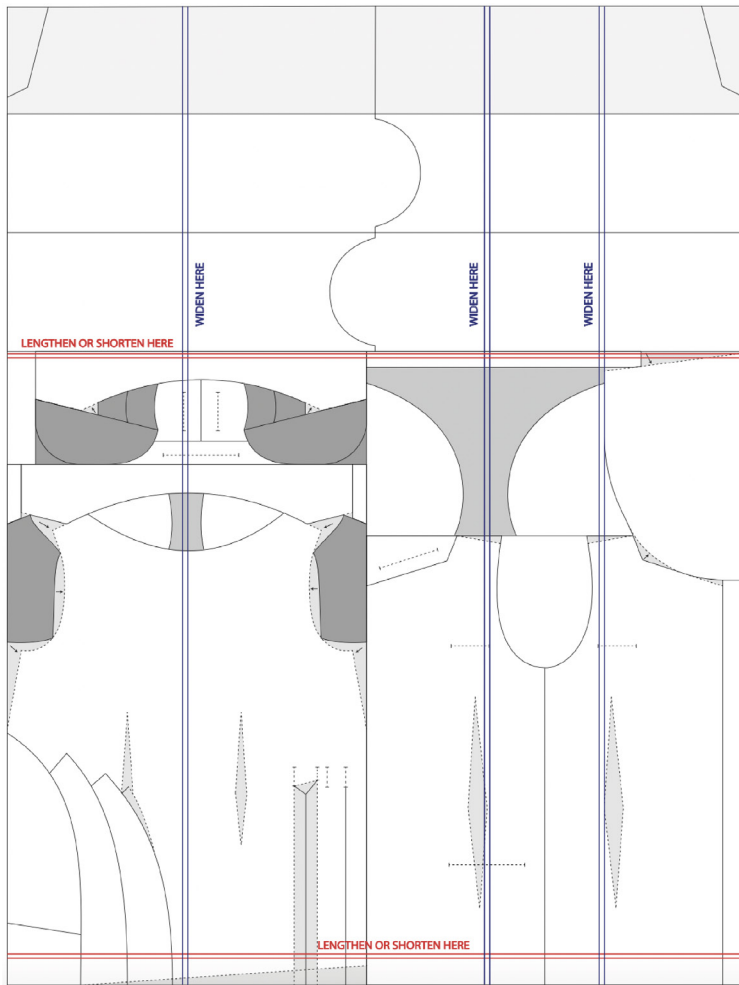


Figure 56.
Adaptability in Practice. Encapsulation main layer pattern with widen and lengthen grading lines, (left) lengthened (right).



Figure 57.
Fit and Styling Adaptability. Reversible
jacket styling with belt lacing details. Jacket
is reversible front-to-back and inside-out.
Further options like removeable sleeves are
possible at making stages.

4.4 Strip Cut Zero Waste

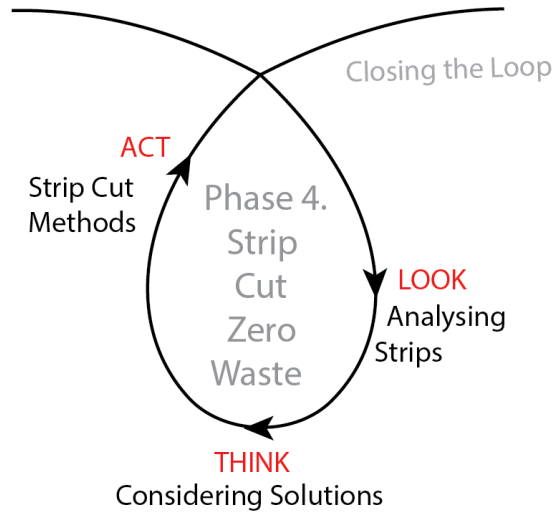


Figure 58.
Phase 4 Strip Cut Zero Waste.

4.4.1 Analysing Strips

Through this research several approaches to strip cut zero waste practices emerged as a way to fully ‘close the loop’ during making. Phase 4 discusses the strip scrap recycling methods applied in this practice (Figure 58). Providing solutions for waste strip usage is significant due to the pattern width rule criteria, which allows the main zero waste patterns to be reproduced on fabric of any width. I regard strips as a zero waste resource to be reincorporated into future designs and a patternmaking solution to irregular waste shapes (Figure 59). When combined with craftsmanship techniques, waste strips can be crafted to produce secondary garments in a sequenced circular collection.



Figure 59.
Trace and Encapsulation
strip waste to be
reincorporated within the
Phase 4 strip cut inquiry.

4.4.2 Considering Solutions

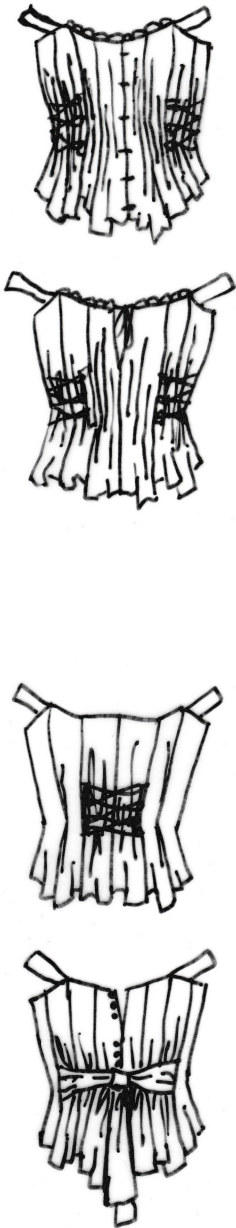


Figure 60.
Trace and Encapsulation
Bodice sketches, front and
back. Designed to use up
secondary strip waste.

The main purpose of adding strip cutting to my designs was to provide solutions to fabric edge waste after cutting single or multiple garment zero waste patterns. To use this linear waste, I considered adaptable zero waste grid patterns by designers McQuillan, Helmersson and Pei-Wen Jin. Given difficulties of having “no global standard for fabric width”⁷⁸, these practitioners designed patterns that facilitate easy pattern widening to match the fabric, additionally increasing garment adaptability through flexible handcraft joining techniques. Alternately I design adaptable patterns which strip waste should be applied to, influenced by McQuillan’s grid matrix patterns which realise “the relationship between body measurements and two-dimensional pattern for a particular garment typology,” and “can be adjusted to suit the interrelated parameters of fabric width/length, size/fit, and garment design variations.”⁷⁹ In the context of this inquiry, a grid pattern can similarly be widened given that waste strips get applied to a pattern of any size following deconstructed patternmaking criteria. This method was tested in initial prototyping, making the Residuum Bodice to use up strip waste. In reverse, I have crafted complex primary zero waste patterns in Phases 2 and 3, following criteria to specifically generate side strip waste that could be reincorporated in Phase 4 experimentation (Figure 60).

