

ONE SYSTEM FITS ALL: PROPOSING A MODULAR DESIGN
SYSTEM FOR DEVELOPING GENDERED PERFORMANCE
FOOTWEAR

by

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In the performance footwear industry, gendered design has historically dictated both the structural and visual differences between men's and women's shoes. While midsoles and outsoles are often engineered on separate male and female tooling platforms to account for biomechanics and load distribution, women's versions of top-tier performance models frequently receive less investment in innovation, storytelling, and fit precision. Uppers, the flexible component responsible for containment, lockdown, and comfort, are shaped around gender-specific lasts, but often lack aesthetic parity across male and female offerings.

This discrepancy has real physiological consequences. Female athletes experience anterior cruciate ligament (ACL) injuries at rates up to eight times higher than their male counterparts in comparable sports, a disparity frequently linked to footwear that fails to accommodate female foot biomechanics. Footwear that lacks appropriate heel fit, arch support, and lateral stability can increase the likelihood of injury during high-impact activities, especially in cleated sports and long-distance running. Meanwhile, many women continue to buy men's models for their more exciting colorways and broader market visibility, despite the fit mismatch. This dynamic underscores a critical gap between product storytelling and performance equity.

This thesis proposes a revised approach to gendered performance footwear: a **dual-last model** that preserves the aesthetic and tooling consistency of high-performing models while delivering anatomically informed fit for both men and women. Rather than attempting to create a unisex upper construction, which research suggests compromises the biomechanical precision needed in elite sport, this model encourages brands to design parallel uppers on gender-specific lasts using the same tooling/upper framework and color/material/graphic (CMG) language. Through a combination of anatomical analysis, industry workflow research, injury data, and firsthand experience developing women's cleated footwear at Adidas, this study explores how product teams can implement this approach in high-performance categories like cleats, basketball, and running shoes.

Ultimately, this work argues that footwear companies do not have to choose between production efficiency and fit equity. By committing to dual-last development in their highest-selling performance models, brands can honor the specific needs of elite male and female athletes, while ensuring that all users have access to the same expressive design language and functional excellence. This is not just a question of inclusivity; it is a matter of performance, injury prevention, and long-overdue parity in the design process.

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Chapter 1: Introduction – The Fit Equity Problem in Footwear Design

Footwear is often viewed as the final interface between an athlete and the ground. Yet for decades, this critical point of contact has been shaped by assumptions that fail to account for the diverse anatomy of the people wearing them. Most performance footwear today is designed around a single last—a standardized foot form—based largely on male morphology. Women’s versions of these shoes are often created through size grading, color updates, or minimal midsole tuning. This practice, known as the "shrink it and pink it" model, reflects a deeper systemic issue: **fit inequity**.

Fit inequity in performance footwear design refers to structural disparities in product development that fail to accommodate gender-based anatomical variation. Research in podiatric medicine and biomechanics has long established that female foot morphology differs from male morphology in more than just scale, including differences in arch height, heel-to-ball length, and forefoot width (Mündermann et al., 2002; Ferrario et al., 2004). The continued use of male-based lasts for so-called “unisex” footwear contributes to performance limitations and elevates the risk of lower-limb injuries for female athletes, particularly in high-intensity sports contexts.

This thesis explores the viability and implications of a **dual-last system**, in which both male-lasted and female-lasted versions of a brand’s highest-performing models are developed in parallel. The proposed system maintains visual consistency across gender lines while providing anatomically appropriate structural differences to enhance fit, function, and safety. By tailoring performance footwear to gender-specific morphology while preserving brand identity and design language, this strategy promotes both inclusivity and technical rigor.

The subsequent chapters investigate this proposition through a multidisciplinary lens. The research combines applied design methods, industry case studies, and practitioner reflection to

evaluate how such a system could be integrated into current development workflows. Drawing on firsthand experience in cleat innovation at Adidas US Sports, the analysis bridges biomechanical theory with practical execution, aiming to demonstrate that gender-specific performance design is both necessary and achievable at scale.

By addressing fit equity through anatomically responsive design solutions, this work contributes to ongoing efforts to advance inclusivity, injury prevention, and innovation in the performance footwear industry.

Chapter 2: Gender Differences in Foot Morphology

Foot morphology differs significantly between men and women, with implications for both footwear fit and injury risk. Wunderlich and Cavanagh (2001) conducted a comprehensive study analyzing foot measurements from over 800 subjects, revealing statistically significant differences in foot shape that persist even when foot length is matched. For example, women generally have:

1. Narrower heels
2. Lower instep heights
3. Shorter arch lengths
4. Higher arch curvature
5. Greater forefoot width-to-length ratios

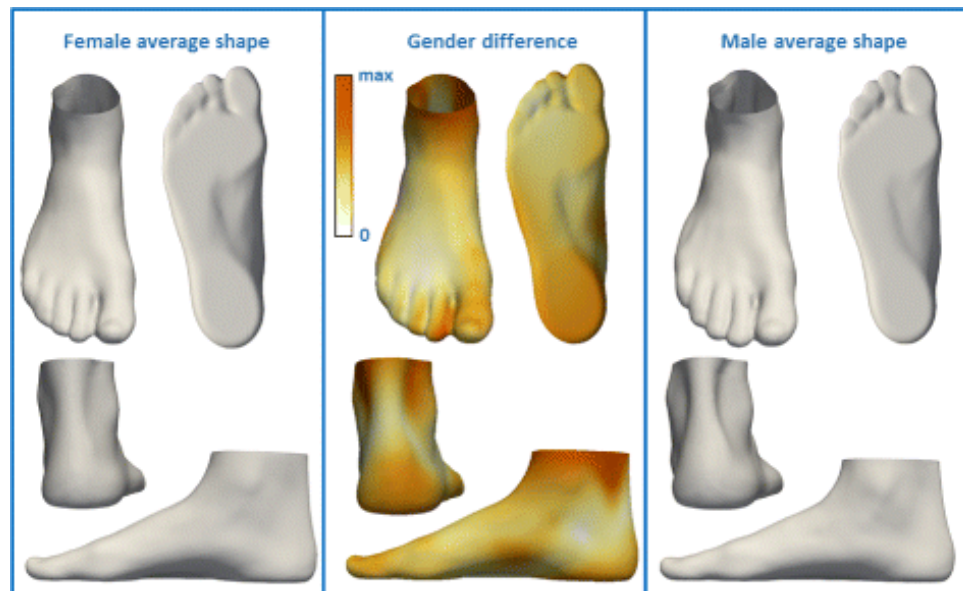


Figure 1: Differences in Foot Morphology Based on Gender

These differences are crucial because many female footwear models are traditionally designed with a "shrink it and pink it" mentality, modifying men's styles by simply reducing size and adding feminine colors or styling, without adequately adjusting the fit. Wunderlich and

Cavanagh argued that ignoring these morphological differences can lead to poor fit, reduced comfort, and greater risk of injury, particularly in performance contexts. Crucially, their research concluded that:

“Female feet and legs are not simply scaled-down versions of male feet but rather differ in a number of shape characteristics, particularly at the arch, the lateral side of the foot, the first toe, and the ball of the foot” (Wunderlich & Cavanagh, 2001, p. 610).

At the same foot length, women exhibited greater calf and ankle circumferences, lower ankle heights, higher arches, shallower first toes, and shorter instep lengths, features that challenge the appropriateness of using the same upper design across genders. Yet, despite these distinctions, Wunderlich and Cavanagh found:

“Although the power to discriminate between the shape of male and female feet is high, it should be noted that the absolute differences in some of the measurements are small” (p. 611).

This nuance reinforces the need for gender-specific fit strategies rather than a universal shared upper. While innovations in stretch-knit textiles, zonal tension systems, and additive manufacturing have broadened the capacity for adaptable footwear, recent research suggests that even with advanced materials, a single upper construction cannot adequately accommodate the biomechanical and morphological distinctions between male and female athletes—particularly in high-performance use cases like cleated sports and running.

As Wunderlich and Cavanagh (2001) emphasized, “Shoe fit should be considered as more than an issue that affects comfort. It is likely that injury prevention is associated with appropriate fit” (p. 611). This point is especially significant given the disproportionate rate of ACL and lower-extremity injuries among female athletes, risks that are compounded when

women are forced to wear downsized men's footwear lacking appropriate arch support, heel containment, and lateral stability.

Rather than seeking to merge male and female needs into a shared upper, a more effective approach is to build functionally distinct uppers on gender-specific lasts, while preserving a similar tooling form and design language. This allows brands to offer athletes of all genders the same storytelling, color/material/graphic innovation, and performance tier, without compromising on fit or injury prevention. Anatomical differences between men's and women's feet do not justify lesser investment in women's product development; they demand targeted design solutions that meet athletes where they are.

Chapter 3: Biomechanics, Footwear Fit, and ACL Injury Risk in Female Athletes

ACL injuries are among the most common and debilitating sports injuries, and female athletes experience them at rates significantly higher than their male counterparts. Studies report that women are two to eight times more likely to suffer non-contact ACL injuries in comparable sports (Arendt et al., 1999). This disparity has prompted considerable investigation into the anatomical, hormonal, and biomechanical factors at play, yet footwear fit remains an underappreciated contributor to injury risk.

3.1 Injury Epidemiology and Gender Disparity

Arendt and Dick (1995) first published epidemiological data from the NCAA Injury Surveillance System revealing that women collegiate athletes had significantly higher ACL injury rates than men in sports such as soccer, basketball, and gymnastics. Subsequent biomechanical research has reinforced that female athletes often land from jumps with greater knee valgus angles and reduced hamstring activation, both of which increase ACL loading during deceleration or pivoting (Renström et al., 2008). These mechanical disadvantages are compounded when footwear fit fails to stabilize the foot within the shoe, introducing uncontrolled movement that travels up the kinetic chain.

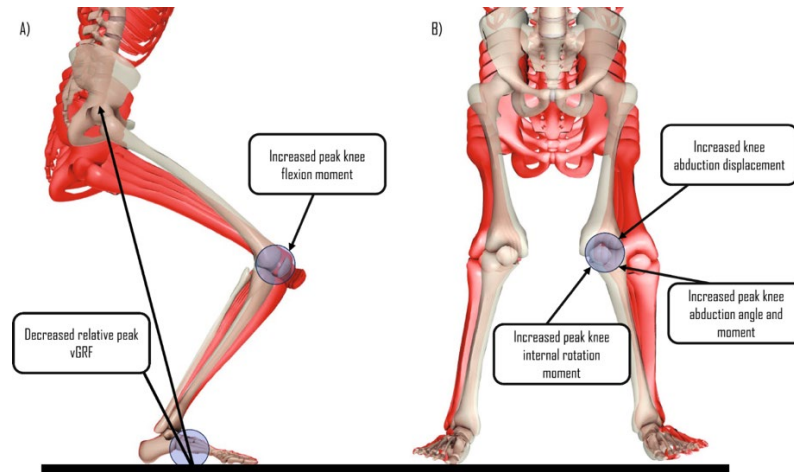


Figure 2: Lower Limb Differences and Implications for ACL Injury in Female Athletes

3.2 Footwear Fit and Its Role in ACL Injury Mechanics

A growing body of evidence suggests that poorly fitting footwear, especially cleated or running shoes, may exacerbate biomechanical risk factors for female athletes. Heel slippage, arch collapse, and lateral instability within the upper can contribute to unstable landings, slower neuromuscular responses, and altered proprioception. In their influential study, Renström et al. (2008) noted that external stabilizers like braces or well-designed footwear could mediate some ACL risk factors, but cautioned that current sports products often fail to account for women's specific needs. As they conclude, "anatomical and biomechanical considerations should inform footwear design as much as they do training interventions."

