
*A safety shoe style from AMF's Infinity collection.*
CREDIT: AMF

# New concepts

MARIA JOSÉ FERREIRA, VERA PINTO, JOANA GOMES, JOSÉ RODRIGUES – CTCP
ALBANO MIGUEL FERNANDES, DOMINGOS ALMEIDA – AMF SHOES

Macro trends are reshaping the way in which companies operate and conduct their businesses. In the footwear industry, consumer preferences are shaping the types of products manufactured and services provided. Customisation now requires companies to invest in understanding differences in consumer preferences and values so as to be able to deliver the right products and to develop new business models and flexible manufacturing systems capable of producing customised products at competitive prices.

Achieving profitable mass customisation is a challenging task because it frequently results in an increase in manufacturing complexity. New technologies enabling the digitalisation of manufacturing may however support the response to greater demands for personalisation while, at the same time, containing costs. In this sense, increasing attention is being paid to a range of digital technologies such as advanced robotics and additive manufacturing.

For example, 3D printing may enable customisation and personalisation of footwear by the introduction of new solutions to make insoles, midsoles, outsoles and some items featuring unique designs. 3D printing is now being used mainly for components and shoe sample prototyping and production of some usable polymeric/plastic customised/personalised insoles and midsoles. Printing upper materials with properties like leather is not as yet a possibility.

A complementary trend is the reshoring of manufacturing away from Asia to be closer to Western consumer markets. It is driven by cost reduction, improved quality, shorter lead times and greater flexibility. Cost deciding factors include those in regard to labour, productivity and logistics. Advanced manufacturing and new product concepts such as knitted shoe uppers, can also play a role in cost reduction and easier reshoring.

## 3D BONDING TECHNOLOGY

In recent years, protective and safety footwear has evolved from a heavy, monocoloured product to a visually more attractive one that is pleasant to wear. In the past, the same base model was used for many different working conditions as the options were quite limited. Today, a range of complementary products support a knowledge-based response to ensure employees have the protection, satisfaction and personalisation they desire.

To remain competitive, Portuguese footwear manufacturers are finding it necessary to embed these new macro and technological trends in their business models, products and processes. 3D bonding is a specific case in point. This is a process in which pieces of flexible material are placed inside a specially designed injection mould system containing a series of channels running adjacent to these pieces. Next, a polymer (usually polyurethane) is injected in liquid state and flows through the channels of the mould creating a stable three-dimensional skeleton that, once solidified, bonds the pieces together.

The Portuguese footwear manufacturer AMF has recognised the potential of this technology, patented and developed by Simplicity Works, as a potential industrial revolution in footwear and immediately started a collaboration. AMF's willingness to innovate means that it will become the first company to apply this technology to personal protective footwear. 3D bonding is said to greatly simplify the manufacturing process and, according to Eng. Albano Fernandes, AMF's CEO, "makes large scale footwear production economically feasible in Europe".

The Infinity collection–part of the company's signature TOWORKFOR brand–will be the first product line in the protective and safety footwear market produced with just one Desma injection machine replacing traditional stitching and assembly activities. At the UITIC Congress in Porto in May, AMF reported several advantages associated with 3D bonding including savings in upper material used, energy costs, production costs, stock levels and logistics.

The technology moulds all the pieces of the shoe together with a polyurethane 3D skeleton and without stitching or a last. The skeleton unites the pieces together, giving it structure, stability and better adaptability. The process is said to require 30% less upper material than traditional safety shoes. The adaptive seams stretch for superior comfort even with the various materials used for construction, leaving a waterproof yet breathable product. Additionally, 3D bonding results in a 70% reduction in labour and a 12% reduction in energy costs, making for a sustainable and efficient alternative to traditional injection.

