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Optimizing Leather Clicking: A Study on Material Utilization and Waste Reduction in Footwear Manufacturing process

Jitender Gupta

Footwear Design & Development Institute

An "Institution of National Importance" as per FDDI Act, 2017 Under Ministry of Commerce & Industry, Govt. of India

Puraposar Road at Gram Maharajpura, District - Guna, Madhya Pradesh

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Abstract:

The footwear manufacturing industry faces persistent challenges related to material wastage, cost efficiency, and sustainable practices, particularly in the leather clicking process. This research paper explores strategies to optimize leather clicking, a critical stage in footwear production where leather pieces are cut into specific shapes. The study focuses on improving material utilization and reducing waste through advanced techniques, technologies, and process improvements.

By analyzing traditional and modern clicking methods, the research identifies key inefficiencies and evaluates the potential of computer-aided design (CAD), nesting software, and skilled labor training in enhancing precision and minimizing material wastage. The findings highlight the importance of innovative approaches, including the integration of automation and smart systems, in achieving operational excellence and sustainability goals.

This study contributes to the body of knowledge on sustainable manufacturing practices by providing actionable insights for footwear manufacturers to improve productivity, reduce costs, and meet environmental standards. The research underscores the necessity of adopting cutting-edge solutions to address the dual objectives of economic efficiency and ecological responsibility in leather clicking.

Keywords: Leather clicking process, Material wastage, Cost efficiency, Sustainable practices, Automation.

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1. Introduction:

The footwear manufacturing industry is a significant contributor to global trade and employment, with leather being one of the primary materials used in the production of high-quality footwear. However, one of the major challenges faced by manufacturers is the efficient utilization of leather, particularly during the clicking process. Leather clicking involves cutting leather into specific shapes or patterns for shoe components, and this stage is crucial in determining both the quality of the final product and the amount of waste generated. Inefficient clicking processes not only lead to increased material wastage but also escalate production costs, ultimately impacting the profitability of footwear manufacturers.

As sustainability becomes a growing concern for industries worldwide, optimizing material usage and minimizing waste have become key objectives in footwear production. The leather clicking process, being a significant contributor to waste, requires focused attention to improve operational efficiency, reduce costs, and meet environmental standards. Technological advancements such as computer-aided design (CAD) systems, nesting software, and automation offer promising solutions to enhance material utilization and minimize waste. Additionally, training and skill development among workers are essential to improve precision and reduce errors that lead to material loss.

This research aims to investigate the various strategies for optimizing leather clicking, focusing on material utilization and waste reduction. Through a detailed analysis of current practices, innovative solutions, and case studies, the paper will provide insights into how manufacturers can adopt more efficient processes that contribute to both economic

and environmental sustainability. By exploring these areas, this study intends to offer valuable recommendations for footwear manufacturers looking to enhance their production processes, reduce operational costs, and align with sustainable practices in the leather industry.

2. Challenges in Material Waste, Cost Efficiency, and Sustainability in the Leather Clicking Process

In the leather clicking process, which involves cutting leather into shapes and sizes required for the production of goods like shoes, bags, and upholstery, several challenges arise, particularly in relation to material wastage, cost efficiency, and sustainable practices. These challenges can significantly impact both the financial performance and environmental footprint of leather manufacturers.

i. Material Wastage:

Shape Optimization: Leather is a natural material with inherent imperfections such as scars, wrinkles, and variations in texture. The traditional clicking process often results in a high amount of offcuts and unusable leather, leading to significant material wastage.

Irregular Shapes: Leather hides are irregularly shaped, and efficient use of material is critical. In the clicking process, inefficient cutting patterns can result in considerable waste as manufacturers try to maximize the use of each hide.

Thickness Variation: Leather hides can vary in thickness across their surface, which may require additional cutting or trimming to achieve uniformity, leading to further waste.

ii. Cost Efficiency:

High Raw Material Costs: Leather is a relatively expensive raw material. As a result, material wastage directly impacts the overall cost efficiency of production. The more leather is wasted, the higher the cost of the finished product, especially for premium leather goods.

