Innovate UK

Results of Competition: **December 2017 Sector Competition: Open - 25 to 36 Months**

Competition Code: **1712_EE_OPEN_R4_36M**

Total available funding is £19 million

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Participant organisation names	Project title	Proposed project costs	Proposed project grant
ALMAC DIAGNOSTICS LIMITED	Almac's novel biomarker platform for patient stratification within immune oncology clinical trials	£1,000,001	£500,001

Project description - provided by applicants
One of the major issues when conducting clinical trials (CTs) in cancer is the need to pre-screen patients with one or more genomic tests to determine if the patient is likely to respond to the proposed new therapy. Typically this means that a tumour biopsy may be required to obtain DNA or RNA to carry out the required genomic testing. Many modern clinical trials evaluate more than one different therapy option requiring a number of different genomic tests to be performed. This can mean that additional biopsies may be required to obtain sufficient genomic material for each test. This has the added issue of increasing the cost of the clinical trial and the potential to introduce delays in administering the appropriate therapy to the patient. The focus of this proposal is on the validation of a comprehensive gene expression (GE) platform that allows the expression levels of all 21,000 human genes to be evaluated in a single experiment. This means that any combination of gene expression tests can be evaluated in a single process using a single clinical sample. The proposal will see validation of the platform to meet all European and US regulatory requirements for use in clinical trials, ensuring it is safe and effective for patient testing. This will represent a major step forward for how we pre-screen cancer patients for enrolment into cutting edge clinical trials, ensuring that each patient has the opportunity to receive the optimal treatment based on their unique gene expression pattern. Almac will utilize its proprietary GE assays, including our immune oncology (IO) assay, as the proof-of-concept to deliver on this objective. Almac's IO assay is a 44 gene expression test that captures the complex biology underpinning response to immune checkpoint inhibitors (as published in JNCI 2014 & 2017). Immune checkpoint inhibitors (ICIs) have revolutionised cancer treatment: they disable the molecular disguise that cancer cells use to hide from the immune system, thereby allowing a patient's own defences to destroy tumours. Our platform will provide the one stop solution to select and stratify patients with different solid tumours within these studies, to improve patient outcome both in the clinical trial setting, in the near term, and subsequently in the clinic.

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MITOCHONDRIAL SUBSTRATE INVENTION LTD	MITOCHOLINE – maintaining brain health through nutrition	£787,454	£354,354

Project description - provided by applicants
Cognition is a mental process related to information processing and storage. It includes the processes of being aware, ability to form memories, attention, perception, action, problem solving, and mental imagery. Decline in numeric ability begins at about 25 years of age and the decline in perceptual speed starts at 40. The decline in inductive reasoning and spatial orientation begins about age 50 and the decline in verbal ability and verbal memory begins at about 60. Changes in cognitive functions occur simultaneously with a decline in intracellular energy production in the brain, assessed using adenosine triphosphate (ATP) in the brain cells. The diminished ATP level is associated with the onset of dementia and a lower level of overall brain metabolism. One way of retaining normal cognitive function and preventing or delaying the onset of dementia is to develop effective agents for maintaining brain metabolism. At Mitochondrial Substrate Invention Ltd (MSI) we have created a novel composition of human metabolites and believe that developing this composition as a functional beverage could provide an early intervention to halt cognitive decline in an ageing population by ensuring that the metabolites required for energy production are sustained in the brain cells at the appropriate levels. Our approach has been the development of a compound we have named Mitocholine. Mitocholine is composed of three nutrients, which, when used separately have a history of safe use in humans. The three components in our composition are choline, succinate and nicotinamide which, when taken orally, become available to the brain. The innovation of MSI is modification and chemical formulation of these components in the right ratio and the best form for human consumption. Our aim is to sustain and support a healthy human brain through nutrition. Our plan is to develop Mitocholine as a beverage, suitable for everyday consumption and for long-term use, to sustain and enhance brain cell metabolism and conceivably delay or prevent the onset of dementia. Our project team has extensive expertise in mitochondrial biology, international food, food ingredient, and speciality chemical regulations, health claims in the nutraceutical sector and are backed by an advisory team composed of a Professor of Experimental Neuropathology, Oxford University, a Professor at the Department of Molecular Neuroscience in the UCL Institute of Neurology and a strategic business expert in thebeverage sector. This project aims to complete the necessary tests to allow us to bring Mitocholine to the market.

