

The Impact Acceleration Account

Review of activities 2012-2017





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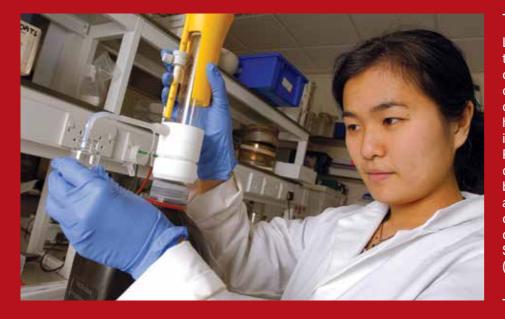
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in Science and Technology at Lancaster



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Lancaster University



Lancaster University is a global top 1% institution with over 12,000 current students and a network of over 130,000 alumni in 183 countries worldwide. Our research has been rated as "world leading" in the 2014 Research Excellence Framework, which assesses the guality and impact of research by UK universities. Lancaster has an outstanding track record of collaboration with businesses, delivering support to over 11,000 Small and Medium Enterprises (SMEs) in the last 15 years.

Introduction

Between 2012 and 2017, Lancaster University was awarded £967,809 from the Engineering & Physical Sciences Research Council (EPSRC) for Impact Acceleration Account (IAA) activities.

Lancaster's IAA activities are focussed on:

- Addressing barriers in university/ Small and Medium Enterprise (SME) collaboration
- Using novel approaches to develop proposals to exploit EPSRC funded research
- Enhancing the capacity of targeted SMEs to take up outcomes from EPSRC funded research
- Evaluating and developing models to enhance impact of EPSRC funded research on SME sector

The IAA provided both seed funding (up to £10,000) and co-funding (up to £25,000 matched in cash by an external partner) for Lancaster researchers. The calls for proposals were run in conjunction with facilitated workshops (mainly discipline specific) that have enabled researchers and external partners to:

- Explore the collaborative potential of partnerships (both new and existing)
- Understand the mutual benefits of collaboration for both partners

 Develop successful applications (funded through the IAA or by some other mechanism such as KTP, Innovate UK or Horizon 2020)

In this report we take the opportunity to provide a set of case studies highlighting some of the exciting projects funded through our IAA and how they benefited the businesses and academics involved. We also show the impact and outputs achieved to date.

We hope that you will be interested in the breadth, diversity and success of our work and that this encourages you to develop your partnership with us.

"The IAA funding has allowed organisations to explore new relationships, which have resulted in considerable academic and commercial impacts."

Dr Mark Rushforth, Head of Business Partnership and Enterprise.





Dr Mark Rushforth

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Achievements of the IAA

Evaluation Of Activities

The way in which the funding was allocated, the funding programmes managed and their outcomes have been subjected to ongoing evaluation. Evaluation took place throughout the programme through a series of interviews and workshops designed to steer the projects towards successful outcomes, at the end of each individual collaboration, and at the end of the project. The tables and figures here illustrate the key findings, which demonstrate that the IAA account was hugely successful.

Allocation Of Funding Across The University

Table 1: Allocation Of Funding Across The University

Department	No. Awards	Value Awarded
Physics	29	£287,800.00
School of Computing and Communications	19	£194,993.00
Engineering	15	£178,577.00
Chemistry	11	£101,630.00
Lancaster Environment Centre	9	£97,117.00
Highwire CDT	5	£12,500.00
STOR-I CDT	4	£20,450.00
Engineering/ Chemistry	3	£35,000.00
Psychology	2	£19,973.30
Total	97	£948,040.30

Lancaster's SME Focus

The majority of awards have involved collaboration with SMEs, reflective of Lancaster's strength in this area.

