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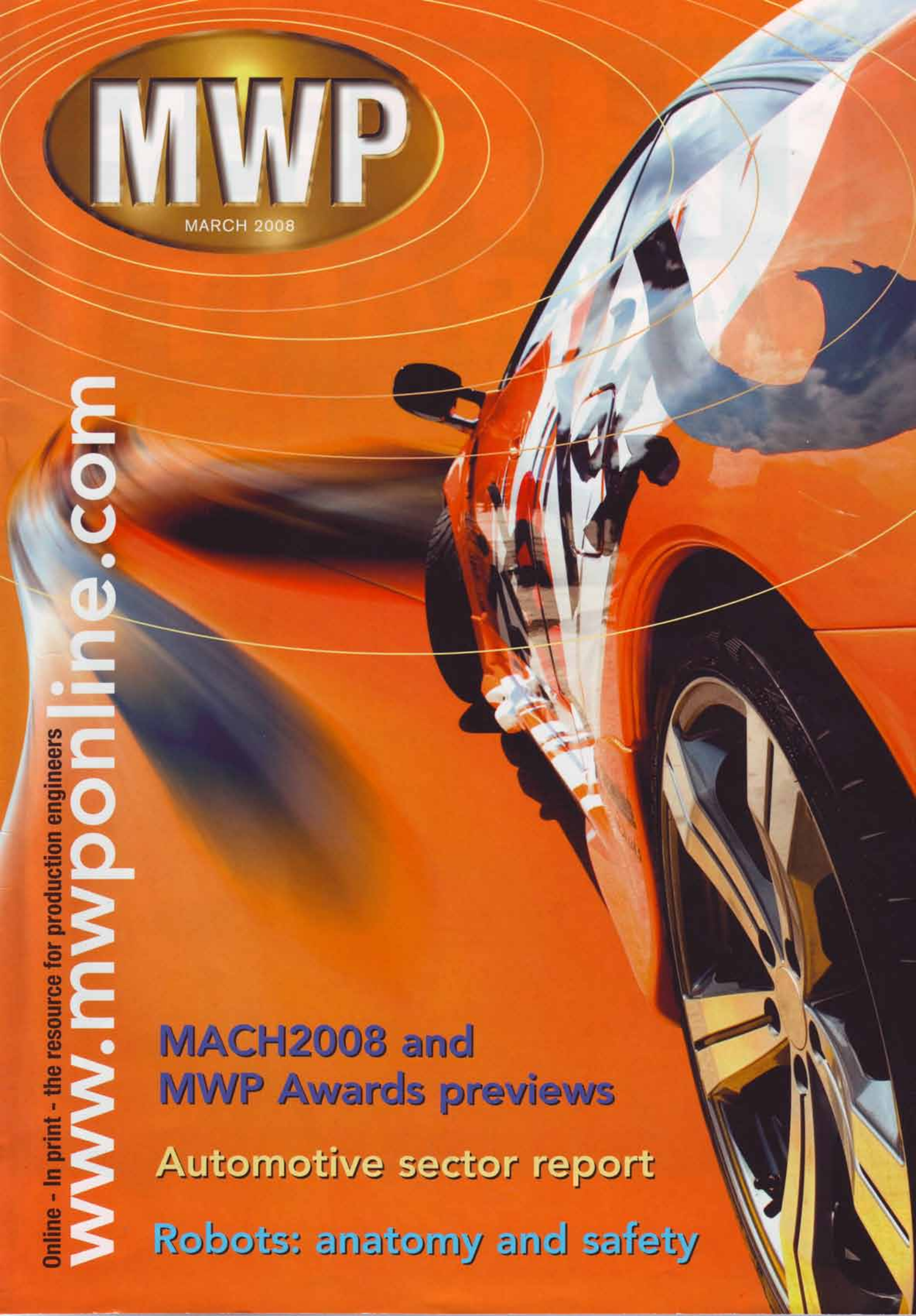

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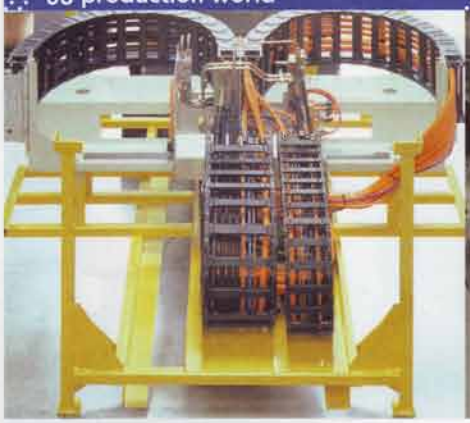

