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Gradable Puffer Vest:
An Investigation into Zero-Waste Outerwear for Mass Production

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Introduction, Concept, & Contextual Review – *Gradable Puffer Vest* was created to build on previous research utilizing the Carrico Zero-waste Banded Grading (CZWBG) method, a technique used to achieve a range of garment sizes using a single zero-waste pattern (Rougeaux-Burnes, 2021, 2022). Each size is accomplished by inserting bands of varying widths into strategically placed garment seams (Carrico, 2021). Bands incorporated into the garment increase in width to achieve larger sizes and shrink to accommodate smaller sizes. Zero-waste garments currently being mass produced are often "one size fits most" and typically loose fitting. Patterns created using zero-waste methods regularly produce only one garment size with various fits achieved through adjustable features (i.e., drawstring, elastic, snaps/buttons, etc.) (McKinney et al., 2020). One of the largest deterrents from introducing zero-waste designs into the mainstream market is an inability to create patterns in a range of sizes (Carrico & Kim, 2014; Saeidi & Wimberley, 2018). The CZWBG method offers a solution to this challenge through the generation of fitted zero-waste garments in a full range of sizes.

In 2011, six design scholars began investigating the applicability of the CZWBG method to a variety of clothing categories intended for mass production. As the project entered Phase III, the designers were challenged to create a pattern and garment in alignment with mass production practices. The researchers first identified criteria the patterns must meet to ensure ease and efficiency of production. 1) Patterns must have stationary notches that do not move between sizes, 2) gathers and/or pleats must not change depth between sizes, and 3) to avoid confusion on the finished shape of pattern pieces, bands must not end on a corner. In addition to these criteria, designers were encouraged to consider all aspects of the design and production process, including aesthetics across the size range, grainline integrity, ease of construction, seam finishes, linings, and more. The study shifted to alpha numeric sizing (S, M, L, etc.) to ensure all garments were being produced in a uniform size range in preparation for a small batch production to be completed during a future phase of the project. A survey of measurement charts from well-known brands was completed to create a standardized bust, waist, and hip measurement for each size. The garments produced during this phase will later be evaluated by industry professionals to assess their readiness for mass production.

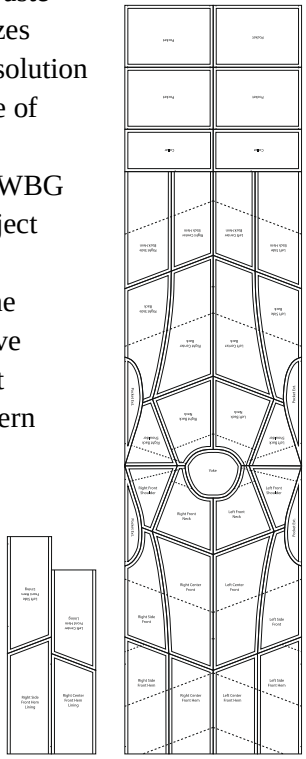

Figure 1. Zero-waste garment and interlining pattern layouts

Process, Techniques, & Execution –A versatile zero-waste vest design was chosen to ensure a marketable product was produced. *Gradable Puffer Vest* is a reversible athletic vest with insulation built into the garment. Water-resistant polyester twill was selected to increase the functionality of the garment and allow for it to be worn in a variety of circumstances, extending the life of the garment. A zero-waste pattern measuring 14.6 by 61.8 inches was established (Figure 1), which allows four copies of the pattern to be cut across a 59-60 inch textile. Seam allowances of ¼ inch were utilized throughout the pattern to align with manufacturing construction processes. Production of this vest requires two copies of the pattern per garment, which can be cut from contrasting textiles to allow the wearer two choices of color. Previous outerwear garments featured 1-inch bands in the mid-size iteration (Rougeaux-Burnes, 2020, 2021). However, in consideration of aesthetics across the size range, bands of 1.5 inches wide were chosen for this garment to ensure the bands did not become too narrow and appear disproportionate in the smallest size. In-seam pockets were chosen over patch pockets to eliminate shifting pattern markings between sizes. In contrast to many zero-waste patterns, the pieces were strategically designed and placed to maintain grainline integrity. Additionally, with the removal of one set of pocket bag pieces, this pattern can be used to construct a non-reversible version of the vest, which would retail at a lower price point and adding variety to a line of clothing. For the non-reversible version of the vest, each zero-waste pattern piece would simply be pre-quilted and stuffed before being attached to bands to create a full garment.

Due to the inclusion of in-seam pockets along the side front hem area, the front waist-to-hem sections of the vest had to first be individually stuffed before being sewn to other pieces. This allowed space for in-seam pocket bags to sit between the puffed layers. An additional zero-waste pattern for interlining of the front waist-to-hem sections was created to act as a backing when stitching and stuffing the bottom half of the vest (Figure 1). All other sections of the vest were stitched shell-to-shell and fiber filling was inserted to create the puffed effect. Once the front lower sections were pre-stuffed, two full vests were constructed (inside and outside layers) leaving one seam of the center back band open. The two vests were then stitched together along the dashed lines of the pattern, stuffing each section in the process, and moving from side seam to center front/center back. Each quilted section was closed at the seamlines by stitching the seam allowances of the two vests together (Figure 2). At center back, the garment was closed using the stitch-in-the-ditch method and the armscye and hemline were finished with bias binding.

Figure 2. Seam allowances of inside and outside vest layers stitched together to close stuffed sections

Aesthetics and Cohesion – Contrasting colors of polyester twill were utilized to offer the wearer two options of color when wearing the vest. One side of the vest was constructed in all black, while a dark cranberry color was chosen for the opposite side, providing the wearer with both statement and staple pieces within a single garment. Diagonal black bands running from side seam to center front angle down, creating a flattering silhouette for the wearer.

Design Contribution – *Gradable Puffer Vest* successfully met the three criteria set forth by the research team. Stationary notches and pattern markers were achieved using in-seam pockets and elimination of all fitting devices other than seams. Quilting lines have been marked on the pattern, which do not run through banded areas, and will therefore remain fixed for all sizes. Band insertions do not end on corners of the pattern but go through straight edges or run to the edge of the pattern. From this, the production team will be able to identify a clear end shape of the band without guides. Grainline integrity was achieved through the strategic design and placement of zero-waste pieces. This waterproof reversible zero-waste garment accomplishes the goal of creating a marketable, sustainably designed piece ready for mass production.

Future applications of this research will include an evaluation of the pattern created during Phase III of the project to assess its readiness for mass production. Based on industry professional feedback, alterations may be made to the pattern before putting it into a small batch production to test efficiency of the XZWBG method when produced using manufacturing-aligned construction practices. Once the technique is fully refined, it could be adopted by sustainably minded companies and incorporated into their product lines. This submission fills a gap in the knowledge of grading zero-waste outerwear intended for mass production.

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