Table 2a: Funding By Partner Type

Partner	No. Awards	Total Budget
SME	67	£660,665.30
LE	25	£245,702.00
Public Body	2	£21,993.00
Charity	2	£10,000.00
NHS & SME	1	£9,680.00
Total	97	£948,040.30

Table 2b: SME Award Location

Location of SME Partner	No. Awards	Total Budget
North West	41	£394,400.90
Other	26	£266,264.40
Total	67	£660,665.30

Impacts Of Collaboration: New Collaborations And Investment

Lancaster commissioned an external review of the impact of these projects funded through the IAA. Key findings are:

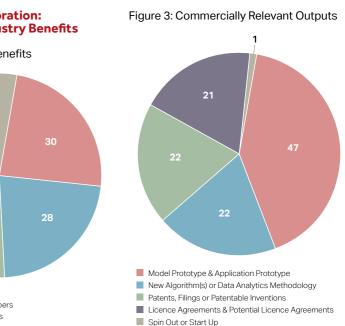
- IAA funding was very successful in developing new partnerships (Table 3)
- 355% (nearly £3.5M) leveraged investment was triggered into the impact pathway (Figure 1)
- Over 80 of the projects have already identified at least 1 follow on project progressing results towards the market
- · There were significant academic and commercial benefits (Figure 2 and Figure 3) demonstrating the mutual value of collaboration

Table 3: Developing New Collaborations

Impacts Of Collaboration: Academic And Industry Benefits

		Projects	Figure 2: Academic Ber
Company New to	Specific Academic at Lancaster	41	
Company New to I	ancaster University	24	
Academic and Co at Lancaster	mpany Collaborated Previously	18	
Academic New to	Collaboration	13	15
Company New to	Any University Collaboration	11	
Figure 1: Ext	ernal Investment Lev	veraged	24
£3,000,000 -			28
£2,500,000 -			
£2,000,000 -	_		Academic Journal papers Academic Conference Pape
£1,500,000 - £1,000,000 -			Potential REF Case StudiesTeaching CasesJoint Publications
£500,000 -			

Contribution in Kind



British Standards Institution

BSI report shows the need for greater 'ethical hacking' standards

British Standards Institution (BSI) is a business standards company that equips businesses with the necessary solutions to turn standards of best practice into habits of excellence. BSI was the world's first National Standards Body and operates globally, publishing over 2,500 standards annually. BSI works with industry experts, government bodies, trade associations, businesses of all sizes and consumers to develop their standards for excellence. www.bsigroup.com

bsi



FACILITATES GREATER STANDARDISATION

ENABLES ORGANISATIONS TO COMPARE THE MARKET

POTENTIAL IMPROVEMENT TO THE SECURITY OF UK ORGANISATIONS "Organisations are increasingly looking to the penetration testing industry to better understand and improve their cyber security. Greater standardisation in this area as identified in the report should allow customers to know they are getting a consistent comparable service. In addition, it will allow providers to better demonstrate and differentiate their capabilities. BSI will use the findings of the report to reach out to the stakeholders in the penetration testing market to determine the demand for new standards."

Tim McGarr, Market Development Manager (Digital), Governance & Resilience at BSI.

A penetration test is a well-established method to test cyber defence capabilities and find vulnerabilities that could be exploited by a malicious hacker, and involves professional 'ethical hackers' attacking an organisation's system with permission.

However, there was little in the way of guidelines as to what a good pentest should involve and how to compare different levels of service. Consequently, BSI wanted to develop new guidelines and industry standard for pentesting.

Dr Alistair Baron and William Knowles, from Security Lancaster - Lancaster University's EPSRC and GCHQ approved security research centre, worked with BSI and completed background research and interviews with key stakeholders and organisations who certify pentest employees. They investigated what related guidelines and standards existed already for pentesting in the UK and globally, what a pentesting standard should include and look like and how it should be written. They produced a report of their findings which defined best practice and highlighted a need for the cyber security industry to have greater 'ethical hacking' standards.

