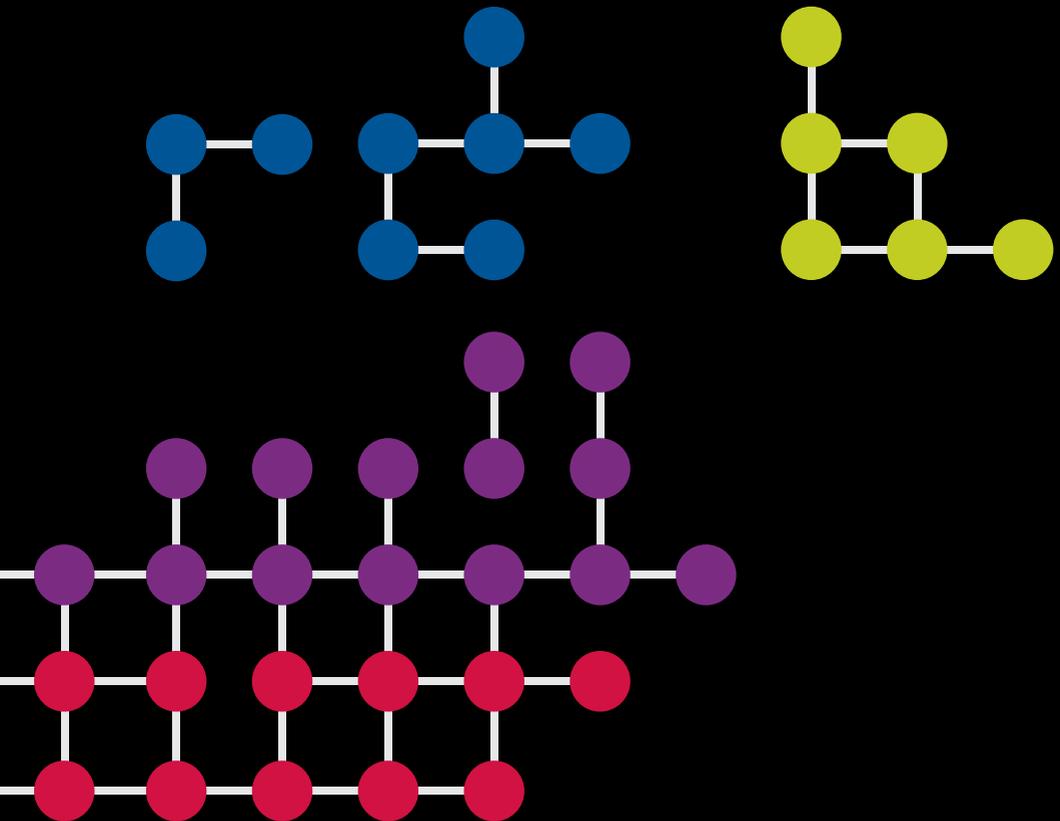


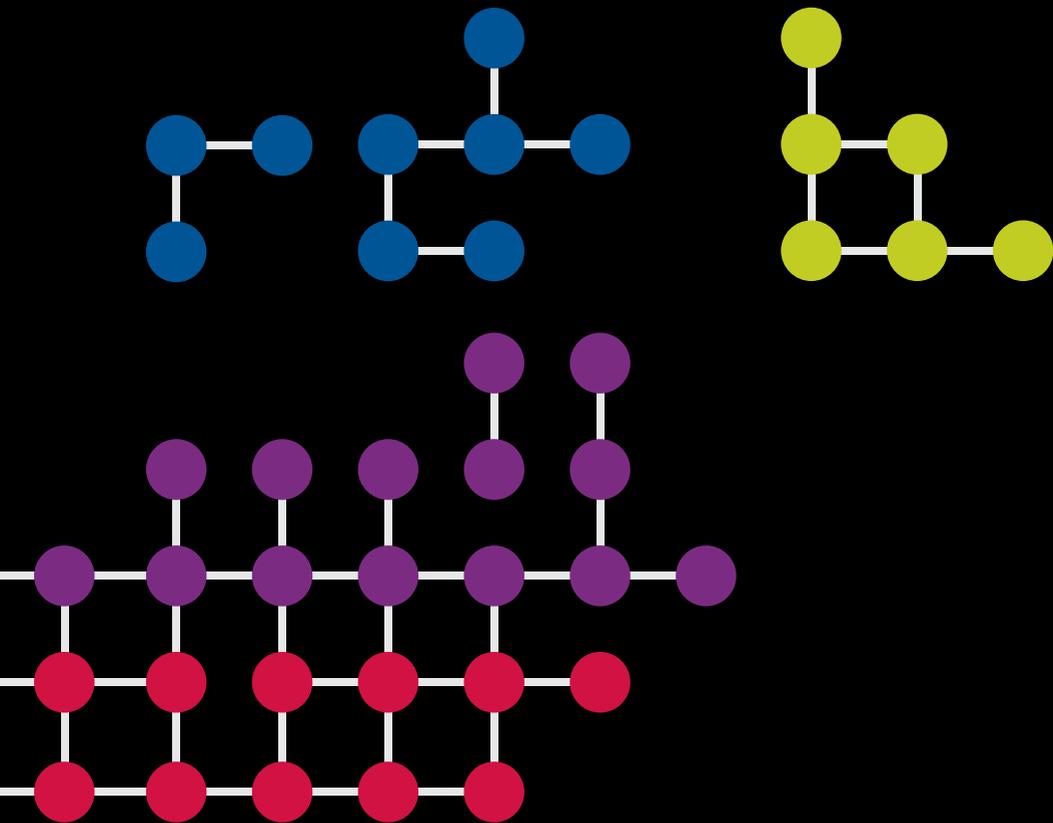
Technology Strategy Board

Driving Innovation

# Collaboration Nation

**Technology-inspired  
feasibility studies 2013**





# Introduction

All market sectors can take inspiration from innovations in enabling technologies that underpin competitive products and services.

The most disruptive early-stage innovation can, however, be too high-risk for many small and medium-sized businesses to undertake without support. Until these new ideas are proven to be technologically feasible, private financial support can be hard to attract.

Our grants for technology-inspired feasibility studies enable new ideas to be transformed into demonstrable technologies and techniques that can attract the partners, investors and future customers needed for successful and timely commercialisation.

This directory showcases the feasibility studies we have funded in 2013 and the businesses involved. These studies were across four technology areas: advanced materials; biosciences; electronics, sensors and photonics; and information and communication technology. Each received up to £25k for a project lasting up to four months.

**Zoe Webster**  
**Head of Technology**

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# 3-Cs Ltd

## High-power density demonstrator for nanostructured, multi-layer, high-temperature superconductor (HTS) technology

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3-Cs Ltd was founded in 2000, initially as a consultancy in the field of HTS. We have patents covering 'coated conductor cylinders', thin-film superconducting components destined for next-generation, high-power density electrical machines. We now have five scientists/engineers.

### What was the business need that motivated the project?

A major advantage of our technology is the extreme power density achieved in superconducting multilayer coils. 3-Cs needs portable demonstrators to illustrate and promote the 'power-to-weight' attributes in areas such as aerospace and transport generally. These will be used at international conferences and exhibitions in order to generate more enquiries and trigger co-development projects with key players worldwide.

### What approach did you take to address the challenge?

We identified three potential demonstrators which could be used to promote our technology in a clear, straightforward way. We developed mathematical models and novel laboratory experiments within the constraints of size, weight and power and also the need to cool the superconducting components. We devised compact energy storage and magnetic levitation demos together with a highly innovative motor. Comparison with alternative technologies/materials has been a key consideration throughout.

### What are the potential benefits?

Our multi-module, lithographed, thin film coil technology is a disruptive platform which could replace conventional windings in many high-power electrical machines and magnets. To offset the extra cost of cooling, the benefits will be seen at the scale of locomotives, ships and aircraft, rather than in the domestic/consumer environment. However, there is also significant potential for 3-Cs components in power generation/distribution 'smart grids'. Magnetic separation is another application area.

### What are the next steps?

The commercialisation phase is based on establishing co-development projects with key players in different sectors, such as transport, energy and medical. Our extensive patent portfolio, mostly concerned with manufacturing processes and structures, covers many countries. The portable demonstrators will undoubtedly help catalyse licensing opportunities in different geographical regions.

# Alterix Ltd

## New laminate materials for interactive displays

---

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Alterix has developed an inherently low-cost multi-touch sensor system for large-scale touch-screen interactive displays. The method scales easily to large sensors of up to 85 inches and is compatible with flat-panel TVs, which is where the future of interactive displays lies.

### What was the business need that motivated the project?

There is an established worldwide market worth more than \$2bn a year for interactive whiteboards, used mainly in schools. Makers of interactive whiteboards face major disruption as the cost of flat-panel TVs continues to fall. This has created an unanswered need for novel technical approaches capable of positioning large interactive TV panels as a suitable replacement.

### What approach did you take to address the challenge?

After developing our electronics algorithm, it was strategically important for us to develop cheap manufacturing methods for transparent TV display overlays. We also needed to devise new ways of integrating these laminated material structures with our proprietary electronics. Our design approach – ultrafine (almost invisible) wire sensor grids laminated in glass overlays – is based on heated glass technology in modern cars.

### What are the potential benefits?

Our technology provides pervasive, multi-touch interfaces by carrying out ultrafast measurements of the signals in a large projective capacitive grid sensor fitted to the display. Using ultrafine metallic wire grids will help to replace the indium component which would otherwise be needed for the sensor grid; indium is a rare element which is increasingly difficult to source. Our innovation will enable TV panels to disrupt the interactive whiteboard market.

### What are the next steps?

The prototypes developed so far allow us to provide critical evidence to companies interested in the licensing of our technology. We expect to carry out numerous sales meetings with interested parties in the next few months.

# AptCore Ltd

## A wireless solar-powered traffic monitoring system

---

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AptCore provides world-leading system internet protocol (IP) for situational awareness systems. We produce highly efficient digital signal processor cores for integrated circuits together with optimised software for licence. Our designs target radar, optical image and fusion processing for collision avoidance systems.

### What was the business need that motivated the project?

The road network is managed using sensors to report traffic density and speed. This is commonly done using inductive loops, but the cost of maintenance is very high, because loops are embedded in the road surface and frequently break. In addition, the initial installation cost is high owing to the need for power supply and wired data communications.

### What approach did you take to address the challenge?

We have investigated the feasibility of producing a roadside traffic monitor unit that communicates wirelessly and whose efficiency makes it suitable for solar power. We tailored our existing low-power radar technology to make it more efficient for this application, and combined it with wireless communications technology to transfer the processed data back to a base station. We sourced off-the-shelf components to build a demonstrator unit for testing by the roadside.

### What are the potential benefits?

A roadside system will greatly reduce operational costs for managing the road network. A solar-powered, wireless system will also significantly reduce initial installation costs, and enable wider roll-out at low cost across the network, making traffic management and incident detection more effective. The system will also provide more accurate, detailed data for better management. Export potential to developing economies with large, busy road networks, but little infrastructure, is good.

### What are the next steps?

We are seeking a large established partner already selling into this market sector, who could utilise this technology as part of their system, and generate worldwide sales. Following a successful conclusion to our feasibility study we will produce a prototype suitable for more extended evaluation in the field.

# Asymptote Ltd

## Portable, self-charging, cryogenic vessel for the shipment and short-term storage of cryopreserved material

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Asymptote Ltd is a company that specialises in cryopreservation – preserving cells, tissue or organs by freezing at very low temperatures

### What was the business need that motivated the project?

A number of live, attenuated vaccines are in development, for tropical diseases such as malaria, East Coast Fever and leishmaniasis. These must be distributed and stored at temperatures below -130°C. Cold chains – temperature-controlled supply chains – in the Third World are unreliable and it is estimated that 50% of cryopreserved vaccines are discarded as a direct result.

### What approach did you take to address the challenge?

We proposed a new concept in cold chain equipment in which we use Stirling cryocoolers to generate small volumes of liquid nitrogen as it is required. The liquid nitrogen is then adsorbed by zeolites to provide a stable low temperature. It is also necessary to address issues of power generation for the cryocoolers – either solar, or an inexpensive generator.

### What are the potential benefits?

Successfully developing and validating of this technology will radically change the supply chain for cryopreserved materials in remote regions. This will ensure that vaccines are delivered with the desired biological function and wastage is reduced. There is a secondary market opportunity in distribution of cryopreserved sperm and embryos for artificial insemination and embryo transfer.

### What are the next steps?

We will build and test shippers (flasks for shipment), develop smaller, cheaper Stirling cryocoolers, reduce manufacturing costs and develop a rugged design. We will also approach funding bodies, such as PATH, GAVI and the Gates Foundation.

# Austin Davis Biologics Ltd

## Coprological analysis for the diagnosis of equine tapeworm infection

---

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Austin Davis Biologics Ltd (ADB) is a biotechnology micro-business, employing three people. Our research is focused on development of veterinary diagnostics, including equine helminth (parasitic worm) burdens and wound healing biomarkers. We collaborate with internationally renowned equine hospitals and universities.

### What was the business need that motivated the project?

Modern equine worming practices require worm burdens to be detected before treatment. Tapeworm diagnosis is particularly problematic and only possible using blood samples. This is uneconomic, resulting in a preference for blanket worming. Providing a tapeworm diagnostic service using samples collected by owners would have unrivalled entry into the equine sector, with the potential to be international.

### What approach did you take to address the challenge?

The focus of our project was to develop assays to diagnose tapeworm burdens, in owner-accessible samples. To achieve this, we generated antibodies specific for various tapeworm antigens, and developed appropriate immunoassays. These were validated with samples obtained at post-mortem where exact tapeworm numbers were determined. We identified assay combinations capable of correctly detecting tapeworm burdens and devised suitable algorithms to enable diagnosis of active tapeworm burdens.

### What are the potential benefits?

In an unrivalled market with an estimated 1 million horses in the UK alone, the financial benefit of a tapeworm diagnostic service is indisputable. In addition, traditional interval dosing worming strategies are generating greater worm resistance to heavily used anthelmintics (drugs that expel parasitic worms). Affordable tapeworm burden diagnosis, using owner-accessible samples, will enable owners to treat only those horses with significant burdens, thereby safeguarding the future efficacy of anthelmintics.

### What are the next steps?

We plan to roll out a diagnostic service during 2014. It is likely that diagnostic kits will be sold exclusively to the internationally renowned Rossgdales Equine Hospital who will then endorse our service. We will continue our research to improve parasite diagnostic approaches and develop a diagnostic platform for animal parasite control.

# AvantiCell Science Ltd

## Nanosafety screening using immune cells from a sentinel species

---

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AvantiCell Science is a biotechnology company providing services and products for cell-based analysis across many industry sectors. Our company specialises in human primary and stem cell isolation and culture. AvantiCell was founded in 2006, employs 17 staff, and is profitable.

### What was the business need that motivated the project?

Our project aimed to address an unmet need for a standardisable, portable and user-friendly platform to quantify the biological effects of nanoparticle exposure. Our specific objective was to develop a unique, cell-based model that captures the exquisite sensitivity of certain sentinel species to environmental contamination. The assay was built using haemocyte immune cells of the marine mussel species *Mytilus*.

### What approach did you take to address the challenge?

Our project has tested the feasibility of using mussel haemocyte cells as the basis for a cell-based assay that measures nanoparticle contamination of aquatic or aqueous samples. Haemocytes possess the biochemical features of cell-based immunity, and are already known to react differentially to a range of nanoparticles (NPs) at environmentally-relevant concentrations. Our aim is to characterise this response, and develop a novel assay based on cryopreserved cells.

### What are the potential benefits?

The principal project output will be a prototypic commercial assay for nanosafety screening, delivered as a service and as a user-friendly assay kit. This will take the first step towards an assay platform which, at maturity, could become an industry tool for measuring NP contamination in a variety of materials and environmental situations. The kit will be attractive to the market, with wide application in a rapidly-evolving technology field.

### What are the next steps?

We will translate the prototypic assay platform into the robust 'productised' format of an assay kit, and place it with beta testers to build market readiness. We have the capability in-house to market and sell it ourselves, and will also engage with European agencies regarding assay accreditation.

# Axsym Ltd

## Intuitive graphic user interface for a science and engineering analytical environment.

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Axsym, founded in 2010, provides engineering services to the aerospace and energy sectors. We specialise in aero-elastic product design and bespoke simulation software development, to enhance rotor and propeller efficiency and stability, and reduce system noise and vibration.

### What was the business need that motivated the project?

No general-purpose engineering software provides accessible cutting-edge analysis across complementary engineering sectors without labour-intensive effort to manage the complex algorithm and data interdependencies. The technical challenges in achieving an intuitive and adaptable simulation environment relate to limitations in existing software architectures and user interfaces. Our project addresses the feasibility of an innovative graphic user interface (GUI).

