

## Results of competition: ADMA - Inspiring new design freedoms in additive manufacturing/3D printing

Total funding available for this competition was £9m, provided by the Technology Strategy Board, EPSRC, AHRC and ESRC.

**Note: These proposals have succeeded in the assessment stage of this competition. All are subject to grant offer and conditions being met.**

Participant organisation names	Project title	Proposed project costs	Proposed project grant
<b>3T RPD Limited (Lead)</b> Within Technologies Limited	GOSSAM – Generation of Optimal Support Structure in Additive Manufacturing	£334,602	£200,761
<b>Project description (provided by applicants)</b>			
<p>One of the ‘dirty secrets’ of Additive Manufacturing (AM) technologies is the necessity of support structures to allow the manufacture of components. Support structures are required to build unsupported geometric features on the part. The reality is that AM does not allow complete design freedom, as supports may need to be built, which cannot be removed post production.</p> <p>Current support software is un-intelligent and un-automated, allowing only highly skilled operators familiar with the AM technology, able to setup a build. This project aims to deliver software that can automatically generate intelligent scaffolds that supply only the support that is necessary, whilst allowing easy removal of both the part and any loose powder. The software developed in this project will move the AM process away from the intuition of a skilled operator, closer to “print from CAD” manufacture.</p>			

## Results of competition: ADMA - Inspiring new design freedoms in additive manufacturing/3D printing

**Note: These proposals have succeeded in the assessment stage of this competition. All are subject to grant offer and conditions being met.**

Participant organisation names	Project title	Proposed project costs	Proposed project grant
<b>3T RPD Limited (Lead)</b> MakieLab Limited Digital Forming Limited Ron Arad and Associates Limited	RAINBOW - Batch coloured powder for laser sintering	£172,430	£103,458
<b>Project description (provided by applicants)</b>			
<p>Additive Manufacturing (AM) has the potential to provide bespoke one-off designs without the need for expensive tooling. Despite the freedom of design from using Laser Sintering (LS), powder colour choice is restricted to black, white and natural polyamide colours. Parts can be dyed, but colours come only from a vivid palette, can vary across location on the part and between batches, and only colour the surface of the part.</p> <p>The aim of this project is to develop and test batch coloured components using Laser Sintering. The innovative nature of this work is the approach to colour batches of powder for individual builds using customer specified colours.</p>			

## Results of competition: ADMA - Inspiring new design freedoms in additive manufacturing/3D printing

**Note: These proposals have succeeded in the assessment stage of this competition. All are subject to grant offer and conditions being met.**

Participant organisation names	Project title	Proposed project costs	Proposed project grant
<b>3T RPD Limited (Lead)</b> The Welding Institute The Manufacturing Technology Centre Limited LimitState Limited Aero Engine Controls Magna Parva Limited Lotus F1 Team Ltd JRI Orthopaedics Limited	Forging the standards which will shape the UK's AM sector (ANVIL)	£892,065	£622,016
<b>Project description (provided by applicants)</b>			
<p>Additive Manufacturing (AM) has the potential to revolutionise the design, production and supply of parts, but exploitation has been limited. A major challenge for industry is to understand the true capability of the new techniques - especially making comparisons between machine platforms.</p> <p>The ANVIL project will overcome this issue, by bringing together key end-user sectors and AM experts to develop a standard way of assessing the capability of metal powder bed fusion processes. This approach will be used to compare the latest machines and the information generated will form the basis of an interactive design for AM guide. Application demonstrators will be designed using this guide and manufactured to provide case studies for promoting the effective use of AM technology. An AM-OLR (On-Line Resource) will be established to disseminate the findings and encourage sharing of data across the UK AM sector.</p>			

## Results of competition: ADMA - Inspiring new design freedoms in additive manufacturing/3D printing

Note: These proposals have succeeded in the assessment stage of this competition. All are subject to grant offer and conditions being met.