BSI HIGHLIGHTED THREE RECOMMENDATIONS FOR STANDARDISATION:

- Standardised terminology for different levels of testing – enabling clients to make informed decisions and compare the market like for like
- Guidelines for reporting structure and content – offering clients greater consistency through the use of metrics and recommendations, as well as educating clients on the security threats their organisation faces
- Guidelines for the use of penetration testing as audit evidence

BSI are taking the recommendations forward and have already conducted an initial scoping workshop. The full report can be viewed here http://shop.bsigroup.com/ forms/PenTestStandardsReport

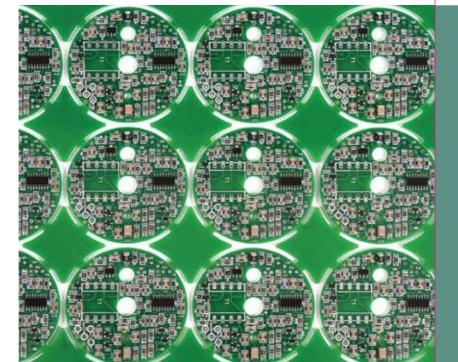
Compound Semiconductor Technologies

Demonstrator built that converts waste heat into electric power

Formed in 2000, Compound Semiconductor Technologies Limited (CST) is a semiconductor foundry specialising in III-V fabrication solutions for a wide variety of photonic devices, including single mode and high power lasers, detectors and integrated circuits. They have clients across the globe in telecommunications, industrial, medical, and consumer markets.

www.compoundsemi.co.uk

Compound Semiconductor Technologies





DEVELOPED A **NEW TECHNOLOGY** DEMONSTRATOR

> POTENTIAL FOR **INCREASED** TURNOVER

Dr Wyn Meredith, Commercial Director of CST.

Energy demand is increasing and there is a huge amount of waste heat created during manufacturing, for example in the glass and steel industry, which could be harnessed. CST has collaborated with experts at the University to develop a demonstrator showing how this energy could be harnessed.

UNIQUE TECHNOLOGY CONCEIVED **AT LANCASTER**

CST have been developing a thermophotovoltaic (TPV) cell, conceived at Lancaster University, that directly converts waste heat into electric power. Professor Tony Krier and his team from the Physics Department collaborated with Dr Wyn Meredith, Commercial Director of CST, and developed a small TPV generator system that can power a radio or LED display from a flame or hot object, to demonstrate the technology.

"I was immediately impressed with the commitment of the team led by Professor Tony Krier, and a real understanding of the requirements of industrial led projects."

NEW LOW CARBON TECHNOLOGY

The device could stimulate a valuable new low carbon energy technology which will have a significant impact on the electricity, heat and transport markets, with potential increased turnover, profit and exports from new products and processes.

eBiogen

Revolutionary rapid blood-testing technology developed

eBiogen Limited is a medical device startup based in Lancaster that focuses on the development of portable technologies for rapid point-of-care diagnostics. Their technology/B-plan has been recognised as the First runner up at International Business Competition in 2011 in India. They were also shortlisted for the finals at world's richest business competition 'RBPC 2012' in Houston.

www.ebiogen.com





"This project passed its feasibility stage and it is now progressing well in its prototype stage with encouraging clinical results. We are starting the regulatory paperwork soon before proceeding to market. Lancaster University has enabled us to develop a rich and supportive expert network."

Michael Mumford, eBiogen.

DEVELOPED AND TESTED A **NEW PROOF OF CONCEPT DEVICE** FOR POINT-OF-CARE-TESTING

SMALLER BLOOD SAMPLES NEEDED THAN CURRENT TESTING PROCESSES

POTENTIAL TO SAVE LIVES AND IMPROVE HEALTHCARE TREATMENTS FOR CANCER PATIENTS, SEPSIS MANAGEMENT, POST-OPERATIVE CARE AND MONITORINGTHE HEALTH OF BABIES IN THE WOMB The conventional means of providing biochemical analyses of patients' samples is in a remote laboratory, engendering delays due to transportation of samples. The analysis requires a large sample volume, often up to 2 mL of serum, which is particular problem when dealing with young children or elderly patients. The accuracy and reproducibility of some assays is inadequate. The cost of reagents can be substantial; and the analysers are not portable and cannot be easily moved to another site.

