

Results of competition: Formulated products - meeting the product and process design challenge – Collaborative R&D

Total available funding for this competition was £7,908,737 from the Technology Strategy Board and ESPRC.

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
Afton Chemical Limited (lead) Centre for Process Innovation Limited University of Warwick University of Sheffield BAE Systems (Operations) Limited Rolls Royce Power Engineering PLC	HiPAdd - Formulation of high performance additives for metalworking fluids	£997,131	£658,219
Project description (provided by applicants)			
<p>Machining of materials such as titanium and nickel-based alloys used in aerospace and nuclear components is typically limited by the amount of heat generated at the cutting zone. Heat is removed by the use of a cutting fluid which acts both as a coolant and a lubricant. A cutting fluid is a complex formulated fluid consisting of many additive components, each providing a specific function such as anti-corrosion and lubrication properties amongst others. The consortium has identified a real opportunity to formulate a novel performance additive with higher heat removal properties that can be incorporated into cutting fluids, to allow end-users the ability to machine at even higher cutting speeds enabling increased productivity and cost savings. This business-led project working with the HVM Catapult will exploit this opportunity to formulate a new performance additive using novel chemicals, materials and processing, to target boundary layers lubrication and the associated packaging chemistry to ensure stable delivery and that it complies with regulatory requirements. This additive will provide significant value to UK industries in particular sectors utilising difficult-to-machine materials.</p>			

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Arecor Limited (lead) University of Manchester Eli Lilly & Company Limited	Novel screening approach for developing new stable biotherapeutic formulations	£994,583	£635,517
Project description (provided by applicants)			
<p>A growing number of drugs that are being developed to combat infection and disease are protein based "biotherapeutics". The supply of these vital biotherapeutics is limited only to areas where there is a sufficient cold-chain i.e. fridges/freezers. Arecor is a biotherapeutic formulation company that has developed technology to stabilise liquid formulations to improve their shelf life. In collaboration with Manchester University's Centre of Excellence in Biopharmaceuticals, Arecor will use the Technology Strategy Board formulated product grant to fund the development of the next generation liquid biotherapeutic formulations that are room temperature stable starting with a new room temperature stable formulation of fast acting insulin. These new biotherapeutic formulations can be shipped to any part of the world without the need for cold-chain storage. Unilever, Lilly and PrismTC will all assist in the development of this new technology that will improve healthcare provision to the third world and reduce the environmental burden of cold-chain provision.</p>			

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<p>AstraZeneca PLC (lead) Pfizer Limited Bristol-Myers Squibb Pharmaceutical Limited GlaxoSmithKline PLC Molecular Profiles Limited University College London University of Bath University of Birmingham Aston University Academy of Pharmaceutical Sciences Kuecept Limited Sporomex Limited Crystec Limited Pharmaterials Limited Oxford PharmaScience PLC</p>	<p>Accelerating paediatric formulation development through smart design and predictive science</p>	<p>£999,842</p>	<p>£660,192</p>
<p>Project description (provided by applicants)</p>			
<p>This project is a collaboration between large UK pharmaceutical companies, academia and technology suppliers to generate a structured approach to designing age-appropriate medicines for children and technology for predicting their quality and performance.</p> <p>Paediatric medicine is currently a "hot-topic" within the pharmaceutical industry and there is a lot of effort going into developing such medicines for children that are acceptable in terms of taste but also provide the relevant dose and exposure required for such patients. The output will provide a smarter route to developing children's medicines to reduce costs and time of development by determination of the most appropriate testing strategies that drive formulation design.</p>			

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AstraZeneca UK Limited (lead) Tecrea Limited University of Manchester	Formulation for targeted delivery of novel therapies for oncology	£889,092	£585,699
Project description (provided by applicants)			
<p>This project combines three partners (2 industrial, 1 academic) with complementary expertise to develop a product for cancer treatment. The research will focus on the development of an injectable formulation based on nanoparticles with the ability to deliver a payload to cancer cells. This ability is based on the presence of chemical groups, which can selectively bind receptors on cell surfaces; specifically, we target a receptor (CD44) that is over-expressed in a number of tumours. The nanoparticles will also be able to release intracellularly an RNA construct capable of cancelling (silencing) the production of an oncogene (a gene with the potential to cause cancer when activated), KRAS, which is often a signature of colorectal, lung and breast cancers.</p> <p>Our consortium will focus on the rational selection of the best candidates using small libraries of nanoparticles; their performance first in vitro and then in vivo will be assessed, and the tumour-suppressing activity of optimised nanoparticles will be finally evaluated in animal models with a view to accelerate regulatory toxicology studies and human clinical trials.</p>			