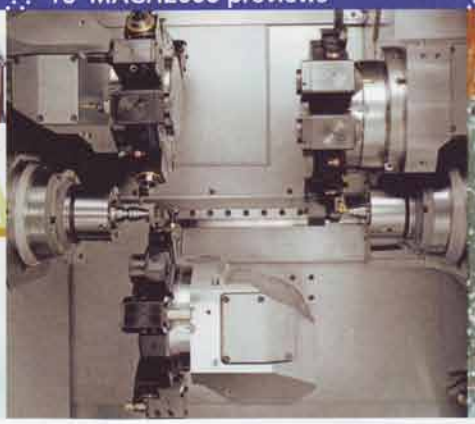

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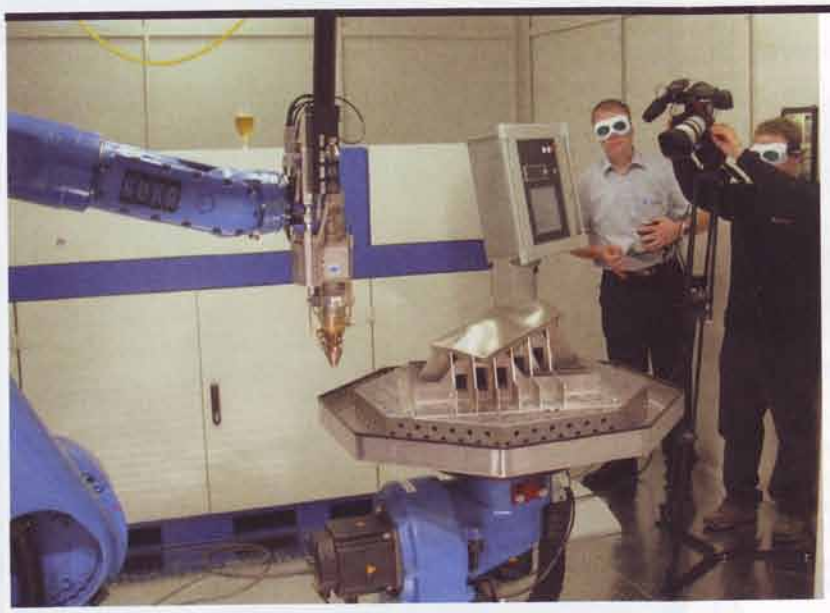

Direct rapid manufacturing of metallic parts - the technology of the future? Or is it here and now? We offer a UK industry overview. (for a full version go to www.mwponline.com)

By Phil Reeves

It adds up

Research into metallic feed systems started in the late 1980's using MIG welding torches fitted to multi-axis robots, as a way of building up material onto expensive damaged parts, such as turbine blades or mould tools. In the 1990's welding wire was replaced with blown powder, which although much slower, enabled far better melt-pool control and subsequent part accuracy.

RAPID Manufacturing (RM) describes the production of 'series' or 'end-use' component parts made using Additive Layer Manufacturing (ALM) processes. Traditionally, these were used to make prototypes and casting patterns, but advances in ALM technologies and materials now allow manufacture of parts in polymers, ceramics and metals for many production applications.

How Does Additive Layer Manufacturing Work? The principle is simple. As opposed to machining, where material is removed from solid block, or casting where material is melted and forced into a cavity, it works by building-up the required geometry particle-by-particle, layer-by-layer, from the bottom-up. There are many different mechanisms for generating a single layer, or for bonding layers together. In some simple systems, layers are cut from sheet material and bonded using adhesives or ultrasonic welding type processes. In others, layers are generated by melting fine powder using a laser or electron beam, and consolidating the new layer onto the previous layer by remelting. There are over 30 different ALM processes marketed by over 40 different companies around the world. Most focus on polymeric materials.

Why is RM becoming important to the economy? Some see it as one of the most important emerging technologies to the future manufacturing economy. A notable advantage is the potential elimination of tooling. Without the constraints of casting or moulding tools, or machining jigs and fixtures, RM enables manufacturers to produce cost effective batches of one, or to make parts at multiple locations or with multiple product design iterations at no extra cost..

A wide range of production engineering metals for components such as these hip joint cups have been processed using powder bed ALM systems

Why is RM different to traditional manufacturing? Because it uses layer-wise manufacturing, many of the traditional Design for Manufacture (DFM) principles no longer need apply. RM components can be manufactured with no split lines, or with complex internal and re-entrant features. It therefore allows for significant part consolidation, reducing manufacturing, assembly and inspection costs; and for the manufacture of topologically optimised components - 'manufactured-for-design' as opposed to 'designed-for-manufacture'. This can eliminate many secondary manufacturing steps such as internal machining ops or secondary fabrication.

How will RM affect the traditional supply chain? In principle, RM can reduce or eliminate many stages of the traditional supply chain, reducing lead times, inventory and supply chain transaction and logistics costs. Moreover, little if any waste material is generated - this is particularly true of the newer metallic processing technologies. Additive processes are lean yet agile, allowing manufacture of low volume component batches, with little manual intervention.

So who is using RM today? There has been an almost exponential increase in the number of companies using RM, across many sectors. Applications include aerospace and automotive components, packaging, medical implants, hearing aid shells and surgical guides, and consumer products as diverse as furniture and football boots.

How did we get to where we are today? The technologies behind RM have existed since the mid 1980s, when processes such as Stereolithography (SLA), Fused Deposition Modelled (FDM) and Selective Laser Sintering (SLS) were introduced to make prototype parts directly from 3D CAD data - the term Rapid Prototyping (RP) was coined. However, the processes produced exclusively polymeric or paper parts. As the accuracy and repeatability of the early systems