### What approach did you take to address the challenge?

Traditional GUIs cannot provide the required control of the proposed adaptable simulation environment and manage algorithm dependencies. MIT's innovative Scratch software, which is a children's programming environment using drag-and-drop icons instead of written code, could potentially meet the requirements. To demonstrate the feasibility we modified the Scratch source code to be compatible with our architecture concept, to enable integration of third party algorithms and to deliver high-performance computing capability.

### What are the potential benefits?

Our software will enable organisations to carry out design activities with reduced cost and lead times, as well as the distribution of state-of-the-art analytical methods between higher education and industry and across complementary engineering sectors. It will also accelerate the implementation of emerging engineering technologies in commercial products and deliver accessible and appropriate analytical capability to start-up and SME engineering organisations.

### What are the next steps?

We will demonstrate the architecture feasibility early in 2014 and then seek collaborations to demonstrate the software for real-world case studies. We will seek investors in late 2014 for a spin-off software company to be incorporated early in 2015 along with Seed Enterprise Investment Scheme (SEIS) pre-approval. We aim to diversify the software's capability for additional engineering sectors from late 2016.

# Bio Nano Consulting

## A portable arsenite sensor for detecting arsenic-contaminated water

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BNC is a technology-focused strategic consultancy operating at the increasingly important interface between bio and nanotechnology. We work with key academic partners including Imperial College and UCL. Our experienced team has served more than 30 international clients from industry, academia and government.

### What was the business need that motivated the project?

Some 70 million people in Bangladesh drink arsenic-contaminated water at unsafe levels, resulting in approximately 20% of all deaths there. UNICEF has said that regular water testing is the first step to address this problem. Existing arsenic test kits are complicated, expensive and/or inaccurate, and create toxic by-products. There is a need for a simple, cheap but precise arsenic test.

### What approach did you take to address the challenge?

Using a unique proprietary enzyme, our project modified the technology within familiar glucose home tests manufactured in their billions annually to make a major improvement in arsenic testing by solving issues of customer usability, cost and accuracy. Our innovation was to combine this enzyme with low-cost electrode materials, achieving the World Health Organisation's sensitivity requirements (10 parts per billion) in less than 60 seconds, with quantitative results from an easy-to-use, low-cost system.

### What are the potential benefits?

The availability of highly precise but affordable arsenic tests will allow millions more wells to be tested on a regular basis, leading to improved health outcomes in Bangladesh and other places where arsenic-contaminated drinking water is a problem. Development of the product will lead to creation of high-value R&D jobs in the UK.

### What are the next steps?

We will develop a commercial prototype and seek to partner with manufacturing groups capable of roll-to-roll batch production of thousands and then tens of thousands of tests. We will also partner with an appropriate non-governmental organisation (NGO), such as WaterAid or UNICEF, for commercialisation in relevant countries.

# Biocatalysts Ltd

## Novel methods for low cost, fast access to new enzymes

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Biocatalysts Ltd is a speciality enzyme manufacturer based in the UK, with a US subsidiary. Through 25 years' experience we have acquired a wealth of knowledge, allowing us to become the fastest and most cost-effective developer of speciality commercial enzymes.

### What was the business need that motivated the project?

Biocatalysts' novel enzyme development produces enzymes primarily for customers in the flavour, fragrance, fine chemical and pharmaceutical sectors. Our business need is to be able to rapidly respond to customers with cost-effective solutions, using state-of-the-art processes to develop an enzyme product that will fit the customer process.

### What approach did you take to address the challenge?

Our objective was to demonstrate the commercial viability for a platform technology to develop novel enzymes with modified thermal characteristics. We generated novel enzyme variants through bioinformatic structural modelling and simulation. These were then expressed in vitro using a protein synthesis robotic system, initially circumventing in vivo expression and its associated pitfalls. All synthetic enzyme variants then underwent extensive characterisation to determine if the predicted improvement had been attained.

### What are the potential benefits?

Our study offers the potential to apply new capabilities to customer enzyme projects. Furthermore, the technological platform we are developing will cut the time to market for our speciality enzyme products. We anticipate increased profitability as a result of strategic and customer-driven products, opening up further potential for innovations in accessing new enzyme applications.

### What are the next steps?

For us, a successful outcome will be a positive correlation between in vitro synthesised enzyme activity and the altered property predicted by the initial bioinformatics approach. In that case, we will incorporate this technological platform into our portfolio of novel enzyme development offerings for customers.

# Biogelx Ltd

## Optimising gelation capabilities of biocompatible peptide gels for cell culture/delivery

---

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Biogelx develops simple, functional peptide gels for use as tissue mimics in cell culture. These gels are tuneable, so can be designed to match the environment that individual cell types require, in areas such as cell-based screening and cell therapy.

### What was the business need that motivated the project?

Our current peptide gels offer an improved cell culture platform for in vitro (test tube) applications only. We had seen that new peptide precursors needed to be designed and developed for in vivo (using a living organism) cell culture applications, offering both cell culture and scaffold-based delivery in vivo. This feasibility study allowed us to develop this next gel product range.

### What approach did you take to address the challenge?

We established a library of short peptides with potential gelation properties, likely to offer a nurturing environment to cells. Through systemic research, we were able to identify assembly capabilities of these peptides and exploit these to offer a range of stiffnesses, mimicking different tissue properties. This capability is not offered by other gel scaffolds in this market. We then tested the optimised gel products for compatibility with various cell types.

### What are the potential benefits?

The success of our project could result in the commercialisation of an in vivo gel range. This would allow us to enter new high-value markets such as cell therapy and regenerative medicine, stimulating growth in the company and making a greater economic contribution in the UK biotechnology and life science sectors. Ultimately these products could revolutionise the way we treat debilitating conditions such as stroke recovery and spinal injuries.

### What are the next steps?

The next steps will be to identify ways of taking these products into the clinic, by furthering our pre-clinical testing. Owing to the niche offering each gel has to a given cell type and application, we need to collaborate with innovative life science businesses.

# Biopta Ltd

## Predictive phenotypic assays to better predict drug-induced cardiotoxicity

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Biopta is a contract research organisation (CRO) that helps pharmaceutical companies to predict which drugs are likely to be safe and effective in patients. We offer sensitive laboratory tests using ethically-donated fresh human tissues as the most relevant model of human drug responses.

### What was the business need that motivated the project?

One of the greatest safety concerns with new drugs is that they cause cardiac toxicity. Prediction of cardiac toxicity is needed at an early stage in drug development, before the huge expense of clinical trials. A major unmet need in the industry is to create laboratory models that more accurately predict human cardiac effects.

### What approach did you take to address the challenge?

By expanding on existing access to ethically-donated human heart tissues, we assessed the feasibility of a model based on the use of intact, fresh cardiac tissue that would retain the physiological characteristics of the heart. Compared to alternative approaches, our method retains the 3-D structure of heart tissues and allows both contractility and electrical properties of the tissue to be measured in the presence of test drugs.

### What are the potential benefits?

Our model has the potential to improve greatly the prediction of cardiac side-effects by new drugs. By using human fresh cardiac tissue, we can remove many of the concerns about prediction and the relevance to human clinical responses. In addition, the responses of different patient cohorts can be explored to determine whether 'at risk' groups, such as those with pre-existing cardiovascular disease, might be more at risk from cardiac side-effects.

### What are the next steps?

We will test an extensive series of drugs with known cardiac safety issues and compare our data with clinical responses. This will form the basis of our marketing campaign. We will engage with industry to ensure we capture the widest possible market opportunity.

# BioSyntha Technology Ltd

## New products from syngas fermentation via energy conservation biochemistry

---

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BioSyntha is an industrial biotechnology company developing microbial catalysts for converting waste gases to high-value chemicals. We also offer bespoke contract research services in biocatalysis and pathway engineering to the pharma, commodity chemicals and biofuels industries.

### What was the business need that motivated the project?

Developing new technologies to produce commodity chemicals from renewable resources, is a substantial industry focus. Synthesis of these important commodity chemicals from waste gases has great potential if the key biochemical energy limitations of this approach can be addressed. The market for the project target commodity chemical is €4.2bn with annual growth projected at 3.5%.

### What approach did you take to address the challenge?

Our feasibility study took an enzyme with a known activity. We characterised it to determine if it could carry out a reaction important for energy conservation, for the synthesis of a target commodity chemical, such as plastic.

### What are the potential benefits?

Our project has the potential to develop routes to multiple products by branching from a common metabolic pathway. A patent filing may follow if the work can be developed further in-house.

### What are the next steps?

Further studies are likely to be needed, depending on the data from this work. If the enzyme activity is proven, enzyme evolution will almost certainly be required to achieve sufficient activity for an industrial process. We will integrate the enzyme into the overall process.

# Bluefrog Design Ltd

## Creating low-cost, high-wear components by applying an amorphous, diamond-like carbon coating to a polymer matrix

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Bluefrog Design is a design and development consultancy with expertise in water control products. Ionbond UK has patented technology in the deposition of amorphous, diamond-like coatings (ADLC). Together we are investigating the potential of novel materials for high wear components.

### What was the business need that motivated the project?

We set out to demonstrate how ADLC could be used in combination with a polymer matrix to replace high wear-resistant components, such as precision-machined metal, castings, or ceramics. Our approach was to substitute low-energy polymers coated with ADLC for high energy-content ceramic discs in domestic or commercial water taps, providing equivalent performance at reduced cost/energy consumption.

### What approach did you take to address the challenge?

Our project entailed material investigation, trials of test pieces to identify the preferred bonding solution and process parameters, then design of a demonstrator and soft tooling for production of advanced material discs. These would then be trialled within commercial cartridges in a demonstrator rig, to confirm performance against benchmarks. There are no other components in the market which are manufactured in this way.

### What are the potential benefits?

In the limited application of water taps, our technology has the potential to tap 10% of the UK market, equating to £300k net profit from a £1.5m turnover, plus a further £60k net profit from the retrofit market. For other applications, we estimate global value for engineered applications of DLC at \$330m. If successful, polymer components coated with ADCL could replace ceramic or metal components, which would expand this market.

### What are the next steps?

Assuming successful feasibility demonstration, we intend larger-scale trials of matrices, coating and techniques with commercialisation through the Ionbond group.

# Brainwave-Discovery Ltd

## Drug repurposing for Parkinson's: teaching old drugs new tricks

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Brainwave-Discovery is a contract research organisation (CRO) specialising in the rapid development and deployment of in vivo brain assays for new drugs for human brain diseases.

### What was the business need that motivated the project?

Development of neuroprotective drugs for Parkinson's disease (PD) needs a relevant animal model that is cheap and fast enough to allow in vivo testing of large numbers of candidate chemicals. The current use of rodents is too expensive and slow, and cell screens are too far from clinical reality.

### What approach did you take to address the challenge?

We have developed new animal models of Parkinson's disease, in which phenotypic changes are seen in weeks, allowing many thousands of drugs to be tested on a reasonable time scale. We use the expression of human alpha synuclein and mutant forms of this protein in the central nervous system of *Drosophila*. The same type of neuron is damaged in both insects and man, making the fly an ideal model.

### What are the potential benefits?

Our new assays for neuroprotection will make a significant contribution to the discovery of Parkinson's disease therapeutics, with complementary benefits for medicine and society in terms of prevention of premature loss of expertise and reduction in medical care costs. Our business development is also enhanced, increasing our service throughout and opening the opportunity of in-house or collaborative drug discovery, accessing part of the huge value that the PD market represents.

### What are the next steps?

This project provides a proof of concept for our *Drosophila* Parkinson's neuroprotection screen. We now need to find collaborators or funding to take the screen to a much larger scale allowing the discovery of valuable drugs. We will be seeking investment and active partners to achieve these aims.

# Cadscan Ltd

## A high-accuracy, low-cost 3D scanning system

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### Managing director

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CADScan was formed in 2011 and is based in Chester. We employ a small team of permanent and sub-contract staff to develop and manufacture 3D scanning systems and have recently launched our first commercial product.

### What was the business need that motivated the project?

Precise digitisation of small objects remains prohibitively expensive for many users, with entry-level scanners ranging from \$8k to \$35k. Lower cost scanners have been developed recently but are unsuitable for capturing small, detailed objects because of their poor accuracy. There remains a strong need for an accurate, low-cost system that can easily digitise small objects for retail and numerous other applications.

### What approach did you take to address the challenge?

The main technical challenge is capturing an object with sufficient resolution and accuracy using low-cost components. For the applications we targeted the accuracy required is 20 microns, with a target selling price of under £500. Our project has developed a complete simulation of a structured light system to optimise this for high accuracy over short distances before construction and testing of a prototype of the scanning system.

### What are the potential benefits?

3D scanning has grown in importance owing to the rapid take-up of low-cost 3D printing systems, a market which is expected to reach \$3.1bn in 2016. If successful, our project will open up a sizeable commercial opportunity for CADScan. There are currently no products available for cost-effective scanning of very small objects with an accuracy of 20 microns, and this project has the potential to transform our business.

### What are the next steps?

We will develop a pre-production implementation of the system based on the prototype. This design task will require further investment to bring the system to market. We will be seeking venture capital investment to fully capitalise on this fast growing opportunity.

# Cambridge Microfab Ltd

## Solid state neutron detection for hostile environments

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### Sensor enquiries

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We have 20 years' experience in particle and photon detection, thin film equipment, precision components and instrument manufacture. Our skills cover product design, production engineering, precision manufacture, process development, materials science and thin film expertise for space, oil, gas, bio and inkjet sectors.

### What was the business need that motivated the project?

We demonstrated a solid state neutron sensor capable of operating at up to 150°C, for use in neutron porosity logging-while-drilling (LWD) tools in the oil and gas industry as an alternative to Helium-3 (3-He) detectors. 3-He is expected to be unavailable to the industry in three to five years. Our innovation could capture significant markets with original equipment manufacturers (OEMs).

### What approach did you take to address the challenge?

Our existing solid state thermal neutron sensors work well at up to 70°C. We are extending our process to make prototype thermal neutron detectors using materials optimised for high temperature operation (150-180°C) and characterising their neutron response at high temperature. If time permits we will explore a second, fast neutron variant.

### What are the potential benefits?

Our innovation would offer reduced weight, compactness, robustness, low power, high neutron specificity, low gamma sensitivity, high area efficiency, high temperature operation, scalable production process and competitive pricing. Our replacement technology for 3-He based sensors has potential to be developed as a product range for reactor instrumentation, particle physics, materials science, radiation safety, cosmic ray detection, special nuclear material detection and other applications.

### What are the next steps?

There is a well-established market for down-hole neutron detection in the oil and gas sector and shortage of He-3 is creating a window of opportunity for alternative types of detector. We wish to build relationships with key original equipment manufacturers and service providers meet the needs of end users.

# Clean Technology Solutions Ltd

## A simple way to make nanostructured thermoelectric materials

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### Director

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Clean Technology Solutions develops and commercialises customised technologies and products in the fields of advanced materials and clean technologies. Our unique modelling expertise allows us to carry out feasibility studies of new technologies and to develop them efficiently as commercial products.

### What was the business need that motivated the project?

Harvesting energy from wasted heat is both a technical and economic opportunity, with the global market of thermoelectric devices estimated to be around £300m. We are developing high-performance nanostructured, thermoelectric materials using low-cost thermal spraying processes. If we can overcome the technical challenges, the potential applications are extremely wide and the market could be worth many billions of pounds.

### What approach did you take to address the challenge?

Recent developments on nanostructured materials have shown that dramatic improvements can be achieved in the performance of thermoelectric (TE) devices. However, current techniques are not practical for large-scale commercial exploitation. We are developing novel thermal spray technologies for rapid deposition of nanostructured coatings. Our computational simulation and initial trials show that this approach promises to manufacture controlled architecture nanostructured coatings and functionally graded layers at large scales.

### What are the potential benefits?

By improving the widely accessible thermal spraying techniques, we could rapidly limit the barriers to commercialisation of nanostructured TE materials. Taking an automotive application as an example, if new thermoelectric materials were to be applied to 30% of the cars in the UK, we could expect the substitution effect to be worth 960,000 kilolitres of oil, which is twice what is assumed from solar energy generation in 2012.

### What are the next steps?

We will build a working unit for waste heat recovery with potential end users to demonstrate the technologies in working environment. From there, we will form partnerships with thermal spraying companies to accommodate these new technologies in existing processes. Thermal spraying companies can then offer such technologies to global markets.

# Clean Technology Solutions Ltd

## Novel capsules to capture CO<sub>2</sub>

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### Development engineer

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Clean Technology Solutions is developing and commercialising customised technologies and products in the fields of advanced materials and clean technologies. Our unique modelling expertise allows us to carry out feasibility studies of new technologies and to develop them efficiently as commercial products.

### What was the business need that motivated the project?

We are developing a novel material which has high capacity to capture carbon dioxide (CO<sub>2</sub>). Carbon capture and storage (CCS) represents a major green growth opportunity for UK companies to establish themselves as market leaders. The export opportunities for UK firms are estimated at £3bn-6.5bn a year by the late 2020s (DECC).