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AUTOTECH ENGINEERING R&D UK LIMITED	ARCH (Aluminium Reduced Cost Hybrid Parts)	£649,978	£324,989
Brunel University London		£277,915	£277,915

Project description - provided by applicants
The continued drive within the automotive sector to support fuel efficiency regulations with value-added lightweighting has put UK manufacturers under pressure from globalisation to minimise manufacturing costs. This can be met, in part, by the integration of higher specific strength materials but the accepted paradigms of material selection and manufacturing processes need to be challenged. The ARCH project seeks to develop a novel fabricated-hybrid-chassis structure to replace the state-of-the-art steel chassis structures currently used extensively for the automobile industry. Driven by the concept of right materials in the right places", a mixture of aluminium extruded and cast node parts are incorporated into the design of the fabricated-chassis-hybrid structure to deliver weight savings of over 30, accurate predictive performance analysis using CAE tools is key to eliminating potential failure without the need for multiple testing loops and correlation. As the industry is moving away from producing prototype parts prior to serial production, the predictive design capabilities will be developed within the project, enabling the formulation of reliable digital design tools to accurately predict the performance, durability and failure of fabricated-chassis-hybrid alloy structures in chassis applications Another critical part of the project is the development of a reliable, robust and cost effective manufacturing process since rapid, repeatable and productive processes are key to accelerating the use of high strength fabricated-chassis-hybrid alloy structures for mass production vehicles. A candidate for the technology will be developed in multiple design iterations, then optimised and demonstrated with the production of full-size chassis components and the performance of the demonstrator systems will be evaluated against relevant benchmarks. Physical test data will enable the validation of the newly formulated predictive design tools.

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PECM SYSTEMS LTD	Modularised multi axis pulsed-ECM machine and metal coated polymer cathode development	£178,290	£80,231
Project description - provided by applicants			
Current art electrochemical machines (ECM) are: (1) High cost; (2) Single axis; (3) Not modular i.e. additional axis modules and associated bearing rails/gears cannot be implemented limiting a diverse range of components that can be manufactured from a single ECM machine. (4) Current operations waste expensive material as 2-3 solid metal cathodes are manufactured before final tolerance is achieved. The above issues impact the ability for small companies to tender for lucrative manufacturing contracts. And remain competitive. We aim to engineer novel methods to allow high quality components to be manufactured with intricate geometries to smaller tolerances with greater precision. BENEFITS: (a) Low lead-time component manufacture; and (b) Very little material wastage.			

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OVATIONDATA LIMITED	OPAA: Oil Production Advanced Analytics	£430,177	£301,124
Imperial College London		£169,391	£169,391

Project description - provided by applicants
OPAA -- Oil Production Advanced Analytics will improve the analysis of oil exploration so that the success rate of oil well exploration for production increases whilst simultaneously reducing costs in the process. Currently, oil discovery and analysis is carried out by teams of engineers and geologists. These specialists analyse separate types of data such as seismic data or the various types of data provided by test drilling well lines including rock type, radiation, magnetic properties, temperature and pressure at different depths. The current human interpretation is subjective and not very accurate, and can be costly due to the limited number of experts in this field. Ovation Data will use its position as a curator for many of the world's largest oil companies' data along with public domain surveys to provide a new analysis service. This service would allow companies to analyse not only newly surveyed data but historical data that had previously been deemed inconclusive or too costly to analyse, to better ascertain if there is potential value at exploration locations. Our proposal will address the needs of the industry by applying Machine Learning algorithms to analyse both seismic and well line data, and attain better overall correlation and analysis for oil companies to evaluate before they decide to begin production drilling. The Department of Earth Science & Engineering at Imperial College London will research, analyse and propose the most suitable algorithms to suit the multimodal data types as part of the proposal. Ovation's service would be more cost effective for oil companies than the traditional method of analysis. Oil companies will become more profitable via better analysis and a higher rate of success. This project would additionally benefit the UK taxpayer via making better use of North Sea oil reserves. In a world where hydrocarbons are required not only for fuel but our everyday life with materials such as plastics the need to make a better more efficient oil discovery process is paramount.

