Innovate UK

Results of Competition: **Connected Digital Additive Manufacturing**
Competition Code: **1605_CRD_HVM_ADMAN**

Total available funding for this competition is up to £4.5M from Innovate UK and up to £1m from EPSRC

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
Additive Manufacturing Technologies Ltd Xaarjet Limited Atomjet Limited	AMSURFIN - Additive Manufacturing SURface FINishing - An automated intelligent solution for polymer parts	£624,074	£396,467

Project description - provided by applicants
Our vision is to create an automated intelligent post processing machine, capable of finishing additively manufactured thermoplastic polymer parts to an injection moulded level surface finish. Current finishing methods are labour intensive, costly and time consuming. Accounting for between 5-60% of the cost depending on part complexity, size and volume. This machine will address the pressing challenge in additive manufacturing of post process surface finishing, particularly at high production volumes. The project team's objectives are to: 1. Create a saleable automated post processing machine capable of generating a repeatable and reproducible surface finish equivalent to that achieved in injection moulding for additively manufactured parts. 2. Develop intelligent algorithms that control the amount of post processing for a given material and geometric design. 3. Develop a machine that is integrated into the digital manufacturing chain. The project is focused on: Automated and predictable surface finishing for thermoplastic polymer parts. Significant quality improvement of the finished part. Reducing costs through the elimination of manual surface finishing. Significantly improving part turnaround time. Innovation lies at the heart of the machine through: Use of proprietary process, discovered by the University of Sheffield, that smooths the surface of parts. Use of automated process feedback to control the level of finishing applied. Use of algorithms to manage different materials and geometric designs thereby creating an intelligent machine architecture.

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Skanska Technology Limited Building Research Establishment Ltd Tarmac Trading Limited HAL Robotics Ltd The Manufacturing Technology Centre Limited Foster + Partners Limited Loughborough University ABB Limited	CAMBER - Concrete Additive Manufacturing for the Built Environment using Robotics	£986,716	£624,213

Project description - provided by applicants
Concrete is widely used in construction due to its ability to provide structural capacity and function cost effectively and at scale. However, its role in construction does not lend itself to creativity in design. High-end clients typically demand state-of-the-art designs, presenting a challenge in a sector where every building is essentially different to the last. The CAMBER project will seek to develop an innovative 3D concrete printing (3DCP) platform that meets these demands. 3DCP has the potential to deliver more creative designs whilst still maintaining building function cost effectively. However, there are challenges that need to be overcome in terms of materials supply to the printing nozzle, providing support material for the concrete prior to setting to produce complex geometries and overhangs, finishing after placement to provide a suitable surface and materials formulation. Work is also needed to link the 3DCP to building information modeling capabilities. Additionally a 3DCP capability needs to be mobile such that it can be readily set up and used on a construction site (or in temporary, near-site factory) in order to optimize productivity in line with recent construction process innovation. Building on recent R&D work and IP developed within the consortium CAMBER will address these barriers and opportunities. Led by Skanska to ensure that user needs remain a focus and to provide a route to market, it brings together a strong, supply chain-orientated consortium from construction (Skanska, Tarmac, Fosters + Partners, BRE), manufacturing automation (ABB, MTC, Loughborough University) and an SME digital solutions provider (HAL). It builds on previous R&D work (and IP) by project partners (including innovation in the application of BIM to product design, as well as materials, process and finishing). It will develop a mobile additive manufacturing platform (and associated supply and processing capabilities) for the costeffective, mainstream 3D printing of a wide range of large concrete components (including complex geometries), such as façade units, wall panels, partitions, street furniture etc. in precast concrete factories or via the mobile platform in a near/onsite flying factory. The initial focus will be on meeting the requirements for 'high-end' markets. However, successful implementation and subsequent economies of scale will mean that the approach will be cost effective in more mainstream construction markets. The platform will integrate recent digital construction sector innovations -- especially Building Information Modelling (BIM).

