Additive Manufacturing for Automotive

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6 Challenges for Additive Manufacturing in the Automotive Industry

Additive manufacturing – or 3D printing as it is sometimes known – has the potential to revolutionise design capabilities and manufacturing processes in a number of industries, the foremost of which is the automotive field. The technology is not new however and the possible benefits that fast, efficient additive manufacturing capabilities would offer car-making firms are all well known and understood. But what are the challenges? What are the key areas where the most research and investment is required to help kick-start the large scale end-production use of additive manufacturing?

1. One of the greatest deficiencies for additive manufacturing is the lack of human capital. It takes time to train people in specific areas of design and production required for this relatively new and rapidly evolving production method. For additive manufacturing to become a reliable and efficient process requires an army of skilled people behind it trained in CAD (Computer-aided design) skills, AM machine making, maintenance, quality assurance, supply chain management and material preparation. It is not just the lack of human capital available in this area that is challenging; what training there is available at this point is not standardized, meaning it is difficult to create a stable and capable workforce, according to a Deloitte University press study. Most training is unofficial and on the job; this will need to be formalised with dedicated skill development programmes if AM is to evolve into a stand alone profession.

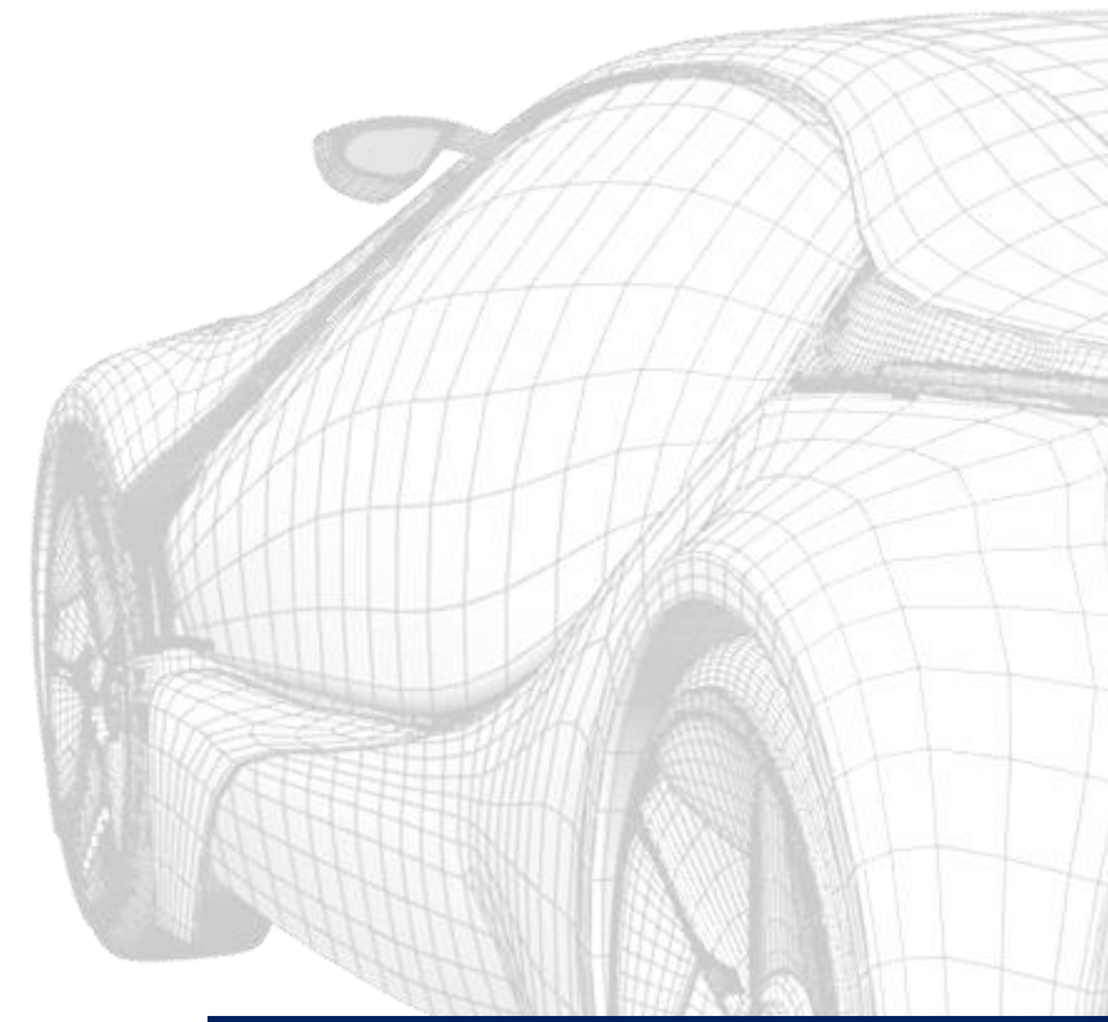
2. The sluggish production times involved in additive manufacturing are hampering widespread uptake of the process in the automotive industry as traditional, mechanized techniques continue to outperform on speed and efficiency. Speed matters; to manufacture an entire automobile from nose to tail takes a matter of hours in efficient factories. Moreover, to highlight the rate of production globally, around 3 cars were made every second in 2013. Additive manufacturing, even if it's only used for small components, in its current guise is potentially a significant bottleneck in the production process. Robust investment in high-speed AM is a noted area of research for academics, material scientists and commercial interests. Despite being a key focus for research in recent years there has been limited progress on this front to date. For an industry driven by volumes, the low-level production AM currently offers is not feasible for general commercial applications.