Further criteria might be applied to the strip cut inquiry. Pattern alignment for gradeability proposes composing the grid to align at the bottom of the pattern so it might be easily widened or lengthened. Deconstructed patternmaking dictates how I might apply fabric to a grid pattern, and fabric shaping techniques allow flat sections of fabric to be shaped to the body with pleats, gathers or darts. Through this research, patternmaking and crafting processes become solutions to linear waste, generating a symbiotic relationship between strips, waste management and garment adaptability.

78 “Make/Use: A System for Open Source, User-Modifiable, Zero Waste Fashion Practice.”

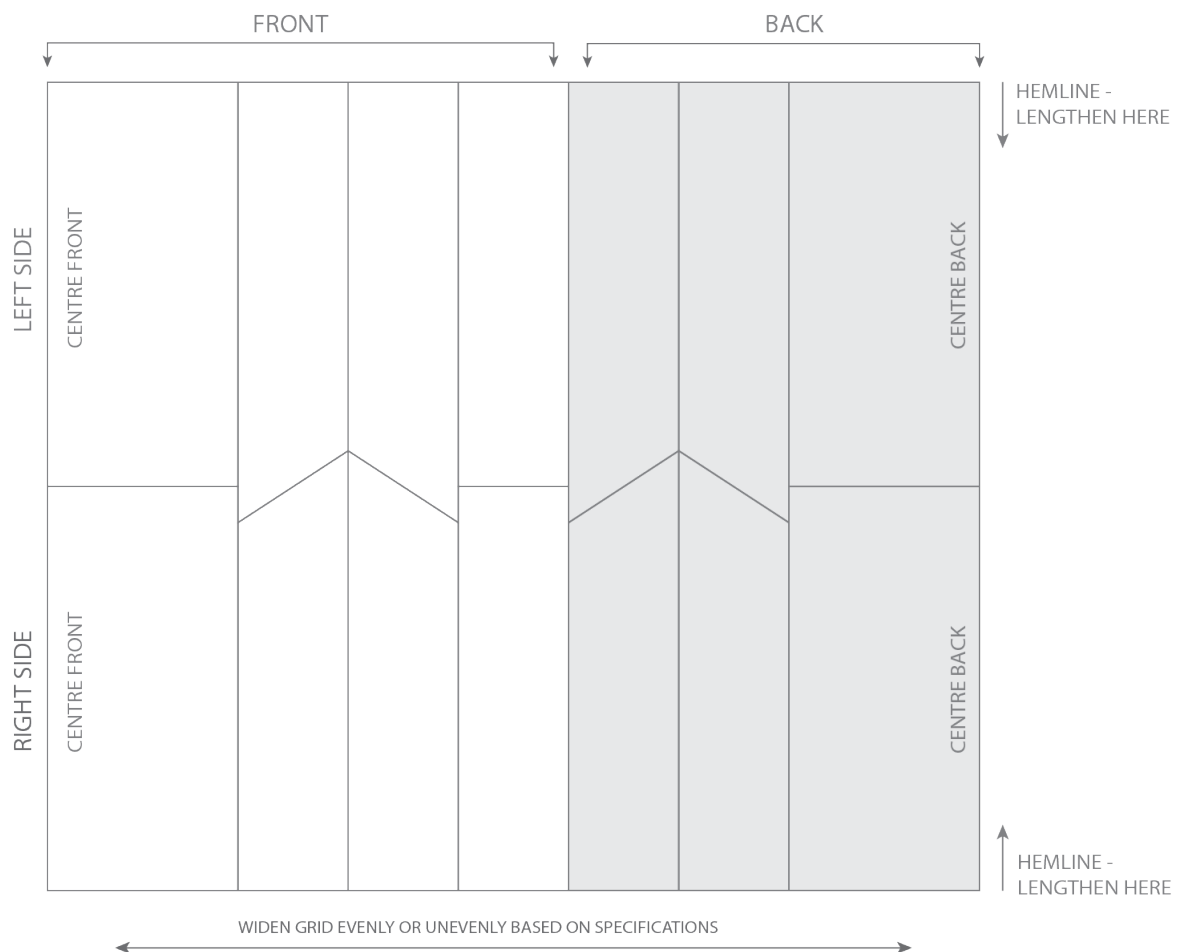
79 *ibid.*

4.4.3 Strip Cut Methods

This practice identified two main methods to utilise strip waste: Multifunctional Grid Method and Strip Ties Crafting Method. The Multifunctional Grid Method uses strips to create secondary garments and the Strip Ties Crafting Method reincorporates strip waste into the primary garments. Each technique facilitates my adaptability considerations as I might use them to produce garments of varied sizes and configurations, and patterns can be graded by evenly adding or removing width and length. These solutions work best with two-way nonpatterned woven fabric, allowing strips to be rotated vertically and horizontally within the fabric yield.

The Multifunctional Grid Method involves patternmaking, joining strips together and applying them to a grid pattern to make either a bodice, dress or skirt secondary garment (Figures 61 & 62). The pattern is easily adaptable at patternmaking and styling stages due to grading options and inclusion of fabric shaping techniques for different aesthetics. Additional to using as a strip waste solution, the pattern is configured with the opportunity to cut as a single zero waste garment.

Figure 61. Multifunctional strip cut grid pattern. Secondary waste side strips can be applied to the grid, or it can be used to make a zero waste Primary garment.