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KEY FORENSIC SERVICES LIMITED	Rapid DNA Profiling Solution for In-field Crime Scene Stain DNA Analysis	£998,766	£599,260

Project description - provided by applicants

DNA profiling for criminal justice evidence is increasing with technological advances in DNA resolution, expanding profiling to include low DNA content and mixed DNA samples. Profiling is carried out in high specification laboratories which are expensive to set up, accredit and maintain. DNA profiling is resource, time and cost intensive - up to 3 days processing time. Crime scene stains (including hair, saliva, blood, semen and other cellular matter) often have low DNA content. DNA analysis of these samples create a bottleneck for criminal investigations and also results in officers pursuing unnecessary lines of investigation when their resource could be better deployed. Delays in DNA profiling also present increased risk to the public and do not provide the best outcomes for victims with suspects remaining at large with insufficient evidence to enable the rapid apprehension and charging early in the investigative process KFS aims to move the majority of DNA processing from specialist laboratories to locations closer to the crime - crime scene vehicles, police stations, etc., by developing a desktop self-contained, no human interference, DNA sampling system to enable low content DNA crime scene stains and dry" samples, including contact traces such as fingerprints, to be analysed rapidly and locally.

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VISITECH INTERNATIONAL LIMITED	Super Resolution Microscopy in Total Internal Reflection Fluorescence (SR-TIRF)	£534,097	£240,344

Project description - provided by applicants
One of the key tools of bio-medical research are light microscopes and to be more specific fluorescent microscopes. A fluorescent microscope allows the scientist to view tagged parts of a Cell, Virus, etc... at a molecular level so it's behaviour can be monitored. Such fluorescent microscopes are driving modern bio-medical research to aid in our understanding of illness, disease and infection and in turn allow the development of improved treatments and possible cures. However, the performance of these light microscopes has been hampered by the previous limit of optical resolution which was defined by a German Physicist in the 19th Century, Ernst Abbe, and as such carries his name, Abbe's Law. Abbe's Law determined that the maximum achievable resolution of a light microscope is given by the wavelength of the light being used to view it (in many cases around 550nm) divided by twice the numerical aperture of the lens used for imaging (in modern microscopes the Maximum NA = 1.4). This limited the resolution at which light microscope could observe biological systems and interactions to >200nm, as scientists developed an improved understanding of biology this was becoming a frustrating bottle neck for furthering research, until that is the development of super-resolved or Nanoscopy techniques and applications. This new emerging field was highlighted by the 2016 Nobel Price in Chemistry which was awarded for the development of super-resolved fluorescent microscopy. However, whilst these new techniques did allow light microscope to resolve as low as 20nm the techniques were quite complex and could not always be used for every tool within the field of light microscopy which the scientist may have wished to use. One such tool is Total Internal Reflection Fluorescence (TIRF) Microscopy. TIRF is currently used in Cell biology to view events which happen at the surface of cells, such events can play a major roll in the behaviour of the cell and scientists who research cancer (for example) are trying to understand the movement and spread of cancer cells by looking at events at the cellular surface using TIRF microscopes. The instrument we propose to develop within this project will double the spatial resolution of a regular TIRF microscope enabling features <100nm to be imaged. This will offer the global science community an imaging system which can do true super-resolved live cell imaging with TIRF (SR-TIRF) allowing further advancements within bio-medical research.

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Oxford Post-Quantum Cryptography	PQ Cybersecurity	£999,698	£699,789

Project description - provided by applicants
Post-quantum cybersecurity: A project that will help prepare the UK for the post-quantum cybersecurity era when a fully functioning quantum computer becomes available. But what's wrong with a quantum computer? Nothing is wrong with it, except that it is conceptually different from a conventional/classical computer and can, therefore, perform some types of computational tasks much faster than classical computers; examples of the computational problems that become easy on a quantum computer include the integer factorisation and discrete logarithm problems, which are the main hard computational problems that our cryptography today relies on. Consequently, a quantum computer can be used to run an algorithm that is able to decrypt any ciphertext that contains confidential data and forge any (currently in use) digital signature scheme. As a result, the whole idea of e-commerce and online transactions/banking will be obsolete! So, how are we going to solve this problem? We will use different cryptography" to build the post-quantum cybersecurity infrastructure. In fact, the National Institute of Standards and Technology (NIST) has just started the process of standardising a new generation of cryptosystems that rely on mathematical problems that are still hard even for a quantum computer to solve. In our project, we will consider these hard mathematical problems and contribute to the standardisation process by evaluating and cryptanalysing the submitted schemes. We will test those schemes by running live yet secure experiments on hybrid cryptosystems (a combination of a current cryptosystem with a PQ secure one). Finally, our main commercial focus will be Post-Quantum IoT and Cloud Computing Services (CCS), which we believe to be the two biggest markets that make use of cybersecurity.

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