### What approach did you take to address the challenge?

To date, the most commercially viable approach is to capture CO<sub>2</sub> from the flue gas using solvents in a packed absorption column, but this is constrained by cost and an energy penalty. Our approach is to encapsulate solvents, so that the new materials have the capacity of liquids and the physical behaviour of solids. Capsules can be easily fluidised by the flue gas, achieving excellent mixing without high energy consumption.

### What are the potential benefits?

The overall market for microfluidic products is growing at an annual rate of 15.5 % (BCC Research 2004) and forecasted to exceed \$3bn in market revenues in 2014 (Frost and Sullivan 2009). Applications of microfluidic to CCS sectors is new and this technology has potential to bring a disruptive product to the emerging CCS market.

### What are the next steps?

We will set up a mass production facility for the CO<sub>2</sub> drops. With such a production facility, a demonstration unit for CO<sub>2</sub> capture can be set up with power companies or other potential end users. This will allow the full evaluation prior to industrial scale application.

# Composites Evolution Ltd

## Low-cost, lightweight, sustainable biocomposites based on aligned jute ‘sliver’ tape reinforcements (BioJUSTICE)

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Composites Evolution supplies innovative, sustainable materials to the composites industry. Our products include fibre reinforcements, resins and intermediates based on natural, bio-derived, recycled and recyclable feedstocks, which enable our customers to meet cost, weight and environmental targets.

### What was the business need that motivated the project?

There is great demand for lightweight, sustainable materials in many industrial sectors. Currently, biocomposites (natural fibres in resins) are almost exclusively based on flax, which is relatively expensive, and woven yarn textiles, which require several processing steps. The resulting reinforcements are at least three times the cost of glass fibres and therefore difficult to justify in many industrial applications.

### What approach did you take to address the challenge?

Our project used ‘sliver’ – low-cost jute fibres in part-processed form – to minimise the raw material cost. A direct, tape-based manufacturing method minimised the number of process steps, thereby reducing processing cost, increasing fibre alignment and minimising fibre damage. We then tested these jute tapes in composite parts and compared them to existing materials.

### What are the potential benefits?

This has potential to lead to a new range of low-cost, lightweight, natural fibre reinforcements. These will significantly increase take-up of sustainable composites as replacements to synthetic fibres such as glass and carbon, which are heavier, non-renewable, with high-embodied energy. It will reduce the environmental impact of a range of products in the automotive, marine, mass transport and construction sectors, during manufacture, use and at end of life.

### What are the next steps?

We will first conduct in-depth testing to prove the performance of the materials in a range of applications, scaling up the manufacturing of these materials to pilot and then industrial scale. Finally, we will work with potential customers to test the materials, develop prototypes and launch products.

# Cortexica Vision Systems Ltd

## Bio-inspired visual recognition algorithms on a mobile device

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Cortexica is the leading provider of visual search and image recognition technology for mobile devices. Our vision platform is used by global retailers, brands, and technology companies to power real-time image search and video search within large databases.

### What was the business need that motivated the project?

Users of smart mobile devices with on-board cameras and photo galleries would find their search experience improved if image searches against large databases could be speeded up. Visual search usually requires access to high-performance servers in the cloud, which can take several seconds, limiting the search experience.

### What approach did you take to address the challenge?

Smart mobile devices are now packing greater computing power through higher frequency central processing units (CPUs) and mobile graphic processing units (GPUs), with many parallel computation units. We ported our bio-inspired visual search algorithms to run on a mobile GPU to prove the concept. Mobile versions of GPUs have simpler architectures and contain fewer parallel units than their datacentre cloud counterparts so we investigated these constraints against our algorithms.

### What are the potential benefits?

The benefits to both industry and users lie in being able to compute locally the 'fingerprints' of images and thereby to perform scalable searches. This reduces the data bandwidth needed in uploading image data to cloud servers and loading of mobile carrier networks. Communication latencies (delays) are also reduced, allowing for a swifter search and also faster sequential searches, for example, on a video feed from the mobile device's camera.

### What are the next steps?

We will use this proof of concept to develop technology demonstrators of local fingerprint computations and perform the fingerprint matching stages, also on the device. This will open up possibilities of real-time search and also richer search interactions with the user.

# Cybermoor

## Big data goes local – Community Data Explorer

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**Partner:** [Swirrl](#)

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Cybermoor is a social enterprise delivering broadband and innovative digital inclusion projects in Cumbria. Cybermoor is working with Swirrl – an SME creating elegant and powerful data solutions for organisations who want to open up their data.

### What was the business need that motivated the project?

Public sector organisations may improve their transparency by making large amounts of data open and available, but citizens lack understanding of how to use of it. Cybermoor and Swirrl are keen on helping citizens to interpret open data so that they can influence how public services are delivered in their area.

### What approach did you take to address the challenge?

Our project has developed Community Data Explorer (CDE) – a package of community data engagement methodologies and data analysis / visualisation tools. This presents different types of public open data and semantic data in a format that can be understood by the public. The CDE enables people to analyse data about their locality and improve the quality of that data by combining it with local knowledge and commentary.

### What are the potential benefits?

With better insight into how ordinary people can use open data, its greater use can influence the delivery of services and improve civic engagement. In visual form rather than numbers on a spreadsheet, people can see what the data means. Citizens can then develop skills in data analysis, helping to avoid a new 'data divide' in addition to the existing digital and economic divides.

### What are the next steps?

We will evaluate the impact of the Community Data Explorer to see if it has made a difference to civic engagement and citizens' understanding of open data. We will then commercialise the package of community engagement and data visualisation for public sector organisations interested in getting citizens to use open data.

# Cyclogenix

## Oral delivery of biotherapeutics

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Cyclogenix is a biotechnology company focused on delivery technologies, using small constrained peptides. The company was founded five years ago by Duncan McGregor, Simon Robins and Bill Eldridge.

### What was the business need that motivated the project?

The majority of biotherapeutic molecules are administered via subcutaneous injection. These agents are expensive and are associated with numerous complications, including issues of patient compliance, injection site reactions and increased immunogenicity.

### What approach did you take to address the challenge?

We have developed a panel of novel peptides which cross gut epithelia at unprecedented levels. We fused some of these peptides to erythropoietin (EPO) to determine levels of oral availability. By measuring the levels of EPO in plasma after oral administration we were able to determine the amount of material successfully delivered from gut to bloodstream.

### What are the potential benefits?

If successful, oral delivery could be applied to a diverse range of biotherapeutics, reducing costs, increasing patient compliance and reducing potential immunogenicity. We expect this to be applied to many biologic drugs as an enabling technology, with a potential value of more than \$500 million

### What are the next steps?

We intend further screening of alternate Cystine knot (CK) peptides to determine optimum performance and further formulation experiments to determine optimum delivery/storage conditions for biotherapeutic/CK microprotein fusions. A pre-clinical data package will include oral availability, PK profile and toxicity for partnering.

# D2 Network Systems Ltd (D2NA)

## Cloud software testing as a service

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D2NA is a fast growing provider of IT solutions to business, specialising in virtualisation, cloud computing, and managed IT services. We add value to businesses by using virtual computing technologies to make IT more reliable and flexible.

### What was the business need that motivated the project?

There is an opportunity to develop a cloud-based platform for testing aspects of the software development lifecycle. This is an exciting and emerging area, with many examples of need among D2NA's customer base, and research has indicated a potential global market.

### What approach did you take to address the challenge?

Our study was aimed at assessing the technical challenges of creating and maintaining a cloud-based software testing platform, also the comparative view between cloud testing and conventional offline testing, and designing simpler user interface concepts. We also focused our research on the size of the market opportunity and addressed the security challenges involved in persuading the market to adopt such a platform.

### What are the potential benefits?

Customers looking to develop and deploy software solutions would be able to gain invaluable insight in terms of performance, availability, security, manageability and costs. For example, they would be able to assess the hardware and software requirements, determine the scale, identify compatibility and interoperability issues, and test deployment methods, without having to make capital investments.

### What are the next steps?

We will investigate the potential for future exploitation in various aspects of the software development lifecycle in the cloud. Our study focuses on non-functional testing (performance, availability, security, manageability and costs), but we may also consider functional testing (debugging, compatibility, and legacy applications).

# Decibel Music Systems Ltd

## MusicHQ

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Decibel Music Systems collects, organises, enhances and delivers data on physical and digital music products, recordings and performances.

### What was the business need that motivated the project?

Commercial sectors will soon want high-quality, innovative databases, and specifically graph databases, for faster, more intuitive query performance. Revamped back-end architecture will create better front-end capabilities but first there will need to be an overhaul of out-dated database models.

### What approach did you take to address the challenge?

We explored the most efficient ways of revamping relational databases and effecting a transition to graph. Few business have large enough data sets (up to 160 data points per song) to create the testing environment needed to find the best practices. We researched the following: semantic data analysis; graph exploration and structural analysis; effective interaction environments to interpret large data sets; and end-user experience and navigation.

### What are the potential benefits?

McKinsey Quarterly reported (March 2013) that proper big data architecture can lead to a 5-6% increase in productivity and profit gains. Testing data migration into a graph database system means that we can now work with equally large databases, such as libraries and archives, to improve their performance, saving them servicing and query response time.

### What are the next steps?

We need to finalise the transition and test the user experience, creating a system error reporting tool. This will ensure that the product is stable and reliable before securing potential clients from music labels, archives and libraries.

# DZP Technologies Ltd

## Laser assisted nano-welding of metal nanowires for flexible transparent conductors

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We are a Cambridge-based technology development company working in the emerging field of printed and plastic electronics. We are involved in a range of key technology areas including conductive printing, graphene, thin film photo-voltaics, and additive manufacturing.

### What was the business need that motivated the project?

Our project aimed to develop a new laser-assisted process for welding of silver nano-wires, to produce highly conductive material for transparent conductive films. The new material can be used as replacement for indium tin oxide (ITO) which is expensive, brittle and not sustainable. Potential applications include flexible electronic devices such as displays, lighting, photo-voltaics and touch screens.

### What approach did you take to address the challenge?

We built upon our recent finding that specific laser radiation can be used to weld the nodes of silver nanowire networks, leading to the formation of continuous conductive material, which can be then processed by printing or coating to produce conductive transparent films. Our study addressed two main challenges: the development of synthetic procedure for synthesis of silver nanowires; and optimisation of the laser welding process parameters.

### What are the potential benefits?

Our project may provide a high-value material that will transform the industry by introducing sustainable, energy efficient materials and processes. This will reduce the cost of consumer electronics, and enable new functionality and user experiences. Printed and plastic electronics have the potential to change our lives, with impacts on all major technology sectors, from energy-efficient lighting, solar energy and medical devices, to automotive and aerospace engineering.

### What are the next steps?

We have to develop better understanding of the synthetic procedure for producing silver nano-wires, and also of the laser assisted welding process. Discussions with potential users of the technology have been encouraging, and we plan to continue the technical development work.

## e2e Services

### Managing service level agreements in real-time within bandwidth-limited networks

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e2E provides technical support for satellite and wireless networks servicing the space, defence and cellular industries. This covers satellite testing, ground segment engineering, systems I&T, operational support, technical training, communications-based service and network management integration.

#### What was the business need that motivated the project?

For machine-to-machine (M2M) communications services running over bandwidth-limited hybrid networks, achieving a dependable quality of service requires real-time performance management (PM). 'Best-effort' service may be impossible to quantify or just not good enough, so the operator needs to be aware of service performance in real-time. That generates large data streams in the network, so how to reconcile big data for PM with limited bandwidth?

#### What approach did you take to address the challenge?

Our study defined a distributed PM architecture allowing data mining and processing rules to be distributed to remote network devices as part of their configuration information. We defined a suitably challenging scenario, requiring real-time PM, applied our architecture and evaluated its effectiveness for managing quality of service, using simulation. The objective was to minimise risks in applying the PM architecture to limited bandwidth networks.

#### What are the potential benefits?

Improved PM and speed of reconfiguration/optimisation to avoid potential faults in the network can stimulate the success and growth of M2M service provider businesses in the UK. Any M2M application that requires good 'service management' would benefit from our technology and this type of architecture can be applied across diverse and international industry sectors.

#### What are the next steps?

We plan a proof-of-concept project to develop an 'agent' for a real communications device in collaboration with an equipment vendor and a 'manager', thereby allowing it to be used as a PM system. We would require further investment to standardise and commercialise the approach.

# Envirup Ltd

## Rapid-fit external wall insulation composite system

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Envirup is a specialist energy efficiency, renewables, energy management and Green Deal consultancy, established in July 2002. We provide high-impact solutions to a range of government, local authority, corporate and smaller business clients in the UK and EU.

### What was the business need that motivated the project?

Our research identified a need for a simple and faster solution for externally insulating the UK's 6 million solid wall homes. We saw the Green Deal and Energy Company Obligation as drivers for growth of the insulation market but the supply of service providers is limited by the high skills level required for a consistent, quality finish.

### What approach did you take to address the challenge?

We created a number of mini research projects to assess the viability of the innovation within identified risk areas, such as insulation performance, aesthetics, product accreditation routes and customer reaction. One of the key technical challenges was in creating a methodology to assess a new technology. We resolved to judge ourselves against the best currently available technology as that would be how customers would judge the innovation.

### What are the potential benefits?

We aim to commercialise our 'quicker install, lower cost, highly productive, less disruptive, weather independent' form of external wall insulation. It will create significant new revenue for our manufacturing partner and allow a greater range of entrepreneurial installation contractors to enter the market. It will tackle fuel poverty by creating new green jobs and reducing the amount of energy required to heat solid wall homes.

### What are the next steps?

The research process has allowed us to make enhancements based upon the results obtained to date and to provide a package of robust evidence of its performance potential. We will use this to reduce product risks and increase the pace of commercialisation.

# Europharma Scotland Ltd

## Mining microarrays for the development of innovative tools for fish health in aquaculture

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Europharma provides fish health solutions to the aquaculture sector. We are interested in developing and/or distributing new products and services for aquaculture alongside our current portfolio. That includes an anaesthetic, SuperSmolt, our biotechnology programme and fish veterinary and laboratory services.

### What was the business need that motivated the project?

Current methods of monitoring fish health are outdated and based upon old knowledge and a mammalian health model, and are therefore not best suited to our customers' needs. We wanted to address this with modern approaches to biomarker discovery and development.

### What approach did you take to address the challenge?

Working in a commercial production environment was the biggest challenge, as we had to work around any production decisions – often at the last minute. We achieved this by ensuring flexibility within our sampling programme and access to our wide network within the sector. The innovative aspect of this study is the modern approach to biomarker discovery for fish health indicators.

### What are the potential benefits?

Novel biomarkers could transform fish health management, providing tools to enable better diagnosis and early management interventions to ensure improved fish health and survival. We will use this as a paid-for service delivered to fish producers in the UK and licensed for similar use in Norway, Chile and Canada. Use of biomarkers will contribute to sustainability and growth of an industry which employs many people in remote areas.

### What are the next steps?

We will begin by conducting further studies to validate any biomarkers discovered against seasonal and geographic variables and then establish an expanded laboratory service to incorporate high throughput analysis of fish tissue for the biomarkers concerned. This will enable us to launch the service on the market within a year.

# Functional Technologies Ltd

## Human-computer interaction through hand gesture recognition

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Functional Technologies specialises in human-computer interaction, multimedia forensics and big data analysis. Since incorporation in 2009, we have been working with the main players in the field and are currently developing an image search engine for INTERPOL.

### What was the business need that motivated the project?

Hand gesture recognition (HGR) is an emerging technology which will certainly lead to profitable and exciting applications yet to be envisaged. Developers are competing fiercely, hoping to be the first to make the breakthrough in bringing the technology to commercial level. Such a breakthrough requires careful and timely focusing of R&D resources.

### What approach did you take to address the challenge?

Existing techniques are rigidly constrained, with high levels of ambiguity, because backgrounds are usually static and hand positions are limited by the camera view. They require high computational complexity because of the large feature set and the need for intensive hand tracking in each frame. We used a compact feature set, insensitive to background interference, and incorporated intelligence allowing the computer to compensate for loss of information should the hand perform out of view.

### What are the potential benefits?

HGR technology will provide a new form of man-machine interaction for the games industry and for healthcare. It will allow numerous applications to emerge, creating new business and jobs. From the social point of view, it provides new entertainment opportunities and experience to enrich human life. It will also help older and disabled people to improve the quality of their lives.

### What are the next steps?

We will identify specific applications so as to commercialise the technology by ourselves. We will also collaborate with two EU companies to identify new applications and apply for Horizon 2020 grants to support further commercial development.

