



SOLE MOLD MANAGEMENT:  
DRIVING **FOOTWEAR TOOLING**  
**OPTIMIZATION WITH PLM**

## Sole Mold Management:

# Why It Matters More Than You Think?

## INTRODUCTION

When we think of athletic shoes, most of us consider style, comfort, and possibly the brand. We often overlook the carefully engineered processes behind each pair, especially the sophisticated manufacturing techniques that shape the soles. Outsole, midsole, and insole aren't just thrown together; they are crafted with precision using specialized molds that can be expensive and complex.

This white paper explores why sole molds are a vital part of the footwear puzzle and how a smarter, more connected approach to managing them, preferably through a PLM (Product Lifecycle Management) system can create significant value.

## UNDERSTANDING MOLDS AND TOOLING

A mold is a precision-engineered cavity used to shape materials like rubber, foam, or thermoplastics into specific shoe components. Typically made from aluminum or steel, each mold is custom designed to match the shoe's intended size, shape, durability, and performance characteristics.

In manufacturing terms, molds are part of a broader category of tools, such as dies and jigs, which are essential for shaping or assembling products. Molds are a specialized type of tooling, regarded as capital assets that require investment and strategic management.

### What parts of a shoe sole are molded

Sole component:	Function	Design considerations
Insole	Positioned to directly contact the foot, the insole enhances wearer comfort and ensures structural support.	Moisture-wicking, antimicrobial properties, orthopedic contours, etc., catering to diverse user needs.
Midsole	The cushioning layer between the outsole and insole absorbs shocks, redistributes pressure, and provides ergonomic support.	Design varies depending on the intended application, from lightweight ethylene-vinyl acetate (EVA) foam in athletic shoes to denser PU in work boots.
Outsole	The most exposed layer, which directly contacts the ground, is designed for durability, traction, and resistance to wear.	Engineered for conditions ranging from casual urban to extreme terrains and high performance.
Inserts & Heel Units (such as air bags, gel/foam pads)	Tuned for performance: heel airbags for impact absorption, gel/foam pads for comfort.	Individually molded and integrated into the sole unit.



## TYPES OF MOLDING PROCESSES IN SOLE MANUFACTURING

There are various methods for molding soles. Each method has a specific purpose:

**Compression Molding:** Imagine it like a waffle iron. Heated molds press foam or rubber into a specific shape. This method is perfect for producing detailed, uniform soles, and is often used for flexible ethylene-vinyl acetate (EVA) midsoles or insoles.

**Injection Molding:** A more automated technique where liquid materials like thermoplastic polyurethane (TPU) or EVA are injected into a mold under pressure and then cooled. This method is perfect for complex or structured sole components such as cleats or shanks.

**Specialized Techniques:** Blow molding (for air units) or casting (for polyurethane soles) are used for unique sole parts that require specific properties.

Modern performance shoes combine these techniques. For instance, combining a compression-molded midsole with an injection-molded outsole and a blow-molded air unit can achieve a balance of cost, comfort, stability, and durability.

**Example:** A training shoe features a compression-molded EVA midsole, a rubber outsole, and a blow-molded air unit in the heel, which requires separate molds.



PU DIP Shoes Mold



Compression Mold



EVA outsole injection mold

## MATERIALS USED IN CREATING SOLES

The choice of sole materials depends on the desired qualities, such as weight, durability, flexibility, and cost. Some common materials include:

### Rubber:

Elastic, abrasion resistant, and slip-resistant, rubber remains a top choice for work boots, hiking shoes, and everyday sneakers.

### EVA:

Lightweight, cost-effective, and shock-absorbing, EVA leads in athletic footwear, providing excellent energy return.

### PU (Polyurethane):

Sturdy & comfortable, PU is popular for extended outdoor use to reduce fatigue and enhance safety.

### TPU:

Resilient, flexible, & abrasion-resistant, TPU is popular in specialty footwear that requires high performance.

### PVC (Polyvinyl Chloride):

Affordable & moderately durable, PVC is a common choice in casual footwear designs aimed at mass markets.

### Phylon:

Lightweight and resilient, phylon is a refined type of EVA used extensively in the midsoles of sports shoes.

A single sole can consist of multiple components, each using a different material.

