



School of Engineering

Annual Report for Research & Impact

August 2018 - July 2019



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1. Foreword:
Research Director
Professor Dewar Finlay

In presenting the Annual Report for the School of Engineering for the academic year 2018-2019, I am happy to report a very successful year for our research activities with particular success in winning research grants, quantity of doctoral thesis completed, development of research collaborations nationally and internationally with renowned universities, research institutes and industries and also our involvement with outreach research activities. The past year has seen us continue to work towards our vision to exploit our unique ability to merge the disciplines of technology, engineering and science to create world leading research impacting highly important global challenge areas and promoting healthy and sustainable futures for all citizens.

Our current research activities are conducted in a vibrant, collaborative research environment consisting of a multi-disciplinary group of over 150 researchers (academic staff, contract researchers and PhD researchers). Our work is broadly conducted in two overarching themes relating to the Nanotechnology and integrated Bioengineering Centre (NIBEC) and Advanced Future Materials and Manufacturing.

During the period covered by this report, we have sustained activity across all of our research themes. This is evident in a research income of £4.9M, 5 successfully completed doctoral research programs and the publication of more than 120 articles, over 90 of which appeared in peer reviewed academic journals. The period is also notable for the growth in our academic staff base which has seen our total number of staff with significant responsibility for research (SRR) grow by almost 50%. Our growth in staffing has been underpinned by several key initiatives that include the University investment of £2M in the establishment of the 'Healthcare Technology Hub'. This investment was designed to consolidate our international reputation for excellence in healthcare technology research by building on significant external income (£32M over five years) via the creation of four new academic positions.

Research activity at NIBEC continues to address key challenge areas including health technology, functional biomaterials and tissue engineering, plasma and nanotechnology, and, clean technology and water. This work has been underpinned with significant research income during the period from a range of sources that include EPSRC, EU Horizon 2020, National Institute for Health (US), Interreg and InvestNI.

Notable initiatives during the period include the continuation of the £4.9M GCRF (EPSRC funded) SAFEWATER project that focuses on the development of low-cost technologies for safe drinking water in developing regions. The project is now in its technology deployment phase with field trials, trialling NIBEC developed water purification technology, currently being conducted in Columbia, Brazil and Mexico.

Also, of note is the establishment of a state-of-the-art X-ray Photoelectron Spectroscopy (XPS) system. This EPSRC funded capital investment has been established as a unique state of the art facility, which complements NIBEC's already strong focus on materials characterisation and analytical science.

Health Technology Research has also featured strongly during the period with the continuation of several major initiatives that include the Interreg funded Eastern Corridor Medical Engineering (ECME) Centre, a researcher training focused platform with 23 PhD researchers now enrolled, 8 of whom are registered at Ulster. NIBEC has continued to build on its long track record of providing a platform for healthcare technology commercialisation as evidenced through the securing of a second round of funding for the Connected Health Innovation Centre (CHIC). This £3.4M investment will see the extension of the current provision that provides a platform for academia/industry engagement on healthcare technology innovation. The period has also seen the successful completion of a portfolio of cardiovascular focused health technology projects that include several significant H2020 projects e.g. CHESS, PATHway, IC-Health and WastCARD.

In relation to our work in the area of Advanced Future Materials and Manufacturing, a significant body of externally funded research has continued over the year. A large body of work has been undertaken as part of the €8.7M North West Centre for Advanced Manufacturing (NWCAM). NWCAM is delivering fifteen individual doctoral level R&D projects by applying advanced manufacturing technologies to enable the development of new and innovative products and processes. The program aims to create a step change in our global manufacturing competitiveness and strengthen regional economic development and impact. This activity is complimented by a plethora of other externally funded projects that include the EPSRC funded Novel High Performance Polymeric Composite Materials for Additive Manufacturing of Multifunctional Components project, along with a number of projects funded by the NI Advanced Engineering Composites Centre e.g. AERO AM2 project. Throughout the reporting period, significant work has continued on providing industrially relevant activity leading to world class impact via our partnership in the NIACE centre.

Looking forward, we are excited to report our involvement in a number of innovation projects in the Belfast Region City Deal which include leading the Digital Healthcare Technology Hub and Living Labs project and strong representation in the Advanced Manufacturing and Innovation Centre.