Nike's Sports Research Lab has also acknowledged the role of footwear fit in ACL injury prevention. Internal testing has shown that women's cleats with poor heel containment and overbuilt uppers—borrowed from scaled-down men's models—contribute to instability during lateral movements. In response, Nike began developing gender-tuned cleats with zonal lockdown features and improved medial containment.

Recent NCAA surveillance confirms that ACL tears remain one of the most frequent season-ending injuries in women's soccer and lacrosse. A 2022–2023 report indicated that over

75% of female ACL injuries in these sports were non-contact, supporting the view that internal biomechanical and environmental factors, such as field conditions and footwear, are dominant contributors. These findings reinforce the urgency for footwear design that accounts not only for anatomical fit, but also biomechanical load distribution.

3.3 Rethinking the Footwear Response: From Shared Uppers to Parallel Models

While earlier design hypotheses explored the potential for shared uppers across men's and women's lasts, the growing body of biomechanical evidence makes clear that gender-specific injury mechanisms demand gender-specific fit solutions. A one-upper-fits-all approach risks flattening key anatomical differences, such as narrower heels, higher arch curvature, or medial instability in female footforms, into a generalized fit strategy. In performance settings where even small biomechanical imbalances can amplify injury risk, this compromise is untenable.

Instead, brands should pursue a **dual-last strategy**: offering the same performance model, same aesthetic language, same storytelling, same innovation stack, but tuned to both male and female anatomies through distinct gendered last based constructions. This means designing a female- lasted upper that addresses high-risk zones for ACL injury: medial forefoot lockdown, arch support, heel containment, and proprioceptive feedback. In parallel, male- lasted uppers should be built to optimize stability and explosive lateral response, which align with common male biomechanical profiles.

Rather than retrofitting men's designs or relying on modular upper systems alone, brands can invest in parallel upper development for their highest-selling cleated and running silhouettes, where injury risk, athlete visibility, and consumer demand converge. This dual-pathway model acknowledges gender differences without compromising equity: women deserve performance

products as thoughtfully engineered as those built for men, but with fit profiles that reduce injury risk instead of exacerbating it.

By drawing on athlete biomechanics, injury surveillance, and user-centered design, footwear teams can transform parallel development into a performance safeguard, not a cost inefficiency. The payoff is not just commercial: it's athletic longevity, biomechanical health, and design equity.

Shared uppers cannot fully address gendered injury risk in high-performance footwear. To protect female athletes, brands must build parallel lasted models—offering identical innovation aesthetics with tailored functional fit.

Chapter 4: Current Footwear Design Practices and the Case for a Dual-Last

Upper System

Historically, footwear companies have developed gender-specific uppers based on gendered lasts—an approach rooted in 19th-century mass production systems that prioritized uniformity over anatomical accuracy. As Riello and McNeil (2011) explain, “The rise of industrial shoemaking demanded uniformity, not individuality. Mass production necessitated the creation of standardized lasts, typically modeled on the average male foot” (p. 14).



Figure 3: Components of a Footwear Last

Women’s footwear, rather than being designed from unique anatomical data, was often “derived from men's patterns, reduced in size but not reconfigured in shape, reinforcing assumptions that female feet were merely smaller versions of male ones” (Riello & McNeil, 2011, p. 16). This legacy persists in performance footwear design, where separate male and female products often differ not only in structure but also in aesthetic investment—further reinforcing gender segmentation in marketing and innovation.

However, this binary approach comes with trade-offs. As Wunderlich and Cavanagh (2001) found, even when normalized for foot length, female feet exhibit distinct differences in arch height, instep circumference, and forefoot width—critical dimensions that directly affect fit, support, and injury risk. Still, many brands treat female cleated footwear or running shoes as scaled-down versions of male product lines, without proportional adjustment in upper construction or midsole geometry.

As Motawi (2017) writes in *How Shoes Are Made*, “Once the last is finalized, every panel, lining, and overlay of the upper must be patterned to fit its exact shape. Even small changes in last dimensions will require a complete redraw of the upper pattern” (p. 47). This makes gender-specific footwear development more costly and time-intensive, as “each new upper pattern typically needs its own set of cutting dies, tooling, and production tests—making gender-specific design not only a design challenge, but a manufacturing one” (Motawi, 2017, p. 49).

Nonetheless, the solution is not to collapse this difference into a one-upper-fits-all model, but rather to standardize the aesthetic and performance storytelling across gendered products while tailoring fit through separate upper builds on male and female lasts. As Motawi puts it, “A last is the heart of a shoe. Patternmakers build everything around it—there’s no way to swap a male upper onto a female last without structural compromises” (p. 50).

The opportunity, then, lies in consolidating tooling platforms when possible and color/material/graphic narratives while differentiating fit through parallel upper development. Footwear brands can achieve this by applying a dual-last strategy to their highest-selling (within men and women consumers) performance models using shared midsole and outsole tooling where appropriate but investing in upper designs tailored to the biomechanical needs of both

male and female athletes. This approach preserves brand identity across product lines while delivering meaningful fit solutions.

As Riello and McNeil (2011) observe, “The shift from bespoke to factory-made shoes meant a loss in anatomical specificity, replaced by averages and generalizations that continue to inform fit today” (p. 20). Inverting this logic, a return to anatomical specificity, through dual-lasted upper systems, could restore performance equity without sacrificing efficiency.

Rather than eliminating gender distinctions in favor of modularity, performance brands should double down on gender-informed fit, while ensuring that the same design language, storytelling, and innovation quality is delivered across both male and female models. In doing so, they can move beyond “shrink it and pink it” and offer equitable product experiences for all athletes.

Chapter 5: Material Innovation and Fit Technologies

Advancements in material science have transformed the potential of upper construction in performance footwear. Brands such as Adidas, Nike, and HOKA have pioneered proprietary textiles, Primeknit, Flyknit, and adaptive mesh respectively—that emphasize zonal support, flexibility, and environmental efficiency. These innovations have enabled more responsive and anatomical fit experiences, but their greatest value may lie in their ability to support fit-specific design, rather than one-size-fits-all solutions. Instead of being leveraged to justify shared uppers across gendered lasts, these materials offer the opportunity to create tailored uppers that honor distinct biomechanical needs while preserving shared design language and tooling.

Bowers et al. (2017) emphasized how knitted uppers enable “directional stiffness to contour specific anatomical regions,” allowing for localized flexibility and structure without additional material waste (p. 142). These characteristics suggest that designers can use the same base silhouette, stitch line, and panel configuration, yet deliver materially differentiated fits across a men’s and women’s version of the same model. In other words, material innovation supports aesthetic consistency and functional divergence.

Nike’s Flyknit technology exemplifies this potential. Introduced in 2012, Flyknit was initially celebrated for cutting production waste by up to 60% compared to traditional cut-and-sew construction. However, its deeper value lies in how it enables adaptive tensioning. Nike has described Flyknit as a system that “adjusts to the athlete’s foot in motion” through zoned knit structures (Nike, 2018). With this capacity, designers could possibly build male and female versions of a cleat or runner using identical pattern shapes, but deploy varying yarn tension, foam density, and stretch zones to achieve fit specificity without altering the visual form.

Adidas's Primeknit platform operates similarly. Their patent documentation notes "knit zones with varied modulus elasticity to stabilize midfoot regions while allowing toe splay" (Adidas Patent US20170361875A1). In practice, this allows pattern developers to hold constant the shell geometry while tuning the internal comfort and lockdown experience. When coupled with a distinct female or male last, these material choices can bridge the gap between biomechanical performance and production scalability.

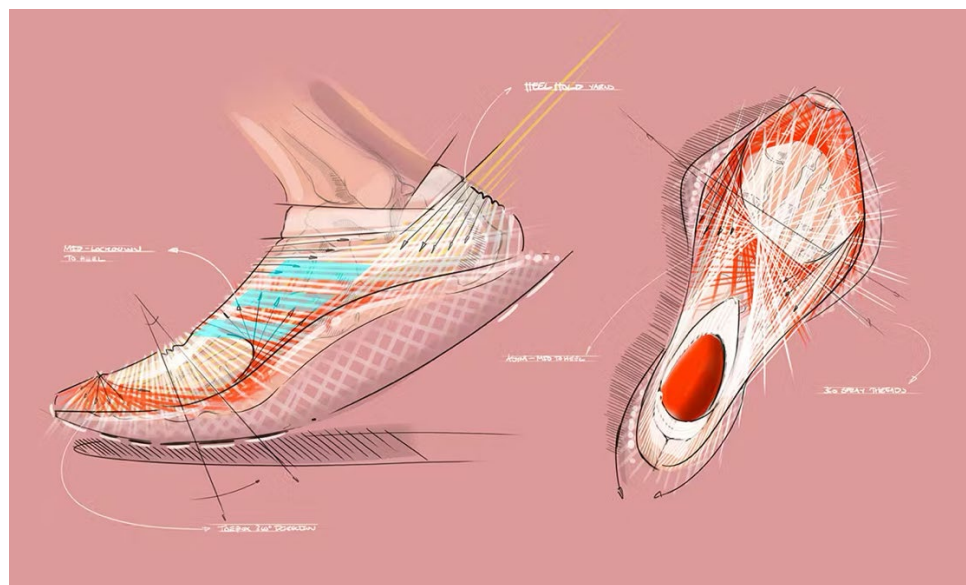


Figure 4: Adidas' Newest Technology *Strung* can Create Zonal Tension in One Upper Flat

However, while stretch materials and engineered knits increase adaptability, they are not a universal solution for gender-based foot differences. Fit remains affected by instep height, forefoot width, heel slip, and overall foot volume, parameters that cannot be corrected through material elasticity alone. As such, brands must resist the temptation to use material flexibility as a substitute for gendered fit strategies. Instead, they should treat innovations like Flyknit and Primeknit as platforms: modular tools for delivering differentiated performance fits from a unified design framework.