eBiogen Limited wanted to develop a new portable bedside blood diagnostic device and knew of Lancaster University's strengths in biochemistry and microbiology medicine, so approached Professor Peter Fielden, Head of Lancaster University's Chemistry Department, and researcher Dr Mukesh Kumar for assistance.

eBiogen Limited, clinicians from Morecambe Bay NHS Foundation Trust, and academics from the Chemistry Department and Faculty of Health and Medicine, worked together to complete a proof-of-concept study on a portable diagnostic device for a near real time blood analysis.

"A unique feature of this new project is the close links and networks developing between academics and clinical end-users at all stages of product development from concept to marketing. This ensures that our products are useful in the modern health care environment."

Dr David Telford, Consultant Microbiologist at Morecambe Bay NHS Foundation Trust.

The research was conducted with professional lab technicians in the clinical labs at Lancaster and Barrow. The feasibility work was to understand the current approaches used for various diagnostics using blood and urine and identify the current technical shortfalls and bottlenecks in the hospital practices, and then the possible routes to improvement.

NEW FAST TEST

The new technology can rapidly measure blood characteristics to monitor for sepsis or toxins. This provides a good indicator of the success of treatments following operations and it could ensure the early detection of sepsis in chemotherapy patients. In addition, it could help evaluate the status of foetuses. The device does this by taking pinprick samples of blood and providing rapid chemical analysis – in less than a minute.

This quick processing of samples enables medical staff to quickly adjust treatments in response to the improved data. Work has begun on designing the prototype and exploring additional applications for the technology.

James Fisher Mimic

Software development help make ships 'smarter'

"By entering into this project with the University we secured a concentrated effort and powerful resource able to focus on areas that we are prevented from considering by the day to day pressures involved with a normal business. We are now able to use the knowledge and information to develop new ways of searching for machinery faults amongst a clutter of normal operational data. After struggling for many years to find the time away from the coal face to concentrate on new projects we now have the confidence to engage with the University in the future to simplify the process of gaining the knowledge we need to progress."

Martin Briddon MBE, Engineering Manager of JFM.

As part of a ship-owner and operating company, JFM use their fleet and experienced personnel to develop a range of products focussing on maximising the use of technology to solve problems within the shipping industry. They provide condition monitoring software that allows companies' maintenance decisions to be based on condition and performance rather than on recommended time basis, which reduces unnecessary maintenance. www.jfmimic.co.uk





NEW LIVE TEST BED OF VESSEL DATA

FACILITATE GLOBAL CHANGES IN THE CULTURE OF MAINTENANCE WITHIN THE MARINE INDUSTR

SUBSTANTIAL MAINTENANCE COST SAVINGS FOR CURRENT AND FUTURE MIMIC USERS Scheduled maintenance costs are a large part of the operating expenses for ship owners; often seen as pure costs, with no immediate need or longer term benefits, which leads to many owners putting it off. However this eventually leads to more breakdowns, resulting in a higher overall cost.

MONITOR WHOLE SHIPS

Monitoring and diagnostics of ships play an increasingly important role in optimal scheduling of maintenance activities. Condition monitoring has previously only been used for specific aspects of a ships system. JFM wanted to develop their software – Mimic, to monitor fuel usage and conditions of whole ships to meet the growing interest in this area, and approached Lancaster's Engineering Department for expertise.

JFM provided real data collected from the operational ships for research on three areas:

- Fault classification through enhanced time-frequency patterns which helps identify multiple events in real time, e.g. mechanical and electrical faults that may occur simultaneously but reside in different frequency bands
- Automatic fault detection to serve as an early warning system for critical equipment, e.g. turbochargers and propulsion engines
- Development of smart sensor systems for condition monitoring approaches for fuel efficiency and energy management

The results from this study, run by Engineering's Dr Xiandong Ma, will further improve competitive operation and could revolutionise fuel efficiency. Most importantly, such a technological advance could be retro-fitted to the majority of the world's ships, thus promising substantial impacts as a result of this research within existing ship systems. This research also contributes to the critically important 'Low carbon innovation programme' of the EPSRC.