3. Even if additive manufacturing significantly improved production speed and upped its volume output, it still cannot produce large single parts. This is another key challenge facing AM researchers as they seek new ways to exploit 3D printing technology for automotive applications. The build envelope for current AM technologies is limited, meaning even larger components that can be printed must still be assembled by mechanical joining or welding. Academia, government and industry are putting enormous resources into overcoming this hurdle, with Department of Energy's Oak Ridge National Laboratory (ORNL) leading research in conjunction with companies including Lockheed Martin and Cincinnati Inc. – on Big Area Additive Manufacturing (BAAM). Last year development work began on a machine that could print polymer components up to 10 times larger than current systems are capable of and at speeds up to 500 times faster than existing AM machines. The design is focused on increasing speed by combining larger nozzles for faster polymer deposition, high-speed laser cutters that handle work areas in feet rather than inches, and high-speed motors to accelerate the pace at which printer heads are moved into position. However, much of the research to date has been invested in plastics not metals, meaning there is a disconnect with the needs of the automotive industry. Although work is being done in this field the challenge remains a significant barrier to entry for manufacturers

4. One of the biggest challenges with additive manufacturing comes not from the capabilities (or lack thereof) of the manufacturing process, but from legal loopholes. AM product designs can only be patented, not copyrighted. The lack of clarity on patent protection and the limited ability to enforce it means the potential for producing counterfeit components is sizable. Gartner, the research firm, has quantified the market for counterfeit 3D printed components in the automotive industry, indicating it could be worth as much as $15 billion in 2016 due to intellectual property theft.

5. One of the key future targets for additive manufacturing in the automotive industry will be to produce single complex parts that incorporate and consolidate many components. This will require the printers and printing processes to improve considerably. The boom in demand is already in progress though with Canalys, a market research firm, forecasting the market for 3-D printers and services to grow globally from $2.5 billion in 2013 to $16.2 billion in 2018.

6. Printing in different materials at the same time is one of the most exciting potential benefits of additive manufacturing; actually developing that capability will be one of the most significant challenges. Multi-material printing capabilities would open up new design possibilities and help create innovative end products. Likewise the challenge of embedding sensors, batteries, electronics and microelectromechanical systems (MEMS) directly into components and parts could revolutionise the manufacturing process.