Interviews with developers at industry giants reinforce this emerging philosophy. As one innovation team engineer noted,

“It’s all driven by data. Pressure mapping, arch mobility, and movement patterns tell us where an upper needs to behave differently, and we would then build that into the knit.”

These insights point toward a workflow where the same pattern files could potentially be layered with different tension profiles, padding volumes, or reinforcement materials, allowing tailored solutions without duplicating design effort.

In high-performance categories, particularly cleated sports, distance running, and basketball these material strategies become critical. Footwear for female athletes must not only account for anatomical variation, but also mitigate injury risk. Material mapping informed by sports science, such as NSRL’s internal foot scans or NCAA injury surveillance data, can guide where extra lockdown, arch support, or collar padding should be placed in the women’s lasted version of a shoe, without abandoning the shared aesthetic or brand narrative.

Ultimately, material innovation should not be viewed as a reason to erase gendered distinctions in fit. Rather, it enables designers to honor those distinctions more precisely and more sustainably. In doing so, brands can achieve a higher standard of fit equity—offering both men’s and women’s lasted versions of their highest-performing models, united by design but separated by biomechanical purpose.

Chapter 6: Operationalizing a Dual-Last Strategy: From Market Signals to Product Execution

The implementation of a dual-last performance strategy is not a theoretical exercise in fit equity alone—it is a practical, data-backed opportunity for brands to align product design with real consumer behavior. By analyzing purchasing trends, reviewing consumer feedback, and strategically investing in parallel last development, footwear companies can deliver anatomically precise fit systems for both men and women, without sacrificing aesthetic continuity or storytelling impact.

6.1 Data-Driven Product Identification

The first step toward execution is identifying which silhouettes warrant dual-last investment. Rather than beginning with R&D speculation or heritage bias, brands should mine consumer sales data to find models with high cross-gender appeal. This includes:

- Top-selling performance models (cleated, running, basketball, etc.) with at least 25% gender crossover in purchasing behavior
- SKUs where female consumers are purchasing the men’s version, typically due to superior colorways or earlier access to tech innovations
- Models where social or athlete-driven storytelling (e.g., Olympic athletes, professional footballers) resonates across demographics

For example, Nike’s internal merchandising report from 2022 noted that women consistently purchased the men’s AlphaFly not for fit, but because the “more aggressive colorways and storytelling were only available in the male version” (Nike, 2022). This underscores the importance of aligning aesthetic storytelling with anatomical inclusivity.

From interviews in Sports Marketing Product Management, “If both genders are buying the same shoe for the story, we owe it to them to give the same fit quality too.”

6.2 Cross-Referencing Fit and CMF Disparities

Once high-priority models are identified, qualitative data should supplement sales figures. Brands can:

- Scrape customer reviews to identify consistent pain points (e.g., “heel slippage,” “tight forefoot,” “needed to size down twice”)
- Compare return rates by size and gender, flagging potential fit misalignment
- Conduct targeted consumer surveys asking users why they purchased across gender lines
- Cross-reference colorway performance and social engagement to determine which visual directions drive multi-gender interest

By triangulating this data, footwear teams can justify investment in a second last for models where women are already compromising fit to access better design. This creates a market-validated case for gender-specific fit on a shared aesthetic platform.

6.3 Cross-Functional Workflow for Dual-Last Footwear Development

Once consumer data pinpoints which models warrant dual-last investment, the implementation process must be led by coordinated cross-functional teams. Developing parallel male- and female- lasted versions of the same performance model—while maintaining shared aesthetics and tooling—requires synchronized contributions across design, development, materials, biomechanics, merchandising, and sourcing.

This section outlines how footwear brands can structure such a system, ensuring that product storytelling remains unified while fit and performance are anatomically tuned.

Design & Color/Material/Graphics (CMG) Teams

- Objective: Maintain consistent visual language across gendered fits.
- Responsibilities:
 - Develop a single silhouette and CMF strategy (color, material, finish) for both versions.
 - Coordinate with biomechanics to ensure that aesthetic overlays do not compromise functional zone construction (e.g., flexible knit zones, foam thickness).
 - Use material libraries and print maps that accommodate different volume builds without changing the appearance.

Key Workflow Adjustment: Design teams must spec two fit volumes into one visual form, enabling gendered differentiation at a structural level but sameness in external storytelling.

Last Engineering & Biomechanics Teams

- Objective: Generate gender-specific lasts that reflect morphological and performance differences.
- Responsibilities:
 - Use 3D foot scan data and athlete testing to define instep height, heel shape, arch contour, and toe spring separately for men and women.
 - Map pressure points and injury-risk areas to inform internal geometry of the shoe.

- Provide last shape feedback to pattern developers and developers, flagging material interference risks.

Key Workflow Adjustment: Both lasts should remain compatible with the same outsole tooling, requiring extreme precision in upper-to-bottom integration.

Pattern Development & Technical Development Teams

- Objective: Build pattern variants based on each last while retaining unified panel outlines and manufacturing process.
- Responsibilities:
 - Adjust stitch lines, tension zones, and material layering to support the volume and biomechanical needs of each gender-specific last.
 - Keep outer shape consistent while internally differentiating fit specs (e.g., gusset height, foam package, heel counter stiffness).
 - Communicate redlines across both gender versions during fit testing and iterative sampling.

Key Workflow Adjustment: One master shell pattern may serve both fits with internal reinforcement and material-specific modifications.

Material Innovation & Testing Teams

- Objective: Identify textiles and construction methods that adapt to gender-specific fit needs while performing similarly.
- Responsibilities:
 - Test knit densities, foams, and fusing layers against each last shape to ensure consistent lockdown and containment.

- Approve alternate textiles that respond to different foot pressure maps without changing external texture or finish.
- Collaborate with design to integrate CMF with technical functionality.

Key Workflow Adjustment: Integrate zonally engineered textiles that perform differently by fit version, not necessarily by pattern shape.

Merchandising & Product Line Management (PLM)

- Objective: Ensure that both gendered versions of the product are positioned, marketed, and stocked equitably.
- Responsibilities:
 - Align drop dates, colorways, and storytelling across men’s and women’s versions.
 - Avoid “tiering” women’s products as lifestyle or less technical—emphasize parity in positioning and access.
 - Ensure size ranges are inclusive and that both products appear in campaigns and retail experiences.

Key Workflow Adjustment: Frame the dual-last strategy as a performance innovation, not a segmentation tactic.

Sourcing, Factory & Operations Teams

- Objective: Implement efficient production of dual-fit products without excessive duplication.
- Responsibilities:

- Coordinate tooling and pattern-cutting dies to support variant lasts on shared outsoles.
- Maintain separate material tension and assembly specs for each version.
- Monitor quality assurance across the two builds to ensure consistent performance.

Key Workflow Adjustment: Establish dedicated lines or alternating batch runs to prevent cross-contamination of fit specifications.

Conclusion: Toward Integrated Dual-Fit Systems

Rather than duplicating design pipelines, this system builds a modular workflow where each department develops fit-specific solutions on a shared visual and tooling base. Athlete insights, 3D scanning, and digital prototyping further support rapid iteration. An athlete consultant noted in a Fit Equity Forum:

“It’s not about having ‘pink’ versions of gear, it’s about having gear that fits our anatomy but still gives us the same footprint on the field.”

Through this collaborative approach, footwear brands can develop high-performing gendered product with shared storytelling, closing the gap between performance and visual aesthetics.

Chapter 7: Design Workflow Analysis

7.1 Analyzing the Current Design Workflow and Integrating the Dual Last System

Footwear design is a complex, multifaceted process that requires careful consideration of multiple elements, from consumer identity to manufacturing processes. The integration of a dual last system, where brands offer both male-lasted and female-lasted versions of their highest-selling models while maintaining a consistent visual aesthetic, must consider how current workflows and methodologies accommodate such innovation. The following analysis explores how this system could be integrated into existing footwear design processes.

1. Kick-Off Meeting & Market Analysis

Current Workflow: The project begins with a thorough understanding of market trends, consumer needs, and emotional connections to the product. Brands evaluate how the product can stand out in the market, which includes setting goals for the collection, determining pricing, and establishing sustainability objectives.

Integration of Dual Last System: When integrating the dual last system, the brand's analysis would need to include gender-specific preferences in both fit and aesthetic, alongside consumer data that highlights demand across genders. The product's visual identity, such as branding and colorways, would need to be adjusted to ensure it resonates with both male and female consumers without deviating from the core identity of the shoe.

2. Design Ideation & Last Creation

Current Workflow: The design process focuses heavily on creating a last—a 3D form representing the ideal foot shape for a specific activity or purpose. A last is shaped to reflect not only functional requirements (e.g., cushioning, stability) but also the desired aesthetic.

Integration of Dual Last System: The dual last system requires designing two versions of each shoe: one on a male last and one on a female last. This necessitates additional iterations of the last, as male and female feet exhibit different anatomical characteristics. Design teams would need to balance gender-specific fit adjustments (e.g., width, arch, toe shape) with an overarching goal of keeping the visual integrity of the shoe consistent across both versions. This may involve the use of adjustable or adaptive design elements, such as modular footbeds or interchangeable parts that allow both lasts to look visually similar while offering a tailored fit.

3. Material Selection & Manufacturing

Current Workflow: Materials are selected based on a combination of aesthetic trends, functionality, and cost. The choice of upper materials, footbeds, and cushioning systems plays a major role in defining the shoe's overall performance and look. Additionally, innovations like Knit-to-Shape uppers are becoming increasingly popular to reduce material waste.

Integration of Dual Last System: For the dual last system to work seamlessly, the choice of materials must allow for slight adjustments in sizing while maintaining the same overall look and feel. For example, materials with some degree of stretch or flexibility might be selected to accommodate both lasts. This could require testing for fit in various foot types across both men and women to ensure that the visual appearance (e.g., the stitching, pattern placement) remains consistent across sizes.

4. Prototyping & Iteration

Current Workflow: Prototyping involves translating initial design concepts into tangible samples, which are then tested for fit and functionality. Samples are typically created in standard sizes for men (size 9) and women (size 7), with multiple revisions made to perfect the design.

Integration of Dual Last System: When implementing the dual last system, prototyping must be done for both male and female lasts. The challenge here lies in ensuring that both prototypes feel the same when worn, while still offering a tailored fit. Collaboration between designers, pattern makers, and manufacturers would be crucial to ensure that all gender-specific differences are accounted for without compromising on style or performance.

5. Testing & Final Adjustments

Current Workflow: Testing is done by assessing the prototype in its intended context, gathering feedback, and making adjustments. The shoe is tested for comfort, performance, and durability, and it goes through rigorous trials to ensure it meets the design brief.

Integration of Dual Last System: Testing the dual last system requires that both male and female versions undergo the same tests for comfort, durability, and performance. The shoe's design, although adapted for different feet, should perform identically in terms of support, traction, and comfort. Consumer feedback must be analyzed not only on a functional level but also to understand how each gender responds to the product's visual design and messaging.