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GEA Pharma Systems Limited (lead) Lacerta Technology Limited National Institute for Biological Novozymes Biopharma UK Limited Genzyme (GENZ) De Montfort University	BioStaRT - Biopharmaceutical Stability at Room Temperature	£727,552	£355,423
Project description (provided by applicants)			
<p>BioStart's aim is to produce lyophilised protein formulations that are stable at room temperature and which reconstitute without compromising product quality (esp. aggregation). Stability at room temperature will extend shelf life and reduce the cold chain costs of refrigerated transportation and storage. Current methods for the development of protein formulations for subsequent lyophilization are largely empirical with little understanding of the mechanistic relationships between the characteristics of the protein and the impact of formulation (esp. electrostatic parameters which influence the protein structure and aggregation state) in relation to the physical changes that occur on freeze-thawing and freeze-drying.</p> <p>THE INVENTIVE STEP in the Bio-StaRT programme is the development and implementation of a number of advanced measurement technologies that integrate microscale down strategies for formulation screening (based on fluorescence, midIR and NIR microwell analysis) with new methods (LyoDEA) for the development of process understanding in order to increase the success rate for developing room temperature stable biopharmaceuticals.</p>			

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Gwent Group (lead) Haydale Limited National Physical Laboratory Limited	FUNGI - FUNctionalised Graphene Inks for Electrochemical Diagnostic Biosensors	£840,000	£476,000
Project description (provided by applicants)			
<p>The FUNGI project will develop a range of innovative functionalised graphene nano-platelet (GNP) based inks with significantly improved performance to that of conventional carbon inks for biosensor applications. Improved ink conductivity and surface topography will lead to improved measurement sensitivity through increased signal amplitude and linear range. As an alternative to improved sensitivity in low cost applications, improved cost performance may be possible through reduced material usage. Because of their improved measurement sensitivity, these inks may open up a new range of sensor chemistries not previously viable with conventional carbon inks or replace high cost Ag inks in some applications. Innovative metrology of the GNP dispersions and dispersion stability will enable optimum ink formulations to be developed. Characterisation of the cured ink surfaces will enable a better understanding of the role they play in the electrochemical process and also to determine optimum processing parameters for the inks to ensure maximum sensitivity with minimum wastage.</p>			

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Imperial Chemical Industries Limited (lead) University of Sheffield	Structural opacity and colour as a route to more sustainable paint formulations	£908,223	£463,045
Project description (provided by applicants)			
<p>The project will develop more sustainable decorative paint formulations based on structure/property relationships that have been derived from the use of characterisation, theory and modelling to define materials that deliver unique optical properties. Synthetic routes to the desired materials, suitable for commercially realistic large scale industrial synthesis, will be defined, and the materials will be evaluated for their potential to deliver key decorative paint optical attributes in decorative paint formulations that will be more sustainable. The product's ultimately attainable property balance and environmental footprint will be defined to ascertain the most fruitful route to commercialisation of these novel decorative paints.</p>			

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Johnson Matthey PLC (lead) Unilever PLC Industrial Tomography Systems University of Birmingham University of Manchester	Embedding Manufacturing Development into Formulation Research (EMFormR)	£1,015,850	£370,033
Project description (provided by applicants)			
<p>Johnson Matthey, Unilever and ITS Ltd have established a project to develop approaches and techniques to allow manufacturing related information to be gleaned during the development of new formulations. Generally, and especially for products which contain multiple components, some of which do not mix (e.g. emulsions, creams, slurries, suspensions), the formulator does not significantly consider the issues that will arise when the new product transfers from the laboratory into pilot scale trials and finally into full scale manufacturing. This is inefficient in terms of research and development, and also leads to sub-optimal manufacturing; higher costs, higher environmental impact.</p> <p>Working with the Universities of Birmingham and Manchester, the project will address the key issues that have largely precluded gaining meaningful process information at the laboratory scale. This involves not only the time honoured issues of scale up but also specific difficulties of measuring in real time the critical product properties across all scales. Johnson Matthey and Unilever will apply the outcomes to vehicle emission control catalysts and hair care products respectively.</p>			