Energy and Labor Costs: The clicking process involves both skilled labor and energy-intensive machinery, adding to the production costs. Optimizing the cutting process to minimize material wastage can help reduce these associated costs, but it often requires investment in advanced technology and employee training.

iii. Sustainable Practices:

Environmental Impact of Leather Production: Leather production itself has a significant environmental footprint, especially in tanning, which often involves toxic chemicals. The leather clicking process, if not managed sustainably, can exacerbate these issues by creating additional waste and contributing to the overall environmental burden.

Use of Non-Recyclable Materials: Many offcuts from the clicking process are difficult or impossible to recycle, contributing to landfill waste. Sustainable practices in the leather industry often focus on reducing the amount of waste generated by the clicking process and finding ways to reuse or repurpose offcuts.

Chemical Waste: The tanning process can sometimes generate mark on leather like dyes or adhesives that are harmful to the environment. There is growing pressure for manufacturers to adopt more sustainable alternatives chemicals that may be used during the cutting and finishing phases of leather production.

Wastewater Disposal: Water used in leather production, including in the tanning process for cleaning and preparation, can be contaminated with chemicals. Proper disposal of this wastewater is essential to avoid environmental harm, yet it remains a challenge for many leather producers.

iv. Technological Constraints:

Limited Automation: While some advancements in automation are being made, many leather manufacturers still rely on manual labor or semi-automated processes for cutting. This limits the potential for optimizing material usage and minimizing wastage.

Advanced Cutting Technologies: Technologies like laser cutting or precision knife cutting can improve the accuracy of the clicking process and reduce waste, but these technologies often come with high initial investment costs. Many small or mid-sized manufacturers may not afford these investments.

Design Flexibility vs. Waste Reduction: Designing leather products with minimal waste often requires a high level of precision and customization. While this

approach can be cost-efficient and sustainable, it may limit the flexibility of designers and manufacturers in adapting to new trends or product lines.

v. Market Demand for Eco-Friendly Products:

Consumer Expectations: Increasing demand for eco-friendly, sustainable, and ethically produced goods put pressure on leather manufacturers to adopt sustainable practices, even if these come at a higher upfront cost. However, balancing cost efficiency with sustainable manufacturing can be difficult.

Sustainability Certifications and Standards: Adhering to sustainable standards such as ISO certifications or the Leather Working Group (LWG) certification can be costly and complex for manufacturers, but they are increasingly demanded by consumers and regulatory bodies.

vi. Supply Chain Challenges:

Availability of Sustainable Leather: Sourcing leather from sustainable sources, such as vegetable-tanned or certified leather, is another challenge for manufacturers. Sustainable leather may cost more or be harder to source in large quantities, leading to higher material costs.

Supply Chain Transparency: Ensuring sustainable practices across the entire leather supply chain, from raw material sourcing to manufacturing processes, requires transparency. Manufacturers must verify that sustainable practices are adhered to at every stage, which can complicate supply chain management.

3. Exploring Strategies to Optimize Leather Clicking: A Key Stage in Footwear Production Where Leather Pieces Are Cut into Precise Shapes":

Optimizing the leather clicking process in footwear production is crucial for improving material usage, minimizing waste, enhancing cost efficiency, and supporting sustainable practices. Given that clicking is a critical stage where leather pieces are cut into specific shapes for shoe components like uppers, linings, and insoles, the following strategies can help streamline the process:

I. Pattern Optimization and Nesting

- **Advanced Nesting Software:** Implementing advanced computer-aided design (CAD) software with nesting capabilities allows manufacturers to create optimal patterns that maximize the use of each hide. This software calculates the best arrangement of shoe component shapes on the leather hide to reduce unused areas and minimize waste.
- **Automated Pattern Recognition:** Using automated systems to analyze the leather hide's texture, defects, and imperfections can help adjust patterns accordingly, ensuring that these areas are not used for critical parts of the shoe.
- **Dynamic Nesting Adjustments:** Real-time data from the cutting machine can adjust the nesting layout to adapt to variations in the leather, ensuring that each piece of leather is used as efficiently as possible, even if the hides are not uniform in size or quality.