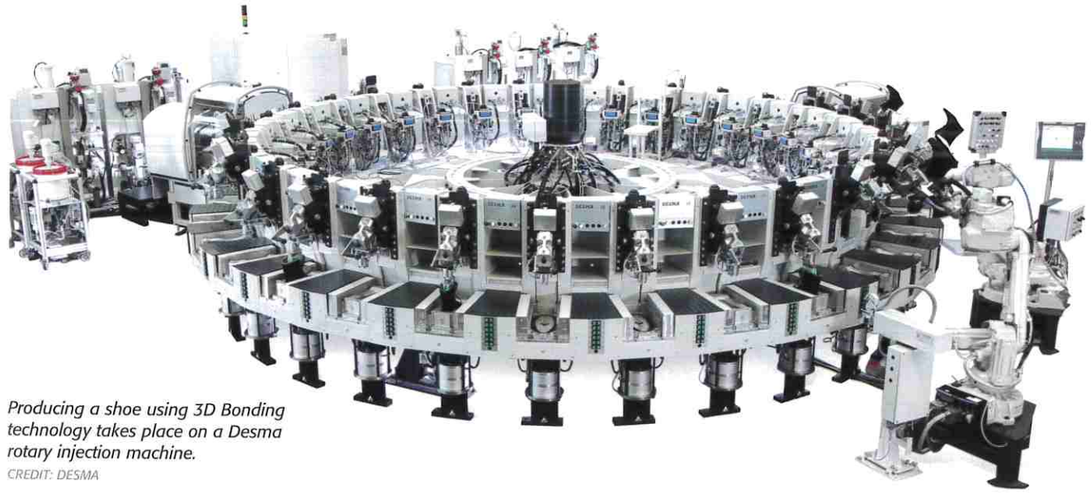
The process makes possible the 3D production of high performance footwear with uppers made of high quality natural origin renewable materials such as leather. The 3D polymeric bonds that replace traditional stitching give the upper stability, eliminate the need of materials overlapping and are flexible. The finished product is created with greater precision using a fast and agile standardised process and, at the same time, is said to offer better technical performance in terms of stability and water resistance.

Coming onto the market this year, this new range of safety footwear couples protection with comfort and design differentiation. It features breathable uppers in different colour options that can be customised, an exchangeable and washable insock for improved fit and a cushioning sole to provide comfort and grip. Added to this are a Kevlar flexible protective insole and a lightweight composite toecap making the shoes non-metallic and therefore suitable for a range of working environments.

## THE RIGHT FOOTWEAR

Making high performance protective footwear available is only one part of the safety at work equation. Selecting the right footwear for the employee is also fundamental. Using adequate footwear reduces injuries, cuts lost work hours and improves productivity and motivation. Footwear selection therefore needs to consider work activities, the type of materials handled by the employee, the type of surface underfoot, environmental conditions and the hazards present at the workplace, evaluating in particular the following risks:

- Objects falling onto, striking or rolling over the feet
- Sharp or pointed objects that might cut the top of the foot or penetrate the sole or side of the footwear
- Slips or falls on slippery surfaces
- Penetration of liquids
- Exposure to extreme heat or cold
- Possible exposure to corrosive or irritating substances
- Possible explosive atmospheres including the risk of static electrical discharges
- Damage to sensitive electronic components or equipment due to the discharge of static electricity
- Electrical hazards
- Exposure to rotating or abrasive machinery (chainsaws, etc.)
- Hot surfaces, radiant heat or fire
- Molten metal that could splash onto feet



*Producing a shoe using 3D Bonding technology takes place on a Desma rotary injection machine.*
CREDIT: DESMA

## FUTURE STEPS - FAMEST

The Portuguese footwear sector has evolved from being an industry driven, resource-based activity to a market led knowledge-based one, taking advantage of styling and technology to preserve Portugal's shoemaking capability. To remain competitive, it will need to concentrate on the creative phase, master the whole product and process life cycle and add value (knowledge and intangibles) to each phase, embracing societal, market, technological, Industry 4.0 and circular green economy challenges, trends and opportunities.