Further details of our research, facilities, staff profiles and research expertise can be found at <https://www.ulster.ac.uk/faculties/computing-engineering-and-the-built-environment/engineering/research>

or by contacting Ruth Holman (Academic Excellence Executive Assistant) at Email: r.holman@ulster.ac.uk; Ph: +44 28 9036 6927.



Professor Dewar Finlay
Research Director, School of Engineering.

2. Research Students

The following research students were registered on research degree programmes during 2018-19.

Surname	Thesis Title
Abdullah, -	SAFEWATER: Sensors for the detection of faecal contamination in drinking water
Afkhami, Arsalan	SAFEWATER: Household based water disinfection systems
Ahmad, Abrar	Drone based hotspot: an internet-on-the-go service for disaster management
Alessi, Bruno	Novel materials for third generation solar cells
Alkharabsheh, Salem	Development of novel mechanisms based on photo and electrodisinfection and decontamination of wastewater and drinking water
Antony Samy, Anto	Development of simulation models for additive manufacturing of polymers
Barber, Robert	Flexible skin sweat electrochemical sensing utilising laser induced graphene
Bigham, Teri	Safewater - Novel Biosensors For The Detection Of Waterborne Microbial Pathogens
Bloomfield, Noel	Development of overmolded parts in injection moulding
Casimero, Charnete	Design of smart catheter systems for the prevention of infection
Clarke, James	The development of a flexible modelling tool to enable the choice of the most cost effective manufacturing route for a given process in this case liquid moulding of a polymer composite to give a finished product
Corduas, Francesca	Development of novel smart scaffolds as potential strategies for skin wound healing
Dahale, Monali	Development of a novel textile/composite for improving crashworthiness
Dalton, Brendan	Analysis of thermal degradation in composite tooling materials
Davidson, Scot	Advancements in Detection and Classification of Anomalies in Multidimensional Biomedical Signals Using Data-Driven Techniques
Devine, Amy	Autonomous Smart Patches: New Approaches to Controlled Drug Delivery
Donnelly, Nicola	Examining the perceived benefits and limitations of patient-centered monitoring solutions for the patient and healthcare professional
Dooley, Christopher	Peptide functionalised gold nanoparticles for cancer treatment
Dsouza, Slavia Deeksha	Advanced Materials for Next Generation Solar Cells
Duffy, Sean	Development of multifunctional PEEK composite materials
Duraisamy, Shanmugha Sundaram	Advanced nanomaterials: Bifunctional non-precious metal catalysts for oxygen reduction and oxygen evolution reactions
Gillies, Aaron	Design and modelling of complex multi composite structures for airbourne applications
Hadia, Rohit	Advanced algorithms for CG Data analysis - Aterial fibrillation (AF) detection in the wearable device setting
Hardman, Andrew	Advanced multi-axial composites and microvascular networks
Harkin, Ryan	Optimisation of the laser sintering of metal parts for medical products.
Harley, Anna	Development of process simulation models for metal laser sintering.
Hegarty, Catherine	Remote telemetry of oxidative stress processes in the management of stroke: Acquisition and processing of metabolomic data
Hendawy, Nourhan	Surface chemical kinetics with low temperature atmospheric pressure plasma for plasma medicine applications in cancer treatment
Hussein, Hussein	Advanced Materials (ADM-07) - Nanofluids for solar thermal applications
Janjua, Ghalib Muhammad Waqas	Electronic/Biomedical Engineering - Blood Pressure Monioring