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Nuformix Limited (lead) Vectura Ltd	Cocystal-enabled inhaled formulations for respiratory disease	£996,157	£597,694
Project description (provided by applicants)			
Nuformix and Vectura will explore pre-competitive applications for the use of cocystal technology within inhalation formulation and product development for the treatment of respiratory disease. It is hoped the output will provide indications for future product development opportunities and the technology Strategy Board funding will accelerate that process.			

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Oxford Advanced Surfaces Group plc (lead) Sun Chemical Limited	Polyfunctional carbenes as uv activated cross-linkers for radcure coatings	£315,593	£179,404
Project description (provided by applicants)			
<p>The project will combine cutting-edge materials chemistry based on highly reactive intermediates combined with sustainable resins and monomers to create a new coatings platform with the potential for all coating market sectors. This platform will use a unique curing chemistry and will enable, within the project consortium, the development of ink-jet printable inks for the graphic signage and food packaging market areas. Issues surrounding the H&S of components used in current UV-curable inkjet products will be addressed along with providing inkjet formulations which have significantly improved environmental credentials.</p> <p>The use of sustainable materials as key components of the ink formulation, the optimisation of the reactive intermediate to allow water-based formulations, the use of lower power radiation sources and the ability of the reactive intermediate to eliminate substrate pre-treatments (for adhesion) will all contribute to inkjet inks having lower environmental impact than is currently achievable. Success in the inkjet market will lead to further exploitation in the graphic arts market and more broadly in other UV-curable coating markets.</p>			

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Process Systems Enterprise Limited (lead) Britest Limited AstraZeneca UK Limited Pfizer Limited GlaxoSmithKline PLC	Digital Design of Drug Products	£999,103	£581,092
Project description (provided by applicants)			
<p>This project brings together experts in drug development, product formulation, process design, systems modelling and manufacture to create a completely new approach to the design and manufacture of formulated drug products, which involves the integration of qualitative tools for process understanding with a range of in-silico models which describe and predict processing and product performance.</p> <p>It is anticipated that successful outcomes of digital design of drug formulations as envisaged in this proposal via the creation of “Design Space Explorer” will provide unparalleled improvements in reliability, quality and manufacturing processes of pharmaceutical products leading to greater trust by regulatory agencies and by society. Furthermore it is anticipated that a successful outcome to the proposed project has potential to significantly decrease the costs and times associated with the development of new medicines whilst also reducing, refining and at times removing the need for some clinical studies in patients and healthy volunteers.</p>			

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PVOH Polymers Ltd (lead) Carclo Technical Plastics Limited Imperial Chemical Industries Limited Unilever Central Resources Limited University of Warwick	Complex structured formulations for tailored additive release and product enhancement	£688,415	£446,196
Project description (provided by applicants)			
<p>This project aims to deliver step-change developments in the formulation and manufacturing capability of complex biodegradable and water soluble plastic components that will transform existing supply chains in terms of resource efficiency and environmental impact. This breakthrough will deliver novel active-self-packaging materials with controlled and tailored release for the laundry goods sector (enhanced effectiveness single dose products), and in-container controlled release of additives for the paint / coatings sector (enhanced shelf-life products).</p> <p>In the first instance, this project will seek to deliver resource efficiency in two sectors: in the laundry product supply chain, using decentralized manufacture of unit dose products to reduce road transport, enable the elimination of detergent builders and encourage the implementation of low temperature wash additives through novel active-self-packaging formulations and products; and in the paints / coatings sector, delivering material savings through reduction in additive dosing and through enhanced shelf-life of products.</p>			