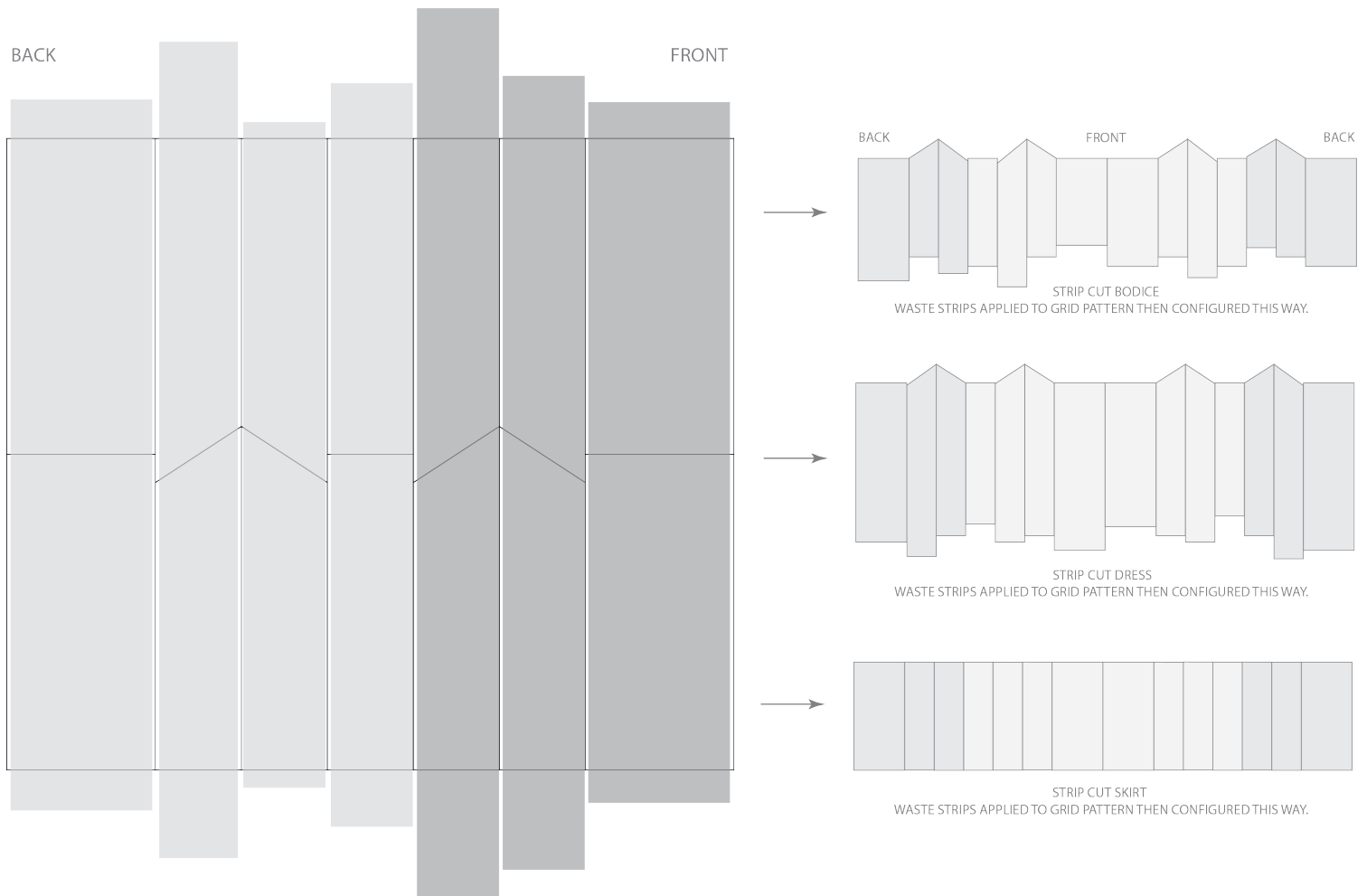


Figure 62.
Strip Grid Pattern Translations. Strips of assorted lengths and widths are applied to adjustable grid pattern, causing asymmetric hemlines. They translate to form bodice/dress/skirt, and are shaped to form with fabric shaping techniques.

Figure 63.
Closing the loop: Residuum Lacing. Scrap waste is encapsulated within silk binding.



The Strip Ties Method uses crafting similar to Wood’s “reincarnation”⁸⁰ joining technique. Reincorporated into the primary garment where the strips were initially generated from, they can be laced or tied to replace seams and enhance the garment’s size flexibility. Potential for modification occurs as sections like sleeves might be untied and removed. The strips may be reincorporated with varied crafting techniques, such as fabric shaping techniques and McQuillan’s modifiable insertion-stitch.⁸¹ Small scrap waste can even be encapsulated within the strips when closing the loop on a collection, as in the Residuum Bodice (Figure 63).

80 “Reincarnated Silk Gown — ROBERTS | WOOD,”

81 “Joining”.