Jennings, Michael	The development of a new integrated diagnostics (biomarkers and ECG) via computational techniques for higher sensitivity detection of heart attacks
Kambley, Ankur	Metal quantum dots and clusters for energy applications
Karakasidis, Anastasios	Hierarchical carbon-fibre reinforced polymer (CFRP) composites utilising graphene nanoflakes
Kashyap, Apoorva	Low energy plasma radiotherapy – could this be a route to gentle and effective treatment of cancer or antibiotic resistant microbes?.
Khalid, Hesan	Exsolution of nanoparticles by plasma processing
Li, Shiyao	Improving the electrical conductivity of thermoplastic composites for aerospace and automotive structures
Lin, Wenyan	Investigation of the processing and properties of PVA filaments for the formation of microvascular channels in carbon fibre reinforced composites
Manzoor, Faisal	The Development of Conductive Polymer Composites for Medical Device Applications
McAlister, Olibhear	An investigation of thoracic impedance and various physiological parameters in development of algorithms to optimise cardiopulmonary resuscitation (CPR) effectiveness
McCallan, Niamh	Benchmark Simulation Model for An Electric Vehicle — Strategy Evaluation for Control, State Estimation, and Fault Diagnosis
McFlynn, Patrick	Development of hollow microneedle arrays for transdermal biosensing and drug delivery
McKillop, Stephen	iBioactive coatings
McLarnon, Liam	Development of optically transparent nanofibrous biomaterial scaffolds for ophthalmic tissue engineering
McMichael, Stuart	Photocatalysis: Solar Water Splitting
Meenagh, Aidan	In vitro cellular models to study the effects of waveform stimulation of cardiac tissues
Menagh, Gareth	Electroconductive electrospun polymeric biomaterial matrices for the fabrication of 3D retinal tissue
Moore, Michael	Printing of Biological Cells: 3D Printing of Biological Cells for Tissue Engineering Applications
Moses, William	Optimisation of composite properties in the third dimension-Composite reinforced composites.
Neale, Geoffrey	Improving the energy absorption capability of 3D woven composites for aerospace and automotive structures
Nguyen, Chi	Non-Orthogonal Multiple Access for 5G and Beyond Systems
Nielsen, Anne-Mette	SAFEWATER - Integrated water and sanitation in architectural design for sustainable housing in developing regions
O'Donnell, Kieran	3D printing of biological cells for tissue engineering applications
Owen, Kathryn	The Use of Ultrasound Derived Carotid Intima-Media Thickness to Predict Coronary Artery Disease
Padmanaban, Dilli Babu	Plasma synthesis of advanced nanoscale oxides for photovoltaics
Rababah, Ali	Development of multi parameter models for rapid diagnosis and treatment of cardiovascular disease
Rawlinson, Sean	New approaches to the design of electrochemical immunosensors
Rioja Cabanillas, Adriana	Investigation and development of electrocatalysts and electrochemical cells for the production of hydrogen from wastewater
Saeed, Khalid	Development of novel materials and techniques for additive manufacturing

Shah Mansouri, Tahereh	Machine learning and patterning recognition in a new sensor systems for chemical-biological detection and biomedical applications
Singh, Anukriti	Clean water: visible light active photocatalytic materials for solar water purification
Singhal, Amit	Photocatalysis: Solar phtocatalytic disinfection of water
Stinson, Harley	Additive Manufacture via Cold Metal Transfer
Ullah, Jawad	The Influence of Additives on the Processing and Properties of Polymers for Medical Device Applications
Wallace, Kerry	SAFEWATER - Innovative water disinfection technologies
Ward, Joanna	Nanotopography for dynamic platelet assay applications
Ward, Richard	Design and development of additive manufacturing process machinery for production of larger structures.
Wilson, Shannon	Titania topography for control of cell response to bioactive calcium phosphate coatings
Zhang, Xushuo	Point-of-Care Lateral Flow analysis for cystatin C-based kidney function diagnostics

Graduated December 2018

Student Name	Thesis Title
Anderson, Ashleigh	Tunable nanomaterials for controlled drug release in smart devices

Graduated July 2019

Student Name	Thesis Title
Jain, Gunisha	Compositional tuning of Zn- based semiconducting nanoparticles by atmospheric pressure plasmas and study of their optoelectronic properties
Kennedy, Alan	Automated computerised detection of Atrial Fibrillation from the Electrocardiogram
McConville, Aaron	Smart patch systems for controlled drug delivery and sensing applications
McGarrigle, Cormac	Engineered thermoplastic polymer composite filaments for through-thickness reinforcement of laminated carbon fibre composites

3. Publications

Details of all Publications by the School of Engineering are on the Ulster University's Institutional Repository- PURE <https://pure.ulster.ac.uk/>. This section reports those outputs published over the period of this report and classified as either journal articles, books/chapters in books and published conference papers.

3.1 Journal Articles

AbuMahady, I, Mohamed, EB, Ikki, S & Yanikomeroglu, H 2019, 'Sum-Rate Maximization of NOMA Systems under Imperfect Successive Interference Cancellation', *IEEE Communications Letters*, vol. 23, no. 3, 8621012, pp. 474-477.

Acheson, J, McKillop, S, Lemoine, P, Boyd, A & Meenan, BJ 2019, 'Control of Magnesium Alloy Corrosion by Bioactive Calcium Phosphate Coating: Implications for Resorbable Orthopaedic Implants', *Materialia*, vol. 6, no. C, 100291.