# GDE Technology Ltd

## Disruptive low-cost rotary sensor

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GDE Technology is addressing untapped, multi-million dollar business potential in developing high-frequency low-cost industrial sensors. This potentially disruptive technology uses patented sensing algorithms running on off-the-shelf microcontrollers and very cheap sensor head structure implemented using PCB-based sensing coils.

### What was the business need that motivated the project?

Most feedback control needs for rotary systems can be satisfied only by optical encoders, which are very fast but expensive. Ratiometric inductive sensors technology was developed more than 25 years ago but there is still no appropriate electronics solution for such sensors capable of performing measurements with update rates well above 1 kHz.

### What approach did you take to address the challenge?

Sensing algorithms invented recently at GDE are delivering a substantial increase in the update rate but without compromising the filtering of external noise. However, the rotary sensor market is heavily segmented and we lack the budget to develop a dedicated application-specific integrated circuit (ASIC) for embedding our algorithm. To achieve a low-cost target we must demonstrate the feasibility of implementing our algorithm using hardware capabilities in modern low-cost microcontrollers.

### What are the potential benefits?

Our new approach to sensing electronics will allow us to address the industrial rotary sensor market, worth more than \$2bn globally in annual revenue. The availability of low cost, fast, accurate and robust rotary position sensors will transform existing applications and enable a fresh wave of commercial innovation in industrial automation and robotics.

### What are the next steps?

Discussions with major industrial sensor companies based in UK, Germany, France, and the US have confirmed that delivering proof-of-principle prototypes developed from our project will allow us to commercialise our technology through strategic relationships with commercial partners – future licensees of our technology.

# Generic Robotics

## Very high force haptic interaction for surgical training

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Generic Robotics is a micro technology R&D organisation comprising engineers and academics, with a wide skill set to draw upon. We have expertise in novel computer interfaces, particularly touch/tactile, and robotics, and have actively worked in these fields for more than ten years.

### What was the business need that motivated the project?

Computer simulation of surgical procedures is becoming widespread in medical training and is approaching the point where, like flight simulation, it will be mandatory. Manual dexterity is central to developing good clinical skills, yet the re-creation of touch in current clinical simulation is often very basic, ultimately limiting its educational and commercial potential.

### What approach did you take to address the challenge?

Haptic (touch) feedback interfaces are essentially robotic devices but with highly specialised characteristics and challenging performance trade-offs. To achieve high output forces sufficient to match those arising in many surgical procedures it is not sufficient to simply scale up existing designs because they will become heavy and cumbersome. Instead, we are designing a novel kinematic configuration based around injection mouldable parts and specially selected servomotors and position encoding solutions.

### What are the potential benefits?

Potentially our design is highly scalable, able to meet a range of different application requirements with minimal redesign necessary. In particular, it can be easily scaled to accommodate much higher force interaction than is presently achievable with current commercial systems. It also lends itself to mass production techniques, something which has, as yet, not been successfully achieved with high-quality haptic computer interfaces.

### What are the next steps?

We will trial our solution with expert orthopaedic surgeons, who have been working closely with us. Should these trials justify our design choices we will proceed to take the design through to a commercial prototype.

## goHDR Ltd

## Effective imaging of industrial processes in extreme lighting

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goHDR, a Warwick University spin-out in founded in 2009, is working on high dynamic range (HDR) video. HDR captures a far wider range of light levels than traditional video, providing significantly more detail in bright and dark regions, simultaneously.

**What was the business need that motivated the project?**

Industrial welding produces a bright light, swamping a traditional video camera's input. Applying a strong filter simply removes the ability to view activity in the surrounding area – perhaps relevant activity such as deformation or weld sputter. With its potential to film across a wide range of light, HDR video increases the practicality of real-time monitoring.

**What approach did you take to address the challenge?**

We are working towards delivering HDR video using standard commercial hardware, combined with its own software for image manipulation and data handling. We are doing this because there is currently no low-cost device capable of capturing the extreme exposure levels required. The extreme light created by welding is beyond even the 20f-stops of the most sophisticated device available.

**What are the potential benefits?**

High speed metal welding is a large part of manufacturing, much of it carried out by robots. As a consequence of high speed production 'machine vision' is often incorporated as part of the quality control process, but this is a challenging area, owing to the nature of welding. We believe an effective HDR video system can help improve quality monitoring in this area, potentially reducing waste and increasing competitiveness.

**What are the next steps?**

Creating a practical, robust and affordable HDR video system capable of deployment on field trials is a crucial next step. Its integration into a working welding system will undoubtedly require further development and collaboration with end-users and system suppliers.

# Haydale Ltd

## Nano-enhanced thermoset composites

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Haydale manufactures plasma-functionalised nanomaterials, including carbon nanotubes, graphenes and zinc oxides. Plasma functionalisation enables compatibility between the particles and matrix materials leading to improved properties. We develop nanomaterials and functionalisation for specific applications including nanocomposites, inks, sensors and dispersions.

### What was the business need that motivated the project?

Advanced composites are lightweight, high-performance, corrosion-resistant materials which are increasingly being used in transportation, construction and energy generation. Improvements in these materials have been seen in the inclusion of nanomaterials in laboratories. We needed to quantify the benefits of using nano-particles manufactured by our innovative Haydale process when using commercial processing methods.

### What approach did you take to address the challenge?

We took nanomaterials, such as carbon nanotubes and graphene nanoplatelets, and applied the plasma surface functionalisation to improve processing characteristics; before mixing them with epoxy resins using commercial processing methods. We manufactured carbon fibres composites using these nano-enhanced resins and compared them with standard materials in terms of physical properties.

### What are the potential benefits?

Improved composite performance will allow thinner, lighter composites to be manufactured. This could result in significant savings in the costs associated with composite components – in manufacture, application and end of life. The requirements for nanomaterial inclusions and surface modifications of the nanomaterials will also be better understood, allowing the supply of optimised nano-filled resins to industry.

### What are the next steps?

We will use project technical reports on the benefits of functionalised nanomaterials in composite applications to add a product line to our portfolio of nano-enabled components and intermediates at Haydale. We will also feed these results into our discussions with industrial partners regarding high-volume commercial exploitation of these materials.

# Hydro Industries Ltd

## Nano-enhanced composites for effluent treatment

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Engineering Consultants Ltd

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Hydro Industries is an established manufacturer of innovative water treatment systems. By using electro chemistry we can treat complex effluent streams. Partnering with Advanced Materials Engineering Consultants Ltd, an SME, has offered the opportunity to further develop the technology.

### What was the business need that motivated the project?

Traditional water, waste water and effluent processing plants require large tanks and high volumes of chemicals and are often unable to treat complex waste streams, which must be diluted and then discharged. Electro-chemical processing offers an 80-90% reduction in footprint, a 25% reduction in operational cost and a reduced need for transporting chemicals and effluents.

### What approach did you take to address the challenge?

Our project focused on developing bespoke nano-enhanced composite electrodes. These offer the opportunity for more effective treatment and targeted ion generation to tackle complex effluents in the most effective manner, and using minimal energy. We prepared and tested composite electrodes with nano-cationic additions to prove the treatment principle and to demonstrate their ability to process waste streams that currently can only be diluted by conventional technology.

### What are the potential benefits?

The primary benefit is the opportunity to treat complex effluent streams with bespoke electrode compositions which would not normally be available. This further reduces the footprint of the treatment plant and improves the efficiency of the ions being generated. This advance in process technology reduces the demand on energy, chemicals and transportation and maintains Hydro Industries as the leader in this field of technology.

### What are the next steps?

Following successful laboratory trials to prove the principle, we will evaluate a greater range of complex effluents. We will then scale up and field test the electrodes before demonstrating our technology to the industry.

# i3d robotics Ltd

## Multi-data fusion and intelligent connectivity enhancing autonomous transport

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i3d robotics has two core technologies – stereo-cameras and thermal infrared. Our key objective is to link these technologies into a new collision avoidance instrument for rail and robotics in unstructured environments.

### What was the business need that motivated the project?

Modern robotics and autonomous vision systems require a multi-sensor approach to enable effective and flexible operations. For this to occur, multi-data fusion from the different sensors becomes essential. This greatly improves the ability of robotic and autonomous platforms to gather and interpret information in real-time, leading to improved reliability, flexibility and safety in a wide variety of applications.

### What approach did you take to address the challenge?

Our innovative approach employs the advantages of two sensors, namely stereo-cameras and Lidar, with on-chip graphics processing, allowing the delivery of high-value, intelligent data. While lasers have been projected into a close-range environment for use by stereo-cameras, no commercial systems exist to fuse Lidar and stereo 3D data. We have built a bench-top demonstrator to confirm that fusing the two sensors will produce a commercially feasible device.

### What are the potential benefits?

Our approach – a fully embedded 3D vision sensor utilising automated data cleansing – is an enabling technology for the design of decision-making autonomous platforms. This sensor could enjoy wider exploitation in handheld devices or mobile phones because this type of pervasive computing will embed connectivity and be available everywhere. This will allow greater everyday use in a wide-range of tasks.

### What are the next steps?

The next stage is to create algorithms and a fused real-time data structure. Then we can complete development of and test a new eye-safe 3D imaging technology. This innovation will enable 3D imaging with a spatial resolution and range perfectly suited for robots operating in human environments.

# Inanovate UK Ltd

## Catalysis by iterative rational design

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Inanovate develops novel microfluidic systems for the life sciences and materials industries. We leverage proprietary nano-scale surface patterning technology and microfluidics flow-control procedures to deliver novel solutions for screening biological molecules (diagnostics) and improving the efficiency of chemical transformations (drug development).

### **What was the business need that motivated the project?**

Currently, catalysts are identified by screening large numbers of speculatively prepared mixtures to find those that show catalytic activity toward a chosen reaction. This is a very wasteful practice as it requires the creation of many formulations to find just one. Furthermore, as there is no way of guiding the discovery process, the 'find' is unlikely to be optimal.

### **What approach did you take to address the challenge?**

We have been looking to demonstrate clear correlations between the activity and/or selectivity to controllable and reproducible changes in nano-particle catalyst size, density or material mix. We are also seeking to prove the feasibility of a process and system that can systematically control the key variables of catalyst size, density and material in order to enable a scalable, 'iterative rational design process' for catalysis design and production.

### **What are the potential benefits?**

Our project could open up a pathway to industrial production of more active, more selective and more efficient catalysts, reducing the cost and energy requirements of catalytic processes and enabling new transformations. The global catalyst market is estimated at £8bn, of which £500m is spent on R&D. If 25% is allocated to identification of new or improved catalysts, the opportunity open to us for catalysis R&D/optimisation services is presently £125m annually.

### **What are the next steps?**

Following successful demonstration of our system for rational catalyst design and production, we will look to advance partnerships with pharmaceutical companies to refine and scale our process for chosen commercial catalytic reactions. We will seek additional investment to support this transition from R&D to commercialisation.

# Inanovate UK Ltd

## Next generation multiplexed protein screening for clinical diagnostics

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Inanovate develops novel microfluidic systems for the life sciences and materials industries. We leverage proprietary nano-scale surface patterning technology and microfluidics flow-control procedures to deliver novel solutions for screening biological molecules (diagnostics) and improving the efficiency of chemical transformations (drug development).

### What was the business need that motivated the project?

Proteins drive many disease mechanisms, and play a central role in disease diagnostics. We have developed the Bio-ID – a bench-top, multiplexed, protein quantification platform which, in real-time, measures protein concentrations from complex samples. The Bio-ID was more accurate and sensitive than alternate protein detection platforms. However, it was designed for research use and is not suitable for clinical diagnostics.

### What approach did you take to address the challenge?

To make the Bio-ID useable for clinical diagnostic applications, we need to design a new fluidics cartridge that eliminates the 'peek tubing' currently in use and integrates the sample inputs on to the disposable cartridge. In doing so, the sample volume requirement of the existing system will be reduced to levels compatible with clinical diagnostic use. Having the sample inputs integrated into the cartridge eliminates the chance of cross-talk between diagnostic tests.

### What are the potential benefits?

An integrated and self-contained disposable cartridge, when coupled to the advantages of the Bio-ID, would signify a breakthrough in the use of multiple protein detection for clinical diagnostic applications. The markets covering the detection and measurement of multiple proteins are estimated to be around \$4bn and are expected to grow to over \$9bn by 2015, driven primarily by clinical diagnostic applications.

### What are the next steps?

Successful proof-of-concept demonstration will lay the foundations for us to raise additional financing to develop and manufacture a next-generation Bio-ID that can directly address the clinical diagnostic markets.

# Industrial Phycology

## Developing a new process using algae to treat wastewater

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Industrial Phycology was founded in late 2012 to commercialise the founder's experience in water and wastewater technology. The company is focused on providing novel solutions to the wastewater industry, initially using our patented microalga process.

### What was the business need that motivated the project?

Increasing populations are producing greater volumes of wastewater. Sewage works are struggling to cope, leading to higher levels of potentially harmful chemicals being released to the environment. Compounding this, new legislation around the world is requiring even lower nutrient levels in final effluents. Solutions are urgently needed.

### What approach did you take to address the challenge?

We used our broad, applied experience to develop a solution for the water industry from the ground up, using some of the latest technologies and methods including the complex area of biophotonics. To fully realise this we have been working with industry and other experts to make sure that our demonstrator is designed robustly and specifically to meet a demanding industry's requirements.

### What are the potential benefits?

Our process would enable industry to produce effluents of dischargeable quality, removing many key nutrients in one step while making use of carbon dioxide from emissions. This process is efficient, produces no waste and the nutrients are recovered into a usable form. Successful completion of this project, and follow-on, will help secure our company's future, create jobs and allow industry to meet its legislative challenges.

### What are the next steps?

We are now trialing the process with industry support. The next stage is to develop the partnerships and funding required, carrying out a larger scale, in-depth trial to devise a process that is commercially ready, tailored exactly to industry needs and prepared for use at scale.

# Inova Design Solutions Ltd

## Non-invasive continuous core temperature monitor

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Inova Design Solutions is a biotech company set up in February 2011. We are involved in research, development and commercialisation of innovative technologies to improve the monitoring of various vital sign parameters of the human body.

### What was the business need that motivated the project?

Heat illness is a major problem for military personnel, athletes, fire fighters and other individuals in harsh environments, as well as for those unable to control their environment, such as older people, the chronically ill and hospital in-patients. Heat illness cannot be determined in the field, nor simply or non-invasively elsewhere. Current procedures for monitoring patients while awake are inaccurate and time consuming.

### What approach did you take to address the challenge?

We had to understand the limitations of existing products and alternative body sites for temperature monitoring. Our innovation is wide-reaching and provides real-time, non-invasive, continuous, automated, portable, and wireless monitoring. There are no existing products that offer a combined solution like this. The aim of the study was to validate a proof-of-principle prototype for further development.

### What are the potential benefits?

Our innovation will make core temperature monitoring much more accessible than current methods allow, and provide vast improvements in the monitoring of heat illness to prevent suffering and mortality. Our study has successfully proved the principle of the innovation and this validation will enable our project to progress to the development phase, with consequent growth in staffing and company value.

### What are the next steps?

We will first develop the technology to make it more robust and reduce the size of the existing prototype. We will then carry out clinical trials and product approvals before commercialising the technology. We will be seeking funding and industry partners to complete these work packages.

# iProov Ltd

## iProov Flick

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iProov, founded in 2011, delivers usable personal identity management to the global market. Our experienced team focuses on delivering the twin goals of trusted security and outstanding user experience on mobile and fixed devices, using advanced biometrics.

### **What was the business need that motivated the project?**

We had a creative and original idea for an entirely new kind of biometric that would provide additional risk metrics to our authentication solution. It had never been tried before, and we had no idea if it would work, or be feasible to implement. But it would provide a big competitive advantage if proven to work.

### **What approach did you take to address the challenge?**

Needing to gather enough data from enough users to be meaningful, we crafted and distributed a mobile app to extract the necessary information from deep within the mobile smart phone. We learned that the phone's sensors produce slightly inaccurate data, which we had to correct. We gathered a vast amount of data from each user, so our biggest task was to discover how to find useful patterns in the data and study just those.

### **What are the potential benefits?**

A successful outcome for the project will give us a tremendous competitive advantage in the large and growing global market for personal authentication. This project is critical to establishing feasibility and the investment case for full development,

### **What are the next steps?**

We are going to build a prototype and confirm its operational validity and robustness. And then we will build it into our product and take it to the world.

# IS-Instruments Ltd

## Transmission Raman instrument with spatially resolved Fourier transform spectrometer

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IS-Instruments focuses on the design, development and manufacture of compact, remote sensing instrumentation targeting the process industry. Our products are built around core technologies, including Lidar and laser-based instruments, Raman spectrometers, and 3D imaging systems, including Lidar and stereo-cameras.

### What was the business need that motivated the project?

Pharmaceuticals is one of the largest global industries, worth around \$800bn. Counterfeit products, estimated by Sanofi to account for 10% of the market, are a major problem requiring new methods of detection to ensure consumer safety and protect the huge investment made. Transmission Raman is of particular interest as it makes bulk measurements of the sample rather than point measurements.