6. Pre-Production & Line Review

Current Workflow: In the pre-production phase, final specifications are confirmed, including sizing, molds, and material choices. A line review is held to ensure that the designs are ready for mass production.

Integration of Dual Last System: The dual last system requires adjustments to the pre-production phase to ensure that both lasts are aligned in terms of fit, function, and aesthetic. While the visual style should remain consistent, the grading of the shoe across different sizes may involve slightly different manufacturing techniques for the male and female versions to

ensure the correct fit. For example, the construction of the shoe's midsole or outsole may need to be tweaked to accommodate different foot shapes while maintaining consistent visual appeal.

Conclusion

Integrating a dual last system into existing footwear design workflows requires thoughtful coordination across various stages of the design process. From market analysis and ideation to prototyping, testing, and production, the goal is to create a product that caters to both male and female consumers without compromising on the shoe's core aesthetic and functional performance. While the additional complexity of working with two separate lasts adds to the design timeline and cost, the long-term benefits of inclusivity, enhanced customer satisfaction, and increased market reach outweigh these challenges. As the footwear industry evolves toward greater customization and inclusivity, the dual last system represents a natural progression in meeting diverse consumer needs.

Chapter 8: The Designer's Expanded Role in Dual Last Footwear

Development

In the shift toward a dual-last system, the designer's role expands significantly—not by narrowing their scope, but by embracing broader responsibilities. In this framework, the designer evolves into not only a translator of human performance needs into tangible form but also a co-developer of fit solutions and a curator of both aesthetics and biomechanics. Their success hinges on their ability to work across disciplines, managing the balance between gender-specific fits while maintaining a unified visual identity across both male and female lasted models. This requires the designer to be fluent in cross-functional collaboration, biomechanical interpretation, and iterative prototyping driven by continuous athlete feedback.

Designers as Systems Thinkers in Dual Last Footwear

Designers working within the dual-last system must approach product creation with systems thinking, considering the interdependent relationships between foot anatomy, material behavior, construction constraints, and user experience (Brown, 2009). Unlike traditional design processes where a single last may be used, the dual-last system requires designers to adapt the silhouette across genders while keeping the visual elements consistent. This challenge necessitates thoughtful adjustments in fit zones—such as forefoot volume, instep support, and heel containment—achieved through material layering, stretch, and padding zones.

While pattern lines across gendered versions of the shoe may remain consistent, these fit zones require specific tailoring to accommodate anatomical differences between men's and women's feet. As Sanders and Stappers (2008) explain, "designers in participatory processes must synthesize data, facilitate collaboration, and create artifacts that invite iteration and

reflection." In the context of footwear design, this means treating design drawings, technical specifications, and prototypes as evolving tools, not fixed aesthetic outcomes.

Cross-Functional Collaboration: Elevating the Product

Footwear design is inherently a cross-disciplinary effort, but the dual-last approach amplifies the need for collaboration. Designers must work closely with:

- **Biomechanics teams** to analyze how different foot shapes impact performance and injury prevention across genders.
- **Pattern developers** to ensure that the necessary fit adjustments preserve the core design silhouette.
- **Material engineers** to select textiles or knit structures that offer the right stretch and recovery properties for both male and female lasts.
- **Testing and wear teams** to gather direct feedback from both elite athletes and everyday users.

As a designer shared in an interview: "You can't just draw the shoe and hand it off. You sit in fit sessions and listen to athletes talk about what isn't working."

This kind of cross-functional collaboration does more than streamline development—it improves product outcomes. As Dym et al. (2005) note, co-creation across disciplines leads to better-integrated solutions, reducing errors and enhancing user satisfaction.

Athlete Feedback and Fit Zone Refinement

Athletes are invaluable sources of insight when refining the fit of footwear. In a dual-last system, user feedback directly informs design iterations, especially regarding the fit zones. Through testing and wear trials, athletes provide detailed feedback that CAD renderings or

pressure maps may not capture, helping to identify areas of discomfort or fit issues that can be adjusted in the next iteration.

As Sanders & Stappers (2012) argue, designers working within human-centered systems must translate deep user knowledge into actionable design changes. This approach refines not only gender-specific fit but also anatomical solutions, offering performance footwear that is precisely tailored to the user's body, regardless of gender.

Modular Design for Fit Equity: A Unified Silhouette

Ultimately, the dual-last system encourages designers to rethink the product silhouette as an adaptive system, rather than a fixed form. A cleat upper can appear identical across genders but feel distinctly different due to varied material tension, padding, or lamination methods in key fit zones.

“It’s not about making two shoes. It’s about designing one architecture that’s smart enough to serve two bodies,” explained a Nike designer involved in the FlyEase and ISPA lines. This shift from gendered designs to fit-informed zones supports both inclusivity and precision, eliminating the need for compromise. These adaptations aren’t just refinements—they actively promote equity in footwear design.

Conclusion: Leading the Shift to Inclusive Fit

Designers now lead the charge in creating inclusive performance footwear that responds to diverse foot shapes without sacrificing functionality or aesthetic coherence. In a dual-last framework, designers must balance biomechanics, material science, and emotional resonance to ensure that both male and female athletes experience a product that performs at the highest level. By focusing on fit equity through modular design, designers create shoes that support performance and promote inclusivity.

Ultimately, the success of the dual-last system proves that great design isn't about simplifying the process but about expanding possibilities through empathy, collaboration, and insight.

Chapter 9: Practitioner Reflection as Applied Research Methodology

In addition to reviewing existing literature and theoretical frameworks, this thesis integrates reflective practitioner experience to ground the proposed shared upper hypothesis within the realities of industry practice. As Donald Schön (1983) emphasizes in *The Reflective Practitioner*, design knowledge is often constructed not solely through abstract theorizing, but through iterative, experience-based problem solving. Similarly, Argyris and Schön (1974) advocate for “action science” methodologies, whereby learning occurs through cycles of action, reflection, and adaptation.

During the summer of 2024, I served as a Product Design Intern within the US Sports business unit at Adidas. Over a 12-week period, I engaged directly with the end-to-end footwear design and development workflow, including ideation, patternmaking, tooling design, prototyping, and cross-functional collaboration. This practitioner experience provided critical insight into the organizational, material, and technical constraints that shape footwear creation at scale—insight that is often difficult to fully capture through secondary sources alone.

Documenting this experience through structured reflection allows this thesis to bridge theory and practice, offering both an academic exploration of dual last feasibility and a grounded evaluation of how real-world processes might evolve to support such innovations. By embedding firsthand observations alongside literature analysis, this methodology enhances the study's applicability to professional design contexts, ensuring that the proposed recommendations are both aspirational and realistically implementable within the footwear industry.

The following section presents a structured journal of this practitioner experience, highlighting key phases, challenges, and insights that inform the dual last design hypothesis.

9.1 Design and Development Internship: A Case Study in Cleated Footwear Creation at Adidas

During the summer of 2024, I completed a twelve-week Product Design Internship at Adidas North America Headquarters in Portland, Oregon. I was embedded within the US Sports division, focusing on cleated footwear innovation and apparel design for emerging female sports markets. My primary assignment was to conceptualize and develop a performance-focused flag football cleat and uniform kit, specifically for female athletes, in anticipation of the sport's inclusion in the 2028 Los Angeles Olympics.

The scope of the project extended across:

- Footwear: New cleated tooling, upper construction, color/material/graphic (CMG) storylines
- Apparel: Fitted jersey and shorts kit addressing mobility and durability needs
- Primary research: Interviews with female athletes at the high school and collegiate levels
- CMG development: Exploring emotional and cultural storytelling through product design

9.2 Research Methodology: Athlete Interviews and Primary Insights

The early weeks of the internship were dedicated to contextual and ethnographic research. Through interviews with female athletes participating in flag football, lacrosse, and volleyball, I uncovered key qualitative insights:

Footwear Selection Behavior: Many female athletes reported purchasing men's cleated footwear models due to broader offerings in colorways, material options, and graphic

storytelling. Despite fit issues (e.g., excess width, improper arch support), the expanded aesthetic variety in men's lines influenced purchase decisions.

Footwear fit concerns: Soccer cleats or scaled-down men's football cleats were insufficient, leading to issues like heel slippage, arch instability, and lateral pressure overload.

Performance movement: Female athletes demonstrated greater ankle mobility, higher pronation rates, and narrower heel widths—confirming literature findings (e.g., Arendt et al., 1999; Renström et al., 2008).

Performance vs. Aesthetic Trade-offs: Athletes expressed frustration that women's performance footwear often lacked both functional support and self-expressive design options. One athlete noted, "It's how scouts, family, friends, and fans can find me on the field," emphasizing the role of footwear visibility in personal identity and performance environments.

These findings reinforce a critical tension: while fit and biomechanics are foundational for injury prevention and athletic performance, **aesthetic self-expression remains a decisive factor in product adoption.** Therefore, it is essential that gender-specific performance adaptations do not diminish the richness of color, material, and graphic narratives traditionally found in men's product lines. Additionally, interviews with Adidas Innovation team members (notably Nicole Schrier) highlighted the ongoing development of gender-specific lasts to better reflect the unique biomechanics of female athletes.

This supports the broader hypothesis of this thesis—that performance footwear can and should integrate zonal anatomical tailoring without sacrificing consumer-driven aesthetic demands.

9.3 Footwear Development: Design and Prototyping Workflow

Upper Design Strategy

Rooted in the concept of "peacocking"—leveraging expressive style as a form of psychological dominance—I sought to design an upper that combined visual aggression, lightweight construction, and feminine performance expression. Key design decisions included:

- Low-profile silhouette with a mid-cut booty to balance speed aesthetics and ankle support.
- External heel counter and cutout for lateral lockdown.
- Transparency in material choices, emphasizing the cleat's technical architecture rather than concealing it.

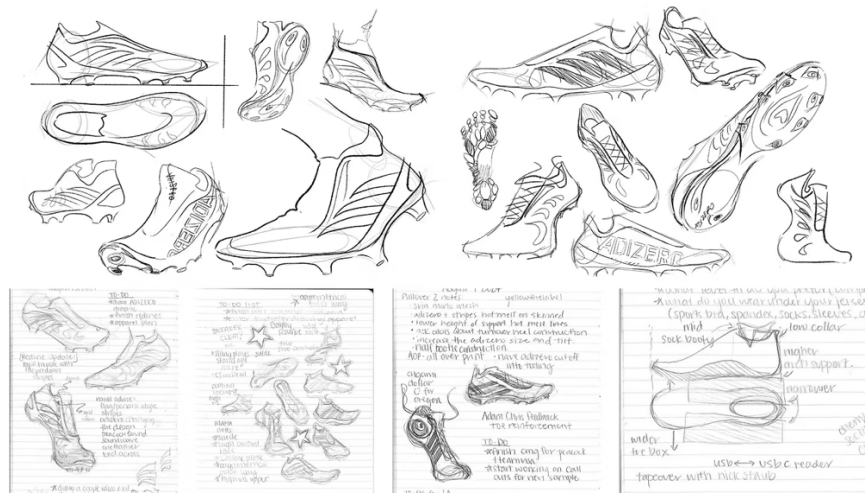


Figure 5: Initial Footwear Sketches and Notes on Process

After presenting initial concepts at the first Design Concept Review (DCR), feedback emphasized the opportunity to push for more boldness and innovation, reinforcing Adidas' design culture of "breaking conventions."