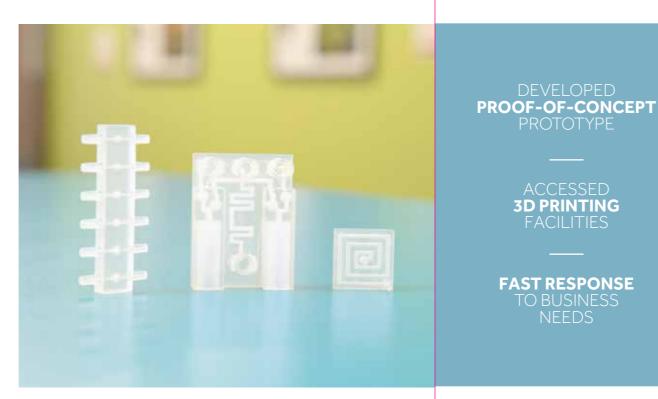
Due to the successful conclusion of this project, JFM continue to collaborate with the University through a Knowledge Transfer Partnership.

Microfab

Exploiting 3D printing to develop a new laboratory device

Microfab Limited was created in 2013 to investigate the application of additive manufacturing or 3D printing for medical diagnostics and chemical diagnostics for small scale fluid handle applications and create inexpensive, portable laboratory devices. Additive manufacturing, or '3D printing,' allows increased geometric freedom and is particularly applicable to high-value, low-volume products, where the ability to customise is important.





"The IAA allowed us to research different 3D printing techniques, develop prototypes and proof of concepts for a low pressure pump system and micro fluid incubator which we can take to industry. The best thing about the collaboration was the speed that things were turned around. The staff have been fantastic."

Nathan Burley, Managing Director, Microfab Limited.

The business challenge with chemical and medical diagnostics Microfab identified was that the instruments require a chemical reagant. That reagant is then used to make the target of choice detectable, or to amplify the signature of that target. The amount of reagant used by older systems is usually quite large, and that has financial and environmental cost, all the way through the chain of usage- manufactures have to make more reagant, shippers ship more reagant, customers dispose of more reagant. Microfab wanted to explore ways to reduce the reagant.

DEVELOPED

3D PRINTING

FAST RESPONSE

TO BUSINESS

NEEDS

Typically, medical manufactures look to micro fluidics to reduce reagant, because this reduces the size of the instrumentationnot externally but internally, so smaller components with smaller internal volumes, smaller tubing, the components themselves are closer together also. However microfluidics is a new science which requires a specialist knowledge base and specialist equipment to design for it.

REDUCING REAGANTS

Microfab wanted to know whether 3D printing could provide an incremental increase in the advantage in staying with macro fluidics, over moving to micro fluids, but take some of the advantages of microfluidics- decrease in size and increased efficiency.

Microfab knew of Lancaster's strong expertise in product development and approached the Engineering Department's Lancaster Product Development Unit (LPDU) with their challenge. Dr Allan Rennie, who leads the LPDU, helped the company apply for IAA funding to pay for research time, materials, and specialist equipment, to develop the prototype. A researcher was recruited to investigate the design of the complex architectures for the fluid handling devices using 3D printing facilities, and develop prototypes and proof of concept for the low pressure pump system and micro fluid incubator, enabling Microfab to then take this to industry. Microfab continues their relationship with the University.

