

Modular Course D: Customization Engineering

Unit D3: 3D Printing for Customization

Seminar



Co-funded by the
Erasmus+ Programme
of the European Union

DISHOLEA | Improving the digital
skills of workforce in Shoe and
Leather goods Industry in Jordan and
Palestine | GA 101129194



T2.2 – Development of modular
courses and training
material.

D2.4 – Modular Course in
Customization Engineering



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Introduction

- ❖ Leather & Footwear industry transformation
- ❖ Growing demand for customization
- ❖ Benefits of 3D printing:
 - ❖ Layer-by-layer production from digital models
 - ❖ Personalized fits (insoles, lasts, midsoles)
 - ❖ Reduced waste, faster prototyping
 - ❖ Quicker trend response & localized production

3D Printing Overview

- ❖ Additive manufacturing vs. traditional manufacturing
- ❖ Applications in multiple industries
- ❖ Democratization via CAD software & affordable printers

Birth of 3D Printing

- ❖ **1980s:** Stereolithography (SLA) – Charles Hull
- ❖ **1989:** Fused Deposition Modeling (FDM) – Scott Crump
- ❖ Early innovations → multiple additive technologies

General Process of 3D Printing

1. Create 3D model in CAD → export as STL
2. Slice STL → generate G-code
3. Layer-by-layer printing
4. Post-processing (supports, sanding, curing, painting)

Manufacturing Techniques

- ❖ **SLA & DLP:** Resin-based, smooth surfaces
- ❖ **SLS:** Powder-based, durable prototypes
- ❖ **FDM:** Thermoplastic filament, cost-effective, popular in education

FDM Technology

- ❖ Filament → heated nozzle → extruded layer-by-layer
- ❖ Key components:
 - ❖ Extruder motor, hot end, nozzle, build plate, motion system
- ❖ Troubleshooting tips: stringing, warping, adhesion

Materials Used

- ❖ **PLA:** Biodegradable, beginner-friendly
- ❖ **ABS:** Strong, heat-resistant
- ❖ **PVA:** Water-soluble supports
- ❖ **HIPS:** Dissolvable support for ABS
- ❖ Advanced materials: TPU, carbon-fiber, high-temp nylon

Setting Up a 3D Printer

- ❖ Bed leveling, filament calibration, nozzle temperature
- ❖ Slicing software (e.g., Ultimaker Cura) → set layer height, infill, supports, speed

3D Software

- **Autodesk Inventor:** Parametric modeling, iterative design
- **Ultimaker Cura:** G-code generation, print preview, beginner & advanced modes

3D Printing Technologies in L&F

- FDM, SLA, SLS, PolyJet, DMLS
- Applications: Customized lasts, insoles, midsoles, tooling
- Considerations: Cost, resolution, durability

3D Printing Pipeline

1. Digital Design (CAD modeling)
2. Slicing
3. Printing
4. Post-processing
5. Validation & Testing

Introduction Cont.

- ❖ What is 3D printing / additive manufacturing
- ❖ Benefits: personalization, faster prototyping, reduced waste

3D Printing in Footwear (1)

- ❖ Market trends & growth
- ❖ Technologies used (SLA, FDM, SLS)
- ❖ Example: STPL3D in India

3D Printing in Footwear (2)

- ❖ Rapid Prototyping: Time & cost efficiency
- ❖ Customized products: Individual foot morphology
- ❖ All operations under one roof

Advantages of 3D Printing

- ❖ Higher accuracy, durability, speed
- ❖ Trend responsiveness, sustainability
- ❖ Localized production

Printing of Custom Shoe Lasts

- ❖ Definition of shoe last
- ❖ Traditional vs 3D-printed lasts
- ❖ Benefits of 3D printing

Workflow for 3D-Printed Shoe Lasts

- ❖ Foot scanning
- ❖ Digital last design (CAD)
- ❖ Printing (FDM/SLS)
- ❖ Post-processing & validation

Benefits & Challenges

- ❖ Benefits: cost-effective customization, ergonomics, sustainability
- ❖ Challenges: durability, printing time, material limitations, expertise required

Step-by-Step Guide

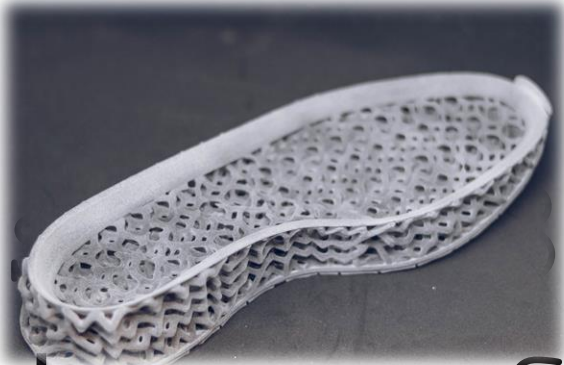
- Step 1: Obtain a Last File (STL models)
- Step 2: Prepare for Printing (split if necessary)
- Step 3: Orientation & Printing Settings
- Step 4: Post-Processing