II. Cutting Technology Improvements

- **Laser Cutting:** Laser cutting offers high precision, allowing for more efficient use of leather by minimizing the gap between cut pieces. It also reduces the need for physical patterns, cutting down material waste, and can be used for intricate and detailed cuts.
- **Water Jet Cutting:** This technique uses a high-pressure stream of water, often mixed with abrasive materials, to cut leather. It produces minimal heat, which can preserve the leather's quality, and also reduces wastage due to its accuracy.
- **Die Cutting with Automated Presses:** Modern die-cutting presses with automatic material feed systems can significantly speed up the process, while automated systems can ensure minimal waste by precisely cutting leather to predefined shapes without the need for manual adjustments.

III. Efficient Material Handling

- **Hide Scanning for Defects:** Implementing hide scanning technology to detect imperfections (scars, wrinkles, or discoloration) in real time allows manufacturers to discard that area of the hide that would otherwise be unusable for the

cutting process, thereby optimizing leather usage.

- **Improved Leather Lay-Up:** Careful handling of leather hides before cutting is essential. Lay-up techniques that involve smoothing and aligning leather hides optimally can reduce waste caused by folds, wrinkles, or misalignments during the clicking process.
- **Cutting Edge Equipment:** Investing in cutting-edge leather handling equipment that ensures the leather is laid flat and remains stable during the clicking process can reduce errors and prevent the material from shifting during cutting, leading to more accurate cuts and less waste.

IV. Waste Management and Recycling

- **Repurposing Offcuts:** Offcuts from the leather clicking process can be repurposed for smaller footwear components, such as heel linings, insoles, or tongue parts, reducing the need for new leather. Alternatively, offcuts can be used in other product lines like wallets, belts, or accessories.
- **Leather Recycling:** Implementing systems for leather recycling, where scraps are collected, treated, and reused in the production of new leather materials, can help reduce the environmental impact of the clicking process and make better use of material.
- **Recycling Soft Waste:** Leather trimmings, which are often considered soft waste, can be shredded and incorporated into composite materials or used for low-cost products, reducing overall waste.

V. Precision Cutting and Accuracy

- **Cutting Machines with High Precision:** Utilizing cutting machines with high accuracy can help minimize the size of the waste generated by the cutting process. High-precision machines can execute complex cuts with minimal margin for error, ensuring a better fit of pieces and reducing the need for rework.
- **Optimizing Cutting Pressure and Speed:** Tuning cutting machine parameters such as pressure, speed, and cutting angles based on leather type can help optimize cutting efficiency and reduce both waste and wear on tools.

VI. Material Sourcing and Quality Control

- **Standardizing Leather Quality:** Consistent leather quality from suppliers, with fewer defects or inconsistencies, leads to more defect and wastage in cutting. By maintaining higher quality standards, manufacturers can reduce the amount of leather that could be discarded due to poor quality.
- **Optimizing Hide Size:** Working with leather suppliers to ensure that the hides received are the optimal size for the designs being produced can reduce the amount of leather waste. In some cases, leather manufacturers can be intimated with request that hides to be pre-cut to standard sizes that match the needs of the production line.

VII. Training and Workforce Development

- **Skilled Operators:** Well-trained operators are capable in ensuring the precision and efficiency of the clicking process. Training to workers on the best techniques for handling leather and operating advanced cutting machinery can minimize mistakes and prevent leather wastage.
- **Real-Time Quality Control:** Regular monitoring of the cutting process allows operators to quickly identify and address issues such as misalignment or material errors, helping to prevent unnecessary waste during production.

VIII. Sustainability Integration

- **Sustainable Leather Alternatives:** Exploring alternatives to traditional leather, such as plant-based or synthetic leather, may also contribute to reducing the environmental

impact of leather clicking. These materials may be designed with optimized cutting efficiency, reducing waste and offering new possibilities for sustainable footwear production.