Participant organisation names	Project title	Proposed project costs	Proposed project grant
<b>Blagdon Actuation Research Limited (Lead)</b> 3T RPD Limited	Productionisation of an additive manufacture technology driven servo valve design	£284,339	£170,603
<b>Project description (provided by applicants)</b>			
<p>Blagdon Actuation Research Ltd and 3T RDP Ltd are collaborating to promote the entry into production of an innovative hydraulic servo valve technology. The programme is focused on providing foundation engineering knowledge and process improvements for an Additive Manufacturing (AM) process.</p> <p>The project includes the generation of pressure fatigue data in both small samples, and for complete hydraulic manifolds. This data will be used to optimise the valve technology which will undergo representative environmental and strength testing.</p>			

## Results of competition: ADMA - Inspiring new design freedoms in additive manufacturing/3D printing

**Note: These proposals have succeeded in the assessment stage of this competition. All are subject to grant offer and conditions being met.**

Participant organisation names	Project title	Proposed project costs	Proposed project grant
<b>Corin Limited (Lead)</b> Stanmore Implants Worldwide Limited	TICLE - Titanium CLEaning	£279,784	£139,784
<b>Project description (provided by applicants)</b>			
<p>Additive Manufacture (AM) is being increasingly investigated within the orthopaedic industry for the production of optimised implant designs. The technology enables complex geometries to be generated which can also be better matched to the properties of bone. Such implants can minimise bone resorbtion and facilitate improved bone ingrowth, thus improving the survivorship of the joint replacement.</p> <p>To date, only one US company is known to have brought AM technology to market. One of the key hurdles to enable commercialisation of existing AM designs is cleaning. Post-manufacture cleaning is required to remove unsintered material/entrapped powder and manufacturing lubricants and it is ultimately of importance to ensure patient safety.</p> <p>Cleaning poses a significant challenge due to the complex, porous implant geometries created by AM. The objective of this project is to develop cleaning methods to enable commercialisation of existing device designs and custom implants.</p>			

## Results of competition: ADMA - Inspiring new design freedoms in additive manufacturing/3D printing

Note: These proposals have succeeded in the assessment stage of this competition. All are subject to grant offer and conditions being met.

Participant organisation names	Project title	Proposed project costs	Proposed project grant
<b>CRDM Limited (Lead)</b> McLaren Automotive Limited Delcam PLC Selex ES Limited Ultra Electronics Limited Flitetec Limited	Automotive and Aerospace Part Production by Additive Layer Manufacture – ‘AA-PALM’	£1,256,600	£681,360
<b>Project description (provided by applicants)</b>			
<p>The objective of this 2.5 year long project is to demonstrate the clear competitive advantages of the use of Additive Layer Manufacturing (sometimes known as 3D Printing) in the manufacture of production metal and polyamide components. The project will demonstrate that ALM is now a reliable and potent production technology which can be included in the gamut of standard manufacturing techniques. This will be done by addressing three key issues, those of ALM component error correction, the automatic finishing of ALM components to acceptable standards, and the generation of ALM Production Part Acceptance Procedures for the industries involved, as well as process control plans and design guides for parts.</p> <p>The project will be led by CRDM Ltd, with McLaren Automotive, Delcam, Selex, Ultra Electronics and Flitetec as its partners. This strong consortium will ensure that the validated ALM techniques will be robust, exploitable and disseminated widely.</p>			

## Results of competition: ADMA - Inspiring new design freedoms in additive manufacturing/3D printing

**Note: These proposals have succeeded in the assessment stage of this competition. All are subject to grant offer and conditions being met.**

Participant organisation names	Project title	Proposed project costs	Proposed project grant
<b>Delcam PLC (Lead)</b> Bloodhound Programme Limited ABSL Power Solutions Limited HiETA Technologies Limited CRDM Limited EOS Electro Optical Systems Limited Simpleware Limited	LIGHT – Inspiring new design freedoms and LIGHTweight solutions for metal additive manufacturing	£1,140,019	£729,091
<b>Project description (provided by applicants)</b>			
<p>This project will inspire new design freedoms for Metal Additive Manufacturing (MAM), in particular Selective Laser Melting (SLM), to create advanced lightweight structures and products.</p> <p>A major constraint of MAM is the requirement of support structures for building overhanging geometries. This will be overcome by an innovative CAD/CAM solution which utilises smart “self-support” low-density lattice structures (down to 5% volume fraction) to efficiently support internal and external overhanging geometries of lightweight products. Furthermore, an end-to-end manufacturing simulation and rehearsal tool will be developed to predict the manufacturability and performance of lightweight products and stimulate design freedom and optimisation which can reduce material and production costs for MAM.</p> <p>The aim of this project is to enable the UK automotive, aerospace and engineering sectors to more effectively exploit MAM technologies.</p>			

## Results of competition: ADMA - Inspiring new design freedoms in additive manufacturing/3D printing

Note: These proposals have succeeded in the assessment stage of this competition. All are subject to grant offer and conditions being met.