Troubleshooting & Common Problems

- Warping
- layer separation
- surface roughness
- material choice

Materials & Printer Recommendations

- Materials: PLA, PETG, ABS, Resin
- Recommended Printers: FDM (Creality, Prusa), SLA



Les .3 - Printing of Soles and Heels

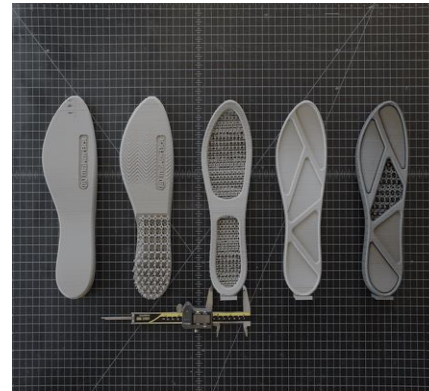
3D Printing Applications in the Leather &
Footwear Industry

1. Introduction

- 3D printing is transforming footwear manufacturing
- Enables customized soles and heels for performance, comfort, and style
- Benefits:
 - Complex geometries
 - Lightweight structures
 - Personalized cushioning
 - Sustainable production

2.1 Workflow – Soles

1. Foot Scanning & Biomechanical Analysis
2. Digital Design (CAD Modeling)
3. Material Selection (TPU, EVA, Nylon)
4. Printing Process (SLS, FDM, PolyJet)
5. Post-Processing (Cleaning, finishing, coating)



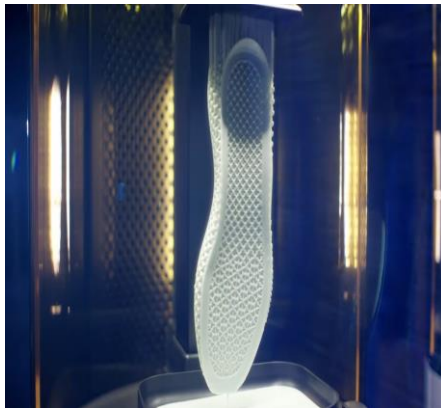
2.2 Advantages of 3D Printed Soles

- Customized comfort & ergonomic fit
- Lightweight and durable
- Rapid prototyping for fast iterations
- Sustainable with reduced material waste



2.3 Challenges in Printing Soles

- Limited scalability due to costs & print times
- Material performance limitations
- Biomechanical testing requirements
- Integration with traditional shoe-making



3.1 Workflow – Heels

1. Design & Aesthetic Customization
2. Material Use (Nylon composites, resins)
3. Printing Methods (SLA, PolyJet)
4. Reinforcement & Finishing



3.2 Applications of Printed Heels

- High-fashion bespoke heels
- Orthopedic applications for foot health
- Sustainable design concepts
- Decorative and luxury customization



4. Case Studies

- Adidas Futurecraft 4D – Lattice midsoles with DLS
- ECCO Quant-U – Data-driven custom silicone midsoles
- Under Armour Architech – Early lattice midsole adoption



5. Discussion Questions

1. What advantages does 3D printing offer over traditional molding?
2. How does it contribute to sustainability?
3. What are the key barriers to large-scale adoption?
4. How can hybrid approaches (3D printing + traditional manufacturing) be used?



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Unit D3 – 3D Printing Applications in the Leather & Footwear Industry

D3.4 – 3D Printing for Leather Goods



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Lesson D3.4 – 3D Printing for Leather Goods

Customization and Innovation in Leather Products



1. Introduction

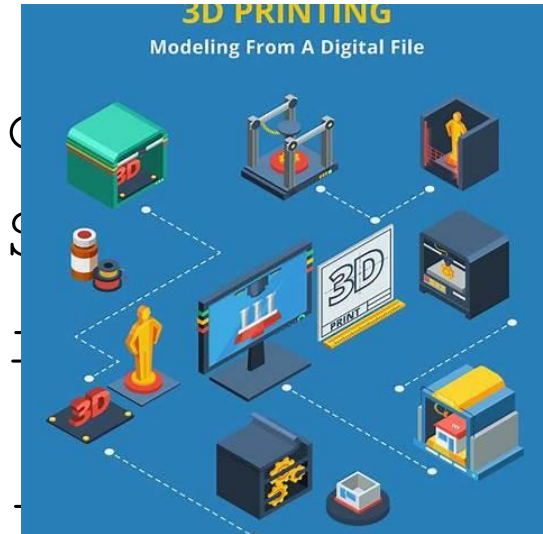
- 3D printing transforms leather goods industry
- Enables customization, sustainability, and innovative design
- Combines traditional craftsmanship with digital technology