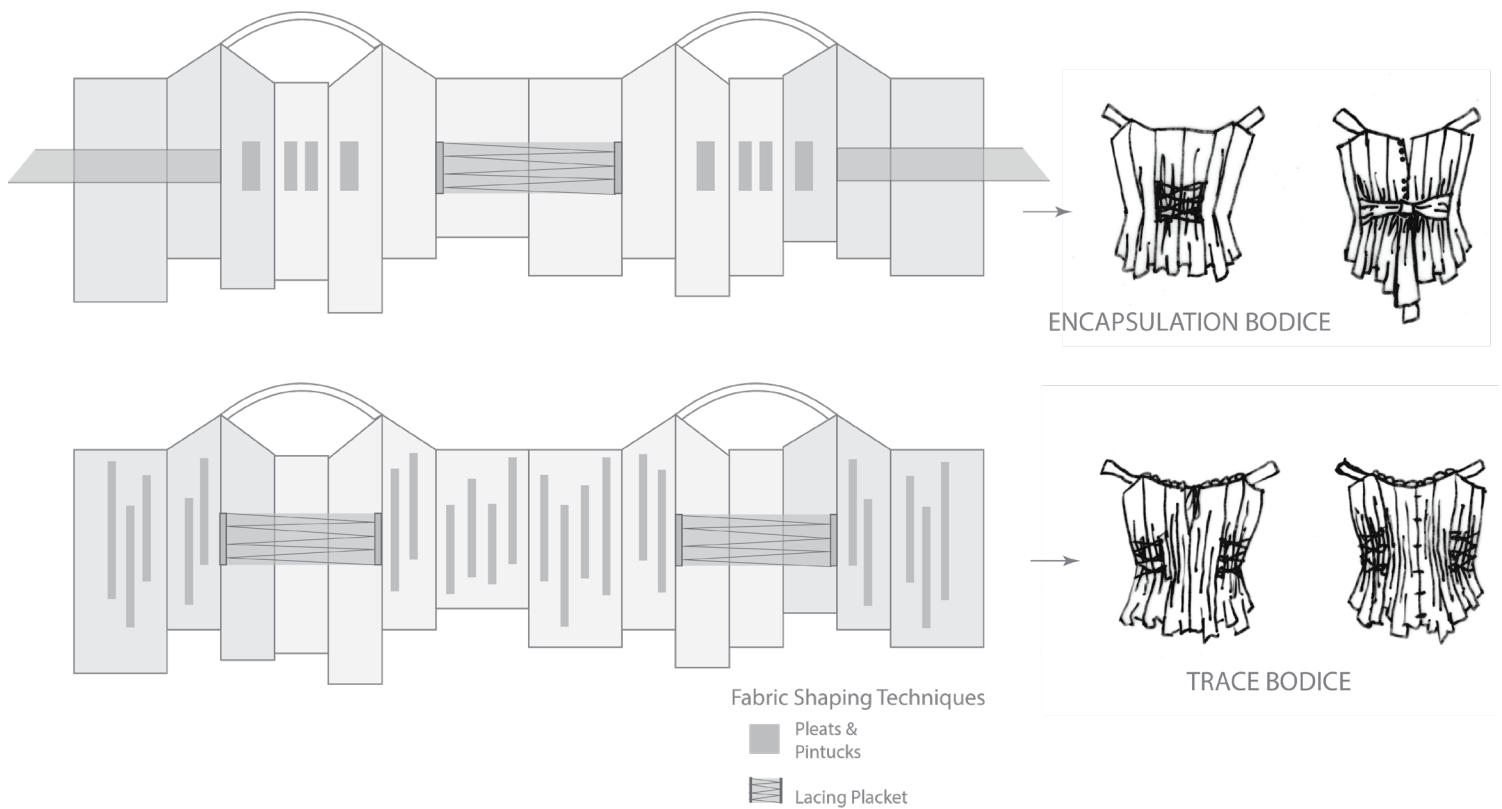


Figure 64.

Fabric shaping techniques for strip grid pattern translations. Strips are translated with fabric shaping techniques to become Trace and Encapsulation Bodices within the grid pattern model.

In this practice, making Trace and Encapsulation bodices to use up side strips from primary garments endorses the inclusion of strip cut methods, criteria set during earlier phases, and the realisation of an effective whole circular collection model. I crafted bodices with the multifunctional grid pattern using strip tie methods for shaping with insertion stitch techniques, thus proving how strip cut methods can work in combination with primary zero waste single or multiple garment patternmaking (Figures 64 & 65). Testing in this Phase 4 demonstrates that waste can be anticipated at the initial design phase of designing a circular collection. Practitioner audiences can choose whether to use patternmaking or strip cut techniques to make secondary garments or reincorporate waste into primary garments. These design decisions depend on the number of garments required, the anticipated quantity of strips produced, and the makers intentions for adaptability and aesthetic of the garments.



Figure 65.
Trace Bodice Toile.

4.5 Phase 5. Final Resolved Practice

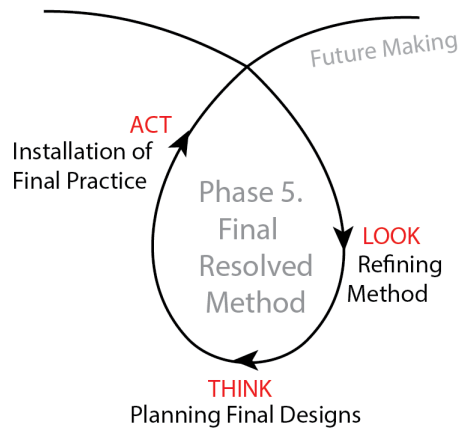


Figure 66.
Phase 5 Final Resolved Method.

4.5.1 Refining Method

Phase 5 is a synthesis of this research and focuses on applying a refined circular collection approach to generate a resolved collection of six zero waste womenswear items (Figure 66). The final garment collection will use selected criteria such as material considerations and fabric shaping techniques to yield a more visually cohesive collection. Reflecting upon design limitations created when testing the first iterative circular collection inspired a resolved circular collection model involving a simplified two-step process. Tested in Phase 5, this model crafts multiple garments from only one pattern, so waste need not be recycled within an overlarge number of secondary garments. The model proposes a primary pattern using single or multiple-garment patternmaking techniques, then using up deliberately-generated side-strip waste in accordance with the strip cut methods to either make a secondary garment or improve the adaptability of the primary garment(s) (Figure 67). Therefore, all waste can be self-encapsulated within a single pattern, making the model more accessible to fashion practitioners.