Aguas, Y, Hincapie, M, Sanchez, C, Botero, L & Fernandez-Ibanez, P 2018, 'Photocatalytic inactivation of *Enterobacter cloacae* and *Escherichia coli* using titanium dioxide supported on two substrates', *Processes*, vol. 6, no. 9, 6.

Alavi, SA, Mehran, K, Hao, Y, Rahimian, A, Mirsaeeedi, H & Vahidinasab, V 2019, 'A Distributed Event-Triggered Control Strategy for DC Microgrids Based on Publish-Subscribe Model Over Industrial Wireless Sensor Networks', *IEEE Transactions on Smart Grid*, vol. 10, no. 4, 8444726, pp. 4323-4337.

Alsheyab, H, Choudhury, S, Mohamed, EB & Ikki, S 2019, 'Near-Optimal Resource Allocation Algorithms for 5G+ Cellular networks', *IEEE Transactions on Vehicular Technology*, vol. 68, no. 7, 8705284, pp. 6578-6592.

Alzahrani, H, Antoine, C, Aoki, K, Baker, L, Balme, S, Bentley, C, Bhattacharya, G, Bohn, PW, Cai, Q, Cao, C, Commandeur, D, Crooks, RM, Edwards, M, Ewing, A, Fu, K, Galejeva, A, Gao, R, Hersbach, T, Hillman, R, Hu, Y-X,

Y, MacPherson, J, McKelvey, K, Minter, S, Mirkin, M, Mount, A, Nichols, R, Nogala, W, Oehl, D, Qiu, K, Ren, H, Rudd, J, Schuhmann, W, Siwy, Z, Tian, Z, Unwin, P, Wang, Y, Wilde, P, Wu, Y, Yang, Z & Ying, Y 2018, 'Processes at nanoelectrodes: general discussion', *Faraday Discussions*, vol. 210, pp. 235-265.

Alzahrani, H, Antoine, C, Baker, L, Balme, S, Bhattacharya, G, Bohn, PW, Cai, Q, Chikere, C, Crooks, RM, Das, N, Edwards, M, Ehi-Eromosele, C, Ermann, N, Jiang, L, Kanoufi, F, Kranz, C, Long, Y, MacPherson, J, McKelvey, K, Mirkin, M, Nichols, R, Nogala, W, Pelta, J, Ren, H, Rudd, J, Schuhmann, W, Siwy, Z, Tian, Z, Unwin, P, Wen, L, White, H, Willets, K, Wu, Y & Ying, Y 2018, 'Processes at nanopores and bio-nanointerfaces: general discussion', *Faraday Discussions*, vol. 210, pp. 145-171.

Askari, S, Mariotti, D, Stehr, JE, Benedikt, J, Keraudy, J & Helmersson, U 2018, 'Low-Loss and Tunable Localized Mid-Infrared Plasmons in Nanocrystals of Highly Degenerate InN', *Nano Letters*, vol. 18, no. 9, pp. 5681-5687.

Banerjee, D, Sankaran, KJ, Deshmukh, S, Ficek, M, Bhattacharya, G, Ryl, J, Phase, DM, Gupta, M, Bogdanowicz, R, Lin, I-N, Kanjilal, A, Haenen, K & Roy, SS 2019, '3D Hierarchical Boron-Doped Diamond-Multilayered Graphene Nanowalls as an Efficient Supercapacitor Electrode', *Journal Of Physical Chemistry C*, vol. 123, no. 25, pp. 15458-15466.