Prototyping and Pattern Development

Working closely with Harold A. and Mitch B. from the Product Creation Team (PCT), I learned traditional footwear shell patterning methods, including taping, flat pattern extraction, scanning, and CAD refinement. After multiple iterations:

- I delivered a pullover sample for early feedback loops.
- Addressed material interaction issues such as gapping at high-stress zones (e.g., vamp and eye stay transitions).
- Utilized exploded shell pattern mapping to visually communicate the material strategy and layering intent.

Throughout this phase, iterative sampling reinforced the critical role of pattern developers in translating 2D design intent into 3D functional product—a key theme supporting the modular shared-upper hypothesis.



Figure 6: Early Prototype Upper Development

Tooling Design: Cleated Plate Development

In parallel, I engaged in cleat plate design for the outsole tooling.

Key challenges included:

- Balancing rotational flexibility with medial-lateral stability
- Maintaining traction while minimizing weight
- Ensuring female-specific foot pressure zones were addressed in stud mapping

The tooling design process consisted of:

- Stud configuration prioritized rotational agility and lateral traction, based on female-specific movement studies.
- With mentorship from Nick Staub, I created 2D tooling techpacks translating organic, three-dimensional foot movement into manufacturable blueprints.
- Iterative sessions with Nick Martushev yielded 3D-printed prototypes—both flexible and rigid—allowing for in-hand validation before finalization.

This experience provided firsthand understanding of how shared tooling platforms could theoretically support modular upper variations—critical context for evaluating shared upper feasibility.

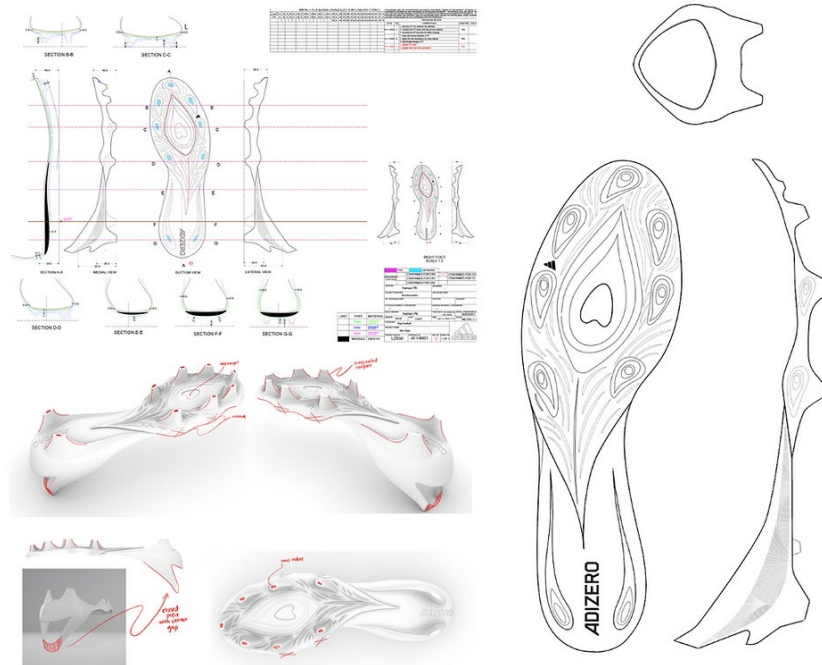


Figure 7: Tooling Development and Redlines

Color, Material, and Graphics (CMG) Development

Partnering with the US Sports CMG team (notably Charlie K., Maria I., and Brett S.), I developed two colorway stories:

- "Peacock" concept: Symbolizing dominance and individuality through expressive tonal color blocking.
- "Team USA" concept: Celebrating national identity in preparation for the Olympic Games.

Through learning sublimation processes and CAD material mapping, I deepened my appreciation for material interaction—an essential factor in modular footwear, where changes in material tension or finish drastically affect fit.

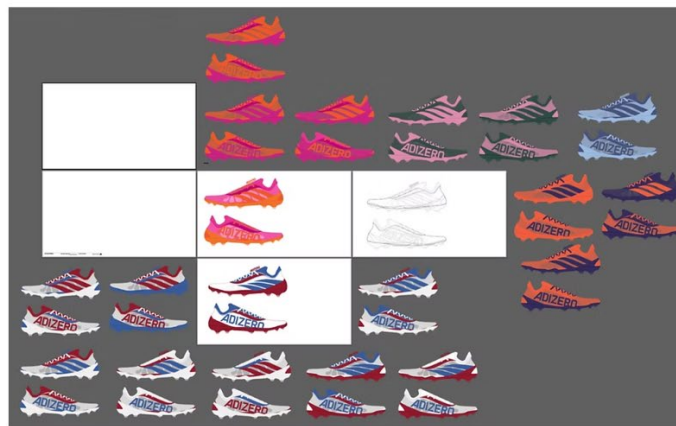
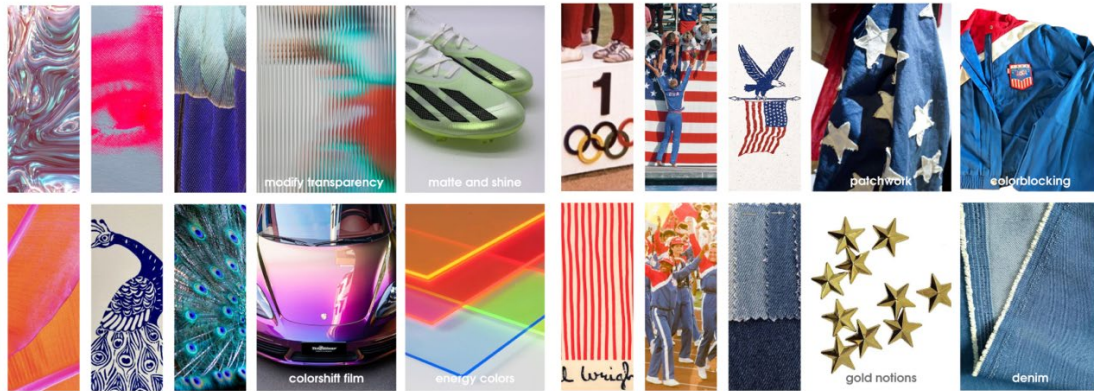


Figure 8: Color, Material, and Graphics Design Iteration

9.4 Final Outcome and Presentation

My project culminated in a final presentation to a panel of approximately 40 Adidas employees, including leadership from US Sports, Basketball, CCP, and PCT. Articles included:

- Final cleat sample with customized upper and printed plate
- Sublimated sock liners and branding applications
- Full uniform kit (jersey + shorts) displayed on mannequin
- Research board and material swatch board

Athlete insights, material maps, pattern shells, and final sample feedback were presented as part of the storytelling journey.



Figure 9: Final Presentation Board

9.5 Reflections and Implications for Shared Upper Design

This internship experience validated several critical themes for this thesis:

- **Pattern flexibility is crucial:** Minor changes to material layering and tension can produce major differences in fit without altering panel outlines.
- **Cross-functional collaboration is non-negotiable:** Successful modular systems require tight loops between designers, pattern developers, material engineers, and athlete testers.

- Athlete-centered feedback is indispensable: Primary research surfaced non-obvious user needs—such as the tradeoff between fit and aesthetic choice—that must inform modular designs.
- Designers must advocate for aesthetic richness even in high-performance segments: Offering a modular upper that only serves biomechanical needs, without emotional storytelling, risks alienating key consumers—particularly young female athletes.
- Shared tooling is plausible: Outsole platforms can anchor multiple upper configurations with strategic zonal fit customization.

9.6 Conclusion

Through this twelve-week immersive product development cycle at Adidas, I gained direct experience in both the challenges and opportunities inherent in creating performance footwear for female athletes. The insights gathered reinforce that future innovation in shared upper footwear must balance anatomical rigor with expressive design storytelling, meeting the full spectrum of athlete expectations for function and identity.

Chapter 10: Testing, Feedback, and Iterative Design in Dual-Last Systems

The development of dual-last systems in footwear is a complex process that relies heavily on iterative design practices. In this chapter, we explore the critical role of testing and feedback—both quantitative and qualitative—in refining dual-last footwear designs. Through rigorous testing protocols, such as wear trials and biomechanical assessments, designers are able to gather insights that allow them to continually improve product fit, comfort, and performance across both male and female lasts. This chapter examines how these feedback loops from prototypes to final products inform the ongoing evolution of the dual-last system, ensuring that the final footwear meets the diverse needs of athletes across genders.

10.1 The Role of Fit Testing and Wear Trials in Improving Dual-Last Footwear

The cornerstone of refining dual-last footwear is fit testing, which involves assessing how the shoes perform in real-world conditions, focusing on comfort, support, and functional fit. This step is especially important in the dual-last system because it allows designers to test the efficacy of their gender-neutral and performance-specific adjustments.

Fit testing begins with prototypes developed from the dual-last design system. During this phase, athletes from diverse gender and foot morphology backgrounds participate in wear trials. These trials provide insights into how well the footwear performs across a range of activities and environments. For instance, professional runners, basketball players, or casual users might wear the shoes for extended periods, providing critical feedback on how the shoe's fit impacts their comfort, movement, and overall performance.

The dual-last system introduces additional layers of complexity. Designers must ensure that both male and female lasts fit comfortably and effectively while maintaining a consistent aesthetic and structural integrity. Through wear trials, designers can track where athletes

experience discomfort or performance issues, such as pressure points or instability, and use that feedback to make precise adjustments to the dual-last prototypes.

Key considerations during testing include:

- The shoe's ability to accommodate foot-specific issues like arch height, instep volume, and forefoot width.
- Performance in different athletic contexts (e.g., running vs. cutting sports).
- Comfort during long-term wear, especially across varying foot shapes and sizes.

10.2 Incorporating Athlete Feedback to Enhance Fit Zones (Forefoot, Instep, Heel)

Fit is a crucial factor when designing footwear that caters to both male and female foot anatomies. While the overall silhouette may remain consistent, the fit zones—such as the forefoot, instep, and heel—must be adjusted to account for the anatomical differences between genders. Female athletes generally have narrower heels and higher insteps, while male athletes may require more room in the forefoot area. By incorporating athlete feedback into the design process, these specific fit zones can be optimized for both performance and comfort.

