



**ROYAL
AERONAUTICAL
SOCIETY**
Loughborough Branch

21 February 2017

**Joint meeting of RAeS and IMech E
3D Printing and Digital Manufacturing
Technology**

Kevin Smith, Sales Director, Voxeljet UK Ltd.

Whatever is presented here will be unlike anything that was said because this was a tour d'force of the accomplishments of 3D printing in its 30 years or so of application. It was delivered with humour and credibility, and it is accepted as a writing challenge to present the speaker's threads appropriately and as seamlessly as they were conveyed on the day.

The humour was evident from slide one: it promised to be the first of 300+ slides, then there was a declaration of many anecdotes, a claim that he would be a boring presenter... and so on. It was a jovial scene-setter that prefaced a more serious and very philosophical call to arms from the engineers present. It called on us to meld fundamental knowledge with new rather than dying skills. He visualised engineering design becoming a less legacy-based and more fundamentally multi-faceted activity. 3D printing technology, embraced as a tool rather than used piecemeal, he sees as a technology that will realign the direction of industries. Some forward-thinkers 30 years ago actually believed that the spreadsheet would usurp the slide rule. They have been proven well-sighted, and there is no reason to think that this man's equivalent vision is any less true.

His motto was "additive manufacturing." It was hard to define the aspects he was keen to consider but a telling expression was that "design for manufacturing" was now out-of-date and must be replaced with "design for functionality." He had extensive experience in foundry-based casting, and contended that the limitations set by using a technique that has been several millennia in the making is being usurped by a new process that is a technology in its own accord. It welcomes designers with the vision to consider materials with new properties, and that beckon from horizons that are not constrained by what has been common knowledge in the past. He brought a veritable truck load of examples, ranging from the minute to the massive. A telling example – to pick just one – was a section of the 2012 Olympic flame-holder which drew air into the core, through which the gas-air mixture was mixed as it flowed up to the flame, and introduced the air through small passages that were an intake on the outer face and trifurcated (there is such a word!) into three entries on the inner face. These were not linear holes, as drilled examples would be: nor did they have a fixed cross-section. Packed in close proximity these apertures were a catacomb-like lattice that could not have been manufactured by any historic techniques. It was a grand illustration of the way that elegance as well as efficiency and simplicity can be integrated.

There was an undertone of dismay from the speaker that many observers have praised 3D-printing as being well-suited to fast-prototyping articles for assessment in factory mock-ups. He saw that as failing to realise – in some regards dismissing - the potential benefits of the new technology. How one conveys that message (which is right 'on song' with the beliefs of many technologists who crave less discipline-constrained and forward-looking design capabilities) is very hard to express without using examples, and he had a comparison. The

first was a component for a Formula Student design project which was produced to conventional 'rules' and the second was a design that applied 3D-printing based manufacturing rules. The latter had barely a straight line, the envelope was more akin to a segment of spaghetti-like lattice work, and the strong message was that it was lighter, more readily manufactured, had a shorter (easier/cheaper to manage?) trail through professions from design to production. He was stressing how the modern designer must look to refine the line from design to production such that it is less labour-intensive, less constrained by the legacies of several millennia of knowledge, and as such will be less expensive per manufactured unit. The implication is that those who design and build products the 'new way' will have cheaper products, be faster to the market than tradition-bound businesses, and will have less employees with more modern skills. He showed an example of an industrial-scale 3D printing unit, and that makes one realise that the 'new way' will need to replace much of what is familiar already. Lower prices in the long run will come at the expense of installing the new systems, and it must revolutionise factories. In terms of staff and machinery they will be multi-disciplinary and more compact. They could be cleaner and boost production per employee. Their life-blood will not be drawings, but computer-aided design (CAD) files importable from almost anywhere. Their flexibility in terms of supplying products to a wide range of customers – even opening the prospect of a customised product (he mused on the possibility of a car with characteristics that made it unique to the buyer) is within sight.

There were many questions asked, and the undertone was often a feeling that the speaker disregarded long-held mantras of good engineering practice: with topics ranging from quality assurance to the quality of materials, their costs and their durability. It is clear that the new technology has such a wide range of possibilities that the scepticism of those from established engineering disciplines will not disappear overnight. There was an emphasis in the presentation of 'out of the box thinking,' a modern euphemism that means little to an engineer who has been trained for, and holds dear, the skills and knowledge of one, or a limited number, of recognised discipline. A more penetrating and viable comment was one of the speaker's observations:

Some make it happen / some watch it happen / some say "what happened?"

This was a presentation that set out to stir the imaginations of those present. Duly note that the speaker is a 'Sales Director,' but his approach was not to sell his area of expertise just as a tool, but as a device which straddles old boundaries and – most important of all – opens new horizons. In a cheerful manner he stressed how 'remote' communities are finding the new opportunities of 3D printing more readily than established areas. The use of 3D printing technology to create a large scale and high-realism model of the Aston Martin DB5 which was explosively destroyed in the film 'Skyfall,' and which was in fact the item that was destroyed, illustrated a non-production application. Subsequently there was an approach from George Lucas, whose 'Star Wars' film production team then adopted 3D printing of character's outfits. A telling reflection was that a props manager whose team created costumes saw the new technology as usurping his job: whereas the team he had was increased from 12 to 60 people, reskilled and opening a new chapter in the history of their profession. This is a 'remote' community to engineers, but it is within our society. In



The model Aston Martin DB5 developed for the film 'Skyfall'

Total size	1,480 x 620 x 270mm
Mass	15kgs
Individual pieces	18
Material	PMMA (poly-methyl-meth-acrylate)
Layer thickness	0.15mm

Source: Voxeljet UK Ltd website

genuinely 'remote' societies; who might wait patiently for new products nowadays, the delivery by electronic media of the CAD files for the product can possibly allow merchandise to appear sooner and with delivery costs (transport and tariffs) avoided. He cited New Zealand, not just geographically remote but also with a small population, having viewed 3D printing as a way to re-energise their own ambitions, and fulfil needs in a better way in the fullness of time. His context was that if established societies don't "make it happen" they are the ones that will be asking "what has happened?"

This was a presentation that deserved the applause it received from an audience that responded to the vote of thanks from Hazel Carlin. The considerable influx of IMechE compatriots had swelled the audience from what might have been an otherwise less impressive turn-out: do the majority of aeronautical engineers realise what is happening?

The advent of a technology that is such a profound and most significant contributor to the modern scene truly deserved this unique and thought-provoking presentation. We were stimulated to not let the shadows of our pass darken the view of what approaches.

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