- Barreca, D, Gri, F, Gasparotto, A, Carraro, G, Bigiani, L, Altantzis, T, Zener, B, Lavrencic Stangar, U, Alessi, B, Babu Padmanaban, D, Mariotti, D & Maccato, C 2018, 'Multi-functional MnO₂ nanomaterials for photo-activated applications by a plasma-assisted fabrication route', *Nanoscale*, vol. 11, pp. 98-108.
- Battaglioli, S, Robinson, AJ & McFadden, S 2018, 'Influence of natural and forced gravity conditions during directional columnar solidification', *International Journal of Heat and Mass Transfer*, vol. 126, no. Part B, pp. 66-80.
- Bhardwaj, S, Pal, A, Chatterjee, K, Rana, TH, Bhattacharya, G, Roy, SS, Chowdhury, P, Sharma, GD & Biswas, S 2018, 'Fabrication of efficient dye-sensitized solar cells with photoanode containing TiO₂-Au and TiO₂-Ag plasmonic nanocomposites', *Journal of Materials Science: Materials in Electronics*, vol. 29, no. 21, pp. 18209-18220.
- Bhattacharya, G, Fishlock, S, Roy, JS, Pritam, A, Banerjee, D, Deshmukh, S, Ghosh, S, McLaughlin, J & Roy, SS 2018, 'Effective Utilization of Waste Red Mud for High Performance Supercapacitor Electrodes', *Global Challenges*, vol. 3, no. 2, 1800066.
- Bhattacharya, G, Giri, RP, Dubey, A, Mitra, S, Priyadarshini, R, Gupta, A, Mukhopadhyay, MK & Ghosh, SK 2018, 'Structural changes in cellular membranes induced by ionic liquids: From model to bacterial membranes', *CHEMISTRY AND PHYSICS OF LIPIDS*, vol. 215, pp. 1-10.
- Bigham, T, Casimero, C, Dooley, J, Ternan, NG, Snelling, WJ & Davis, J 2019, 'Microbial water quality: Voltammetric detection of coliforms based on riboflavin-ferrocyanide redox couples', *Electrochemistry Communications*, vol. 101, pp. 99-103.
- Bond, RR, Novotny, T, Andrsova, I, Koc, L, Sisakova, M, Finlay, D, Guldenring, D, McLaughlin, J, Peace, A, McGilligan, VE, Leslie, S, Wang, H & Malik, M 2018, 'Automation Bias in Medicine: The Influence of Automated Diagnoses on Interpreter Accuracy and Uncertainty when Reading Electrocardiograms', *Journal of Electrocardiology*, pp. 1-12.
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- Callan, J, Nicholas, D, Logan, K, Sheng, Y, Gao, J, Farrell, S, Dixon, D, Callan, B & McHale, AP 2018, 'Rapid paper based colorimetric detection of glucose using a hollow microneedle device', *International Journal of Pharmaceutics*, vol. 547, no. 1-2, pp. 244-249.
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3.2 Books/Chapters in Books

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3.3 Published Conference Papers

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Bhalla, N, Funari, R & Shen, AQ 2018, 'Nanoplasmonic platform for multiple biosensing applications' Paper presented at MicroTAS, Kaohsiung, Taiwan, Province of China, 28/11/18.

Ekerete, I, Nugent, C & McLaughlin, J 2019, An unobtrusive sensing solution for home based post-stroke rehabilitation. in *2018 IEEE International Conference on Bioinformatics and Biomedicine (BIBM)*. 2018 IEEE International Conference on Bioinformatics and Biomedicine, Madrid, Spain, 3/12/18.

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- Uhomoibhi, J, Cherner, Y, Mullett, G, Kuklja, M, Mkude, C, Fweja, L & Wang, H 2019, 'Implementation of Interactive and Adjustable Cloudbased e-Learning Tools for 21st Century Engineering Education: Challenges and Prospects' Paper presented at III IEEE World Engineering Education Conference EDUNINE2019, Lima, Peru, 17/03/19 - 20/03/19.
- Uhomoibhi, J & Hooper, L 2019, 'Digital Learning Challenges and Innovations for Sustainable Education in Developing Countries: Issues of Policy and Practice' Paper presented at INSPIRE XXIV, Twenty-fourth International Conference on Software Process Improvement Research, Education and Training, Southampton, United Kingdom, 15/04/19 - 16/04/19, pp. 103-116.

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Uhomoibhi, J, Cherner, Y, Mkude, C, Mullett, G & Cherner, T 2019, 'Activity-Based Gamified e-Learning for IoT and Energy Efficiency: Academic Education, Workforce Development, and Public Literacy' Paper presented at LINC 2019 International Conference, Boston, Massachusetts, United States, 18/06/19 - 20/06/19.