- **Waste-to-Energy Initiatives:** Some manufacturers have implemented energy recovery systems that use waste material from leather production (such as offcuts) to generate energy or heat for the production process, which can offset energy costs and support sustainability goals.

IX. Software and Data Analytics

- **Production Analytics:** Implementing data analytics systems that track material usage, waste rates, and production efficiencies can provide insights that allow manufacturers to continuously refine their clicking processes. By monitoring these metrics, adjustments can be made to improve efficiency, reduce waste, and increase profitability.
- **Real-Time Feedback Loops:** Using software systems that provide real-time feedback at cutting machines and operators and that can help ensure consistent production standards and quick identification of areas where waste can be reduced.

X. Collaboration with Suppliers

- **Collaboration for Custom Leather Solutions:** Manufacturers can work closely with leather suppliers to source leather hides that are optimized for specific footwear components, reducing the wastage or trimming to meet production requirements.
- **Supplier Waste Reduction Initiatives:** Suppliers can also be encouraged to implement waste reduction strategies in their production processes, which can ultimately benefit the footwear manufacturers by providing them with more uniform and usable leather materials.

4. Study Aims to Enhance Material Utilization and Minimize Waste Through Advanced Techniques, Technologies, and Process Improvements":

Improving material utilization and reducing waste in the leather clicking process is essential to enhancing the sustainability, efficiency, and cost-effectiveness of footwear production. The leather clicking process involves cutting leather into specific shapes, and adopting this step requires a focus on advanced techniques, technologies, and process improvements. Below are key strategies and areas of focus for achieving better material utilization and waste reduction:

I. Advanced Pattern Design and Nesting Optimization

- **Computer-Aided Design (CAD) and Nesting Software:** CAD software, when combined with advanced nesting algorithms, can maximize the use of each leather hide by optimizing the arrangement of pattern pieces. Nesting ensures that components are placed in the most efficient layout, minimizing gaps and unused leather. Advanced software can also account for hide defects, such as scars or wrinkles, and adjust the pattern layout in real time to avoid those areas, reducing waste.
- **Automated Nesting Systems:** These systems take data from the CAD designs and automate the process of arranging the pattern pieces onto the hide, ensuring the most efficient material use. By analyzing the size and shape of each piece, automated nesting systems can significantly reduce offcuts and waste.
- **Dynamic Adjustment for Variability:** Leather hides are often irregular in shape and may have inconsistencies in thickness. Using software that dynamically adjusts the nesting based on the current condition of each hide ensures that the patterns are placed with maximum efficiency, even when the leather quality varies.
- **Intelligent Material Tracking:** Integrating tracking systems that monitor leather usage and waste occurred can lead operators to take more correct decisions during the clicking process. For example, data-driven insights can identify areas where waste is particularly high

and suggest improvements in cutting strategies.

II. Process Improvements and Automation

- **Automation of the Cutting Process:** Fully automated cutting systems can ensure consistent, precise cuts with minimal human error. Automation reduces variability in the cutting process, which leads to fewer misaligned cuts and less wasted leather. It also speeds up production, allowing for higher throughput without sacrificing material efficiency.
- **Integrated Feedback Loops:** Real-time feedback systems in automated cutting machines allow for continuous optimization. These systems monitor material usage and provide immediate adjustments to the cutting process based on real-time data, ensuring that each hide is used as efficiently as possible.

VI. Minimizing Leather Waste During Trimming and Shaping

- **Precision Trimming:** After the leather is clicked, precise trimming techniques can further reduce waste by ensuring that only the excess portions of each hide can be removed. Cutting-edge machines that trim leather with high accuracy ensure that excess material should be trimmed during this secondary process.
- **Reduced Overcutting and Margin Improvements:** In the footwear industry, patterns often include margins for stitching, which can be optimized. By fine-tuning the design of the shoe components to minimize the extra material needed for stitching and assembly, manufacturers can reduce unnecessary material waste.

