

## Results of competition: Towards zero prototyping – Collaborative R&D

Total available funding for this competition was £5.5m from the Engineering and Physical Sciences Research Council and the Technology Strategy Board.

**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>Alstom Limited (lead)</b> Cranfield University Lanner Group Ltd	Towards Zero Prototyping of Factory Layouts and Operations Using Novel Gaming and Immersive Technologies	£804,695	£587,005
<b>Project description - provided by applicants</b>			
<p>This project aims to integrate a world-leading UK-developed Discrete Event Simulation (DES) tool called WITNESS with two complementary innovations in gaming technologies: Oculus Rift, a Virtual Reality (VR) goggle, and Microsoft Kinect, an integrated 3D sensing device. The resulting technology will address the barriers that prevent more effective use of modelling and simulation in manufacturing by incorporating novel immersive VR and live event feedback capabilities into WITNESS.</p> <p>It will enable engineers to (i) design and test new processes and layouts in an immersive collaborative environment generated from the simulation model, (ii) compare the model with the actual shop-floor, (iii) action any necessary changes from within the virtual environment, (iv) verify whether the requested changes are implemented, and (v) whether the expected outcome is achieved.</p> <p>This project will result in (i) a step change in the way that DES software is used, (ii) compelling, highly marketable software products for the consortium, (iii) significant savings in the lead partner's globally expanding factory operations, and (iv) improvement in the UK industry's competitiveness.</p>			

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<b>Aurora Medical Limited (lead)</b> University of Southampton	The Virtual Patient Software	£439,208	£341,605
<b>Project description - provided by applicants</b>			
<p>The Virtual Patient Software is an industrial research project that will allow Aurora Medical Ltd to up-skill in order that they are ultimately in a position to offer a service to the orthopaedic community, whereby a statistical model of human joints will be utilised to predict implant outcomes.</p> <p>The proof of concept model already established at the University of Southampton will be developed so that this can support a significant reduction in the number of prototypes required during the development and clinical trial phases of new implant product market introduction, whilst improving the safety of those devices by accounting for the inherent variability in patients (including physiology and loading) and surgical factors.</p> <p>We anticipate that the costs of development to clinical trials can be reduced by 75%, with reduced timescales by 10%. By being able to account for some of the biomechanical factors that affect revision outcome (cases such as aseptic loosening, implant fracture, mis-alignment and wear), in the longer term, the Virtual Patient Software will also have a significant impact on revision rates, and on the costs burden these represent on National Health Services.</p>			

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<b>CFMS Services Limited (lead)</b> Airbus UK Limited Aircraft Research Association BAE Systems (Operations) Limited EADS UK Limited Imperial College London Rolls-Royce PLC UK Aerodynamics Centre Zenotech Limited	Hyper Flux	£730,628	£596,978
<b>Project description - provided by applicants</b>			
<p>While Computational Fluid Dynamics (CFD) is used in a many engineering sectors, greater accuracy &amp; efficiency are required before CFD can replace expensive physical prototypes for unsteady flows (including acoustics) and for resolving shed vortices and wakes. High-order flux reconstruction methods developed by Dr. Peter Vincent at Imperial College (IC) are a potential solution.</p> <p>IC will work with the Centre for Modelling and Simulation (CFMS) and high-tech SME Zenotech to create new software (using the latest in high-performance computing: conventional and many-core processors for speed and energy efficiency) for evaluation by Airbus, BAE Systems, EADS, Rolls-Royce, DSTL and the UK Aerodynamics Centre.</p> <p>Industrial primes will contribute benchmarking test cases. Via cloud access to its virtual engineering hub, CFMS will make the UK software available to other sectors (civil, automotive and renewable energy) and support its uptake with local specialists - further establishing a center of expertise in the application of new models to on-ramp new users – particularly SMEs. This supports government strategies for HVM and ICT, and the new UK Aerospace Technology Institute.</p>			

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Dyson Technology Limited (lead) University of Salford	Development of a Hybrid Virtual Acoustic Prototyping Tool	£263,817	£197,839
<b>Project description - provided by applicants</b>			
The aim of this project is to develop a Hybrid Virtual Acoustic Prototype (HVAP) framework. This tool will enable the sound characteristics of a product to be experienced and evaluated without having to build prototypes for each design change.			

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<b>Ford Motor Company Limited (lead)</b> AVL Powertrain UK Limited Claytex Services Limited	MModel-based Real-time Systems Engineering (MORSE)	£984,520	£492,299
<b>Project description - provided by applicants</b>			
<p>In today's competitive market, Automotive Manufacturers and Suppliers must achieve faster time to market as well as improved quality and reliability. Additionally they must satisfy customer and regulatory demand for greater powertrain efficiency and refinement. Product development and design must be optimised and verified with limited number of available physical prototypes. This means much of the electronic control systems testing and verification must be carried out automatically through mathematical modelling and simulation. These models must cover multiple physical domains such as Mechanical, Electrical, Hydraulic and Thermal and satisfy sufficient accuracy to replace the real prototype.</p> <p>To validate the functional requirements of the real electronic control systems with embedded software one has to simulate these models in 'real-time', i.e. the responses of the model must have the same profile and take the same amount of time as the real system. MModel-based Real-time Systems Engineering (MORSE) project tries to address some of the challenges in this approach, particularly the trade-off between accuracy and real-time capability of the generated models.</p>			