### What approach did you take to address the challenge?

Our project developed a new Raman spectrometer targeted at transmission measurements, using a spatially resolved fibre Fourier transform spectrometer at its core. This device offers 100 times greater throughput than traditional devices, has no need for a slit and can be coupled to a 1mm-1.5mm diameter optical fibre with no loss of light. Key to achieving the overall performance was optimising the optical layout of the instrument.

### What are the potential benefits?

This new Transmission Raman system could represent a major advance in this field, by dramatically simplifying a potential transmission Raman Quality Control instrument and making any future product relatively low cost (under £40k). The system could be used for both hand-held spot measurements of tablets and on the assembly line to look for any defects or problem in production, offering efficiency savings within the industry.

### What are the next steps?

The next steps are to develop the instrument as a viable product that can be accepted by the pharmaceutical industry. This will include longer term testing in a representative environment. The instrument will also need to be made more compact and robust for wider distribution.

# IS-Instruments Ltd

## A novel integrating probe for whole-tablet Raman spectrometry

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IS-Instruments focuses on the design, development and manufacture of compact, remote sensing instrumentation targeting the process industry. Products are built around core technologies including Lidar and laser-based instruments, Raman spectrometers and 3D imaging systems, including Lidar and stereo-cameras.

### What was the business need that motivated the project?

Bulk measurement of the molecular make-up of samples is a key issue in a variety of industries, such as pharmaceuticals. They need fast, affordable quality control (QC) systems to quickly determine the bulk constituent of individual samples. Raman spectrometry offers a potential solution but current systems suffer throughput restrictions and are very costly.

### What approach did you take to address the challenge?

To develop the new Raman probe we initially reviewed existing collection methods and how they are integrated with current spectrometers. We carried out intellectual property rights searches to ensure freedom to work and then developed the collection design. We then built this as a bench top demonstrator and tested it on a variety of samples using different spectrometers for comparison.

### What are the potential benefits?

To provide cheap, portable QC systems requires a new approach to collecting the Raman photons. We have investigated the feasibility of a new collection system that is cheap to produce, simple to use and can be adapted to many different spectrometer designs; it can be deployed with new and existing systems to provide cost-effective Raman QC systems across a range of industries.

### What are the next steps?

We need to investigate further to improve the Raman photon collection and to develop the bench top demonstrator into a marketable product. Once complete we will work with our significant client base to ensure fast regulatory and industrial acceptance into key markets for the end product.

# Keracol Ltd

## Creating natural blue food colouring – KeraBlu

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Keracol is founded on 'sustainability with performance', combining high-end physical science with innovative consumer products. We extract active ingredients from renewable and waste materials and formulate them into a wide variety of natural ingredients for cosmetic and food applications, particularly in colorants.

### What was the business need that motivated the project?

A true blue colouring of food can be achieved with Brilliant Blue FCF, a synthetic dye, but this can induce allergic reactions, so a natural replacement is highly desirable. Blue is very difficult to achieve from natural sources and there are specific requirements relating to different media, stability issues, and regulation. Anthocyanins dominate natural blues in EU, but are unstable under acidic conditions.

### What approach did you take to address the challenge?

We developed clean methods to extract natural anthocyanins. Our molecular structure preservation technology is not seen in competing anthocyanin extracts and through biomimicry we formed stable blue colours in aqueous solution – classified as true blue, unlike competing products. We then developed colorants for formulation and application in various food application media, evaluated their coloration properties, stability to temperature, pH, light, and antioxidant capacity.

### What are the potential benefits?

The market value for blue colorants is around US\$260m and we are aiming for significant share of that market through collaboration with industry leaders. We will produce a highly-desirable product that is safe for human health, and sustainably produced. We have developed a technology to bring us closer to our aim. Collaborations will help us grow significantly with this technology, increasing both company turnover and staff.

### What are the next steps?

Commercialisation is our priority. There is an unmet need for the products and technologies we are proposing and they could be brought to market within 12-18 months, particularly working with a global brand. We have good contacts to ensure products can be evaluated by potential customers in their applications.

# Laser Cladding Technology (LCT Ltd)

## Lifetime extension of rail brake discs by laser cladding

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LCT Ltd employs 22 people and has turnover of around £3m. We are the primary provider of laser cladding services to UK industry, applying hard-facing materials to customers' components to enhance wear/corrosion performance. We can also remanufacture worn components.

### What was the business need that motivated the project?

There is an ongoing requirement to develop train brake discs which offer improved frictional performance, along with longer service life and lower overall mass, without hugely increasing overall cost.

### What approach did you take to address the challenge?

Our study examined the potential of using laser cladding to apply particle-reinforced, metal matrix composite materials or advanced steels to provide a thinner, but improved frictional wear surface, which should also enable significant weight savings. We also investigated the feasibility of remanufacturing worn discs with this enhanced friction cladding, to allow their re-introduction into service.

### What are the potential benefits?

This has the potential to reduce the mass of each rail carriage in the UK by 240kg. Taking just four carriage types, this equates to 136 tonnes of excess steel, requiring approximately 45,500 extra gallons of diesel fuel a year. Discs are replaced every five years, which involves scrapping 590,000 tons of steel, but remanufacturing these parts via laser cladding would mean that the majority could be returned to service.

### What are the next steps?

We have developed our project in consultation with Faiveley Transport UK, one of Europe's leading brake disc manufacturers. Faiveley will provide a direct route for further development and commercial exploitation of this technology following a successful outcome of this feasibility study.

# Lein Applied Diagnostics

## Tuneable lenses for high speed, high precision optical sensors for co-ordinate measuring machine (CMM) applications

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Lein provides innovative products for non-contact measurement of position, thickness, refractive index, concentration and distribution of pharmaceutical drugs and glucose via the eye. Our technologies enable, cost-effective compact and accurate products for applications ranging from pharmacokinetics to metrology.

### What was the business need that motivated the project?

There is a need to provide faster non-contact measurements of position for co-ordinate measuring machines (CMM) and the monitoring of micro/nano-scale production defects. Modern materials and coatings may be damaged by contact sensors and highly automated, high speed production processes require solutions to operate far in excess of current contact probe speeds. Non-contact optical sensors are an ideal solution.

### What approach did you take to address the challenge?

The challenges were how to operate an electrically tuneable lens so that it made measurements tens to hundreds of times per second. We achieved this by adapting our existing electronics and software and the innovation was in using such lenses for this application.

### What are the potential benefits?

Our innovation could open up new applications for Lein's technology and products, which will in turn create new jobs in the company and benefit the UK's economy.

### What are the next steps?

We will look to improve the accuracy, precision and repeatability of the measurements. This will be achieved by developing a novel encoder solution.

# M Squared Lasers Ltd

## Differential absorption light detection and ranging (LIDAR) imaging

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M Squared Lasers explores, develops and manufactures next-generation lasers and photonic instruments that bring new capabilities, higher reliability and greater ease of use to a diverse range of industrial and scientific applications.

### What was the business need that motivated the project?

Light detection and ranging (LIDAR) and differential absorption LIDAR (DIAL) are established technologies used for remote sensing. To date, these systems have relied on point detection only, while many applications, such as environmental monitoring, explosives detection and hydrocarbon leak detection would benefit from a DIAL system capable of recording four-dimensional data (3D in space and 1D in wavelength).

### What approach did you take to address the challenge?

We investigated the feasibility of implementing a dual-wavelength, optical, parametric, oscillator-based, hyperspectral imager, extending its capabilities to differential absorption measurements. The beam interrogates a target gas and we evaluated the back-scattered light from the scene to determine concentration and range. M Squared's existing hyperspectral imager is well suited for LIDAR applications as it uses a pulsed light source and point detector, readily adapted by modifying the electronics and software.

### What are the potential benefits?

The recorded data can be used to determine precisely the origin and nature of a detected compound at a distance. The system is capable of performing real-time, high-resolution imaging of a wide range of molecules and compounds at stand-off distances of tens of meters. Combining this technology into a DIAL system capable of offering imaging with three-dimensional, spatial resolution represents a ground-breaking technology.

### What are the next steps?

We will next increase the technological readiness through further development of the core technology, to devise a pre-production prototype. This will enable us to verify the system capabilities in promising application areas through collaboration with research institutions and potential end-users.

# M Squared Lasers Ltd

## High-power, single frequency semiconductor disk laser

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### Business development manager

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M Squared Lasers explores, develops and manufactures next-generation lasers and photonic instruments that bring new capabilities, higher reliability and greater ease of use to a diverse range of industrial and scientific applications.

### What was the business need that motivated the project?

High-power, continuous wave laser sources are well established in a wide range of applications and are particularly important to the major markets in optical pumping and the excitation of nonlinear optical processes. Their deployment is severely limited, however, by their cost, operating wavelength, polarisation control and tuning ability.

### What approach did you take to address the challenge?

A semiconductor disk laser (SDL) solution can potentially address all of these issues in a compact and cost-effective device. SDLs offer a route to high power, continuous wave products with significant advantages over traditional solid state or fibre laser approaches. SDLs eliminate the major hurdles associated with spatial hole burning and are simple to polarise which is crucial because both of these characteristics are essential during non-linear conversion processes.

### What are the potential benefits?

The opportunities for a highly engineered, linearly polarised, high-power continuous wave, single frequency SDL system cover a wide range of application areas. The significant cost/benefit advantages of this technology mean that this new laser will be a key component of our next-generation, ultra-low noise visible lasers and widely tuneable optical parametric oscillators (OPOs) operating in the under-served, strategic 4-10 $\mu$ m wavelength region.

### What are the next steps?

With the feasibility of the power scaling of these devices established, we will further develop our technology to a pre-prototype level. Subsequent engineering steps will introduce M Squared's proprietary InvarianT™ mounting technology and ICE-BLOC® control modules into a final prototype system.

# MAC SciTech Ltd

## Advanced materials for electrochemical energy storage

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### Director

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MAC SciTech is a UK-based company specialising in the design and development of electronic and electrochemical systems. We are currently developing technology for the generation and storage of electrical energy.

### What was the business need that motivated the project?

Modern localised energy generation such as solar, wind and wave power cannot always generate power where and when it is required. Developments in national power grids require distributed storage devices to cope with peak demand and to smooth surplus energy generation from renewable sources. Our technology is designed to provide a low-cost energy storage device to meet these demands.

### What approach did you take to address the challenge?

Our technology centres on electrochemical energy storage and we are seeking to use low-cost highly abundant elements to replace the more expensive and less abundant lithium-based battery storage devices which are currently favoured. Recent developments in room temperature organic ionic liquid technology has allowed us to embark on the development of novel battery cell electrochemistry and cell architecture based around these materials.

### What are the potential benefits?

Take-up of this technology will enable localised electrical power generation and aid in 'grid smoothing' and the development of the Smart Grid; this will reduce the likelihood of power outages at times of peak consumption and offer the environmental benefit of increased adoption of renewable and localised energy generation. Our technology promises to offer a long-life, serviceable, rechargeable electrochemical cell with low environmental impact and easy end-of-life disposal.

### What are the next steps?

Our cell architecture is novel and development of control and monitoring systems will run alongside future electrochemical development. We will develop consumer products with energy production in the region of 1-50kW followed by scale-up of the technology to meet local Smart Grid requirements, with energy production of 500kW to 2MW.

# MediaNav Ltd

## MediaNav Cloud

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**Partner:** FOCAL International

### Managing director

David Wallace

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MediaNav Ltd is a new company, building on more than ten years of innovation by the founding team in media taxonomy (classification structures) and automated metadata extraction research. MediaNav will offer cloud-based indexing and taxonomy-assisted discovery as a web service.

### What was the business need that motivated the project?

The stock footage industry under-performs its earning potential by some 400%, owing to licensing/search complexity. Media licensees require important details before purchasing, with TV producers needing to know that content will integrate visually with other production media and educational resource sites requiring data accuracy. Both need to make high precision searches. Our project investigates the potential of cloud-based search solutions.

### What approach did you take to address the challenge?

We envisaged a web service for taxonomy-based tagging/search, via an application programme interface (API). Uncertainties concerned, firstly, taxonomies and the web – compatibility/performance issues in combining large, complex taxonomies with open/W3C-compliant tools and metadata extraction/metrics. Secondly, we had to investigate metadata packaging – writing metadata as a ‘track’ in ISO-based files (.mp4), enabling bulk-reading/ingestion of collections, and giving users confidence that they ‘own’ their data. We are trialling a partial demonstrator with content owners.

### What are the potential benefits?

Media organisations worldwide share common value chains, and welcome shared standards/ resources to enable their unique creative content to reach markets. We will develop our project’s capabilities while our partner, FOCAL International, will support adoption among the 300 commercial libraries it represents. Once commercialised, MediaNav Cloud will save organisations the cost/complexity of creating their own taxonomies/supporting infrastructures, and will provide a web service to third party developers of media aggregation sites/content management systems.

### What are the next steps?

We will work with cloud infrastructure services – currently Amazon Web Services – as well as those interested in using our proposed API, and media companies wishing to offer content search.

# Mediwise

## Non-invasive glucose sensing using low-power radio waves

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We are a med-tech, knowledge-driven company that helps individuals to take control of their health. We pioneer metamaterial technology to develop breakthroughs for the non-invasive, wireless sensing of glucose.

### What was the business need that motivated the project?

Diabetes is a global health problem with no known cure. The disease can be managed by constant monitoring of blood glucose levels and then injecting the correct dosage of insulin daily. Monitoring is therefore critical to management of the disease. Current monitoring solutions are invasive – requiring a small sample of blood – painful, costly, unhygienic and in some instances inaccurate.

### What approach did you take to address the challenge?

We developed a high accuracy, non-invasive, continuous glucose monitoring sensor based on the transmission of low-power safe radio waves through the earlobe. The system consists of a wearable on-ear sensor, a mobile application for receiving and displaying the glucose data, and a cloud-based, front end software platform. We use metamaterial technology to bypass the most significant roadblock of other non-invasive monitors, allowing the penetration of signals through the skin.

### What are the potential benefits?

Firstly, it is non-invasive; our patent-pending dual sensor radio wave-sensing technology allows pain-free, single or continuous glucose monitoring. Secondly, it is accurate, offering better precision compared to other non-invasive technologies, and surpassing the ISO15197:2003 specifications for self-testing blood glucose monitors. Thirdly, the proposed \$1,500 retail price is more affordable than continuous monitors (more than \$5k a year) as well as strip-based monitors (more than \$2k a year).

### What are the next steps?

We are planning a new round of lab tests to enhance the accuracy of our device, while simultaneously designing a miniaturised portable version. By leveraging government funding and raising \$1.5m, we expect to have a clinical prototype within two years. We are also seeking to establish industrial and clinical partnerships.

## mLED Ltd

## Using ion implantation to improve the efficiency and beam quality of micro-pixelated linear arrays for maskless lithography

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### Technology manager

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mLED produces extremely high brightness, pattern-programmable micro light emitting diode (LED) arrays based on gallium nitride (GaN) material. Our company was spun out in 2010 from the successful microLED research group at the Institute of Photonics within Strathclyde University.

### What was the business need that motivated the project?

We have been approached by numerous potential customers interested in using our microLED arrays for maskless photolithographic and printing applications. These require a well-defined, focused beam. An etched or bonded external lens would normally be necessary for this, but our project considers an alternative approach based on modifying GaN substrate material.

### What approach did you take to address the challenge?

Our feasibility study was a very early-stage project that looked at the potential of using an ion-implantation process to modify the light emitting diode (LED) substrate material properties. This is a highly innovative approach that would lead to further longer term studies if it is shown to be promising.

### What are the potential benefits?

We are introducing a new generation of LED technology – the ultra-high brightness microLED array for monochromatic display and projection applications. The lithography market grew to \$6bn in 2010, with new extreme UV lithographic systems being valued at some \$125m. There is now significant demand for lower cost systems for rapid prototyping, based on a maskless approach. There is a near-term market opportunity for mLED devices of more than \$40m annually.

### What are the next steps?

This feasibility study represents a first stage in investigating potential benefits of an ion implantation process. A promising conclusion would give mLED a valuable intellectual property opportunity. The next step would protect this and we would then seek further funding leading to a commercial product suitable for maskless photolithography.

## mLED Ltd

**High-brightness inorganic microLED array light engine for near-to-eye applications under brightly lit conditions**

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**Technology manager**

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mLED produces extremely high brightness, pattern-programmable micro light emitting diode (LED) arrays based on gallium nitride (GaN) material. Our company was spun out in 2010 from the successful microLED research group at the Institute of Photonics within Strathclyde University.