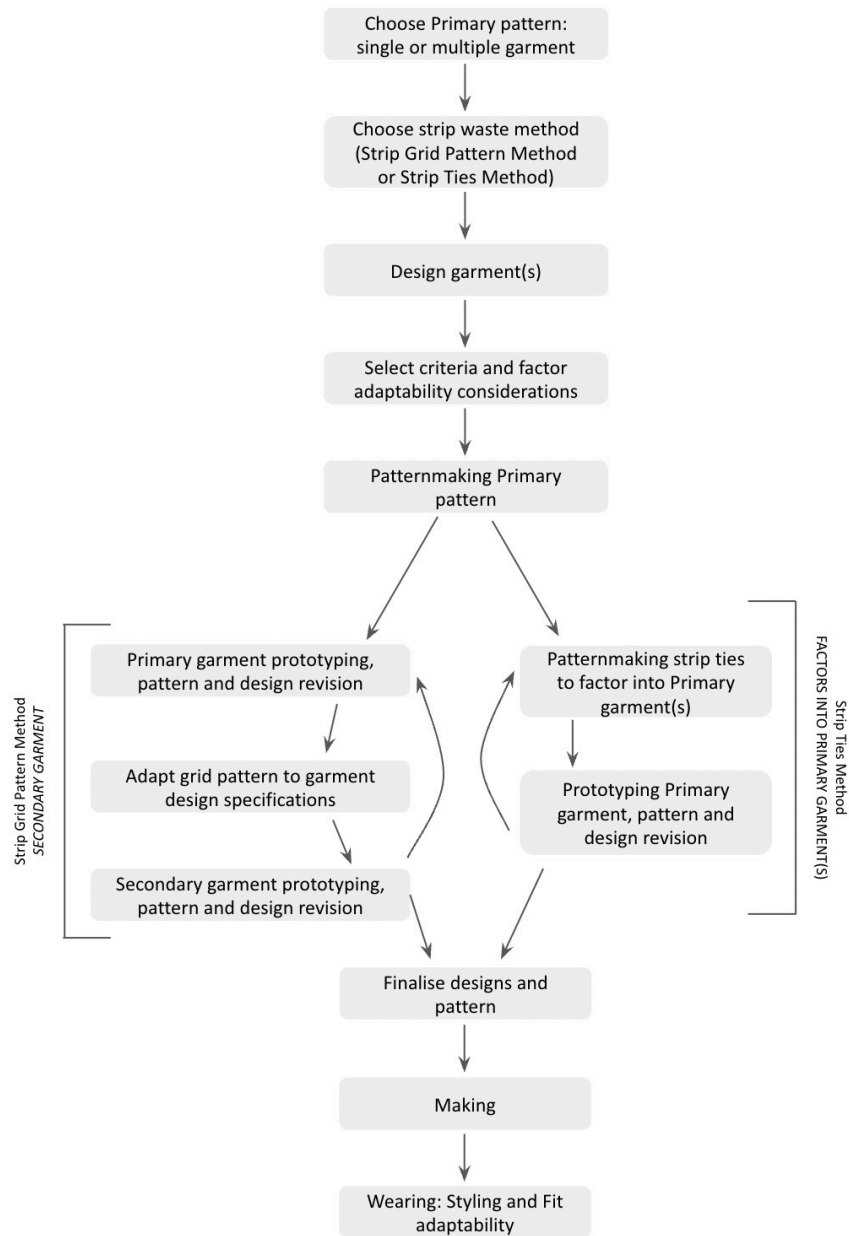


Figure 67.
Resolved Circular Collection
Development Process.

The refined circular collection model anticipates waste, so one primary pattern and strip cut method can be chosen and designed in initial stages. Therefore, waste is self-encapsulated within the pattern.

Through this zero waste garment practice, the physical patterns have become key artefacts of this research.⁸² Therefore garments and patterns produced in this final phase will be exhibited together. A synthesis of this practice will be exhibited at St Paul St Gallery, Tamaki Makaurau Auckland, from 29 June – 2 July, 2023. The final practice will demonstrate the application of the refined circular collection model, with photographs added to the thesis as Appendix A. This installation will present zero waste patterns as the key artefacts of the research, combining Phases 1–5 patternmaking findings through each self-encapsulated circular collection so that the viewer might visually trace the scrap reincorporation journey.

82 "Reflection in and on Action and Practice in Creative-Production Doctoral Projects in Art and Design"

5.0 Conclusion

This inquiry asked: How can zero waste patternmaking techniques be applied to generate an alternative approach to waste management in fashion practice? The research mapped a making framework as a circular collection model, involving zero waste patternmaking and ongoing scrap reincorporation. Exploring this question became a journey of self-reflection to develop a personal mode of making, underpinned by the 1977 *femme* concept⁸³ of waste collection and craftsmanship. The inquiry tested methods of single garment, multiple garment and strip-cut zero waste patternmaking when carrying out iterative testing through Phases 1-5. Design and patternmaking criteria were tested and reflectively edited to inform conclusive solutions to waste generations and patternmaking constraints. Through this process, the importance of being able to anticipate all waste generation at the initial stage of designing was recognised, so fashion practitioners might properly map a complete collection.

This research communicates a personal process of zero waste making and is intended to increase designer understanding of potential sustainable practices in the garment making process. The practice provides designers with tools to develop their own zero waste cyclical collections. The size of the collection became a limitation of the practice since all garments needed to be produced for all waste to be used up. Further limitations of this practice were the difficulty in communicating personal intuition and tacit knowledge during zero waste design and patternmaking decisions. Criteria such as textile printing, multiple fabrics or fabric shaping techniques proved it was possible to extend the practice creatively. However, garment designs became secondary whilst refining the zero waste techniques resulting in a visually incohesive collection. Additionally, the overapplication of too many varied criteria caused some visually incohesive outcomes, such as technical fabric shaping techniques taking over the design in Phase 3, causing the Encapsulation jacket, bra and knicker to have incohesive differing aesthetics. Phase 5's exhibited collection, using the resolved circular model, intends to use a refined basis of criteria to generate a more cohesive aesthetic through colour, design and styling.

83 "Waste Not, Want Not: *Femme*."

This research builds upon existing practitioner knowledge within the field of zero waste garment generation. The inquiry is significant as it explores solutions to problems identified by zero waste patternmakers, such as McQuillan's acknowledgement of side strip waste as a cutting issue. Methods provided for fabric waste usage are supported by the contextual positioning; combining embedded zero waste design-thinking and the *femme* ethos of scrap collection and reincorporation. Considering the zero waste patterns as key artefacts, this practice facilitates complex configurations of multiple-garment patternmaking, which couldn't generally be achieved in conventional zero waste practices. It incorporates practitioner considerations of pattern and garment modification through design, patternmaking and styling stages, allowing fashion practitioners to modify the patterns to their own preference.

In future practice, this research may be expanded to become accessible to a wider range of audience skill levels. Publication booklets and an open-source digital database could visually support this practice to communicate the potentials of the circular collection model, pattern adaptability and side strip waste solutions. The scope of the design criteria could also be expanded to guide the work in new directions, such as furthering the placement print criteria to add another level of design to a garment's aesthetic. This resolved model and its patternmaking processes could form the basis for an educational tool to inform learning design audiences about the variable potential of zero waste practice through an alternative approach. Through this inquiry designers might be informed of the destructive impacts of the current fashion industry, and be equipped to prioritise fashion waste management by undertaking ongoing zero waste making at personal or industrial levels.