Participant organisation names	Project title	Proposed project costs	Proposed project grant
<b>Delcam PLC(Lead)</b> Cookson Precious Metals Limited Future Factories Limited Birmingham City University Finishing Techniques Limited	Additive manufacturing of precious metal jewellery (PRECIOUS)	£471,856	£281,862
<b>Project description (provided by applicants)</b>			
<p>This project is aimed at rapidly bringing to full commercial maturity the process of 3D-Printing (or Additive Manufacturing) of precious metal jewellery items that is currently at varying stages of partial readiness at a small number of UK companies.</p> <p>To achieve this the members of our consortium will work together to mutually solve a number of outstanding problems by use of some clever, problem solving, end-to-end system integrations. Ranging from optimising the design creation and development process, through the various known manufacturing issues to produce items of well designed, high quality and highly polished, commercially saleable jewellery. To achieve this the consortium partners will also create operational and viable supply, distribution and value chains that reflect effectively the development of the new business model this project requires.</p>			



## Results of competition: ADMA - Inspiring new design freedoms in additive manufacturing/3D printing

Note: These proposals have succeeded in the assessment stage of this competition. All are subject to grant offer and conditions being met.

Participant organisation names	Project title	Proposed project costs	Proposed project grant
<b>Delcam PLC (Lead)</b> Warwick Manufacturing Group The Manufacturing Technology Centre Limited Kennametal Stellite Unlimited BOC Limited Cortus Limited Hybrid Manufacturing Technologies Limited Short Brothers PLC BAE Systems (Operations) Limited Magna Parva Limited	ACcelerated CLAdding and Integrated Machining (ACCLAIM)	£1,050,545	£694,215
<b>Project description (provided by applicants)</b>			
<p>Directed Energy Deposition Additive Manufacturing (AM), known as cladding, where a metal powder or wire feed is melted using electron/laser beam or electric arc, has significant advantages over powder bed fusion AM. Cladding offers very high deposition rates, material flexibility, and can be used in a hybrid approach, enabling complex features or different material to be deposited onto an existing component produced conventionally.</p> <p>In the ACCLAIM project Plasma Transfer Arc (PTA) cladding will be employed, offering excellent weld quality, low capital/running costs, very high deposition rates, material flexibility and minimal substrate interaction. Novel techniques will be developed to reduce thermal stress and provide a robust inert gas environment to ensure material quality. Moreover, a machining process will be integrated to enable fully finished components to be produced. This route is not only applicable for new part production but could also offer a very effective repair technique.</p>			

## Results of competition: ADMA - Inspiring new design freedoms in additive manufacturing/3D printing

Note: These proposals have succeeded in the assessment stage of this competition. All are subject to grant offer and conditions being met.

Participant organisation names	Project title	Proposed project costs	Proposed project grant
<b>ECM Developments Limited (ECMD) (Lead)</b> The Manufacturing Technology Centre Limited 3T RPD Limited	Improving Additive Manufactured Metal Parts Using Laser Surface Finishing and Electrochemical Machining (IMPULSE)	£197,453	£141,962
<b>Project description (provided by applicants)</b>			
<p>Additive Manufacturing (AM) can produce complex metal parts in low volumes. Unfortunately, AM inherently produces a stepped surface finish and metal parts produced by powder bed fusion processes can also have a granular texture. Parts are generally shot blasted to mask the effect of the stepped surface. Machining is only used in localised areas, due to the cost and difficulty in accessing complex part geometry. Automated abrasive finishing methods have shown significant promise but these offer poor control of part accuracy and in some cases can also be expensive/slow to apply.</p> <p>In the IMPULSE project a rapid automated finishing process, giving precise control of material removal, will be developed. This novel approach is based on robotically controlled non-contact methods using laser 'polishing' and electrochemical machining. Using two complementary methods will provide maximum flexibility in terms of materials, part geometry and final surface finish</p>			

## Results of competition: ADMA - Inspiring new design freedoms in additive manufacturing/3D printing

**Note: These proposals have succeeded in the assessment stage of this competition. All are subject to grant offer and conditions being met.**