VII. Sustainability Integration in Material Sourcing

- **Sourcing Sustainable Leather:** Using leather from sustainable sources—such as vegetable-tanned leather or leather certified by environmental organizations—can lead to more efficient production processes. Sustainable leather suppliers often ensure that the hides they provide are of higher quality, reducing waste caused by defects and improving overall material utilization.
- **Circular Economy Practices:** Adopting a circular economy model involves reusing leather offcuts, scraps, and even waste leather from other industries to create new products. This not only reduces waste but also lowers costs associated with raw material procurement.

VIII. Training and Skill Development

- **Skilled Labor in Leather Cutting:** Proper training of workers in advanced cutting techniques and the effective use of technology is crucial for reducing waste. Skilled workers are better able to handle leather hides carefully, align them properly, and make precise cuts, minimizing errors and offcuts.
- **Cross-Training in Waste Reduction Practices:** Ensuring that operators are trained in waste reduction strategies, including efficient layout planning and material handling, can help reduce the amount of leather waste that ends up as scrap. Regular training on sustainability initiatives also helps workers understand the importance of waste reduction.

5. Conclusion:

In conclusion, the leather clicking process faces significant challenges related to material wastage, cost efficiency, and sustainability. By adopting innovative cutting technologies, investing in sustainable practices, and improving waste management strategies, leather manufacturers can mitigate these issues and create a more sustainable and cost-effective production process.

By integrating these strategies into the leather clicking process, manufacturers can significantly improve material efficiency, reduce waste, enhance cost-effectiveness, and promote sustainability in footwear production. The key is adopting both technological innovations and best practices in

material handling, cutting precision, waste management, and operator training. These efforts will ultimately lead to a more efficient and sustainable production cycle while maintaining high quality products.

To improve material utilization and reduce waste during the leather clicking process, manufacturers must integrate advanced technologies, precision cutting methods, and process improvements. By focusing on pattern optimization, automation, waste repurposing, and sustainable material sourcing, leather producers can significantly improve efficiency and minimize environmental pollution impact. Moreover, adopting a data-driven approach that tracks and analyzes material usage throughout the process enables continuous improvement, helping manufacturers meet both sustainability and cost efficiency goals in footwear production.

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Researcher Profile:

Mr. Gupta holds a B.Sc. degree with a specialization in Chemistry and Mathematics, along with a Company Secretary (Foundation) qualification from the Institute of Company Secretaries of India as well as Pursuing MBA in order to upgrade himself. As an alumnus of FDDI's SFT 1999 batch, He is a footwear technologist with approximately 27 years of extensive experience across academia and industry. He has provided consultancy services to various organizations, including Vision India and the DDU-GKY Project, OEF (Ministry of defence GOI). His professional journey includes roles such as Quality Controller at Mirza International Ltd., Footwear Technologist in the National Leather Development Programme (UNDP-assisted), and Quality Inspector for Simon Corporation Ltd., Tokyo, Japan.

He also held significant academic and managerial positions, including Dean/HOD at IISTEM and Senior Faculty/Center In-Charge at FDDI, where he joined in 2008 to work as bridge between industry and academia. His contributions include leading various training programs under government schemes such as PSDP, NSKFDC, UPSDM, and MAPCET in states like Uttar Pradesh, Madhya Pradesh, Rajasthan, Chhattisgarh, and Gujarat. He has served as Project Manager for the Support to Artisan Project under (DIPP GOI) in Rajasthan and Academic In-Charge at FDDI Fursatganj.

In addition, he is a member of the Board of Studies for Leather & Footwear Technology at Aligarh Muslim University (AMU) as well as external examiner at AMU, and shortlisted for the Regional Director role at CLE (Ministry of Commerce, GoI).

Presently he has been serving as the Center In-Charge at FDDI Guna Since December 24, 2021 to teach modern technique of footwear manufacturing to student as well as tie up with the industries for consultancy, placements of students.