**What was the business need that motivated the project?**

We have identified a near-term market opportunity to develop monochrome projection devices for use in near-to-eye (NTE) and similar head-mounted and head-up displays. Our unique high brightness pattern-programmable devices would be a compelling light-engine for such applications, but devices capable of higher resolution are needed. Our project investigated a novel approach to achieving this capability, based on positive-type GaN (p-GaN) modification.

**What approach did you take to address the challenge?**

The usual fabrication procedure to isolate an individual LED pixel element in a display is to physically etch through the GaN material to form individual 'islands' of active GaN material that emit light. This proposal considers a new approach that uses a plasma procedure to convert the top p-GaN material from electrically conducting to insulating material and thus allow smaller isolated pixels to be addressable electrically.

**What are the potential benefits?**

A higher resolution display capability is crucial to mLED to enable us to access a near-term market opportunity of some \$80m for monochrome near-to-eye devices. The overall market for NTE-wearable devices is expected to become around \$1.5bn. Our feasibility study has allowed mLED to develop a novel approach to fabricate higher-resolution light engines.

**What are the next steps?**

Further development and funding will be needed to take this monochrome device into production. The feasibility study has been crucial in demonstrating and developing the early stages of a long-term development programme that will eventually lead to a high-resolution, multicolour NTE projection device.

# Mudlark

## Chromaroma – ‘Off the rails’

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Mudlark specialises in digital design and production of playful innovations. Chromaroma Oystercard game, Half The Sky social impact games for the developing world and Such Tweet Sorrow (RSC Twitter play) are among our originals. User experience and game design are specialities.

### What was the business need that motivated the project?

There is an opportunity to broaden the Chromaroma user base and extend the reach by taking the game ‘off the rails’ and adapting it to smartphone technology. By designing a transport data exploration system, with a simple, intuitive user interface, we can incorporate and monetise the different data elements and give non-expert users better visualisations of their travel data.

### What approach did you take to address the challenge?

We built a working prototype of a mobile app that, using experimental algorithms (tracking a combination of accelerometer and GPS), collects data on personal movement. It then takes this data and passes it through basic game mechanics that reward players for making switches in their transport mode. We tested it with a small user group over a sustained period to assess both gameplay and behavioural effect.

### What are the potential benefits?

A successful outcome will see us extending the reach of the game and its commercial potential in London and other travel regions. It also will make it marketable to regions that do not use smartcards. In both cases we will be well placed to monetise incentives for more ecological and healthy modes of transport. An integrated mobile and locational entertainment platform can provide benefits for its investors and the communities it serves.

### What are the next steps?

Detailed discussions have started with a European public transport network looking for a game platform that integrates users’ travel with their entertainment and awareness of the network. We are seeking investment to turn this early prototype into a full-scale demonstrator for scaled technical and market research.

# New Wave Innovation

## An intelligent sensor system to combat metal and equipment theft

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### Director

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We develop and commercialise novel technologies in the energy and security industries. Our team have significant experience in all aspects of the innovation process and since 2010 we have developed many new technologies for smaller businesses and multinational organisations.

### What was the business need that motivated the project?

Building sites can be a goldmine for thieves. Metal theft is thought to cost the UK economy £700m every year, with more than 7,000 crimes reported to police every month. A wide range of security solutions have been developed in response, but they are generally expensive and require significant time to install.

### What approach did you take to address the challenge?

By working closely with some of the UK's largest construction and maintenance companies we developed a concept of an all-inclusive, intelligent sensor system for site security. We tackled the technical challenges of ease of use and very simple installation by developing long-range sensor systems, which are capable of combining multiple readings to produce an intelligent result.

### What are the potential benefits?

Combined with remote data connectivity, our project will strengthen the first line of defence against planned and opportunistic metal theft, equipment theft and vandalism. With a retail price of £300 to £450 per sensor solution, the new Safeguard technology will yield significant economic returns. We expect the new sensor technology to be manufactured in Leicestershire and result in the creation of 12 new jobs over four years.

### What are the next steps?

Some of the UK largest construction and maintenance companies are validating the performance and reliability of the new technology. Following a further 12-month development programme and a second stage of testing, the Safeguard technology will be market-ready in 2015.

# Optosignal Ltd

## Precision registration laser-based mapping sensor (PROMAPP)

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Optosignal Ltd (OSL) is a micro-business involved in the design and marketing of scientific test equipment, and in providing sensor design services. We develop optoelectronic sensors.

### What was the business need that motivated the project?

A shortcoming in scanning Lidar units is the absence of a definitive identification of the laser beam location to enable precision, geo-rectified mapping. This shortcoming has been pointed out to us by geophysicists at Royal Dutch Shell and by Defence Science and Technology Laboratory (DSTL) staff at the UK Ministry of Defence.

### What approach did you take to address the challenge?

Our idea was to increase the registration accuracy and the sensitivity of the scanning Lidar mapping sensor by combining the following: radar pulse compression techniques; high-speed, high-resolution, digitising and storage of the reflected optical waveform; synchronising an optical line scan with each laser pulse; and using the optical line scan data to register the location of the laser pulse.

### What are the potential benefits?

Our technology will offer the possibility of developing and manufacturing a precision geo-rectified scanning laser terrain profiling sensor. It could be used in digital elevation mapping, detecting vehicles underneath foliage, aircraft navigation, collision detection for unmanned aircraft and unmanned ground vehicles and in ash cloud monitoring.

### What are the next steps?

We will discuss the results of our study with potential partners to address any gaps in the capability of our new sensor and to plan for the development of several product types for use in field testing.

# Oxford nanoSystems Ltd

## Use of nanocoatings for anti-corrosion and heat transfer properties in heating systems

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Based out of the European Space Agency Innovation Technology Access Centre at Harwell, Oxford nanoSystems is using emerging technologies to refine longstanding heat transfer techniques for consumer and industrial platforms.

### What was the business need that motivated the project?

Our aim was to develop a nanocoating that would prevent corrosion and increase thermal conductivity in domestic heating systems. These systems are based on 100-year-old technology, so our motivation was the need to update these systems and improve efficiency.

### What approach did you take to address the challenge?

The project was split into three distinct stages to maximise its potential. We first synthesised the nanocoatings and carried out preliminary corrosion testing. The second stage involved testing the coatings on parts of heating components, followed by thermal tests and further corrosion testing. The final stage was to coat a full component, together with imaging analysis and final thermal tests.

### What are the potential benefits?

Using nanocoatings on heat exchanger surfaces will give the following benefits: reduced fuel consumption, leading to a cut in carbon emissions; reduction in manufacturing costs and consumption of materials; and the ability to manufacture components with cheaper materials.

### What are the next steps?

The next steps to commercialisation are focused on meeting with one of our customers and integrating the coating process into their manufacturing system. We will also look into new markets in which the coating could prove beneficial.

# OXIS Energy

## New conductive carbon materials for lithium-sulfur batteries

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OXIS Energy develops high gravimetric energy lithium-sulfur (Li-S) battery technology with a high degree of inherent safety for a number of markets including light electric vehicles, solar storage and military applications.

### What was the business need that motivated the project?

One of the barriers to high performance and hence commercialisation of Li-S battery technology is the insulating nature of sulphur, resulting in high cell internal resistance. In our project we aimed to address the issue of high cell internal resistance.

### What approach did you take to address the challenge?

We used AC impedance and charge-discharge methods to assess internal resistance and cycle life in Li-S pouch cells. We evaluated the effect of using different mixtures of conductive carbon materials in the cathode formulation to reduce internal resistance and hence increase cell performance.

### What are the potential benefits?

Our project addresses a technological barrier to the commercialisation of Li-S battery technology. Li-S batteries are regarded as one of the next generations of battery technology, capable of replacing Li-ion chemistry to power future mainstream electric vehicles owing to their high theoretical gravimetric energy. This market is expected to be worth several billion pounds within the next decade.

### What are the next steps?

We will conduct a full lab-scale study into the best performing materials and optimise the process for integration into cathodes to improve performance. We will also be seeking academic and industrial partners to produce functional conductive carbon materials, as well as processing techniques for successful integration into the cathode material.

# Phytoceutical Ltd

## Formulation and stability of biological products for skin delivery focusing on Retinol

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**Partner:** Tecrea Ltd.

### Director

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Phytoceutical has expertise in the areas of natural products used as ingredients in skin treatments, including Asian botanicals. We have developed a wide range of skin care formulations, some with encapsulation delivery systems for unstable actives.

### What was the business need that motivated the project?

The emerging opportunity is the global pre and post-surgical skin support sector, minimising trauma and aiding more rapid recovery post-surgery, including recovery of the skin in wound treatment. Opportunities in the anti-ageing market are estimated to be \$292bn by 2015 while global wound care will be worth more than \$22m by 2016.

### What approach did you take to address the challenge?

We tested the feasibility of a novel nano formulation and delivery approach for the biological vitamin A product, Retinol, and for ascorbic acid. We tested the chemical stability of these formulas under accelerated ageing conditions and optimised the formulating process to refine nanoparticle formation and creation. We also assessed the regulatory landscape for use of this formula with cosmetics. We found evidence of particle formation with a stable and optimised formula.

### What are the potential benefits?

The project has allowed us to make the first significant steps in collaborating on new product development for a technically demanding market. If the next stages are successful it will accelerate growth for both companies in a global sector, creating additional jobs and contributing economic growth to the UK. The nature of the formulation materials will lessen environmental impacts compared to current less biodegradable materials.

### What are the next steps?

Our partnership with Tecrea Ltd provides the complementary strengths needed to take this project forward. Some further R&D work is required and additional partnership with companies interested in delivery or stability of actives for skin applications would be welcome, including companies working in the cosmetics sectors.

# Prail Price Richardson Diagnostics Ltd

## Point-of-care device to differentiate between gram positive and gram negative bacteria – an aid to diagnosis and antibiotic therapy

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PPR Diagnostics was established by scientists at King's College London. We have expertise in the synthesis of biochemicals and develop novel diagnostic tests, including diagnostic kits for NAG (N-acetyl- $\beta$ -D-glucosaminidase), chromogenic media for salmonella, candida and a test for mycoplasma.

### What was the business need that motivated the project?

The over-prescription of antibiotics is the leading cause of increases in bacterial resistance. Antibiotics prescribed for one type of bacteria may be ineffective against the other. Currently, there is no point-of-care (POC) test to determine the type of bacteria causing the infection. The availability of such a test would avoid incorrect or over-prescription of antibiotics.

### What approach did you take to address the challenge?

Our aim was to develop a POC strip test to distinguish between gram positive and negative bacteria. We used antibody-based methods to establish and optimise the interaction of antibodies with bacteria, which we then incorporated into a lateral flow platform. We assembled a prototype strip, to distinguish between gram positive and negative bacteria, using antibodies coupled to gold nanoparticles.

### What are the potential benefits?

The £3.4bn POC testing market is forecasted to grow at roughly 7% annually. However POC tests for infection have not successfully penetrated this market. Bacterial infections are currently diagnosed using laboratory-based culture methods and can take up to a week. A POC test would meet an unmet need within health services, and have application in developing countries, veterinary medicine and the military.

### What are the next steps?

We will develop custom-made, robust antibodies and run the test with actual clinical samples in a clinical setting. We would need to establish contact with a company skilled in the manufacture of lateral-flow based strip tests for POC use.

# Pre Chasm Research Ltd

## Intelligent systems in road safety

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Pre Chasm Research Limited (PCRL) is a Cheshire-based high-tech business with two core activities – generation and commercialisation of intellectual property through spin-outs or licensing and provision of bespoke business transformation services.

### What was the business need that motivated the project?

The Safe and Sustainable Roads report says road safety is one of the world's greatest development challenges and predicts the number of people killed in traffic accidents will rise to 2 million a year by 2020 if action is not taken. Our project investigated the use of intelligent machine systems to make complex decisions about conditions affecting road safety.

### What approach did you take to address the challenge?

We developed an intelligent machine system in which safe and unsafe scenarios can be determined automatically, without relying on human decision making. This involved research into vector algorithms, machine algorithms and pre-set preferences, along with an accompanying database of 'conditions'. We have developed a fully working 'feasibility' proof and filed several patents.

### What are the potential benefits?

Our technology aligns with core initiatives in the United Nations Decade of Action for Road Safety policy document. Further, it offers an opportunity to apply science-based machine learning to reducing fatalities on a massive scale, and could have a positive impact on hundreds of millions of road users worldwide. This presents knock-on benefits in a variety of sectors, including healthcare, insurance and motoring related industries.

### What are the next steps?

The technology has already been spun out of PCRL for commercialisation.

# ProteinLogic

## A rapid point-of-care diagnostic test for tuberculosis

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**Partner:** OJ- Bio

### Chief operations officer

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ProteinLogic has established a unique protein 'signature' which can diagnose active tuberculosis (TB) cases using serum samples. Our partner, OJ-Bio, has developed a rapid diagnostic sensor platform with a surface acoustic wave sensor suitable for use as a platform for a point-of-care diagnostic device.

### What was the business need that motivated the project?

There were 8.8 million new cases of TB in 2010 and 1.4 million deaths, making this disease one of the world's biggest infectious killers. Our project aimed to show feasibility of quantification of ProteinLogic TB biomarkers in serum, using the OJ-Bio platform. This would enable ProteinLogic and OJ-Bio to collaborate to develop a rapid point-of-care blood test for TB.

### What approach did you take to address the challenge?

The ProteinLogic signature contains many protein biomarkers. The aim of our project was to show that up to three of the ProteinLogic biomarkers with different concentration ranges in serum could be measured on the OJ-Bio platform. This involved initial testing and optimisation, followed by testing both the functionalised OJ-Bio SAW device and the previous lab test of ProteinLogic with the same TB and healthy serum samples to compare results.

### What are the potential benefits?

Combining these technologies not only replaces much lab-based testing but opens up new expanded opportunities in near-patient testing and extra-pulmonary TB testing.

### What are the next steps?

Both ourselves and OJ-Bio are developing relations with partners in various countries to enable distribution and rapid acquiring of market share. Patents for the intellectual property generated may also be licensed to partners in high burden, high volume TB countries and we have preliminary relationships with suitable potential licensing partners.

# Protein Technologies Ltd

## Process intensification using microalgae

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### Chief executive officer

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Protein Technologies Ltd (PTL) is a biotech SME based on the Manchester Science Park. We specialise in protein engineering and, in particular, the development of novel products and processes based on fluorescent proteins.

### What was the business need that motivated the project?

We have recently developed a small, ultra-bright fluorescent protein which emits in the infra-red region. The protein has applications in small animal optical imaging, diagnostics and deep tissue photo-dynamic therapy. The protein requires the use of co-factors which are not present in *E.coli*. These are however present in microalgae which could therefore be used as an alternative expression system.

### What approach did you take to address the challenge?

Our study sought to express the target infra-red protein and a truncated version thereof in the chloroplast of *Chlamydomonas reinhardtii*. The study was in two parts: gene modification and cloning; and expression, purification and analysis. A number of proteins had been previously expressed in microalgae, but our innovation was to do so with the requisite co-factors intact, thereby obviating the need for an expensive *ex vivo* reconstitution step.

### What are the potential benefits?

The infrared protein is a highly versatile molecule, enabling the creation of novel biological imaging systems, biosensors, probes/markers, diagnostic techniques and cancer therapies. This 'one step' expression system will greatly facilitate its cost-effective production. If applied to other co-factor dependent proteins, our telescoped manufacturing technology will also enable multiple applications and the development of a variety of products.

### What are the next steps?

We will try to improve expression levels, which in turn will improve production yield. We will achieve this by growing the microalgae under a variety of different culture conditions – light, temperature, media etc. The infrared protein is currently the subject of a number of trials.

# PVOH Polymers Ltd

## Water-soluble biodegradable polymer shellfish bait release

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### Director

Peter Morris

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PVOH Polymers was established in 2009 and develops bespoke water soluble polymer formulations. Our team, headed by Peter Morris, specialises in injection-moulded products, including detergent/fishing bait encapsulation and single-use medical devices.

### What was the business need that motivated the project?

Our project was prompted by the need to take a waste stream of negative value, namely fish offal, and give it a positive value, and in a way that could not only reduce fishermen's costs by unit weight but enable more efficient fishing techniques. This substitution will enable conservation of global fish stocks.

### What approach did you take to address the challenge?

Fish offal is fragmented and quickly dissipated in water, reducing effective fishing time. Encapsulating it into a container, its release can be controlled over a 72-hour period by varying the formulation of water-soluble polymer inserts. The innovation lies in the polymer formulation we have developed for sustained and controlled release and its use in conjunction with reusable containers, thereby reducing overall cost.

### What are the potential benefits?

As well as increased sales and growth of PVOH polymer products, our innovation utilises a waste by-product to replace clean fish, not only reducing disposal but conserving fish stocks. Adopting this concept will create jobs to prepare and distribute bait and these innovative containers.

### What are the next steps?

We will seek further funding to take this to the industrial research stage and we will involve as collaborative partners fish processing plants, injection mould companies, bait distributors and local fishermen. We will develop prototype models and refine them to achieve full commercialisation within 12 months.