Forefoot Adjustments:

The forefoot area is critical for stability and propulsion in many athletic activities. Female athletes may require more volume in the forefoot to accommodate a wider metatarsal base, while male athletes may need more lateral support in the area. Feedback from wear trials can pinpoint areas where adjustments are necessary, such as increasing volume or modifying the materials used in the toe box to prevent pinching or discomfort during activity.

Instep and Heel Adjustments:

Athletes' feedback regarding instep fit is equally important, as it impacts comfort during long periods of movement. Women tend to have higher arches, which might require additional

padding or design adjustments to provide proper support. Male athletes, on the other hand, may have lower arches, necessitating different solutions to ensure fit without compromising on stability.

The heel area is often a pain point for athletes who experience slippage, particularly with footwear that is meant to fit both male and female last molds. Athlete feedback can reveal how the heel cup performs, whether it secures the foot comfortably without friction, and how the shoe responds to lateral movements or intense activity. Adjustments based on this feedback might involve tweaking the heel counter design, adding cushioning, or modifying the upper material to better conform to the athlete's foot.

Enhancement of Fit Zones Based on Feedback:

- **Forefoot:** Adjustments in volume or structure to prevent pressure points and improve toe flexibility.
- **Instep:** Modifying padding and structural support to accommodate varying arch heights.
- **Heel:** Tightening or loosening heel cups to minimize slippage and enhance overall stability.

10.3 Quantitative vs. Qualitative Data in Iterative Design

In the iterative design process for dual-last systems, both quantitative and qualitative data play indispensable roles. While quantitative data provides measurable insights into the shoe's performance—such as pressure points, stride analysis, and load distribution—qualitative data offers deeper, more subjective feedback from athletes regarding comfort, aesthetics, and overall satisfaction.

Quantitative Data:

Quantitative data typically comes from biomechanical assessments, such as pressure mapping, gait analysis, and motion tracking. These data points help designers understand how the shoe performs during various activities, identifying pressure imbalances, areas of excessive strain, or poor traction. For example, pressure maps can reveal whether the shoe's fit properly distributes weight across the foot or whether any area experiences excessive stress. Gait analysis can help designers assess how the shoe moves with the athlete, detecting potential stability issues or foot movement restrictions.

Qualitative Data:

Qualitative feedback from athletes is equally essential, particularly for understanding aspects of comfort and usability that can't be quantified through sensors or analytics. Athletes' subjective experiences—how the shoe feels during various stages of movement, the level of support provided during specific sports, or their perceptions of comfort and fit—are critical to improving the design. This feedback can often highlight issues that quantitative data alone cannot, such as discomfort during longer periods of wear or irritation in specific areas of the shoe.

The combination of these two types of data allows designers to triangulate the design adjustments needed. Quantitative data offers concrete evidence, while qualitative data provides context and human insight, enabling designers to make decisions that balance both functional performance and athlete satisfaction.

10.4 The Feedback Loop and the Role of Testing in Validating Design Hypotheses

The iterative design process for dual-last footwear is driven by an ongoing feedback loop that moves from initial design concepts to prototypes, testing, and final products. The feedback

loop is crucial in validating design hypotheses, ensuring that each iteration moves closer to an optimal fit and performance solution.

The Feedback Loop in Action:

- **Initial Prototype:** The first iteration of the dual-last footwear is developed based on initial design hypotheses, gender-specific fit considerations, and biomechanical insights. This prototype undergoes internal testing and initial wear trials.
- **Testing and Feedback:** During the testing phase, athletes provide feedback on the prototype's performance, comfort, and fit. Data from quantitative measures (e.g., pressure mapping) and qualitative athlete feedback are gathered and analyzed.
- **Design Revisions:** Based on the collected data, the footwear undergoes design revisions to address identified issues, such as inadequate fit in the forefoot or heel area, excessive pressure points, or suboptimal material choices.
- **Final Prototype and Validation:** The revised prototype undergoes further testing, with the process repeated to ensure the design aligns with the initial goals. Each iteration is more refined than the last, with the feedback loop driving continuous improvements.

This process ensures that design hypotheses are continuously validated, and that the footwear meets the evolving needs of athletes. By repeatedly testing and refining the dual-last system based on direct feedback, designers can ensure that the final product is both functional and comfortable for all foot types, genders, and athletic activities.

10.5 Real-World Case Studies from Brands Implementing Dual-Last Models

To illustrate the effectiveness of the dual-last system, this section explores real-world case studies of brands that have successfully implemented dual-last models. These examples demonstrate how iterative design processes, driven by athlete feedback and data, have led to the development of inclusive, high-performance footwear.

Case Study 1: Nike's FlyEase System

Nike's FlyEase system, which incorporates a modular design that adapts to various foot shapes, serves as a key example of how feedback and testing can drive inclusive footwear design. In the FlyEase system, Nike gathered extensive feedback from athletes with varying mobility needs to develop a shoe that accommodates different foot sizes and shapes while maintaining performance standards. This iterative process, informed by athlete trials and biomechanical testing, has resulted in a product line that effectively serves a broader range of athletes.

Case Study 2: Adidas UltraBoost 21 and Gender-Specific Fit Enhancements

Adidas has incorporated gender-specific fit adjustments in its UltraBoost 21 model, using feedback from wear trials to address the distinct fit needs of male and female athletes. Data from pressure mapping and athlete feedback were key in refining the shoe's midsole cushioning, forefoot volume, and heel containment, ensuring optimal performance across genders.

Conclusion

The iterative design process, driven by a robust feedback loop and guided by both quantitative and qualitative data, is essential to the success of the dual-last system in performance footwear. Through fit testing, wear trials, and real-world athlete feedback, designers can ensure that both male and female versions of a shoe provide a perfect blend of fit, comfort, and performance.

As demonstrated by leading brands like Nike and Adidas, the integration of athlete insights and the use of testing data are pivotal in refining the dual-last system, ultimately pushing the boundaries of inclusive design in the footwear industry.

Chapter 11: The Role of Color, Material, and Graphics in Performance

Footwear Design

Color, material, and graphics are fundamental elements in the design of performance footwear, often regarded as purely aesthetic choices. However, they carry significant functional implications that influence not only the performance but also the emotional and psychological connection athletes have with their shoes. These design elements contribute to both the practical and emotional aspects of a product, impacting fit, comfort, durability, and performance. Furthermore, they play an essential role in aligning the product with an athlete's personal identity, goals, and needs, while also reinforcing the brand's narrative and market position.

Footwear, particularly performance-driven shoes, must strike a delicate balance between functionality and emotional appeal. As athletes demand shoes that not only excel in performance but also resonate with their personal values and experiences, color, material, and graphics serve as vital tools in satisfying both functional and psychological needs. By considering these elements holistically, designers are able to create products that elevate performance while connecting emotionally with their user base. This chapter will explore the impact of these design choices and their significance in the world of performance footwear.

11.1 Color: Emotional Appeal and Performance Enhancement

Psychological Impact of Color

Color is often the first feature consumers notice, and it plays a profound role in influencing psychological responses. In the context of performance footwear, color choice can have a direct impact on an athlete's perception of their own abilities and confidence. Bright, dynamic colors such as red and orange are often associated with energy, power, and speed,

qualities that athletes seek to enhance. Conversely, colors like blue and green invoke calmness and stability, which might be chosen for sports or activities requiring focus and endurance.

The emotional resonance of color extends beyond personal perception—it also communicates the shoe's purpose. For instance, Nike's use of bold and vibrant colors in its running shoes communicates a sense of speed and agility, aligning with the brand's focus on high-performance footwear. Color also plays a key role in product positioning within the market. A design with high contrast and bold colors may signal innovation and high-tech performance, while more muted tones may appeal to consumers seeking a sleek, minimalist design. Ultimately, color choices are a strategic decision that can reinforce brand identity and influence consumer purchasing decisions.

Color for Performance

Beyond its psychological impact, color serves a functional role in performance footwear as well. For example, visibility is a significant concern for athletes who run or cycle in low-light conditions. Bright, neon colors are often incorporated into running shoes and sportswear to enhance visibility, contributing to safety while maintaining performance.

Moreover, color can also highlight specific design features that contribute to performance. Color blocking is a technique used by many brands to draw attention to particular zones in the footwear, such as the heel containment area, the midsole cushioning, or the traction zones of the outsole. These visual cues not only enhance the aesthetic appeal of the shoe but also communicate the technology and design focus behind the product. For instance, in trail running shoes, bright colors might accentuate the shoe's durability and grip features, reinforcing the product's practical functionality alongside its visual appeal.

11.2 Material: Functionality Meets Innovation

Durability and Performance

The choice of materials in performance footwear has far-reaching implications for both durability and overall performance. Materials such as breathable mesh, lightweight synthetics, and durable rubber soles are integral to a shoe's function in high-intensity sports. The ability of a shoe to manage heat, wick away moisture, and provide adequate breathability is essential in sports where foot health and comfort are paramount.

For example, advanced breathable mesh uppers provide ventilation to reduce moisture build-up, which can lead to discomfort and skin irritation. Similarly, the soles of high-performance shoes—constructed from durable rubbers and innovative compounds—are designed to provide optimal grip, ensuring stability and traction during intense athletic activity. These materials, when carefully selected, help to ensure that the footwear can withstand the rigors of professional sports while maintaining comfort and performance over time.

Sustainability and Material Innovation

The growing demand for sustainable practices in product design is also influencing material selection in performance footwear. Eco-friendly materials such as recycled plastics, organic cotton, and bio-based synthetics are increasingly being incorporated into footwear design. This shift is not only a response to consumer demand but also to the environmental challenges associated with footwear production. For example, Adidas has developed shoes made from ocean plastics, which not only reduce waste but also contribute to a cleaner, more sustainable product line.

The integration of sustainable materials does not mean compromising on performance. Advanced material science allows for the creation of textiles and components that meet both

ecological and functional standards. Recycled polyester and nylon offer durability and strength similar to virgin materials, while biodegradable soles and non-toxic dyes contribute to the shoe's environmental impact without sacrificing performance. For brands that embrace sustainability, material choice has become a defining characteristic of their products, aligning with the broader movement toward ethical consumption in sports and fashion.

Comfort and Fit

Material innovations also have a significant effect on comfort and fit, which are central to the performance of footwear. Memory foam, EVA (ethylene-vinyl acetate) cushioning, and innovative knit uppers are increasingly used to provide a personalized, comfortable fit. For instance, memory foam footbeds mold to the individual shape of the foot, providing targeted cushioning and support. This is particularly important in high-performance shoes, where comfort during prolonged activity is essential to prevent fatigue and injury.