Participant organisation names	Project title	Proposed project costs	Proposed project grant
<b>Embody Orthopaedic Limited (Lead)</b> Imperial College London Matortho Limited HCA International Limited	Transforming the high value joint replacement industry with additive manufacture	£337,634	£242,834
<b>Project description (provided by applicants)</b>			
<p>We want to transform the delivery of knee replacement to the patient from traditional manufacturing practices, into a 'just-in-time' process. Currently every operation needs an entire inventory of prostheses and instrumentation; with our planned patient matched procedure, each patient will need a single 'pizza box' containing exactly what is needed for his or her procedure.</p> <p>The use of additive layer manufacturing allows us to automate the design and manufacture of instruments for each patient at low cost, and in volume. This will reconfigure the supply chain, into a leaner model with significant savings for all the stake-holders, and a superior product that has been planned for each patient, with the tools to enable the surgeon to perform a reliably good job every time.</p>			

## Results of competition: ADMA - Inspiring new design freedoms in additive manufacturing/3D printing

**Note: These proposals have succeeded in the assessment stage of this competition. All are subject to grant offer and conditions being met.**

Participant organisation names	Project title	Proposed project costs	Proposed project grant
<b>FaraPack Polymers Limited (Lead)</b> Unilever Central Resources Limited BAE Systems (Operations) Limited Cobham CTS Limited Xaar Plc Marker Block Limited Loughborough University	Industrial Implementation of Additive Manufacturing through Advanced Polymer Sintering (I AM APS)	£1,442,126	£734,721
<b>Project description (provided by applicants)</b>			
<p>This project will develop supply chain and full scale production capabilities for novel Additive Manufacturing Technologies based on laser sintering (LS) and high speed sintering (HSS) for application in three major industrial sectors within the UK economy. These include Fast Moving Consumer Goods (Unilever), Aerospace (BAE Systems) and Space (Cobham Technical Services). The manufacturing capability owned by Loughborough University will be developed and exploited by the consortium partners that comprise in addition to end-users, manufacturing machine capability developers (Xaar), product design speciality (Sebastian Conran Associates) and polymer processing and additive manufacturing specialists (Farapack Polymers Ltd) based at the University of Sheffield.</p> <p>The project will deliver a validated supply chain with suitable demonstrator products in multiple industry sectors and an appropriate exploitation plan for effective commercialisation of LS and HSS.</p>			

## Results of competition: ADMA - Inspiring new design freedoms in additive manufacturing/3D printing

**Note: These proposals have succeeded in the assessment stage of this competition. All are subject to grant offer and conditions being met.**

Participant organisation names	Project title	Proposed project costs	Proposed project grant
<b>FDM Digital Solutions Ltd (Lead)</b> Salfordinsole Healthcare Limited University of Salford East Lancashire Hospitals NHS Trust	Additive manufacture value chain to deliver bespoke orthotics within 48 hours with greatly improved health economics	£1,393,364	£997,888
<b>Project description (provided by applicants)</b>			
<p>FDM Digital Solutions, experts in Additive Manufacturing will develop 3D Printed bespoke foot orthotics with partners Salford insole Healthcare, The University of Salford and East Lancashire NHS Trust.</p> <p>Research in this project will use innovative Additive Manufacturing techniques to combine foot shape capture with other data to design novel foot orthotics. Digital technology prescription allows design freedom, potentially delivering the orthotic device within 48 hrs.</p> <p>The innovative part of the project is that the orthotic will be 3D printed replacing traditional hand-made techniques. The 3D printing manufacturing method allows shape of the insoles and properties of the materials to be altered to exactly match the needs of a patient's foot. This disruptive technology offers a radically new end-to-end system integration creating a virtual manufacturing cycle triggered by patients needs by introducing a lean supply chain and scaleable business model into the orthotics sector.</p>			

## Results of competition: ADMA - Inspiring new design freedoms in additive manufacturing/3D printing

**Note: These proposals have succeeded in the assessment stage of this competition. All are subject to grant offer and conditions being met.**

Participant organisation names	Project title	Proposed project costs	Proposed project grant
<b>HiETA Technologies Limited (Lead)</b> Delta Motorsport Limited	Selective Laser Melting Micro-turbine (SLaMMiT)	£771,511	£510,905
<b>Project description (provided by applicants)</b>			
<p>The SLaMMiT (Selective Laser Manufacture Micro-Turbine) aims to develop a new micro-turbine employing Selective Laser Melting, a metal powder bed fusion version of Additive Manufacture. The micro-turbine will initially be targeted at the market for range extenders for electric vehicles, but it will also be suitable for micro-chip, concentrating solar power, and waste heat to power conversion, including automotive auxiliary power units operating off the waste exhaust heat from the vehicle's main internal combustion engine.</p>			