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Appendix

Appendix A – Final Images

Modes of Making: Adaptable Zero Waste Patternmaking Encapsulation Pattern Set

Examining the issue of material offcut waste within fashion production systems, the Modes of Making: Adaptive Zero Waste Patternmaking exhibition presented a refined circular collection of garments. This approach to clothing design illustrates an alternative design framework to circular fashion design, referencing techniques studied throughout this thesis practice. These techniques include Phases 1; Scrap Recycling, Phase 2; Single Garment Zero Waste, Phase 3; Multiple Garment Zero Waste, and Phase 4; Strip Cut Zero Waste. The collection of garments identified the underpinnings of zero waste patternmaking as criteria setting, adaptability considerations (in patternmaking and styling stages) and side strip waste solutions (in strip ties or grid patterns for secondary garments). The development of each self-encapsulating pattern involved choosing a primary zero waste pattern technique (single garment, multiple garment or strip grid), then a secondary solution (strip ties, or strip grid pattern garment) when side strip waste may be produced if the chosen final fabric proved larger than the primary pattern. The capacity to adapt patterns, embed shapes and curved lines, produce complex forms like undergarments, encapsulate irregular waste shapes, and adaptively utilise linear waste was demonstrated. The suspended garments and mounted patterns served as the artefacts of the exhibition, accompanied by flyers with illustrative labelled pattern diagrams.

Pattern One - Single Garment Zero Waste Pattern

Cropped Encapsulation Jacket

Side Strip Waste Solution: Strip Ties

Pattern Two - Multiple Garment Zero Waste Pattern Main Layer

Combined with lining: Encapsulation Jacket, Bra, Knicker

Side Strip Waste Solution: Strip Cut Bodice

Pattern Three - Multiple Garment Zero Waste Pattern Lining Layer

Combined with main: Encapsulation Jacket, Bra, Knicker

Side Strip Waste Solution: Strip Cut Bodice

Pattern Four - Strip Cut Grid Pattern

Strip Cut Dress

Side Strip Waste Solution: Strip Ties



Figure 68.
Paul Chapman, *Modes of Making: Encapsulation Pattern Set Exhibition composition*, August 30, 2023.



Figure 69.
Georgia Rose, personal
photograph, *Modes of Making
Exhibition*, viewed by audience,
August 29, 2023.



Figure 70.
Paul Chapman, *Pattern
One: Single Garment Zero
Waste Pattern and Cropped
Encapsulation Jacket with strip
ties*, August 30, 2023.

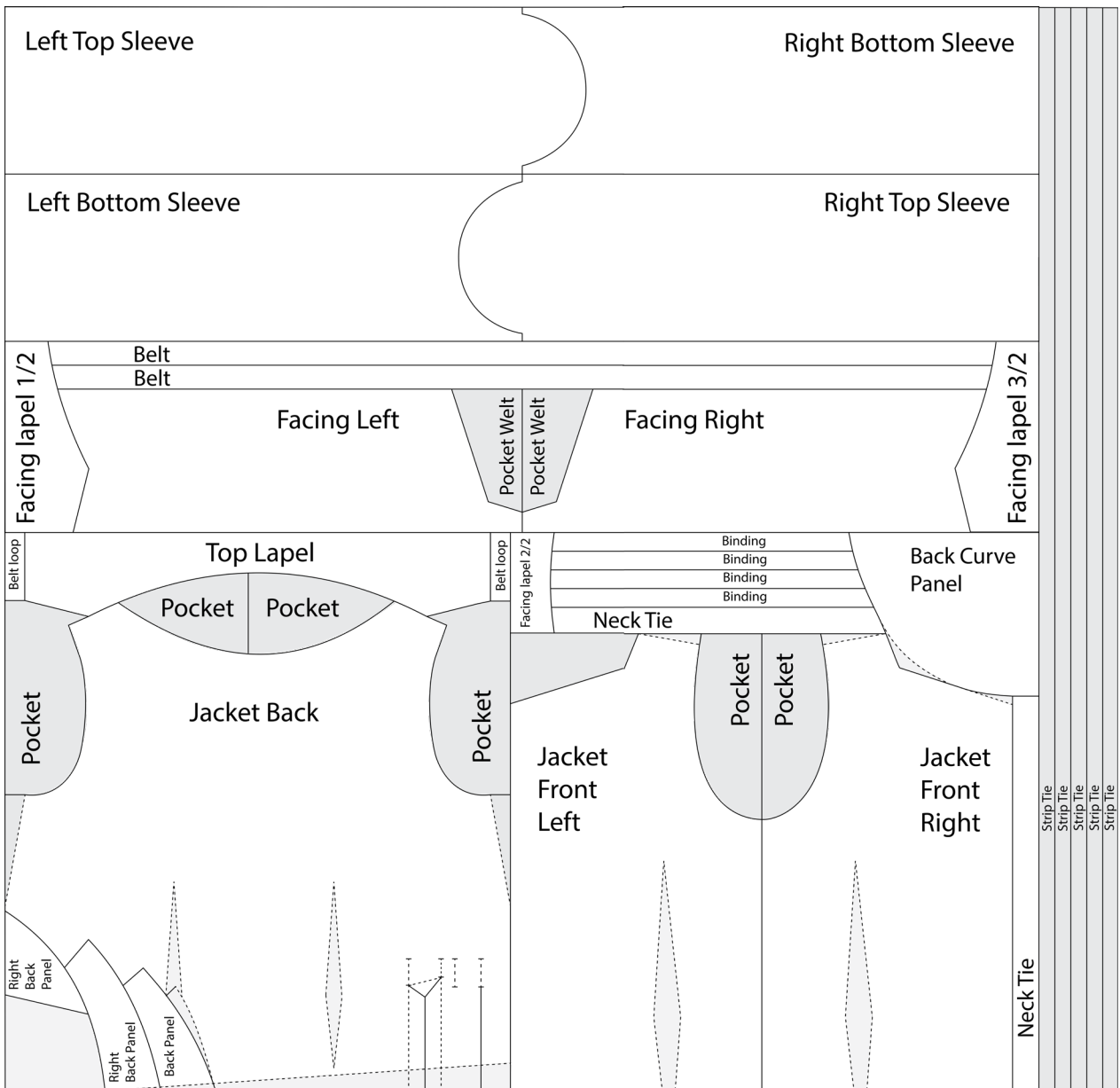


Figure 71.
 Single Garment Zero Waste
 Pattern diagram. Makes
 Cropped Encapsulation Jacket
 with strip ties. Diagram by the
 author.



Figure 72.
Paul Chapman, *Cropped
Encapsulation Jacket with strip
ties for styling adaptability*,
August 30, 2023.



Figure 73.
Paul Chapman, *Pattern Two and Three: Multiple Garment Zero Waste Pattern Main and Lining layer. Makes Encapsulation Jacket, Bra, Knicker, Strip Cut Bodice*, August 30, 2023.