**Example:** A typical basketball shoe might use a PU midsole for shock absorption, a TPU plate for stability, and a rubber outsole for grip.

## DIFFERENT TYPES OF MOLDS

The choice of sole materials depends on the desired qualities, such as weight, durability, flexibility, and cost. Some common materials include:

### Mold Set A:

The first original mold made when a new component is developed. It acts as the master reference from which multiple production copies are later produced.

### Prototype Molds:

Temporary molds used during product development for design testing, material trials, and validation before final production tooling is approved.

### Multi-Size Molds:

Designed to produce various shoe sizes in a single production run, improving manufacturing efficiency.

### Single Size Molds:

Designed to produce a specific shoe size, ensuring accuracy and consistency in high-quality footwear lines.

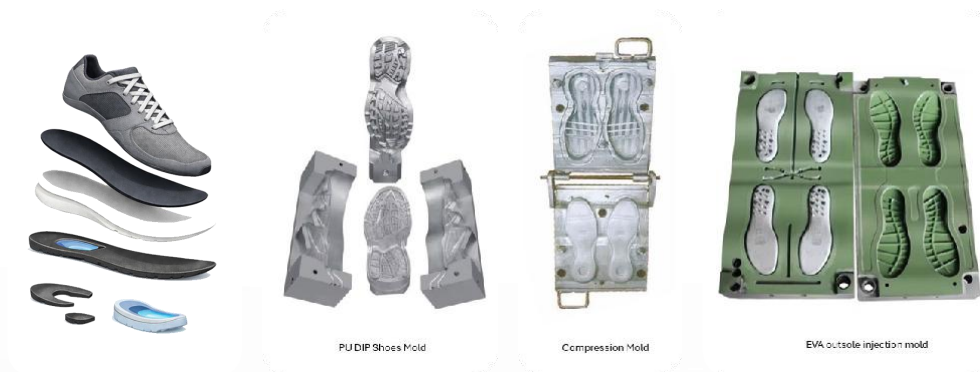
### The Main Mold:

Mainly used to shape a specific sole unit, forming the overall structure, including contour, size, and main tread pattern.

### Sub-Mold:

An auxiliary or modular component of the main mold system used to form specific parts of the sole, such as logo blocks, size inserts, lug patterns, or regional variations of the main mold.

**Here's the catch:** each part, in every shoe size, requires its own mold. Making 14 sizes? You might need 14 molds for each part. The numbers and costs increase quickly.



## WHY MANAGING MOLDS IS CRUCIAL

Molds are a significant capital asset, and poor oversight can cause costly delays, defects, or waste. Proper mold management guarantees efficiency, consistency, and financial control throughout production cycles.

### Cost Control:

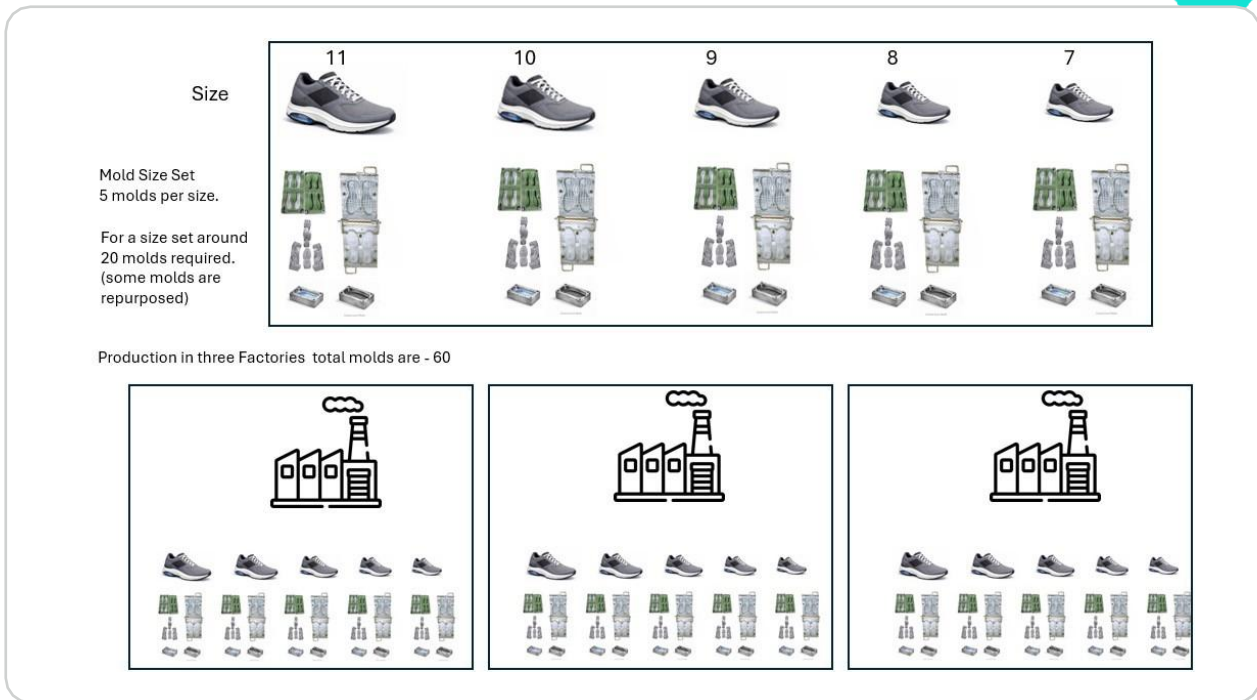
A complete set of molds for a single shoe style can cost between **\$20,000 and \$100,000**; avoiding premature replacements helps lower rework expenses.