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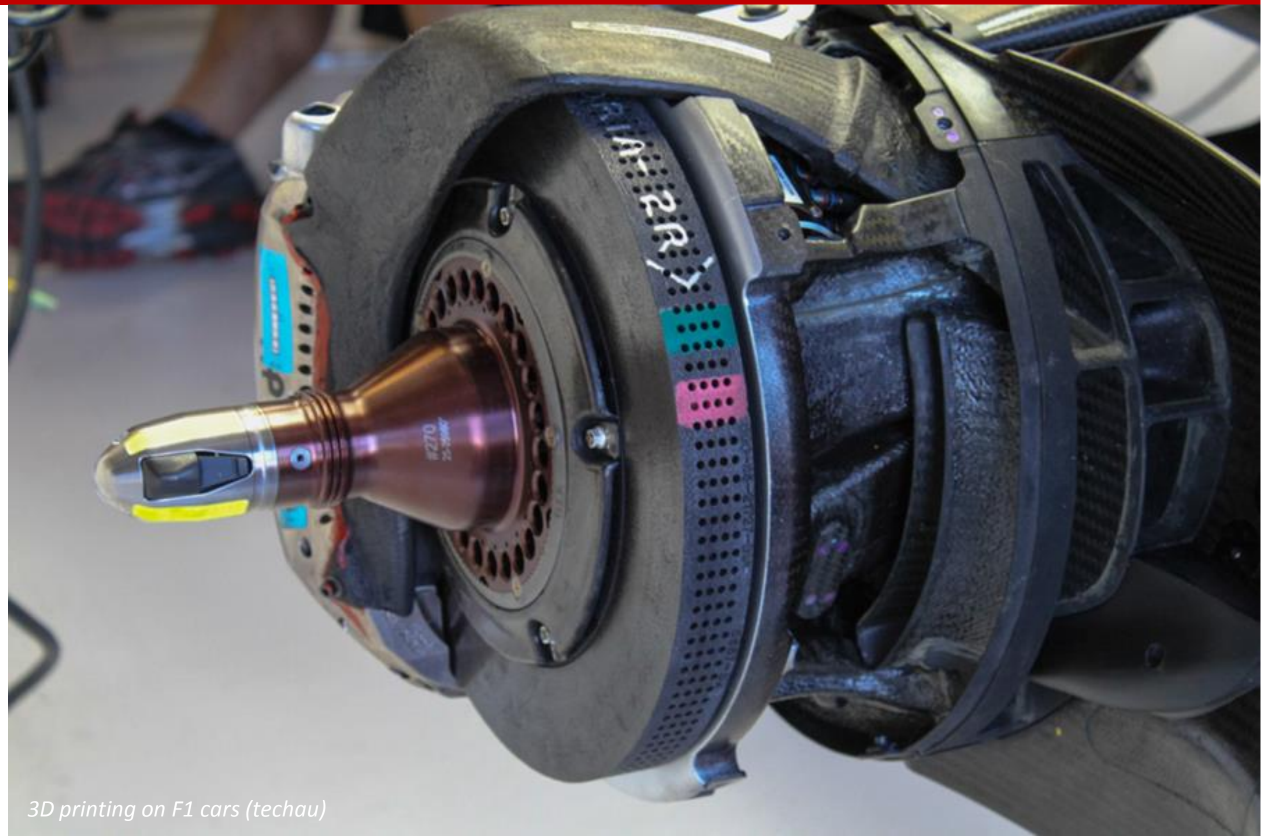
When teams are looking to improve speed, reliability and efficiencies by fractions of a percent, the circa 30% weight savings offered by 3D printed parts over traditional manufacturing methods can make the difference between winning and losing. It's the difference between leading the field – both on the track and in the design engineering studio – and following the herd.



3D printing on F1 cars (techau)

In addition to the improved mechanical properties, the printing process itself is also more conducive to the racing environment due to rapidly changing technology, race rules and track specifications. The specification of individual parts often changes from circuit to circuit, meaning that short production runs in the printing process are an ideal fit for F1 requirements. It also allows designers significantly more flexibility when engineering the components to better fit the specific stresses and conditions of individual tracks.

Additive manufacturing is also advantageous since design times for F1 components are short, as is their useful life on the cars. While 3D printed plastic parts have many advantages over hand-forged or machined metal components, they are not as strong or heat-resistant. One solution F1 teams have devised to counter this is the process of 'metalising' plastic parts. This is the application of a thin layer of copper to the plastic surface, which increases the structural integrity of the part as well as boosting its heat resistance.

The printing of metal parts has improved over recent years but more investment is required to further advance their design and manufacture. The production of composite parts is however a reliable and suitable alternative in many cases.

Perhaps the biggest myth about additive manufacturing is that is cannot produce strong enough parts that prove durable for high impact applications. The 3D printing of composite roll hoops – the part of the car that arguably needs to be stronger and more robust than any other – entirely blows away this misconception. Roll hoops printed with additive manufacturing technology are believed to have been in production with a number of F1 teams for the last four seasons, although it's unclear who pioneered this.

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Although additive manufacturing processes are being utilised by F1 teams there is still a great deal of untapped potential for this technology. The pace of technological change is so rapid that ever more complex designs will be needed to push F1 engineering to its limits.

Investing in ruggedized, mobile 3D printers that can be transported from race to race and give teams the ability to design and print components on the road would be a giant leap forward for additive manufacturing in motorsport. There are rumours of small printing units being currently used in some race

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