## Results of competition: ADMA - Inspiring new design freedoms in additive manufacturing/3D printing

**Note: These proposals have succeeded in the assessment stage of this competition. All are subject to grant offer and conditions being met.**

Participant organisation names	Project title	Proposed project costs	Proposed project grant
<b>HiETA Technologies Limited (Lead)</b> Renishaw PLC The Logistics Business Limited Sustainable Engine Systems Limited Sysemia Limited	High efficiency END-to-end (HiEND) Project	£1,555,416	£945,237
<b>Project description (provided by applicants)</b>			
<p>The High Efficiency END-to-End (HiEND) project addresses the ability of AM to operate as an effective manufacturing route for mid to mass market by proving a viable business/manufacturing model for producing 50,000 units p.a. for our target product within 3-5 year.</p> <p>Once completed we expect to be able to redefine the boundaries of AM capability and the component features that will make it an attractive process. Successful proof is not only that the number of units can be produced but includes achieving production at a competitive cost, quality and with an acceptable performance envelope.</p>			

## Results of competition: ADMA - Inspiring new design freedoms in additive manufacturing/3D printing

**Note: These proposals have succeeded in the assessment stage of this competition. All are subject to grant offer and conditions being met.**

Participant organisation names	Project title	Proposed project costs	Proposed project grant
<b>JRI Orthopaedics Limited (Lead)</b> Glass Technology Services Limited 3T RPD Limited University of Sheffield (Mercury Centre) Delta-T Devices Limited The Manufacturing Technology Centre Limited	Novel 3D coating of bioactive glass and metallic composites	£795,108	£569,249
<b>Project description (provided by applicants)</b>			
<p>This project brings together partners with expertise in additive manufacturing, glass technology and orthopaedic implants. The aim is to develop the next generation of coatings for orthopaedic implants such as hip replacements. The new combination glass and metal coatings will have better mechanical stability and faster integration with bone thus improving long-term clinical performance and reducing the revision rate.</p> <p>This will deliver a significantly better clinical outcome for patients and savings for the health service. The technology developed during this project has the potential to transform the manufacture of orthopaedic implants and has applications in other fields requiring specialist combinations of glass and metal.</p>			



## Results of competition: ADMA - Inspiring new design freedoms in additive manufacturing/3D printing

**Note: These proposals have succeeded in the assessment stage of this competition. All are subject to grant offer and conditions being met.**

Participant organisation names	Project title	Proposed project costs	Proposed project grant
<b>Renishaw PLC (Lead)</b> Cardiff Metropolitan University Abertawe Bro Morgannwg University Health Board LPW Technology Limited	Additive-manufacture for Design-led Efficient Patient Treatment - ADEPT	£987,479	£4651,494
<b>Project description (provided by applicants)</b>			
<p>This project will revolutionise the market in patient specific implants and put UK expertise at the forefront of R&amp;D in the sector. The application of advanced manufacturing technologies, such as Additive Manufacturing (AM) in the production of bespoke, patient-specific devices and implants is currently constrained to those with in depth expertise and relatively large budgets. This is due to the high level of technical competence required to understand and design for the processes, intensive nature of design and verification and high production costs.</p> <p>This project intends to overcome these barriers by building in the tacit knowledge of designers, engineers and medical specialists into an intelligent software-driven service that drives production capability and the supply chain. This will create a more economically viable service that will encourage much wider benefits to healthcare markets across the world.</p>			

## Results of competition: ADMA - Inspiring new design freedoms in additive manufacturing/3D printing

Note: These proposals have succeeded in the assessment stage of this competition. All are subject to grant offer and conditions being met.

Participant organisation names	Project title	Proposed project costs	Proposed project grant
<b>Samsung Electronics (UK) Limited (Lead)</b> Digital Forming Limited Assa Ashuach Studio EOS Electro Optical Systems Limited	AM 'Bridge' Platform	£1,369,105	£727,836
<b>Project description (provided by applicants)</b>			
This project considers issues relating to innovation in design freedoms in additive manufacturing/3D printing bringing together three partners, all leaders in their fields, to consider the aspects of design, AM production and market in a field chosen for its potential adoption of project outputs. The intention is to unlock issues relating to hardware production through the development of 3D design and hardware.			