Stretchable textiles like engineered mesh allow for a flexible, adaptive fit that accommodates varying foot shapes while maintaining breathability and support. In dual-last systems, these materials are crucial, as they enable a single design to fit multiple foot shapes without compromising on comfort or performance. By seamlessly integrating these materials into the footwear's design, manufacturers can offer a high degree of customization while keeping production costs manageable.

Aesthetic Considerations in Materials

The aesthetic potential of materials should not be overlooked. Materials contribute not only to the functional aspects of footwear but also to its overall visual appeal. The use of premium materials, such as high-quality leather, suede, and technical fabrics, signals a high-end product while elevating the product's prestige in the consumer's mind. These materials are often

used in limited-edition or signature performance shoes, where the visual appeal matches the exclusive nature of the product.

Materials also play a crucial role in brand identity. For instance, Nike's use of Flyknit technology offers both a visual and functional statement. The intricate patterns created by Flyknit not only contribute to a lightweight, breathable upper but also create a visually striking design. This innovative material has become synonymous with Nike's commitment to cutting-edge performance technology, making it a hallmark of their product line.

11.3 Graphics: Brand Storytelling and Identity

Visual Identity and Branding

Graphics are not merely decorative elements in performance footwear—they are essential in shaping a product's identity and conveying the brand's narrative. Logos, patterns, and symbols act as direct communication tools between the brand and the consumer. For example, Nike's "swoosh" is more than just a logo; it is a symbol of movement, performance, and athletic excellence. In performance footwear, graphics are a way for the brand to visually communicate its technological innovations and athletic aspirations, allowing consumers to connect emotionally with the product.



Figure 10: Adidas Pushed the Traditional 3-stripes in this Pair of Harden 8's

In many performance shoes, graphics also play a key role in storytelling. Limited-edition shoes, collaborations with athletes, or culturally inspired designs often feature unique graphics that reflect the athlete's journey or the story behind the collaboration. For example, the collaboration between Puma and Rihanna resulted in footwear that not only reflected Rihanna's style but also incorporated bold, expressive graphics that appealed to both fashion-conscious consumers and athletes.

Functionality of Graphics

Graphics in performance footwear can also serve functional purposes. Reflective graphics are commonly integrated into shoes designed for running or cycling in low-light environments. These graphics help increase visibility, contributing to the athlete's safety during night-time activities. In addition, textured graphics or embossed patterns on the outsole or upper can provide functional benefits, such as enhanced grip or additional structural support.

Graphics also influence the overall design and aesthetic appeal of the shoe. In many instances, intricate graphic designs are used to enhance the shoe's perceived technological sophistication. Adidas, for example, employs graphic design to highlight the innovative features

of their shoes, making the shoes visually compelling while reinforcing the product's advanced engineering.

11.4 Case Studies: Real-World Examples of Color, Material, and Graphics in Performance Footwear

Nike's Flyknit and Material Innovation

Nike's Flyknit technology, introduced in 2012, utilizes specialized knitted materials to create lightweight, breathable, and supportive footwear. The Flyknit upper is both flexible and structured, offering a high degree of customization in fit. The colors used in the Flyknit line reflect Nike's dynamic approach to design, with bright, energetic tones signaling speed and agility. The graphics used in Flyknit shoes further emphasize Nike's commitment to innovation, making the shoes visually striking while supporting their high-performance claims.

Adidas UltraBoost and Color Performance

The Adidas UltraBoost line exemplifies how color can communicate both performance and comfort. The use of vibrant, contrasting colors in the Boost cushioning adds visual interest while signaling the shoe's high-performance nature. Meanwhile, the sleek, neutral upper tones contribute to the overall aesthetic, appealing to a wide range of consumer tastes. The material innovation in the UltraBoost line, with its responsive cushioning technology, complements the color choices by providing both comfort and superior performance.

Integrating Aesthetics with Functionality

Color, material, and graphics in performance footwear are integral to more than just visual appeal—they are essential to the product's performance and the emotional connection it establishes with the consumer. These elements communicate a product's identity, reinforce the brand's values, and contribute to the athlete's overall experience, whether in training,

competition, or daily wear. By balancing aesthetics with functionality, designers can create products that not only meet the performance needs of athletes but also resonate with their emotional and psychological desires. As materials and graphic design continue to evolve in response to technological advancements and consumer demands, the importance of these elements in footwear design will only continue to grow.

Athlete Insight Interviews: Footwear as a Vehicle for Individuality

In interviews with athletes across various sports, one theme consistently emerged: while uniforms are standardized across teams, footwear became a key avenue for personal expression and differentiation. Athletes explained that, while the team uniform often had a shared aesthetic dictated by team sponsors or coaches, their footwear provided an opportunity to stand out. This insight reveals an important aspect of the role of color, material, and graphics in performance footwear: they are not just about performance but also about identity.

Uniforms vs. Footwear: The Need for Personal Expression

Athletes often face the challenge of feeling part of a team or community while also maintaining their individuality. Team uniforms, which are typically designed to be uniform and cohesive, leave little room for personal style. For many athletes, footwear offers a rare opportunity to showcase their personality, beliefs, or even their personal achievements, allowing them to stand out in a visually meaningful way. This insight highlights the functional role that color, material, and graphics play beyond their immediate performance functions—they also serve as a form of self-expression.

For example, one professional basketball player shared how, while the team's uniform was designed to create a unified appearance, his footwear choices allowed him to make a visual statement on the court. "When you're on the field, everyone looks the same in the jersey," he

explained. "But with my shoes, I can show who I am. I might go with a specific color that means something to me personally."

Footwear as a Tool for Differentiation

Footwear has evolved beyond a mere performance tool to become an extension of an athlete's personal identity. For many athletes, shoes have become a blank canvas for self-expression, allowing them to communicate personal messages through the design, graphics, and colors they choose to wear. The ability to customize shoes or select from a variety of color schemes has made footwear a powerful tool for differentiation, even in team-oriented sports.



Figure 11: Track Star Shacarri Richardson Wearing her Classic Neon Spikes

In the world of professional football, one athlete explained how different color schemes, graphic designs, and even custom cleat patterns became a way for players to express their unique personalities. "The game is fast, and we all wear the same uniform, but our shoes are how we express ourselves," he said. "Whether it's a bright color or something that represents my culture, my footwear speaks for me in a way the uniform never can."

The Role of Customization in Footwear Design

Customization is an essential aspect of how athletes personalize their footwear. Whether through custom colorways, unique graphic designs, or special materials, athletes see their shoes as an opportunity to convey their identity in a way that is not possible with other aspects of their uniform. Some brands, like Nike and Adidas, offer athletes the ability to select from a range of colors and materials or even design their own shoes, allowing them to showcase their unique personality on the court or field.



Figure 12: Nike Provides University of Oregon Player Exclusive (PE) Product Every Year.

For example, Nike’s “NIKEiD” (now called Nike By You) service allows consumers and athletes alike to customize their footwear with personalized colors, materials, and patterns. This service has become particularly popular among athletes who want to reflect their own style and identity, both in and out of competition.

The Intersection of Function and Individuality

What’s unique about footwear is that it blends both function and individuality. While athletes express their personal identity through color choices, graphic designs, and materials, these elements do not detract from the shoe's core purpose: performance. Athletes interviewed

emphasized that, while they want their footwear to look distinctive, the shoes must still support their performance needs.

One professional runner noted, "I love customizing my shoes with a color that reflects my personality, but it's also critical that they support my race. A shoe can look amazing, but if it doesn't give me the performance I need, I won't wear it."

This balance between individuality and performance is where the role of color, material, and graphics in footwear becomes especially important. The customizability of these elements allows athletes to align their footwear with their own identity while ensuring that the shoes support their specific needs, such as cushioning, support, and stability.

Footwear as an Emotional Connector

Finally, the personal connection athletes feel to their shoes is not just about self-expression—it is also about building a psychological connection between the athlete and their gear. Athletes frequently mentioned that wearing custom or unique footwear made them feel more confident and prepared, reinforcing the connection between personal style and performance. The emotional value of footwear design cannot be underestimated: an athlete's bond with their shoes can boost motivation, evoke pride, and enhance overall satisfaction with the product.

For example, a female semi-pro soccer player explained, "When I put on my boots, it's not just about performance; it's about the pride I feel in wearing something that's my own. They represent my hard work, my goals, and who I am as a player."

Conclusion: Footwear as a Canvas for Individuality and Performance

The interviews with athletes underscore the increasingly important role that footwear plays in balancing performance with individuality. While uniforms remain consistent and

standard across teams, athletes use color, material, and graphics in their footwear to differentiate themselves, express their personalities, and reinforce their emotional connection to their sport. Footwear has thus become a unique outlet for self-expression, allowing athletes to align their performance needs with a visual identity that speaks to who they are, both on and off the field. The customization of color, material, and graphics not only meets the functional demands of athletes but also serves as a visual representation of their personal journey, their goals, and their values.

Chapter 12: Market Impact and Consumer Adoption of Dual-Last Footwear

The advent of dual-last systems in footwear represents a significant shift in both design philosophy and market dynamics. While the traditional approach to footwear design has been gender-segmented, the dual-last system seeks to transcend these boundaries, offering products that cater to both male and female athletes while maintaining a consistent aesthetic and functional performance. This chapter explores the market implications of this shift, examining how brands can position dual-last footwear for successful consumer adoption, the challenges of educating the market, and the strategies needed to create demand in a competitive industry.

12.1 The Role of Marketing and Brand Storytelling in Promoting Fit Equity

Brand storytelling plays a crucial role in framing the dual-last system as more than just a design innovation—it is positioned as a movement toward inclusivity and equality. In the past, footwear brands have reinforced gendered distinctions through both design and marketing, emphasizing performance differences between men's and women's shoes. However, the dual-last system challenges this narrative, creating an opportunity for brands to market their products based on a more inclusive, fit-driven message.

Marketing campaigns that emphasize the value of fit equity—where performance shoes cater equally to both genders without compromising on function or aesthetic—could resonate strongly with consumers. This approach focuses on the idea that athletes of all genders deserve footwear that enhances their performance while accommodating their specific anatomical needs. The storytelling around this could highlight diversity in sport, using real athletes to show how dual-last systems contribute to better fitting shoes, thereby fostering an emotional connection with the product.

For example, Nike has long used athlete narratives to drive its marketing, focusing on the performance needs of individuals while promoting inclusivity in sports. A similar approach could be applied to dual-last systems by showcasing athletes from various backgrounds—highlighting how the system provides customized fit solutions for all, irrespective of gender. By framing the dual-last system within a context of equality and personalized performance, brands can connect with a wider audience, making the product feel relevant and essential for athletes who value both inclusivity and top-tier performance.



Figure 13: Example of Athlete Marketing by Nike with icon, Serena Williams

Consumer Segmentation and Understanding Demand for Gender-Inclusive Footwear

The success of dual-last footwear relies heavily on understanding the shifting consumer landscape and demand for gender-inclusive products. Traditional segmentation in footwear markets often places products into distinct male and female categories, but this model is evolving as more consumers seek products that meet their individual needs rather than adhering to gendered expectations.