4. Research Funding

Ongoing and Active Research Projects, notably:

Unit of Assessment Member	Title of Award	Funding Body	Value	Project Dates
Prof JAD McLaughlin Dr PJ McCullagh Dr N Soin Prof CD Nugent Dr J Synott Dr I Cleland Prof D Finlay	Connected Health and Innovation Centre (CHIC)	Invest NI	£9M	2013 - 2022
Prof JAD McLaughlin Dr AR Boyd Prof B Meenan Prof CD Nugent Prof J Davis Prof D Finlay Prof R O'Kennedy, DCU Prof B Caulfield, UCD Dr R Bond	Eastern Corridor for Medical Engineering (ECME) Project	INTERREG VA	£2.71M (Part of an £8M cross-border centre award)	2017 - 2022
Prof A McIlhagger Dr E Mancuso Dr Shaun McFadden Dr Z Ullah Prof E Harkin Jones Dr D Dixon Dr D McCracken Dr JP Quinn Dr E Archer D Tormey, IT Sligo	North West Centre for Advanced Manufacturing (NW CAM)	INTERREG VA	£3.22M (Part of an £8M cross-border centre award)	2017-2022
Prof JAD McLaughlin Prof PD Maguire Prof B Meenan Prof D Finlay Dr D Guldenring Dr D McEaney, Craigavon Area Hosp Prof J Davis Dr P Catherwood Prof OJ Escalona Dr PSM Dunlop Dr D Dixon Dr AR Boyd Dr G Burke	Biodevices Proto-Typing Lab	INVEST NI	£3.6M	2015-2020

Prof P Papakonstantinou Prof JA Byrne				
Prof D Mariotti Prof PD Maguire Prof JAD McLaughlin	XPS-UPS system with in situ processing	EPSRC	£1.1M	2018-2020
Prof JA Byrne Prof JAD McLaughlin Dr P Fernandez-Ibanez Dr A Brown Prof J Davis Dr NG Ternan Dr G Burke Prof JSG Dooley Prof D Finlay Dr R Price Prof M Keenan Prof HM McNulty Prof R O'Connell Dr PSM Dunlop Dr M Ng Dr D Dixon Dr M Brennan Dr MS Gallagher	SAFEWATER – Low cost technologies for safe drinking water in developing regions	EPSRC	£4.79M	2017-2021

Portfolio of Research Grants awarded during period 1 August 2018 - 31 July 2019

Unit of Assessment Member	Title of Award	Funding Body	Value
Dr D Dixon Dr A McIlhagger Dr E Archer	KTP Programme between University of Ulster and MSO Cleland Limited	Innovate UK/INI and MSO Cleland Limited	£152,771.00
Prof OJ Escalona Dr W Duddy Prof A Smith Dr M Brennan Prof JAD McLaughlin David McEneaney, SHSCT Ivan Mendoza, Sociedad Venezolana de Jurandir Nadal, Universidade Federal do Tania Araujo, Oswaldo Cruz Institute Victor Herrera, Universidad Autinoma	Neglected vector-borne diseases with cardiac affections in Latin American ecosystems	Department for the Economy-GCRF	£19,800.00

Vilma Irazola, Instituto de Efectividad			
Dr PSM Dunlop Dr S Gaihre Dr M Long Dr M Brennan Prof JA Byrne Alan Liddle Dr F Reygadas, Cantaro Azul (NGO) Mr A Jaffrey, UU Ms C Herrera, CTA (NGO) Prof L Sabogal, University of Sao Paulo Prof M Hincapie, University of Medellin	Development of GCRF overseas partner capacity and capability toolkits and training programmes (DOCC)	Department for the Economy-GCRF	£19,800.00
Dr D Dixon Dr A McIlhagger Dr E Archer Dr PSM Dunlop	Accelerated ageing and weathering facility - Extension	NI Advanced Engineering Competence Centre	£27,175.00
Dr P Fernandez-Ibanez Prof JA Byrne	PANI Water	CEC-H2020-Pillar-Societal Challenges	£329,660.00
Prof E Harkin-Jones	AERO AM2	NI Advanced Engineering Competence Centre	£183,436.00
Prof JAD McLaughlin Prof D Finlay	Microneedles for Emergency Treatment of Synthetic Opioid Overdose	National Institute of Health - USA	£73,674.00
Dr A McIlhagger Dr D Dixon Dr E Archer Dr G Stewart, Axis Composites Mr N Bloomfield, Denroy Plastics Mr N McKribbon, Rockwell Collins Mr P Quigley, CCP Gransden Mr R Lemon, Bombardier Aerospace	Developing Effective Cost Modelling Tool for Industrial Applications	NI Advanced Engineering Competence Centre	£72,000.00

Dr R Bond Prof CBT Moore Prof D Finlay Prof JAD McLaughlin	Smart Theatre Data Science and Object Tracking for Image Guided Therapies	EPSRC via IGT	£39,641.00
Prof JAD McLaughlin	Collaborative Research Support Fund - theme Leader Digital Health (NICP)	Department for the Economy	£116,504.00