Process Instruments

New sensor developed to improve water treatment

Formed in 1998, Process Instruments (UK) Limited (Pi) is a pioneering Burnley based manufacturing, sales and service company that provides water analyser instrumentation solutions through distributors, under private label/OEM agreements and to end users in the water, wastewater, and related industries. Pi has customers in over 60 countries across six continents.

www.processinstruments.net

Pi





"We chose to work with Lancaster's new Chemistry Department because we know Professor Fielden from previous collaborations and we are excited about the team he put together. Coupled with Lancaster's proven and on-going commitment to working with SMEs it was an easy choice to make. The collaboration will benefit our business by resulting in a world beating sensor that we can couple with our existing electronics to grow the business to the next stage."

Mike Riding, Managing Director, Process Instruments (UK) Limited.

Efficient water and wastewater treatment requires the continuous measurement of the amount of solids in a flowing stream. Current measurement technologies using microwaves and ultrasound are cumbersome, expensive and unreliable; leading to a low take-up in the industry.

LOW COST SENSOR DESIGN

Pi wanted to extend their sensor measurement range by evaluating an alternative technology and demonstrate the feasibility of using a different measurement technology to create a low cost sensor capable of measuring percentage solids in aqueous media.

Professor Peter Fielden, Head of Lancaster University's Chemistry Department and his team worked with Pi to complete a feasibility lab-based study to develop and test a new prototype sensor that could provide initial data to demonstrate the likely operating range in the field and the precision of the measurement. The research led to an encouraging proof of concept.

ACCESS TO FURTHER FUNDING

Pi and Lancaster University continue their research collaboration through a Innovate UK funded three year Knowledge Transfer Partnership (KTP) to realise the potential of the new sensor. Pi also identified clients willing to collaborate with the field evaluation of the new prototype.

Quantum Base

Developing photonic circuits for a pioneering quantum security system

Quantum Base Ltd, a Lancaster University spin-out company formed by Phillip Speed and Dr Robert Young, has bases in Stockport and at InfoLab21. The company provides security solutions that are simple, scalable and practical using Quantum Security. Quantum Base develops and patents technology using quantum devices, based on the latest research.

www.quantumbase.com





CREATED **PROOF-OF-CONCEPT** PROTOTYPE

> POTENTIAL DEVELOPMENT FOR **MASS-MARKET** PRODUCTION

POTENTIAL TO ENABLE **QUANTUM KEY DISTRIBUTION TO BE INTEGRATED INTO** ALMOST ANY DEVICE. SECURING THE INFORMATION IT CARRIES "The ability to partner with a world-class institution such as Lancaster, and the benefits that brings - both in terms of cutting edge facilities and A-class caliber people - means that we have a real chance of building a great British company, capable of innovating and creating real-world impact on a global scale. We are truly grateful to everyone who is helping Quantum Base achieve its objective of bringing simple, scalable, small, cheap and practical quantum solutions into mass-market deployment."

Phillip Speed, Quantum Base Limited.

Securing links against eavesdropping has remained an unsolved problem since the dawn of communication. At present, public systems tend to use protocols based on mathematical complexity, but these are vulnerable to intelligent attacks and the ever-increasing power of computers.

Quantum Base Ltd provides quantum security to address this problem by exploiting a basic principle of quantum physics; when an unknown quantum state is transmitted it cannot be read without unintentionally altering it, thus allowing the sender and receiver to detect the presence of an eavesdropper by monitoring the channel.

PHOTONIC CIRCUITS

This technology has been proven to provide ultimate security, but only in bulky systems that are expensive to purchase. Adoption has been hampered by these flaws. Quantum Base Ltd wanted help to develop photonic circuits, at the micron-scale, which could perform the functions of both the transmitter and receiver of the quantum security system.

A researcher was funded through the IAA to create cutting edge semiconductor systems with standard, mass-manufacturing processes to produce the devices, which are small, low-cost, and have a small power footprint. The majority of the work was conducted in Lancaster University's Quantum Technology Centre under the supervision of Dr Robert Young.

Photonic circuits for quantum communications were simulated and optimised using finite-difference-time domain techniques, fabricated at Lancaster University in the Quantum Technology Centre's cleanroom, and tested in the quantum optics laboratory.