Consumer data shows an increasing trend toward unisex and gender-neutral products, driven by a desire for inclusivity and self-expression. Brands that embrace these shifts by promoting dual-last systems can tap into a growing demographic of consumers who feel that their needs are often overlooked in traditional models. By understanding these evolving preferences, brands can position dual-last systems as a direct response to the demand for greater inclusivity and performance equity.

For example, younger consumers, especially Generation Z and Millennials, are more likely to prioritize sustainability, inclusivity, and performance when choosing footwear. These consumers are also more likely to challenge traditional norms, rejecting overly gendered marketing. Dual-last systems cater directly to this market segment by offering customizable fits that transcend gender boundaries and by leveraging the growing demand for products that align with social and environmental values.

12.2 Competitive Analysis: How the Dual-Last System Compares to Traditional Gendered Footwear

The competitive landscape of footwear brands has long been defined by gendered segmentation, with separate lines for men and women. However, as the demand for gender-neutral and inclusive products grows, dual-last systems are poised to disrupt traditional footwear categories. A comparative analysis between dual-last systems and conventional gendered footwear reveals both challenges and opportunities.

Challenges:

Consumer Familiarity: Traditional gendered footwear lines have been well-established in the market, and some consumers may be resistant to change, perceiving dual-last systems as an unfamiliar or unnecessary innovation. Overcoming this resistance requires educating

consumers on the benefits of the dual-last system and demonstrating that fit and performance are not compromised.

Manufacturing and Design Complexity: Creating dual-last footwear involves more complex design and production processes, as brands must ensure that each shoe can accommodate both male and female foot anatomies without sacrificing performance. This may require investment in research, development, and testing to ensure the shoes meet the highest standards for both genders.

Opportunities:

Market Differentiation: Brands that embrace dual-last systems can differentiate themselves from competitors by offering a solution that appeals to a broader demographic, including athletes who reject traditional gender distinctions in footwear.

Sustainability and Efficiency: Dual-last systems reduce the need for separate men's and women's product lines, leading to potential cost savings in production and inventory management. Additionally, brands that adopt these systems may reduce waste and improve sustainability by offering more versatile products.

12.3 Strategies for Educating Consumers About the Benefits of Dual-Last Systems

To drive consumer adoption of dual-last systems, brands must focus on educating their target audiences about the benefits of these innovative designs. Effective communication strategies should emphasize the value of fit, comfort, and performance, while debunking misconceptions about the need for gender-segmented footwear.

Key Strategies:

Educational Campaigns: Brands can use content marketing and educational campaigns to raise awareness about the advantages of dual-last footwear. This could include blog posts,

social media videos, and influencer collaborations that explain how dual-last systems work, the science behind them, and the benefits they offer.

Athlete Endorsements: As with many performance footwear products, athlete endorsements are a powerful tool in consumer education. By showcasing athletes using dual-last footwear in real-world settings—whether on the field, court, or track—brands can provide tangible proof that the system works for athletes of all genders.

Trial and Feedback: Offering trial periods or free wear testing could allow consumers to experience the benefits of dual-last systems firsthand, further reinforcing the messaging around fit, performance, and customization.

Chapter 13: Conclusion: The Future of Dual-Last Systems in Footwear

Design

As we have explored throughout this thesis, the evolution of footwear design is increasingly defined by the need for inclusivity, performance, and adaptability. The introduction of the dual-last system marks a significant shift in how brands approach the design and production of performance footwear. This thesis has provided a comprehensive analysis of the dual-last system, from its theoretical foundations to its practical applications, market implications, and future potential.

The dual-last system represents not just a technical innovation, but also a profound transformation in how footwear is conceived, marketed, and experienced by athletes. By offering a design framework that accommodates both male and female foot anatomies within a unified silhouette, the dual-last system challenges the traditional gendered design of performance footwear. It not only addresses the diverse needs of athletes but also responds to the growing demand for gender-neutral products in the marketplace.

13.1 Summary of Findings from the Dual-Last Hypothesis

At the heart of this thesis lies the hypothesis that the dual-last system provides an inclusive solution for performance footwear without sacrificing functionality or aesthetic appeal. The dual-last system allows footwear to be designed with a shared upper, accommodating the anatomical differences between male and female athletes, while maintaining a consistent visual and functional identity across both versions. This approach is driven by a deeper understanding of foot morphology, biomechanics, and performance needs, combined with the ability to deliver a product that resonates emotionally with consumers.

Through an analysis of gender differences in foot morphology and the biomechanics of athletic performance, it has become evident that the dual-last system offers a significant advantage in addressing the distinct needs of male and female athletes. This system does not just address fit issues but provides an opportunity for brands to deliver footwear that supports both athletic performance and individual expression.

Moreover, the feedback loop from athlete insights has reinforced the importance of creating products that prioritize fit equity. Through interviews with athletes, we discovered that footwear has become a vital tool for athletes to assert their individuality. As uniforms are standardized, footwear serves as a medium for self-expression, allowing athletes to differentiate themselves on the field or court. The customization of color, material, and graphics further enhances this sense of personal identity, making dual-last footwear a product that not only performs but connects emotionally with its users.

13.2 Long-Term Impact of Dual-Last Systems on Performance Footwear and Inclusivity

The dual-last system is not merely a temporary trend in footwear design but a paradigm shift with long-term implications for the industry. As consumers increasingly demand products that reflect their individual needs and identities, the dual-last system offers a practical solution that transcends gender distinctions. This approach aligns with broader societal trends toward inclusivity, where brands are expected to offer products that cater to a wide range of body types, preferences, and performance needs.

As the market for gender-neutral and performance-driven products continues to grow, dual-last systems are positioned to become a cornerstone of the footwear industry. Brands that embrace this model are not only responding to changing consumer demands but also setting the stage for a more inclusive future in athletic wear. By focusing on functional fit and performance

rather than gender, the dual-last system promotes an understanding that performance footwear should serve all athletes equally—irrespective of gender.

Additionally, dual-last systems offer a chance for brands to rethink how they design and produce footwear. By eliminating the need for separate men's and women's product lines, the dual-last system streamlines manufacturing processes, reduces waste, and leads to a more sustainable production model. This approach presents an opportunity for brands to not only improve the environmental impact of their operations but also align with the growing consumer preference for sustainability in product design.

13.3 Future Trends in Gender-Neutral and Performance-Driven Footwear

The future of performance footwear will likely be shaped by the integration of inclusivity and customization. With the advent of advanced materials, 3D printing, and personalized design options, the traditional model of gendered footwear will continue to be challenged. The rise of gender-neutral footwear, such as the dual-last system, reflects a broader shift in how consumers approach athletic wear. Rather than seeking products that align with traditional gender norms, athletes are increasingly prioritizing fit, comfort, and performance.

As brands continue to experiment with modular design, adaptive materials, and responsive technologies, the future of footwear will be defined by products that are not just functional but tailored to individual performance needs. Dual-last systems offer a pathway to such customization, ensuring that athletes, regardless of gender, can find footwear that fits them perfectly while still benefiting from the latest performance-enhancing technologies.

Furthermore, as the demand for gender-neutral and inclusive products grows, footwear brands will be expected to provide greater transparency in their design processes and the materials they use. Innovations in sustainable materials and manufacturing techniques, such as

recycled plastics, biodegradable textiles, and low-waste production methods, will likely become standard practices. Brands that adopt these technologies and integrate them into dual-last systems will be better positioned to meet both consumer expectations and environmental standards.

13.4 Implications for Sustainability: How the Dual-Last System Could Reduce Waste and Improve Product Longevity

Sustainability is increasingly a driving force in consumer purchasing decisions, particularly in the footwear industry. Dual-last systems have significant implications for reducing waste and improving product longevity. By designing footwear that can serve both male and female athletes, brands reduce the need for separate product lines, leading to a reduction in the overall number of shoes produced. This streamlined approach not only minimizes waste but also optimizes inventory management, as brands no longer need to produce excess stock to account for both men's and women's styles.

In addition, dual-last systems can extend the lifespan of footwear by allowing for more tailored fit adjustments, reducing the likelihood of wearers needing to replace their shoes due to discomfort or poor fit. This emphasis on fit equity ensures that consumers will have a more positive and lasting experience with their footwear, further contributing to the sustainability of the product lifecycle.

Moreover, as the dual-last system evolves, brands will continue to explore materials that are both performance-driven and environmentally friendly. The potential for dual-last footwear to incorporate eco-friendly materials—such as biodegradable soles, recycled fabrics, and water-based adhesives—offers a significant opportunity to further reduce environmental impact. Brands that prioritize these innovations will not only appeal to environmentally conscious consumers but will also set a new standard for sustainability in performance footwear.

13.5 Recommendations for Brands Looking to Adopt Dual-Last Strategies

For brands looking to adopt dual-last systems, several key strategies should be prioritized:

1. **Invest in Research and Development:** Dual-last systems require substantial investment in research to understand foot morphology and biomechanics across genders. Brands must collaborate with footwear scientists and biomechanists to ensure that their products meet the performance needs of all athletes.
2. **Embrace Consumer Education:** Educating consumers about the benefits of dual-last systems is crucial to driving adoption. Brands should focus on storytelling, using athlete endorsements, social media, and educational campaigns to explain how the dual-last system works and why it benefits athletes of all genders.
3. **Leverage Data and Feedback:** Collecting data from athletes through wear trials and feedback loops will be essential to refining the dual-last design. Continuous improvement through athlete insights will ensure that the footwear delivers on its promise of superior fit and performance.
4. **Adopt Sustainable Practices:** As sustainability becomes a key factor in consumer decision-making, brands must integrate eco-friendly materials and manufacturing practices into their dual-last systems. This approach will not only reduce waste but will also position brands as leaders in responsible design.

13.6 Future Research Directions and Opportunities for Further Study

While this thesis has explored the foundational principles and current applications of dual-last systems, further research is needed to fully understand the long-term impact of these systems on athletic performance and consumer behavior. Future research could explore:

- The quantifiable impact of dual-last systems on injury prevention and performance enhancement across different sports.
- The role of consumer psychology in adopting gender-neutral products and how it varies across demographic segments.
- The long-term market adoption of dual-last systems and their integration with emerging technologies, such as personalized 3D-printed footwear or adaptive materials.

Final Thoughts

The dual-last system represents a significant leap forward in footwear design, blending performance with inclusivity in a way that challenges traditional gender-based norms. As this innovative model continues to evolve, it offers brands an opportunity to not only revolutionize their product offerings but also to reshape the future of footwear, making it more accessible, sustainable, and performance driven. With an increasing demand for gender-neutral, high-performance footwear, the dual-last system is poised to become a foundational model in the footwear industry, ushering in a new era of inclusivity and innovation.

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