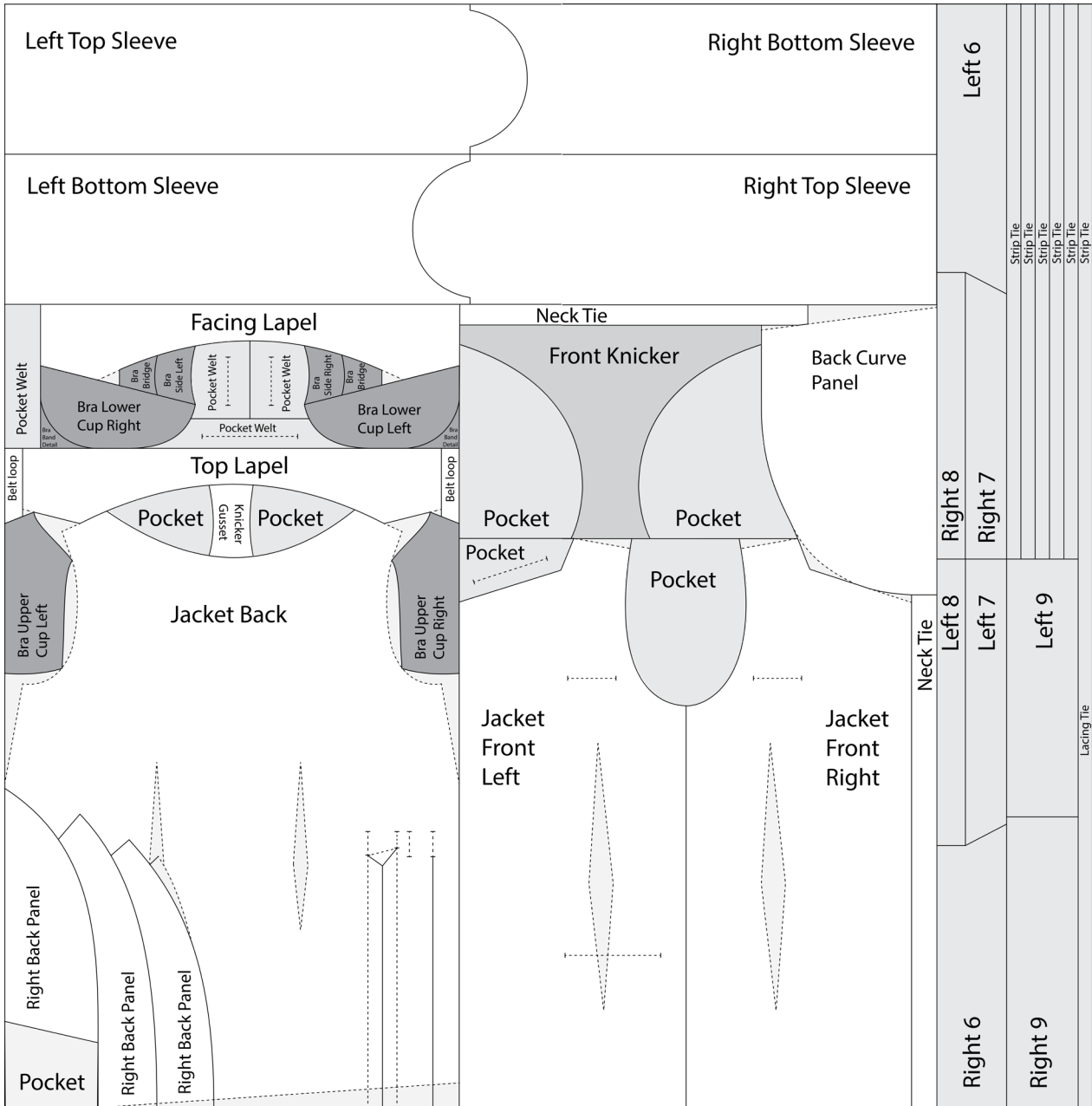


Figure 74.
 Multiple Garment Zero Waste
 Pattern Main Layer diagram.
 Makes Encapsulation Jacket,
 Bra, Knicker and Strip Cut
 Bodice. Diagram by the author.



Figure 75.
Paul Chapman, *Encapsulation*
Bra, August 30, 2023.