# Reflex Arc Ltd

## Advanced gesture recognition for stroke rehabilitation

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**Partner:** [Hassell Inclusion Ltd](#)

### Director

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This project brings together innovative teams. Reflex Arc is a games studio specialising in 'natural user interface' solutions with Microsoft's Kinect. Hassell Inclusion is a consultancy creating products to support the needs of disabled people, and GamelabUK is a learning media company.

### What was the business need that motivated the project?

Strokes were responsible for 1% of all NHS in-patient episodes in England and 2% in Scotland in 2010/11. Reducing the mean length of stay in hospital is critical to minimising the costs of these episodes, as is ensuring that stroke patients continue their process of recovery in their own homes when they leave hospital so that relapses do not occur.

### What approach did you take to address the challenge?

Our study has investigated the feasibility of extending our existing gesture-based visual and audio-game technology framework to create rehabilitation aids for stroke patients. Our approach is user-centred, employing experts in occupational therapy and patients who are recovering from strokes to advise our games' creation and evaluate their impact on their rehabilitation.

### What are the potential benefits?

Our study supports the case that gesture-based games, created specifically to motivate stroke patients to repeat exercises that are a key part of their recovery, can drive recovery of function. That is without requiring occupational therapists and physiotherapists to constantly be present to guide and motivate them. This could free up therapists to concentrate on higher levels of care for their patients, making more effective use of their valuable time.

### What are the next steps?

We are looking for an investment partner to help fund continued development of the prototype games demonstrated in our study into a more complete system. We also need a clinical research organisation and large-scale medical facility with whom we can partner to undertake a larger-scale clinical study of their effectiveness.

# Regentec Ltd

## Improving the delivery of cell therapies

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### Director

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Regentec is a regenerative medicine spin-out from The University of Nottingham. Operating for more than 10 years, our technology platform TAOS (tailored orchestrated signalling) is an adaptable injectable material that solidifies in situ for use as a tissue repair scaffold/delivery matrix.

### What was the business need that motivated the project?

Current approaches to stem cell delivery are over-simplistic and result in very poor viability and retention post-injection, thus compromising their therapeutic potential. Cells are delivered as suspensions in aqueous buffers, creating problems owing to poor injection fluid dynamics and reflux away from the injection site. Gel-based carriers are an alternative but their properties limit their suitability.

### What approach did you take to address the challenge?

TAOS uniquely employs micro-particles that, post injection, rapidly form solid porous matrices. The particles should provide a more protective environment during transplantation and the scaffold is stronger than a gel, providing protection from compression. If the cells can be precisely localised by the matrix and maintain their viability, our materials could reduce treatment costs by eliminating the need for multiple procedures.

### What are the potential benefits?

We aim to create a fit-for-purpose delivery vehicle for cell delivery. If successful, we hope to establish our delivery systems as an essential component of efficacious cell therapy products. In turn, there will be added value for the UK in our developing a product platform with both near-term returns and significant growth potential.

### What are the next steps?

Our project will be deemed successful if we can demonstrate improved delivery compared to current methods. We envisage collaborating with cell therapy companies, where some formulation refinement for specific therapies will be required. There are fewer than 250 companies involved in cell therapy so the potential for exploitation is significant.

# Rescon

## Wearable acoustics

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Rescon is a micro human performance technologies company which has been trading since January 2011, supplying corporate, government and third sector organisations. Our hardware and software solutions are focused on enhancement of individual and population health.

### What was the business need that motivated the project?

Contemporary monitoring of respiratory sounds has a high human resource cost and is limited to static and objective measurements. The utility of wearable sensors for monitoring health is well established, although there is a lack of wearable acoustic solutions. We identified a need to develop a wearable acoustic measuring system to continuously measure and quantify changes in the respiratory system.

### What approach did you take to address the challenge?

There were two main technical challenges. The first was how best to acquire the data using commercially available microphones. We developed and blindly tested a variety of wearable microphone housings with various materials, altering size, shape, layering and position before settling on our final design. Our second challenge was data compression. Using bandwidth restriction techniques, we compressed the data to less than 1% of the original.

### What are the potential benefits?

Continuous and objective respiratory monitoring could lead to great advances in objectively stratifying individuals into different diagnostic and targeted treatment groups, optimising outcomes. This approach will also reduce the costs in clinical personnel-driven monitoring. The impact will be especially pronounced in groups that have been medicalised, such as those with learning disabilities. The outputs could be further enriched by combining with other sensors, user inputs and analytics.

### What are the next steps?

We wish to develop in conjunction with end-users prototype wearable devices for testing in real-world environments. For this we will develop the electronics, wearable, analytics and visualisation components. We will integrate the technology into our current wearable ECG and movement sensor offering, in readiness for clinical trial development.

# RoboScientific Ltd

## Making gas sensors selective using computer modelling techniques

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**Partner:** Netscientific plc

RoboScientific Ltd owns the Bloodhound® brand of volatile detection instruments, including a range of electronic-nose devices that provide digital fingerprints of smells and odours. Applications include breath analysis for diagnostics, detection of infections, quality controls in foods and water monitoring.

### What was the business need that motivated the project?

The chemical selectivity, and therefore specificity, of gas and volatile chemical sensors is poor and all current sensors are essentially non-specific in nature. For example, acetone sensors also respond to ethanol, albeit at a slower rate. Thus accurate detection of a specific compound in a chemical mixture using sensors is very difficult, if not impossible, using current technology.

### What approach did you take to address the challenge?

Using a computational modelling technique to predict specific molecular interactions with the target volatile chemicals, the selectivity of sensors becomes possible. Incorporating the identified molecular species from the simulated selection process into the sensor surfaces will improve the detection of the target volatile chemicals. The principle is similar to the simulated generation of molecularly imprinted polymers, although in this case we used simple functional polymer structures. .

### What are the potential benefits?

Improving the selectivity in volatile sensors makes it possible to detect and measure more accurately the specific volatile chemicals that are biomarkers of disease. For example, using such sensors for breath analysis is likely to improve significantly the diagnosis of target infections such as pulmonary tuberculosis where WHO requirements are 98% selectivity and 95% sensitivity. In addition, selective volatile measurement may open new markets such as horticulture and contamination monitoring.

### What are the next steps?

We are actively seeking funding to take this feasibility study into a full research project, with the aim of producing a breath diagnostic device having selective sensor capability. We are looking for the right collaborators and the funding schemes to proceed and generate new instrumentation.

# RoboScientific Ltd

## Plastic electronic sensors for volatile organic compound detection (PEVOC)

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RoboScientific Ltd owns the Bloodhound® brand of volatile detection instruments, including a range of electronic-nose devices that provide digital fingerprints of smells and odours. Applications include breath analysis for diagnostics, detection of infections, quality controls in foods and water monitoring.

### What was the business need that motivated the project?

Chemical sensors used for volatile chemical detection can be expensive because most are based on microelectronics technology and designed for multiple use. By using simple printing technology, low-cost electrodes can be produced in significant quantities, allowing the possibility of disposable gas sensors. Such technology is already used for glucose sensors in diabetic monitoring.

### What approach did you take to address the challenge?

The focus of the project has been on production and testing of printed electrodes for use in gas sensor applications. Using UV offset litho printing in collaboration with the Ryedale Group, we have fabricated and tested several sets of printed electrodes in Bloodhound® volatile detection instruments. We have demonstrated the printed electrodes in the detection of volatile chemicals from different sources, including bacterial cultures.

### What are the potential benefits?

Availability of low-cost printed electrodes could open up new markets for diagnostics and, in conjunction with the correct sensor materials, could make electronic nose-type devices available at an affordable level outside the laboratory. Single-use disposable sensors could be linked to inexpensive electronic readers, including mobile phones, to give simple breath tests for many different disease types and, potentially, a low-cost diagnostic for telemedicine.

### What are the next steps?

We are looking for funding schemes to take the results from the feasibility study into a full research project. Our aim is to produce a range of low-cost sensor devices, for the healthcare industry, the food sector and for environmental monitoring.

# Sensor Coating Systems Ltd

## Self-healing and durable thermal barrier coatings

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Sensor Coating Systems' lead technology addresses the need for high-performance thermal sensors for medium and high temperatures (100°C to 1,400°C) in harsh environments. It enables accurate temperature detection, corrosion and erosion monitoring and life-time predictions on industrial components.

### What was the business need that motivated the project?

Thermal barrier coatings (TBC), in combination with sophisticated cooling systems, are crucial for the operation of highly efficient advanced gas turbines. The combination of ultra-high temperatures and cycling causes today's coating systems to crack at the surface and eventually to fail. Our project will develop a patent-protected 'self-healing' thermal barrier coating enabling high frequency cycling at ultra-high temperatures.

### What approach did you take to address the challenge?

We will produce the coating on an industrial production line and test it against standard coatings, using a unique thermal gradient test facility owned by SCS. In collaboration with Cranfield University and a UK coating manufacturer, we will demonstrate the superiority of the technology in comparison to standard coatings. Our technology is clearly based in a growing market and can be used across different industrial sectors.

### What are the potential benefits?

A self-healing coating could increase energy efficiency and reduce maintenance costs. We also propose applying the coating as an additional surface layer on a standard, widely accepted TBC, which will open up the aftermarket, with less stringent requirements for acceptance. Eventually, this coating can be used beyond the power generation sector for other high temperature applications, such as in automotive, oil and gas, rocket engines and jet turbines.

### What are the next steps?

We will work with the UK science base and the aftermarket supply chain to deliver the new coating. In parallel, we will introduce our own technology development user club to the durability coating and seek further collaboration opportunities to finalise its development.

# Sherard Consulting

## Automating process modelling for simulation and knowledge management using machine learning and advanced modelling techniques

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Engineering Design Centre

### Director

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Sherard Consulting offers advisory, strategic and implementation services in mobile services, mobile payments, big data and business process analytics.

### What was the business need that motivated the project?

Simulation and analysis of business processes is increasingly important to how complex organisations run. Two needs are addressed in this study: firstly to optimise and de-skill the task of modelling business processes, using historical data to automate the construction of the simulation model; secondly to verify the veracity and reliability of the simulation model against real world data.

### What approach did you take to address the challenge?

We are building a prototype system utilising existing tools that have been shown to support the advanced business modelling and machine learning techniques that we require. After initial testing on simple case studies we then tried the same approach on a complex real world business problem that has been successfully analysed in the past. We will then compare the results.

### What are the potential benefits?

If successful, this approach will lead to the following benefits: reductions in time, resources and skill required to construct sophisticated simulation models of real world business processes; increased confidence that these models provide good representations of real world behaviours; a repeatable foundation to allow the extraction of re-usable elements of knowledge about how organisations operate and how to improve them.

### What are the next steps?

Assuming this study is successful, then the results will be incorporated into new modules within the computer-aided modelling and simulation software tool. This will then support the commercialisation of the CAM software in a new company to be created by the participants and marketed through partners active in this area.

# Sophimark Ltd

## Next generation point-of-care diagnostic platform for the detection of biological agents down to the strain level

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**Partner:** Applied Enzyme Technology Ltd

Sophimark is focused on the development of molecular diagnostic technology. The three founders bring over 50 years of diagnostic industry and engineering experience to our two-year-old company. Our partner, Applied Enzyme Technology, has considerable expertise in sensor design.

### What was the business need that motivated the project?

There is an unmet need for rapid tests to identify accurately biological agents at the location where the sample is collected. Such 'in situ' testing avoids the cost and delay of transporting the sample to a suitably-equipped laboratory. These tests need to be robust for use in the field by non-specialists and be attractively priced for widespread adoption.

### What approach did you take to address the challenge?

Whereas many point-of-care molecular diagnostic tests are based on microfluidic technologies, we have conceived our tests in a lateral flow format. This presents a number of technical challenges for executing and controlling appropriate molecular assays. For example, an elevated temperature has to be provided for the assays to proceed but this causes undesirable side effects. Through this project we have advanced substantially the design of our tests to compensate accordingly.

### What are the potential benefits?

Attractively-priced 'in situ' molecular testing will offer substantial benefits in many fields. In human healthcare, earlier diagnosis of biological agents will enable earlier treatment with significant benefits for both patients and health funders alike. This may be especially true in less well resourced areas of the world. The successful development of our proof-of-concept test will propel forward our development programme and help secure additional financial backing to complete product development.

### What are the next steps?

Using the insights and data collected from this feasibility study, we will develop a complete test prototype to pin down the key parameters for our commercial product range. In order to achieve this we will need additional partners in lateral flow device design and nucleic acid extraction technologies.

# Spi3Dr Ltd

## 3d printing of nanofibre-reinforced polymer composites

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Spi3Dr is an early-stage micro-company based in the South West, and focused on the development of advanced materials for additive manufacturing applications. We believe that the key to the adoption of 3D printing technology is through improving the materials.

### What was the business need that motivated the project?

Low-cost, desktop fused deposition modelling (FDM) 3D printers are now available at £300, making them an affordable option for many homes. However, the usefulness of items that can be produced is severely limited by the materials that can be printed. Improving these materials will greatly expand their usefulness and hence the take-up of FDM printing around the world.

### What approach did you take to address the challenge?

Most low-cost FDM printers use thermoplastics such as acrylonitrile butadiene styrene (ABS) or polycarbonate, which have intrinsic properties that limit the scope of their use. We have chosen to develop a method of reinforcing these thermoplastics with nanofibres, produced 'in situ' at the print head. Ultimately these fibres will be patterned and tailored to give specific material properties to the 3D printed structure, allowing stronger, lighter, conductive or chemically active printed structures.

### What are the potential benefits?

The project has allowed us to take a risky concept and turn it into a reality. This in turn will enable us to attract significant funding to expand the business, creating high-tech jobs and developing IP with a global significance within the UK. More broadly, the development of this idea should increase the speed at which 3D printing is adopted globally, putting the UK at the forefront.

### What are the next steps?

Having proven the concept, we now need to refine and develop the technique such that a demonstrator unit can be shown to produce 3D printed materials with significantly enhanced material properties. This will involve raising additional funding and could include partnering with an existing 3D printer company.

# Sunamp Ltd

## High-energy density heat storage materials for high-grade heat

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Sunamp aims to make possible renewable and low-carbon heat through its innovative Heat Battery technology incorporating high power and high energy-density heat storage based on phase change materials (PCMs). Our Heat Batteries can deliver space heating and hot water on-demand.

### What was the business need that motivated the project?

Our current range of PCMs is ideal to work with heat sources up to 80°C. We identified the need for a high-temperature range of PCMs that allow for the use of high-temperature heat sources. These would include solar thermal systems, biomass boilers and high temperature CO<sub>2</sub> pumps able to reach temperatures of more than 90°C.

### What approach did you take to address the challenge?

To date there has been a lack of PCMs able to perform in the range of 75-90°C and we identified a need for a higher melting temperature PCM in this range. We carried out small-scale laboratory testing on the phase change material of interest, and its performance. By the end of the project, we will have studied performance at production-scale.

### What are the potential benefits?

This project will allow the development of a new family of products in the high temperature range, able to be incorporated into the next generation of heat batteries. Sunamp's existing range of Heat Batteries will be doubled from the current 20-60°C range to 20-100°C. This higher temperature range allows for a greater compatibility with a wider range of renewable heat sources, from biomass to solar thermal systems.

### What are the next steps?

We will refine the batteries' design and perform further tests to reach the commercialisation stage of our high temperature range of Heat Batteries. We will then produce and commercialise Heat Batteries tailored to high temperature applications, and focus on recovery of waste heat at high temperatures from industrial applications.

# Sunamp Ltd

## Heat battery state of charge determination through a network sensor

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Sunamp produces heat batteries which are novel, high-efficiency heat stores. We aim to facilitate renewable and low-carbon heat with our innovative Heat Battery (HB) technology incorporating high power and high energy-density heat storage based on phase change materials (PCM).

### What was the business need that motivated the project?

To maximise heat harvesting from heat sources, such as a solar thermal panel, a system controller must choose to route heat to the Heat Batteries that will most benefit from it. The aim of our project is to establish a state of charge (SOC) meter for each Heat Battery.

### What approach did you take to address the challenge?

PCMs change volume as they melt and freeze, resulting in a pressure-change in the gas void in a rigid enclosure. A pressure measurement enables the SOC to be determined over the phase change temperature range, where there is a significant volume change. Global temperature, measured with a single/network of temperature sensors, accurately determines the SOC as it varies with temperature when frozen and molten.

### What are the potential benefits?

Our control electronics will be able to fully exploit the intrinsic modularity of Sunamp's heat storage by finely tuned control of thermal fluxes to and from each heat battery, maximising the heat stored/released and hence the overall performance of the system. This alone will significantly increase the efficiency of Sunamp's Heat Battery, especially in applications involving intermittent heat sources, such as solar thermal.