### Product Quality:

Poorly maintained molds cause inconsistent soles, misalignments, excess material (called "flash"), or a poor fit.

### Smarter Planning:

Visibility into mold inventory, usage history, and remaining lifespan enables better production scheduling, style launches, and reorder planning.



## WHAT IS MOLD MANAGEMENT?

Good mold management, which results in fewer defects, lower costs, increased production reliability, and higher customer satisfaction, involves a few key activities:

- **Inventory Tracking:** Maintaining detailed records of every mold: its size, type, location, and condition.
- **Production Planning:** Ensuring the right molds are ready and available at the right time and location for upcoming orders.

This approach enables teams to proactively resolve tooling problems, increase throughput, and maintain consistent quality.

## TRADITIONAL MOLD MANAGEMENT WITHOUT A DEDICATED SOLUTION

Mold management is often done manually with spreadsheets, emails, and locally stored documents. Important information, like mold specifications, usage history, supplier details, costs, and location tracking, is fragmented across multiple Excel files, with ownership spread across different departments and individuals.

This fragmented approach creates significant challenges:

- **Lack of visibility:** Without a single source of truth, teams struggle to track mold availability, lifecycle status, or cost amortization, which often delays decision-making.

- **Data inconsistency:** Manual updates are susceptible to human errors and duplication, leading to outdated and unreliable information about mold status, location, and usage history.
- **Inefficient decision-making:** Teams spend excessive time searching for mold-related data across departments, compounded by miscommunication, which often results in poor decisions and missed deadlines.
- **Poor cost control:** Without integrated cost tracking, it becomes nearly impossible to monitor tooling investments and identify reuse opportunities.

Organizations face operational inefficiencies, increased tooling costs, and missed opportunities for mold reuse and optimization. These issues become more severe as volumes and production diversity increase.

**Example:** A global brand discovered they were unknowingly and needlessly spending hundreds of thousands of dollars each year on molds of similar designs being duplicated across regions.

## WHAT DOES GOOD MOLD MANAGEMENT LOOK LIKE?

**Managing molds isn't just about storage; it's about visibility and planning.**

**Here's what that entails:**

- **Knowing What You Own:** Maintaining a clear inventory of every mold, detailing what it is for, where it is, and what condition it is in.
- **Tracking Use:** Keeping tabs on the lifecycles of molds (molds have a limited life after which they degrade and cannot be used in production), ensuring smooth production planning.
- **Aligning with Production:** Making the right molds available at the right factory and at the right time.
- **Sharing Across Teams:** Providing mold data to designers, developers, sourcing, and vendors, which is only possible if it lives in a system everyone can access.
- **Advancing Sustainability:** Enabling mold reuse, reducing tooling redundancy, and minimizing material waste to improve sustainability.
- **Maintaining Mold Libraries:** Preventing duplicate mold creation, promoting virtual prototyping to reduce sampling emissions, and supporting sourcing from environmentally certified vendors.