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Kuka Systems UK Limited University of Strathclyde Cranfield University FMC Technologies Limited Glenalmond Group Limited Airbus Defence and Space Limited	RoboWAAM	£1,435,667	£931,460

Project description - provided by applicants
3D printing or additive manufacture (AM) of metals has the potential to revolutionise some areas of industry such as aerospace and energy. This particularly applies if it can be used for the production of large parts at low cost and with high quality for critical engineering applications. It has been demonstrated on a laboratory scale that 3D printing based on conventional welding methods using an electric arc and wire feed to deposit weld beads in a layer wise fashion has the potential for this. However there are currently no commercial systems available to enable this to be exploited on an industrial scale. The objective of the RoboWAAM project is to develop a 3D metal printing system based on large scale flexible robotics and welding technology. The developed system will be adaptable so that other process such as inspection can be incorporated during the printing of the part. This will ensure that the printed parts have the required high quality. The system will be suitable for subsequent commercialisation. Adoption of the system by industrial users will lead to significant cost savings in a range of industrial sectors including aerospace, construction and energy. The project is a collaboration between Kuka Systems, Airbus Defence and Space, FMC Technologies, Glenalmond Group, CU and the University of Strathclyde (including the Advanced Forming Research Centre, which is one of the High Value Manufacturing Catapults).

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Hieta Technologies Ltd Insphere Ltd University of Sheffield University of Leicester Metalysis Limited Renishaw PLC McClaren Automotive Limited University of Exeter LSN Diffusion Limited	Tailorable and Adaptive Connected Digital Additive Manufacturing	£1,482,626	£1,066,030
Project description - provided by applicants			
The TACDAM project will perform targeted Additive Manufacturing (AM) pre- and post-process value chain technology developments, develop an adaptive quality assurance model, introduce parametric design as a key process variable and demonstrate the capability to deliver cost and quality outcomes at Manufacturing Readiness Level 6 to the automotive industry.			

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Toolroom Technology Limited JRI Orthopaedics Limited Ether NDE Limited The Manufacturing Technology Centre Limited ATS Applied Tech Systems Ltd Meggitt Aerospace Limited Zeeko Limited	SEAMLESS - Digitally-Enabled, Automated Post-Processing for AM	£1,264,702	£888,926

Project description - provided by applicants

The SEAMLESS project represents a major technical and commercial advance in the area of post processing for additive manufacturing. The poor surface quality for AM parts has been a major barrier for full process adoption, which will be addressed in this project. The SEAMLESS solution combines a number of surface finishing and post processing technologies including super finishing, laser peening, laser polishing and adaptive linishing, together with in-process inspection and simulation tools to address the post processing requirement for the widest range of end-users. This will be underpinned by a digital platform to ensure full and seamless connectivity between all aspects of the solution, leading to significant cost and time reduction. The outcome of this will be a flexible, automated and digitally enabled solution for post procesing for AM.

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L.P.W. Technology Limited The Manufacturing Technology Centre Limited Farleygreene Limited Aegleteq Limited Malvern Instruments Limited	PowderCleanse - Automated powder recycling and quality assurance for enhanced additive manufacturing material reuse	£1,001,134	£680,907

Project description - provided by applicants
Metal additive manufacturing (AM) is often billed as the future of manufacturing, providing unlimited possibilities in terms of part design and complexity, minimal material wastage and the ability to manufacture parts anywhere in the world through the internet. An aspect of AM that receives relatively limited attention, yet underpins the foundation that AM relies upon, is powder management. Powder bed AM processes typically use up to 20 kg of powder for each 1 kg of manufactured part. This means that AM users must be able to effectively handle and recycle vast amounts of powder during the process. In the current generation of AM machines the powder handling equipment provide a potential risk to both powder traceability and powder quality. This is largely driven by exposure of the powder to the environment and the use of non-optimal equipment. The PowderCleanse project will develop and demonstrate an effective solution for powder management which utilises digital connectivity to both monitor and control every aspect of the process. Key innovations will be developed for; metal powder sieving, online process monitoring, foreign body contamination detection and fully enclosed powder handling environments. The PowderCleanse system will be directly driven by the needs of end user through the formation of an industrial advisory board (IAB). The IAB will act as both the voice of end-users and as a beta test group.

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ESP Technology Limited Nottingham Trent University Attenborough Dental Laboratories Ltd	ALF: Additive Layer Flexomer Manufacturing	£793,544	£606,820
Project description - provided by applicants			
The output of this project is an end-to-end digitally connected 3D data capture process that combines with additive manufacturing work cells structured to produce next generation products for aerospace, industrial & healthcare applications, including custom manufacture of medical implants using a combination of solid and elastic materials to improve functionality and clinical efficacy.			

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