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<b>Mars Space Limited (lead)</b> University of Southampton	Development of a modelling tool for performance optimization in pulsed plasma thrusters	£101,728	£76,833
<b>Project description - provided by applicants</b>			
<p>Mar Space Ltd is the first company to offer pulsed plasma thruster (PPTs) suitable to cubesat and nanosatellites operations. Thanks to PPTs these classes of satellites can increase their capability e.g. increasing their lifetime in space, flying in a formation or modifying their orbit ultimately increasing the services they can provide hence their economic value.</p> <p>The aim of this project is to develop a mathematical model to be used to design PPTs with optimized performances. The use of such a model will allow the consortium to avoid long empirical design phase hence resulting in shorter and cheaper design time and final product. This will allow Mars Space to respond more quickly to customers proving cost effective tailored propulsion solution.</p>			

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<b>Numerion Software Limited (lead)</b> Change of Paradigm Limited Lightwork Design Limited University of Surrey	Fabric based garment and structure design, selling and manufacture with zero prototyping.	£478,352	£360,490
<b>Project description - provided by applicants</b>			
This project will carry out research to acquire the knowledge and skills required to simulate the behaviour and photorealistic visualization of fabric based garments and structures, as 3D virtual prototypes with usable interactive performance, to enable the design, manufacturing and selling of fabric products with zero physical prototypes.			

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<b>Skanska Technology Limited (lead)</b> Building Research Establishment Limited Unit 9 Ltd	BIM City; Gamefication of construction design	£753,692	£401,796
<b>Project description - provided by applicants</b>			
<p>The project will develop an innovative approach to zero prototyping in the construction sector via the gamification of the design process. It will go beyond the current state-of-the-art, integrating existing Building Information Modelling (BIM) techniques and information from previous construction projects with state-of-the-art gaming technology. It will develop a generic approach to enable the design process for each construction project to be turned into an immersive game to enable 'players' to work out the best solutions.</p> <p>It will enable the user to optimise the building design in order to better meet the client's requirements and explore the impact of different design features. It will include construction sequence, machines options (cranes etc), site topography, delivery logistics, and time and cost parameters.</p> <p>The project will bring together leading construction sector players (Skanska and BRE) with an innovative SME gaming company, Unit9. It will enable Skanska, and other construction companies, to innovate in construction techniques in ways that would not otherwise be possible without expensive physical prototypes.</p>			



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<b>Teer Coatings Limited (lead)</b> Cobham CTS Limited The Open University	Modelling of Magnetron Sputtering for High Value Manufacturing (MOMS4HVM)	£917,902	£577,712
<b>Project description - provided by applicants</b>			
<p>MOMS4HVM extends the application envelope of modified steady state electromagnetic modelling for the efficient &amp; accurate prediction of industrial magnetron deposition systems. The project will determine &amp; mitigate the limitations of the approach, when compared to more traditional, resource-heavy hybrid particle &amp; hydro-dynamic models, where complex fluid flow equations have to be solved.</p> <p>This industrially led project's outcomes will be generically extendable to a range of current industrial deposition equipment, itself applicable in multiple HVM markets. Such equipment addresses the needs of lead customers of the UK's advanced surface engineering sector.</p> <p>MOMS4HVM will reduce development times, eliminating the need for extensive proto-typing activities, at multiple levels, including: prediction of coating distribution &amp; functionality on complex industrial parts; efficient transfer of the magnetron coating process for a given range of parts across different coating equipment; design of next generation coating equipment; &amp; optimised in-batch fixtures &amp; composition for the coating of multiple components. It will create new market demand for advanced modelling software.</p>			

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<b>Unilever UK Central Resources Limited (lead)</b> CDDM Technology Limited STFC Daresbury Laboratory University of Manchester	In silico evaluation of manufacturing concepts for non-Newtonian products	£570,647	£414,627
<b>Project description - provided by applicants</b>			
<p>The goal is to accelerate the introduction of new &amp; better products into the market by the simulation of manufacturing processes for complex multiphase liquid products for fast moving consumer goods (FMCG), including skin care and food.</p> <p>The project team consists of Unilever, CDDMtec an SME with a novel mixing platform, the University of Manchester Modelling and Simulation Centre and Science and Technology Facilities Council (STFC) at Sci-Tech Daresbury.</p> <p>The technical challenge is the development of Computation Fluid Dynamics (CFD) to incorporate the evolving non-Newtonian liquid rheology as the product is assembled and processed. This requires the construction of coupled models detailing how the interaction of materials, process and equipment design affect product rheology and performance. The results of the simulations will be tested through rapid prototyping (eg 3D printing) of promising concepts.</p>			

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<b>Unipart Eberspacher Exhaust Systems Ltd (lead)</b> Coventry University	Virtual Exhaust Prototyping System (VExPro)	£780,529	£585,360
<b>Project description - provided by applicants</b>			
<p>The aim of the VExPro project is to optimise the throughput of multi-disciplinary and multi-physics optimisation problems and validate the methodology against current prototype development approaches for the production of a lightweight exhaust system. It will encompass areas of thermo-mechanical, mechanical, acoustics, vibration, manufacturing and light-weighting analysis and design in a High Performance Computing (HPC) Environment.</p> <p>The project will explore the aspect of numerical accuracy and uncertainty between physical principles, theory, mathematical modelling and analytical methods. This will be achieved by “scaling” model complexities in order to “harmonise” multi-physics computing requirements, run time and accuracy.</p> <p>The project aim is to investigate the potential trade-off between accuracy and the computing time in a multi-physics and multi-disciplinary optimisation context by defining, developing and validating (against physical experimentation) an optimisation algorithm for HPC computing with an ultimate aim of eliminating the use of prototypes.</p>			