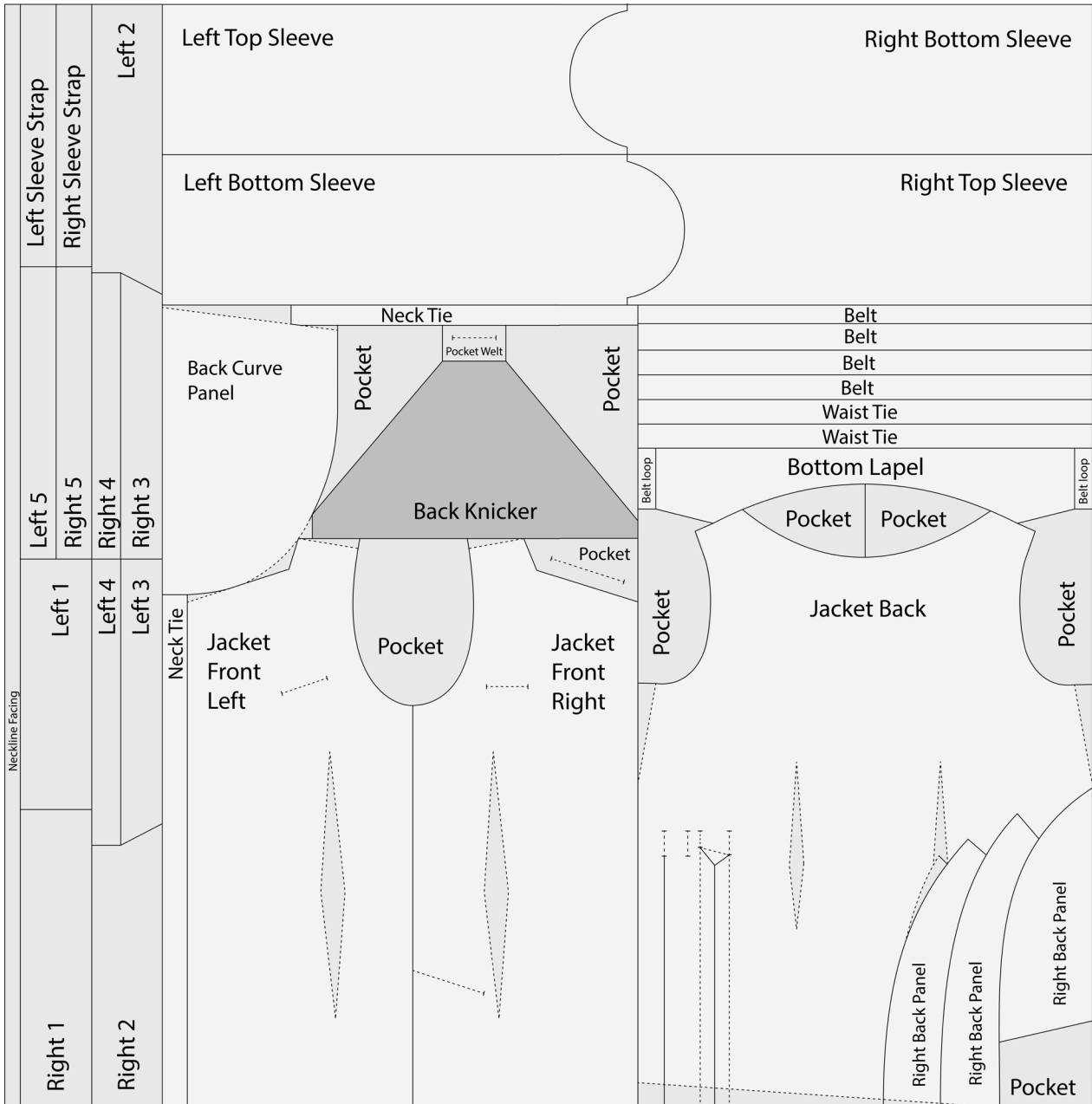


Figure 76.
 Multiple Garment Zero Waste Pattern Lining Layer diagram. Makes Encapsulation Jacket, Bra, Knicker and Strip Cut Bodice. Diagram by the author.



Figure 77.
Paul Chapman, *Strip Cut*
Bodice, August 30, 2023.

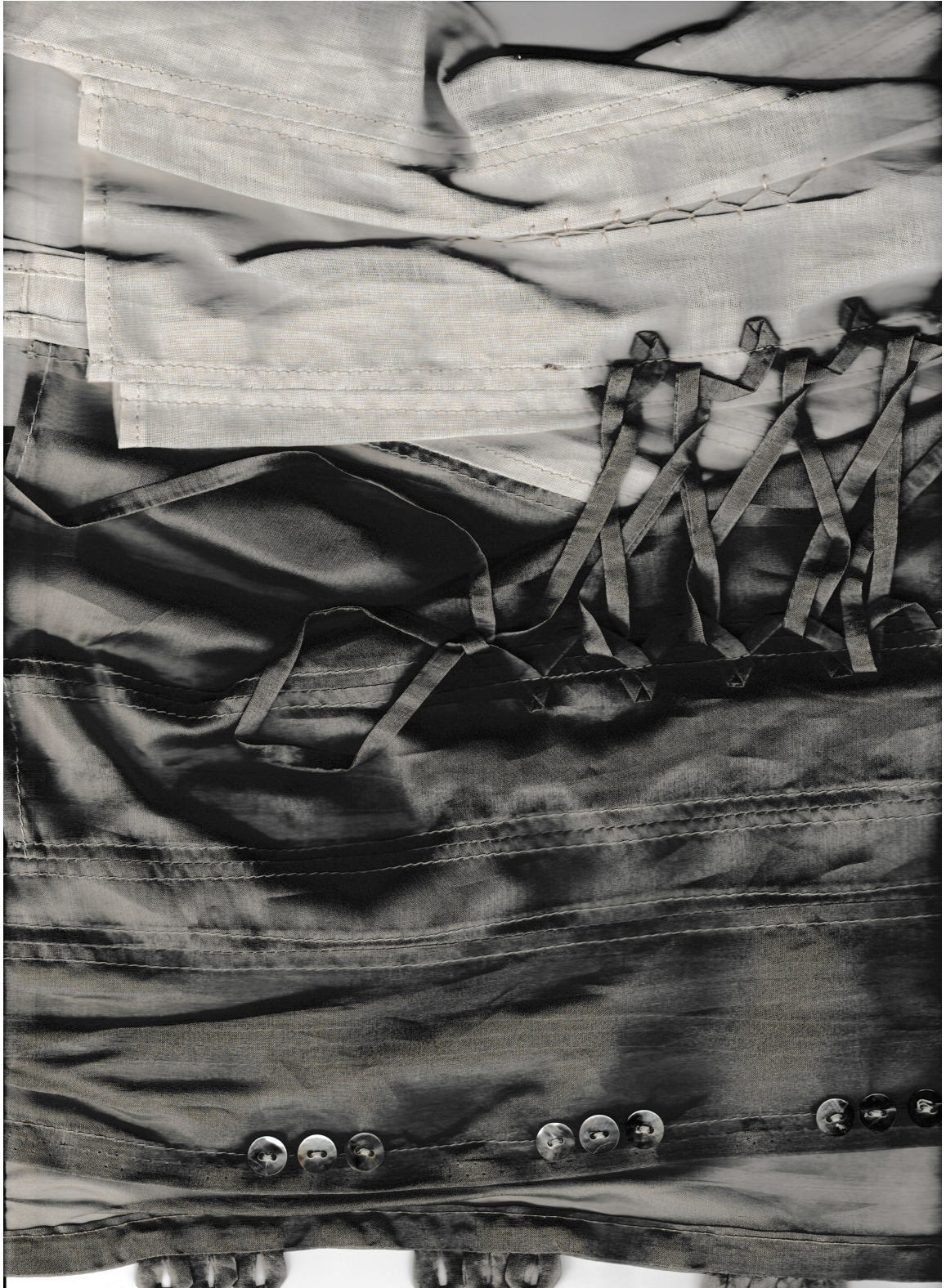


Figure 78.
Strip Cut Bodice: flat lay detail.
Image by the author.



Figure 79.
Paul Chapman, *Pattern Four:
Strip Cut Grid Pattern and
Strip Cut Dress with strip ties*,
August 30, 2023.



Figure 80.
Paul Chapman, *Strip Cut Dress*
with strip lacing and insertion
stitch detail, August 30, 2023.