The key is to transform mold management from a manual, reactive task into a coordinated, proactive strategy.

## UNDERSTANDING AMORTIZATION: SPREADING THE COST WISELY

Tooling isn't cheap, but thankfully, mold costs are typically amortized meaning they are spread out over the number of pairs produced.

If a manufacturer invests \$50,000 in molds and plans to produce 100,000 pairs of shoes, the investment is amortized over the production run, adding \$0.50 per pair to the cost of goods sold. If actual sales reach only 50,000 pairs, the cost increases by \$1 per pair, highlighting the importance of realistic cost planning.

Some brands lower amortization costs by reusing molds for different models. Sharing an outsole between two shoes, for example, doubles the mold's value. It's a smart strategy that offers financial benefits.

Brands that reuse molds across styles, regions, or seasons maximize amortization and minimize tooling costs.

## WHERE SHOULD MOLD DATA LIVE? IN YOUR PLM SYSTEM

**Your PLM platform is where your product lives, from initial sketches to BOMs and sample approvals. So, why not store mold data there as well?**

**With PLM, you can:**

- Maintaining a clear inventory of every mold, Make the mold and amortization data available in the Design and Development of the style
- Log every mold's specs, size range, supplier, cost, and lifecycle stage
- Link molds to styles, seasons, and development calendars
- Give global teams and vendors access to the same source of truth
- Use dashboards to visualize usage, availability, and tooling spend

Whether you develop this capability directly in PLM or build a custom module, the outcome remains the same: your mold data becomes an integral part of your product story not a secondary detail.

## MANAGING MOLD & LAST LIBRARIES IN PLM

**In a footwear product development environment, managing mold and last data is essential for controlling tooling investments, reducing duplication, and ensuring accurate style development. A modern PLM system provides a centralized and structured approach to managing this information via dedicated Mold and Last Libraries.**

- **Mold Library Structure:** The PLM mold library contains detailed data about each mold, including mold type, construction method (such as compression or injection), cost, vendor information, size range, and lifecycle status. Molds are classified as main molds and sub-molds. Each main mold can be linked to one or multiple sub-molds, reflecting the hierarchical structure and reuse logic within the PLM system.
- **Last Library Integration:** The Last Library within PLM stores dimensional and structural data for each footwear last (the form around which the shoe is built). Each last record includes attributes such as fit type, heel height, toe shape, and size range. PLM enables a direct connection between molds and lasts, ensuring that each mold is linked with compatible lasts for accurate fit and functional design.
- **Linking Molds to Styles:** To enable smooth product development, PLM systems allow linking molds (main and sub) to specific footwear styles.

#### **This connection ensures:**

- Accurate costing and tooling planning
- Traceability of mold usage across product lines
- Better amortization tracking
- Improved speed-to-market by enabling mold reuse

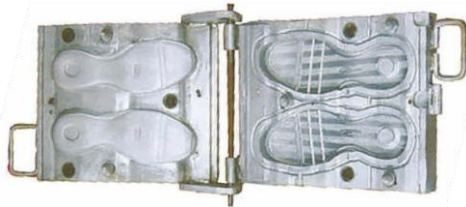
When a style is created in PLM, designers and developers can choose from approved molds and related lasts from the library, reducing guesswork and minimizing redundant tooling creation.

## **CONCLUSION: MOLD MANAGEMENT NEEDS TO LEVEL UP, AND PLM IS THE WAY**

**In a footwear product development environment, managing mold and last data is essential for controlling tooling investments, reducing duplication, and ensuring accurate style development. A modern PLM system provides a centralized and structured approach to managing this information via dedicated Mold and Last Libraries.**

- Sole molds, though rarely visible in finished products, are critical assets that influence brand identity, affect cost structure, and determine time to market. Managing molds effectively is not just an operational or factory concern; it's essential to brand reputation.
- By centralizing mold data within a PLM system, organizations turn mold management into a strategic, connected process. This integration provides end to end visibility, reduces waste, and enhances operational agility, allowing teams to make better, quicker decisions.
- Including mold management in PLM ensures that all components involved in creating a product, including molds, are part of a unified system, leading to increased efficiency and profit. The shift from viewing molds as one time factory tools to recognizing them as valuable strategic assets indicates a commitment to product excellence.

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