- Applying 3D printing to leather goods and accessories



2. Workflow for 3D-Printed Leather Goods

1. Customer-Centered Customization (3D scanning, personalization)
2. Digital Design (CAD modeling of parts & ornaments)
3. Material Selection (TPU, Nylon)
4. Printing Process (SLA, FDM, SLS)
5. Integration with Leather (stitching, embedding)
6. Post-Processing (painting, polishing, embossing)



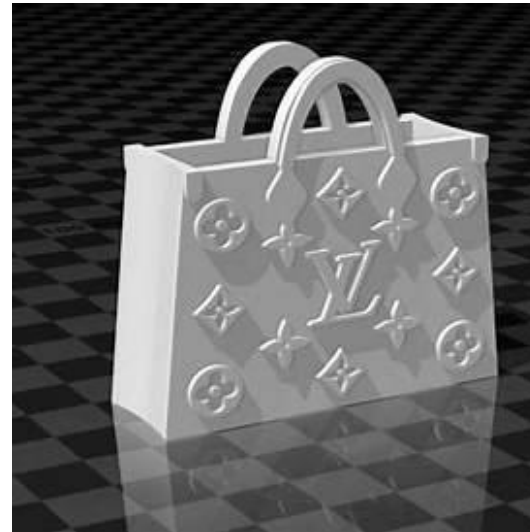
3. Applications of 3D Printing in Leather Goods

- Fashion Accessories: buckles, fasteners, ornaments
- Luxury Goods: custom panels, monograms, handles
- Functional Enhancements: reinforcements, lightweight structures
- Sustainable Design: repairable components



4. Case Studies

- Louis Vuitton x Stratasys - experimental handbags
- Iris van Herpen - fashion with 3D embellishments
- Startups - custom buckles, wallet parts, panels



5. Advantages

- Personalization at scale
- Waste reduction and sustainability
- Creative freedom in design
- Faster prototyping and iteration

6. Challenges

- Material compatibility with leather
- Durability of printed components
- High production costs
- Need for skilled craftsmanship in hybrid assembly



7. Discussion Questions

1. How does 3D printing change luxury leather goods?
2. How can artisans adopt 3D printing?
3. How does it support sustainability?
4. What new designs are possible with hybrid leather goods?

Lesson D3.4 – 3D Printing for Leather Goods

Customization and Innovation in Leather Products



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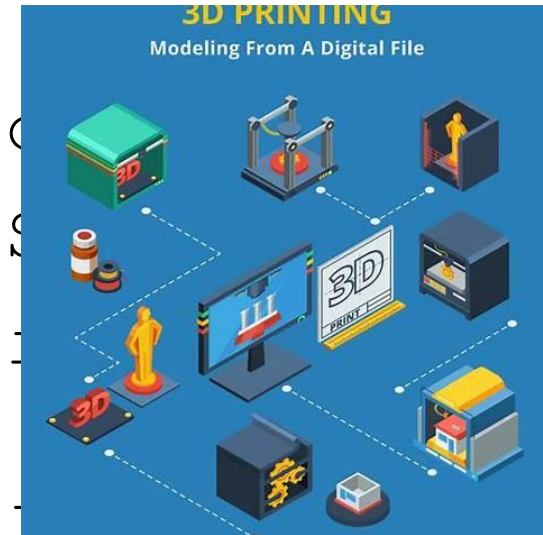
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- Applications include customizing straps, handles, and closures

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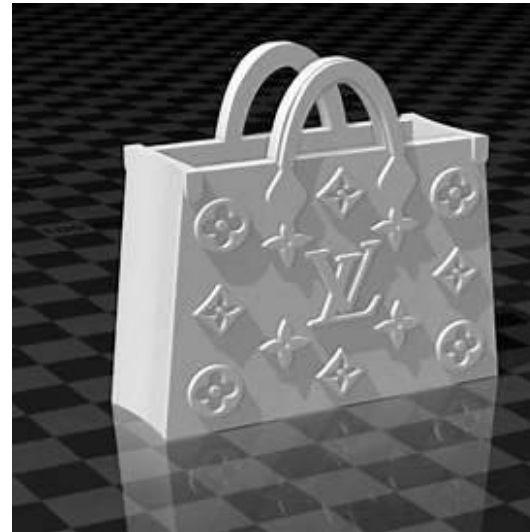
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