### What are the next steps?

Once we have demonstrated that pressure/temperature measurements can be used to determine the SOC of Heat Battery, cost reduction is going to be the next important step. This SOC measurement will then be incorporated into the control system programme improving efficiency and monitoring of the Heat Battery.

# Tecrea Ltd

## Formulation of messenger ribonucleic acid (mRNA) or intracellular delivery and expression

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Our business is to develop, market and license out cell delivery technology for research and drug development within the biotech/ pharmaceutical sectors. We have been established just over one year and have a staff of five, including two directors and three scientists.

### What was the business need that motivated the project?

There is a need for improved cell delivery technology. For example, problems with DNA delivery into cells is often limiting, where researchers attempting to transfect cells often encounter poor efficiencies. Also, for clinical applications delivery in vivo is typically very inefficient.

### What approach did you take to address the challenge?

One strategy is to transfect messenger ribonucleic acid (mRNA) rather than DNA. This can improve performance by removing the need for nuclear import and, for translational medicine, mRNA represents the minimal genetic element, does not require antimicrobial resistance markers and is much less likely to recombine. Therefore, mRNA transfection can provide improved efficiencies for certain difficult cell lines and can provide a safer compound for clinical development.

### What are the potential benefits?

The results will provide comparative and quantitative data on transfection efficiency and test the feasibility of using our technology for mRNA transfection. mRNA transfection is an attractive opportunity for us, but before proceeding it is important to test feasibility. If successful, we foresee development of marketed mRNA transfection reagents to complement our current product range in the transfection area and for opportunities in clinical development.

### What are the next steps?

We will complete our characterisation of mRNA: Nanocin nanoparticles and transfection efficiencies. We aim to provide a technology that out-performs the competition and is compatible with clinical development. This will allow us to place the technology within our product range which currently provides kits for plasmid DNA and siRNA delivery.

# Thalia Design Automation Ltd

## Extraction and display of electromigration and current density values from a semiconductor power device network – a 3D analysis

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Thalia Design Automation is an electronic design automation (EDA) solutions provider focused on reducing cost and time to market for analogue and power integrated circuit (chip) products.

### What was the business need that motivated the project?

Electromigration is becoming increasingly relevant to the physical design of electronic circuits. Semiconductor power devices are large networks needing careful design to conform to the electro-migration limits. Incorrect design could result in the failure of semiconductor chips.

### What approach did you take to address the challenge?

The technological challenge of our project was that most of the published electro-migration modelling techniques were too simplistic and inefficient. A hybrid technique was required. We investigated the feasibility of an innovative hybrid 3-D electro-migration modelling technique to accurately extract the current density values; and also a design system to export these values into Thalia's proprietary power device design and optimiser.

### What are the potential benefits?

Our feasibility study will aid Thalia Design Automation in its growth, and in development of disruptive solutions for the semiconductor market place. The technology would make our power device design solution unique, comprehensive and would spawn several innovative products. This would increase sales and new business opportunities in the design automation marketplace, leading to new jobs within the UK.

### What are the next steps?

We intend to submit an application for further funding to validate and improve the shortlisted hybrid 3-D electro-migration modelling techniques as well as design methodologies to integrate the technique into our proprietary power device software. This addition would make our solution unique and comprehensive in the power automation market.

## TISICS Ltd

**Lightweight, large diameter bolts for safer wind turbine maintenance**

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TISICS, formed in 2005, develops silicon carbide fibre-reinforced titanium (TMC) for lightweight, high performance applications. Our target sectors are aerospace, space and energy, all of which can benefit from TMC's increased operating temperatures and corrosion resistance compared to conventional materials.

**What was the business need that motivated the project?**

Offshore wind turbines operate in aggressive environments, experiencing humidity, high loads and salt. Large diameter steel fasteners require frequent manual tensioning owing to vibration and creep. On-site manual handling can be problematic because gearboxes have some 60 fasteners each weighing 10kg. TMC is 40% lighter, has high specific stiffness and strength, with potentially less elongation through 'creep' and less frequent maintenance.

**What approach did you take to address the challenge?**

We compared the performance of our TMC bolt with that of high-strength steel. Since titanium threads are weaker than steel, we evaluated rolled threads on titanium and adapted rolling methods to avoid fibre damage, or designed a steel jacket for rolled threads. Finite element stress analysis will inform design; we will fabricate TMC bolts, test in tension and shear and compare creep properties with those of steel.

**What are the potential benefits?**

We compared the performance of our TMC bolt with that of high-strength steel. Since titanium threads are weaker than steel, we evaluated rolled threads on titanium and adapted rolling methods to avoid fibre damage, and designed a steel threaded bolt with a TMC core. Finite element stress analysis will inform design; we will fabricate TMC bolts, test in tension and shear and compare creep properties with those of steel.

**What are the next steps?**

Demonstrating a viable approach will enable TISICS to engage with wind turbine supplier and / or fastener manufacturer partners, such as David Brown Gears, Vestas, ABB. Our current contacts within the wind turbine industry are waiting to see whether results corroborate potential.

# VueKlar Cardiovascular

## Nanofibre-based materials for covered stents

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VueKlar Cardiovascular was founded in 2010 and is developing a stent to transform the treatment of peripheral arterial disease. VueKlar's patented MR-Enhancement technology removes complications, reduces fatalities, and reduces overall treatment costs by enabling non-invasive, non-toxic, x-ray-free follow-up procedures.

### What was the business need that motivated the project?

Covered stents incorporate a thin membrane over the stent's metal framework. Such membranes have been shown to reduce the rate of re-blockaging of the artery. However, the cover adds substantial production cost and cycle-time, at a time of mounting cost pressures on healthcare systems. Our project tested the feasibility of an alternative cover technology which was less expensive.

### What approach did you take to address the challenge?

We started by establishing the key requirements to be met by the cover technology. We considered different materials and manufacturing techniques for appraisal. We examined their feasibility in terms of biocompatibility and development requirements, manufacturability, manufacturing cost and freedom-to-operate/patent opportunities. We produced some initial prototypes and performed simple pre-clinical tests.

### What are the potential benefits?

A viable new cover technology may provide the company with additional product differentiation, and new intellectual property, with a production cost that may be competitive compared to existing materials/techniques. The project has allowed us to make a high-level assessment of feasibility, and has helped identify technical and commercial risks, and the key development tasks to be addressed in the next stage of development.

### What are the next steps?

Additional design iterations and manufacturing process development are required, integrated within the overall system development programme. This will include extensive pre-clinical testing to demonstrate safety for regulatory approval. Further work is required on intellectual property opportunities.

# Wind Technologies Ltd

## Gate drive technology, SmartDrive, for power electronics converters used in offshore wind turbines

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Wind Technologies has over ten years' experience in the wind energy industry. Our main activities include the design and development of drivetrains and electrical and electronic systems for multi-megawatt wind turbines, specifically the generator and its associated control systems.

### What was the business need that motivated the project?

Power electronics converters (PEC) are an essential part of modern offshore wind turbines so improving their efficiency and reliability is important. We have developed a new gate drive technology, SmartDrive which can significantly reduce the switching losses and failure rate of PECs. Quantifying the economics is important in successful commercialisation of the technology.

### What approach did you take to address the challenge?

Although we demonstrated the concept and benefits of SmartDrive on laboratory prototypes, its performance and capabilities must be assessed and optimised in real wind turbines and under real operating conditions. Our project addressed these challenges by testing SmartDrive in a 20kW wind turbine and by assessing its technical feasibility for a 5MW offshore turbine.

### What are the potential benefits?

Power electronics converters (PEC) are an essential part of modern offshore wind turbines, accounting for 10 to 15% of their cost, 15 to 20% of losses and 10% of failure rate. SmartDrive is based on an advanced, integrated hardware and controller design which can reduce the switching losses and failure rate of PECs by more than 25% and 40% respectively, compared with existing commercial products.

### What are the next steps?

After completing this project, we will continue development of SmartDrive, specifically with regard to industrialisation of the hardware and software and its testing on megawatt-size wind turbines.

# WISEMEDCO Ltd

## Using data mining technology in a crowd-sourcing doctor application

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WISEMEDCO is a young company developing an innovative e-health solution. We aim to bring healthcare to the medically underserved population by integrating artificial intelligence, health sensor and smartphone technologies. The WISEMEDCO vision is being trialled in India by volunteer doctors.

### What was the business need that motivated the project?

In 72 of 190 countries doctor-patient ratios are less than the World Health Organisation (WHO) recommendation of 16 physicians per 10,000 people. By 2050, 25% of the world population will need elderly care. We have developed solutions using artificial intelligence (AI), health sensors and smartphone technologies. But the full potential of these technologies, if utilised in an integrated solution, has rarely been explored.

### What approach did you take to address the challenge?

By integrating AI, health sensors and smartphone technologies in an innovative way, we are helping less well trained health workers to make quality and timely diagnoses by firstly connecting them to a cloud of doctors. Secondly, the AI agent makes recommendations on the diagnostic process, diagnosis, and treatment, based on past cases. This incremental learning ability, extended to include future specific problems, is a key feature of the AI agent.

### What are the potential benefits?

Our solution aims to optimise the allocation of medical professional resources. With little change, the core of the WISEMED solution can be integrated into various localised models. They may include crowdsourcing opinions for medics working alone in remote regions, a virtual family doctor for home-based elderly care and a learning tool for junior doctors. The project is enabling us to prove the concept through an early-stage prototype and trial.

### What are the next steps?

We will identify a complete set of portable health sensors that are connectable to smartphones. We intend to use available solutions for sensor data streaming, and to develop a modulated AI framework for sensor data analysis. We are reaching out to non-governmental organisations, pharmaceutical companies and hospitals to achieve a shared vision.

# Xelect Ltd

## Automated image analysis of muscle phenotypes for genetic marker discovery in Atlantic salmon

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### Chief executive officer

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Xelect Ltd develops and licenses genetic markers for broodstock selection in farmed fish. Our lead product is a marker for increased fillet yield in Atlantic salmon. The company also provides genetic services for aquaculture including genotyping, sex and triploidy determination.

### What was the business need that motivated the project?

Broodstock selected for high muscle fibre number (FN) show increased growth rate and improved flesh quality. Current methods for measuring the FN trait involve manual measurements and are too labour intensive for processing the large numbers of fish required for marker discovery and validation. The business need was to identify a more automated method to accurately determine the trait.

### What approach did you take to address the challenge?

Because of the extended recruitment of fibres in fish, early image analysis software had difficulty distinguishing between very small diameter fibres, capillaries and other cell types, so measurements had to be performed manually. We have exploited advances in image analysis software to reliably distinguish and separate objects from background enabling FN phenotyping to be semi-automated, thus greatly speeding the workflow for collecting trait data.

### What are the potential benefits?

By exploiting improved phenotyping technologies we have been able to sample the FN trait in several hundred Atlantic salmon covering a two-fold range of trait values. This opens the way to using genomic approaches to identify genetic markers for the trait and to readily validate any candidate genes discovered in the broodstock of potential customers.

### What are the next steps?

The next step is to re-sequence the genomes of individual fish to discover genetic polymorphisms associated with a high muscle fibre number. We will design high throughput genetic assays for validation and engage with fish breeders to assess the performance of the markers in specific stocks prior to licensing.

# Zagres Ltd

## Low-cost titanium dioxide (TiO<sub>2</sub>) dye-sensitised solar cell technology for use in high-volume applications

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### Director

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Zagres, spun out from Cambridge University, aims to commercialise materials and electronics technologies developed over more than ten years of research at the university for renewable energy applications, specifically solar cells technologies and power electronics converters.

### What was the business need that motivated the project?

Cost and efficiency are the main barriers to widespread adoption of solar energy. We have developed a unique and patent-pending atomic layer deposition (ALD) technology for nanostructured TiO<sub>2</sub> dye-sensitised solar cells (DSCs). It reduces titanium material use by 300 times and achieves a record efficiency of 13.4%. Quantifying the economics is vital in the exploitation process, however.

### What approach did you take to address the challenge?

We built and successfully tested a 35cm x 35cm TiO<sub>2</sub> DSC module based on our new ALD technology. We assessed the materials synthesis and manufacturing processes for high volume applications and quantified the economics of the technology. Our findings show that our ALD technology can offer significant reduction in the cost of manufacturing, contributing to reduction in the cost of solar energy.

### What are the potential benefits?

Commercially available solar cells, which are mostly silicon-based, cost 0.7£/Watt and have efficiencies between 10 and 15%, far from industry's target of 0.05£/Watt and 30%, respectively. Alternative solar cell technologies have been developed based on new materials, such as DSCs which promise substantial cost reduction, by a factor of x10, compared with silicon-based cells. Our ALD-DSC technology reduces titanium use by 300 times whilst achieving an efficiency of 13.4%.

### What are the next steps?

We will continue the research and development of the technology, specifically at larger size modules. We expect to work with the research group at Cambridge University during the follow-on development activities.

# Zagres Ltd

## Ultra-high voltage silicon carbide power electronics converter technology for electricity grids

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Zagres, spun out from Cambridge University, aims to commercialise materials and electronics technologies developed over more than ten years of research at the University for renewable energy applications, specifically solar cells technologies and power electronics converters.

### What was the business need that motivated the project?

Improving reliability and reducing the cost of large-scale power electronics converters are vital to the wider adoption of resilient, efficient electricity grids. We have developed a silicon carbide (SiC) thyristor technology which promises significant improvements over Si-based devices, including higher voltage ratings (up to x10) and switching frequencies. It is vital to quantify the economics in the exploitation process, however.

### What approach did you take to address the challenge?

We assessed the technical feasibility of the new SiC technology by testing it in a 5kW prototype grid-tied converter. In addition, we studied and assessed the economics and advantages of the new technology by modelling its operation for use in large-scale converters. The findings show that the SiC technology can offer significant reduction in the cost of energy if used in smart grid applications.

### What are the potential benefits?

The new ultra-high voltage silicon carbide thyristor technology promises significant improvements over Si-based devices, including higher voltage ratings (up to x10), meaning many fewer devices are needed, higher switching frequencies (x10), requiring smaller peripheral circuitry, lower losses (x100) and higher operating temperatures (x3), meaning cheaper cooling and higher efficiency and reliability. Its exploitation can accelerate the growth of smart grids, currently growing at 10% annually.

### What are the next steps?

High-level discussions with major players have confirmed that delivery of a proof-of-principle prototype will allow the exploitation of the technology through strategic partnerships with commercial partners. The findings from this project, specifically the testing of a 5kW converter, allowed us to provide sufficient evidence to establish active negotiations with investors.

# Zynaptic Ltd

## Application of behaviour-based design to distributed sensor and actuator networks

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Zynaptic has a track record of delivering hardware and software design services across a wide range of telecom, datacom and broadcast applications. We are now focussing on the technical challenges presented by designing for the emerging 'Internet of things'.

### What was the business need that motivated the project?

The design of wireless sensor/actuator networks for the 'Internet of things' currently relies on ad-hoc proprietary implementations which are tightly coupled to specific application domains. In order to address the rapidly increasing number of market opportunities for this type of technology, it will be necessary to move away from this ad-hoc approach to a more rigorous design methodology.

### What approach did you take to address the challenge?

We saw that wireless sensor/actuator networks have many similar properties to the distributed control systems already used in behaviourally-based robotics. We investigated the feasibility of adopting proven design methodologies from the robotics domain and applying them to networks of wirelessly connected devices. We tested this approach both in simulation and using a network of our own wireless development boards based on the IEEE 802.15.4 standard.

### What are the potential benefits?

As a company, we already have the technical expertise to design complex systems of internet connected wireless devices. However, we see considerable economic benefits in opening up the technology for use in a wider range of problem domains. Critical to this aim will be ensuring that the design methodology and associated tools allow domain experts to quickly construct and deploy this type of system without requiring in-depth technical knowledge themselves.

### What are the next steps?

We will continue to develop the software which we used to demonstrate the underlying design methodology. We intend to produce an early beta release in conjunction with development hardware derived from current prototypes. Where possible we will use open source licensing to engage with the wider development community.

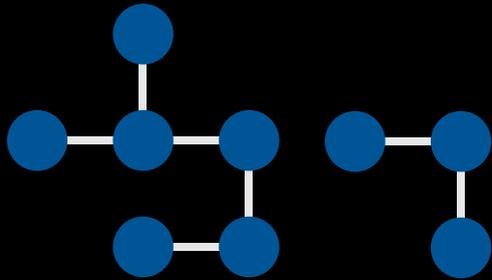
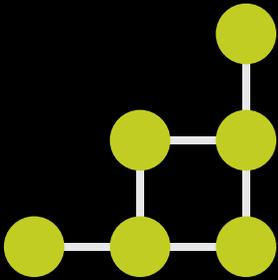
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Information for the entries in this directory was provided by the companies involved in the winning projects. The Technology Strategy Board cannot guarantee its accuracy or completeness.



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