The company hopes to demonstrate working prototypes of single photonic circuits and forward this technology to be ready for mass market production. The technology developed will enable quantum key distribution to be integrated into almost any device, securing the information it carries.

T.E. Laboratories

Expertise and facilities to establish a new industry standard and tap into a market worth €300,000 per year

Formed in 1991, T.E. Laboratories (TelLab) is a multi-divisional analytical and manufacturing company operating in the chemical and environmental sectors. working alongside national and local government, as well as with customers in environmental consultancy, pharmaceutical manufacturing, and fuel distribution.

www.tellab.ie





"We found an efficient way to complete a short-term technical research project with significant support and input from highly skilled University principle investigators. The company has planned a longer term relationship with the University, with funding secured to develop further applications."

Mark Bowkett, Managing Director, TelLab.

€300.000 POTENTIAL

DEVELOPING A NEW INDUSTRY STANDARD

SIGNIFICANT R&D **FUNDING**

Collaborating with experts using specialist facilities at the university TelLab has developed a new sampling technique for the monitoring of pollutants in surface waters. Designed to assist with meeting the requirements of the EU's Water Framework Directive, the new system allows in-situ sampling, and offers a more robust, reliable and cost-effective alternative to traditional methods.

A LONG-STANDING PARTNERSHIP

TelLab worked together with Dr Andy Sweetman and colleagues from the Lancaster Environment Centre and the Engineering Department to achieve the breakthrough sampling technique, which is set to become a new industry standard for the assessment of surface water quality. This has been achieved through collaborative access to the university's knowledge, facilities and research funding.

POTENTIAL FOR GROWTH

The research has brought TelLab closer to the possibility of a commercial service that will enable the company to tap into a UK market worth an estimated €300,000 annually, in addition to similar opportunities across Europe. In order to further the project's development, TelLab has set up a satellite office at the University.

Tomorrow's Medicines

New digital patient recruitment services using social media



Dr Clare Nolan, CEO, Tomorrow's Medicines Limited,

Tomorrow's Medicines Limited is an early stage digital patient recruitment company helping clinical trial sponsors and sites access more of the right patients. Tomorrow's Medicines provide their commercial service through a social enterprise called which helps patients access a clinical trial of their choice. www.yourtreatmentchoices.com





SHIFT FROM A PASSIVE TO ACTIVE TARGETED RECRUITMENT SERVICE

POTENTIAL FOR LARGE COST SAVINGS IN CLINICAL TRIAL PROVIDERS

COULD HELP BRING **TREATMENTS TO** MARKET MORE QUICKLY

Recruiting patients to clinical trials is key to advancing medicine. However, recruiting participants is costly and time consuming. Tomorrow's Medicines Limited sought to use social media data in order to find people in affected by health conditions for clinical trial recruitment opportunities.

EXTENSIVE EXPERTISE IN SOCIAL MEDIA

Professor Jon Whittle and colleagues at the School of Computing & Communications used their extensive expertise in social media analytics to test the feasibility of using social media to gather reliable data on difference types of illnesses, in order to identify patient needs and to identify potential patients. The research has spearheaded the transition and sustainability of a social enterprise to a commercial enterprise, enabling Tomorrow's Medicines to support clinical trial sites and sponsors, as well as individual patients.

"The outcome was that it has enabled Tomorrow's Medicines to expand its businesses offering. Together with our in house screening algorithms, it's enabled us to reach out to patients using targeted social media marketing. We'll be working on a bigger, longer project together to improve the service, and that's a bigger opportunity, so it's provided a great foundation and a

EXPANDING THE BUSINESS OFFERING

Tomorrow's Medicines can now use the knowledge gained from the project to provide clinical trial sites and sponsors and with an enhanced service. This could reduce the recruitment period and overall costs of clinical trials, provide better trial opportunities matches for patients, and allow the product or healthcare innovation to be brought to market much more quickly.