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Sherwin-Williams UK Coatings Ltd (lead) TWI Limited Lambson Limited Integration Technology Ltd University of Liverpool Intrinsic Materials Limited	NIRVANA - Near Infra-Red photoinitiated curing of industrial wood coatings and varnishes	£910,866	£649,241
Project description (provided by applicants)			
<p>Radiation Curing utilising Light Emitting Diodes (LED) offers substantial energy savings for industrial wood coating applications compared to conventional UV mercury arc lamps (~60% less) and traditional gas fired drying systems (~90% less). However, the growth of Radiation Curing applications has been limited due to: Poor depth penetration of UV in pigmented coatings; Poor surface coating properties (due to oxygen inhibition) and the absence of optimised coating formulations.</p> <p>NIRVANA will deliver 3 novel solutions to these challenges by:</p> <ol style="list-style-type: none"> 1. Developing an innovative near-infra red (NIR) photoinitiator within the 880-1000 nm transmission window where light is not typically absorbed or scattered. 2. Developing novel hybrid organic-inorganic nano-materials to increase surface cross linking density and hardness and reduce oxygen inhibition. 3. Creating formulations of 100% solids acrylate-based resin wood coatings that can be cured using energy efficient NIR LED irradiation. 			

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Unilever Central Resources Limited (lead) Infineum UK Ltd Syngenta Limited STFC Daresbury Laboratory	Computer Aided Formulation - CAF	£993,276	£645,534
Project description (provided by applicants)			
<p>Unilever, Syngenta and Infineum, together with STFC Daresbury and Novidec, have recognised the potential of mesoscale modelling to drive a radical change in speed of formulated product design for manufacturability and in-use performance. Although applications to both material and manufacturing process design have been demonstrated, modelling is not always on the critical path of commercial formulation development. Against a tough, highly volatile market environment, speed-to-market is critical, especially for companies that need to put on the market new products every year.</p> <p>Formulation-led product innovation is a key differentiator for success in competitive markets. The technical challenge is to develop predictive models that are simple and affordable yet accurate enough to enable novel product design. This will reduce the time to market and development costs of a new or reformulated product by between 50 and 80% leading to larger benefits for the UK chemical industry as a whole. Our consortium has identified the STFC Daresbury supercomputer, a major government investment into eScience infrastructure, as a key enabler.</p>			

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Unilever UK Central Resources Limited (lead) Croda Limited British Sugar plc Cybula Limited University of Liverpool University of Manchester University of Sheffield	Bio-renewable formulation information and knowledge management system	£739,296	£272,662
Project description (provided by applicants)			
<p>Innovative ICT can play a crucial role in many innovation processes, but its potential is not always exploited in many industries. A route to innovation in chemical-using industries is the exploitation of materials in what would otherwise be lost to waste streams from current manufacturing processes. This is interesting both in terms of realising additional value from manufacturing, but also in reduced utilisation of unsustainable material sources and exploitation of novel feedstocks for novel functional materials with new application benefits.</p> <p>This project will develop an information system based on highly innovative information technologies with the capability to rapidly identify the feedstock and functional material opportunities, and demonstrate its value in rapid bio-derived surfactant discovery. The key advances made will be in automation of large-scale information analysis and mining, and in development of many-criteria optimisation algorithms to pinpoint innovative candidate materials from the very large numbers of possible options.</p>			

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Wymbs Engineering Ltd (lead) Mondelez UK R&D Limited The Manufacturing Technology Centre Limited	Process Innovation for accurate chocolate deposition (PINNACLE)	£481,414	£332,786
Project description (provided by applicants)			
<p>This project addresses the need for a controlled process for precisely depositing formulated food products, allowing for optimisation in a sustainable and stable manner. Pinnacle will focus on one key product during the project, chocolate, a complex formulated product consisting of cocoa, fat, sugar and proteins which undergoes crystallization to form the solid product. Deposition of molten chocolate is critical in the manufacturing process to achieve and maintain the crystalline form and is a key element of product formulation and flavour development.</p> <p>Currently, deposition is an uncontrolled, non-scientific black-art with little known about its influence on formulation. Depositing systems are outdated and inefficient, lacking the flexibility required to adapt new global, standardised approaches to chocolate manufacturing and regional variation in formulation. Pinnacle will utilise state-of-the-art simulation techniques, in-process sensing technology and advanced manufacturing processes to develop a step change in depositing technology, capable of monitoring and adapting to changes in the ingredients, providing a foundation for future optimisation of chocolate formulation.</p>			