FAMEST (Footwear, Advanced Materials, Equipment & Software Technologies) is a Portugal 2020 R&D collaborative project, promoted by a consortium of 23 companies covering the whole footwear value chain. It includes leather, insoles/insocks, soles, chemical products, software, production equipment, logistics and footwear, representation and leadership, as well as nine R&D bodies with multidisciplinary and complementary abilities *(Figure 1)*.

As explained by Maria José Ferreira, head of the research and quality department at CTCP (Portuguese footwear technological and research centre) and FAMEST coordinator, the project seeks to mobilise the whole sector with the aim of researching, developing and creating in the following three areas:

- New materials, footwear components and advanced technologies
- New concepts of fashion, technical, customised, personalised and work footwear and economically competitive, incorporating the materials developed, produced and commercialised by new digital flexible technologies and business models
- Solutions to minimise and evaluate the waste materials generated during the sector industry's productive phase and by used products

One of the main goals pursued by FAMEST is to deliver technologies that enable companies to adapt to the challenging ecosystem in which we live and grow. To do this, they need to contribute towards attracting, retaining and empowering suitably qualified employees They also need to engage with customers, optimise operations and design business models supported by new products and services *(Figure 2)*.


*Figure 1: The FAMEST consortium.*

CREDIT: CTCP

As regards qualifying and empowering workers, the project will deploy digital solutions to connect people in the factory and across the value chain, to the information and knowledge available so that they can learn, prevent and solve problems in real time, and work and manage their businesses more productively and securely *(Figure 3)*.

As companies and value chains go digital, an enormous amount of data is obtained. FAMEST aims to support employees and companies in using this data to stay updated and competitive, using automated data capture, high processing power, machine learning and augmented intelligence across new technologies. This will help to motivate new ways of working centred around data, with real potential to drive innovations in products, services and customer experience, all contributing to new work and business opportunities.

FAMEST will also seek to explore advanced technologies such as artificial intelligence/simulation/modelling, robotic process automation and the industrial internet of things. It will then use these assets to promote innovative work environments, productivity tools and encourage manufacturing employees to become more connected and mobile, and working in a more collaborative way in order to foster high output at the required level of quality. The project will run until 31/10/2020. In the meantime, further articles will give details regarding complementary R&D results and initiatives.

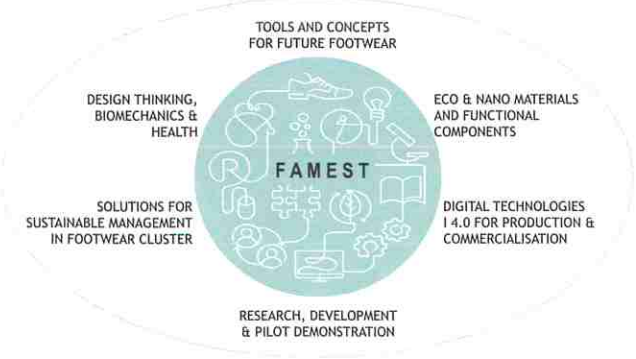



*Figure 2: FAMEST main areas.*

CREDIT: CTCP

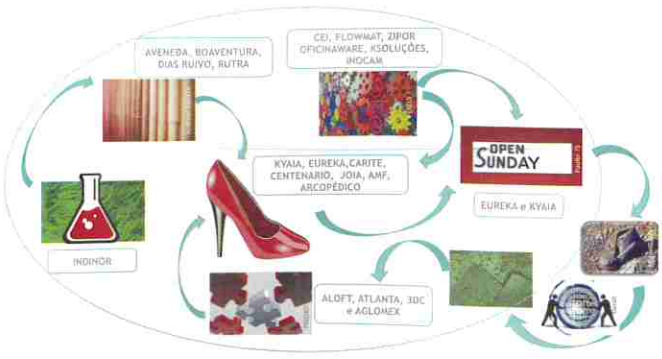



*Figure 3: FAMEST involves and targets the whole value chain.*

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