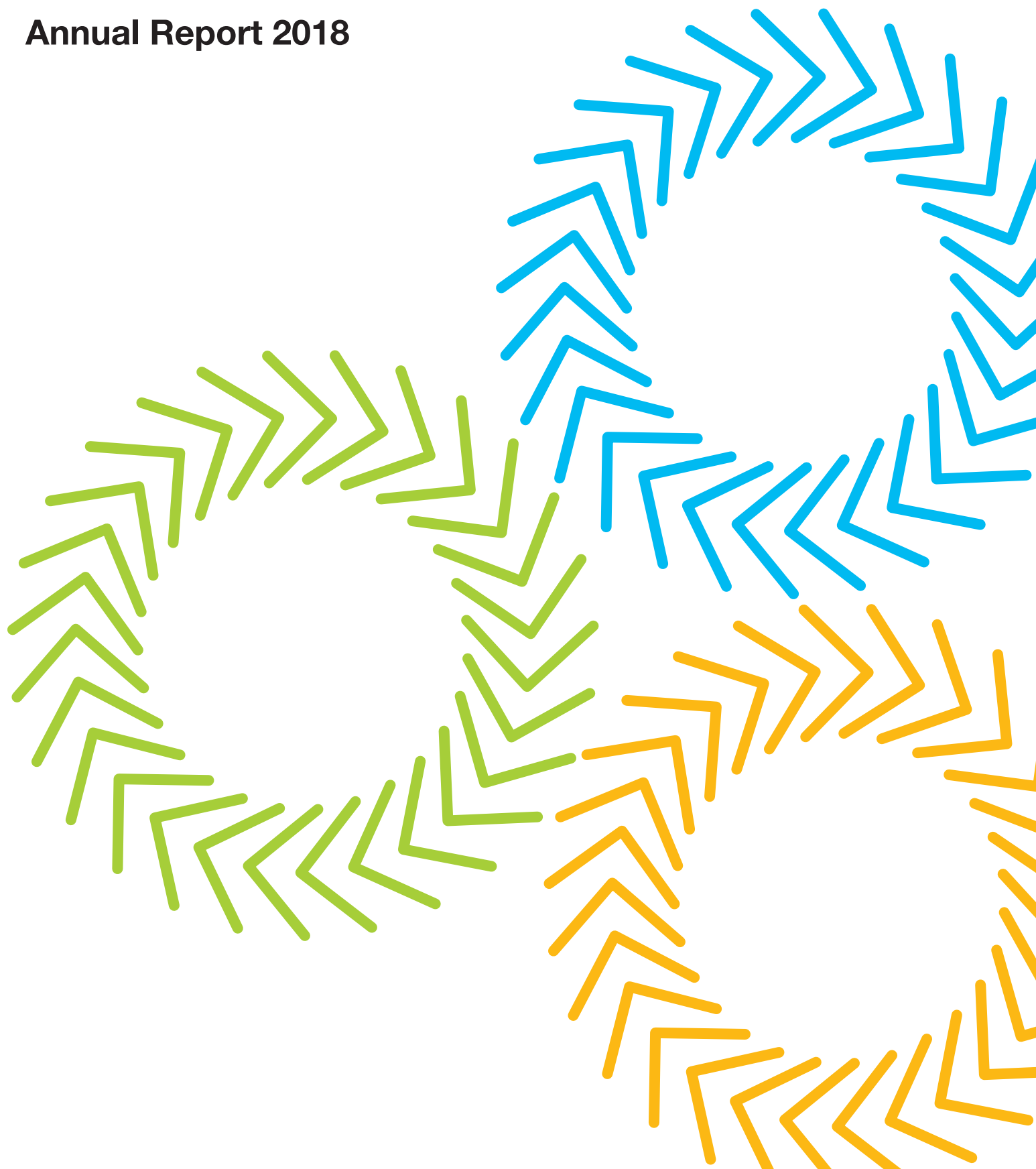


## Annual Report 2018





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# Foreword

It is a pleasure to introduce the 2018 annual report of MaynoothWorks, the Maynooth University office for Knowledge Transfer, Enterprise Partnership and Entrepreneurship Innovation. The report provides an overview of the University's 2018 knowledge transfer activities and highlights some of the many successes and achievements in our partnerships with industry. These include the exploitation of intellectual property developed at MU and support for a burgeoning start-up community - both in the form of MU spin-outs and external spin-in companies attracted by the University's excellent overall infrastructure and environment.

Building new innovation led partnerships has been a particular focus in 2018. MaynoothWorks provides direct supports for regional innovation and entrepreneurship in partnership with the Merits Innovation Hub in Naas, Co. Kildare, and the Boyne Valley Food Innovation District, centred in Navan Co. Meath (both funded by the Enterprise Ireland Regional Enterprise Development Fund).

The Mid-East Regional Enterprise Plan 2020 sets the goal to develop a network of innovation workspaces across the mid-east, and the MaynoothWorks incubation centre will be an essential element of that, with a particular focus on knowledge-intensive industries where the expertise and skill-sets within Maynooth University play a critical role. The business innovation centre is operating at essentially full capacity, and is developing a range of unique business development tools for client companies.

Of similar regional significance, the knowledge transfer alliance led by MU, which includes Waterford, Athlone

and Carlow Institutes of Technology, continues to achieve significant success as demonstrated by both metrics achieved and engagement with industry.

Internationally, an important new partnership has been established with the University of South Florida, USA, to share know how and experience in supporting start-ups.

The MaynoothWorks office has been pivotal in developing an embedded culture of research commercialisation and innovation at Maynooth University, and has played a central role building effective external relationships that last. It represents a vital part of the overall MU strategy, and will be an important part of the University's future success.

It is through sustained effort over the last fifteen years, and working closely with the University's dynamic research community, that has led to the picture of impressive activity presented in this report.

**Professor Ray O'Neill**

Vice President for Research and Innovation

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# Introduction

MaynoothWorks continues to evolve and focus on key activities that drive regional and national development goals, namely:

- > Developing a culture of knowledge transfer and entrepreneurship at Maynooth University;
- > Connecting Maynooth University researchers with industry and the market place;
- > Providing incubation support for our extended start-up community;
- > Linking the broad expertise at MU with private and public knowledge seekers;
- > Identifying and commercialising the IP developed by Maynooth University researchers.

The MaynoothWorks team comprises Dr John Scanlan, Office Director; Lorraine Kane, Operations Manager; three commercialisation executives supporting MU and our TTSL partners; Peter Conlon, Dr Karen Griffin and Dr Paul Tyndall; and Joe Moore, business innovation centre manager and Tracy Travers, centre administrator.

Activities of the commercialisation office and business incubation centre are coming together under the MaynoothWorks brand to deliver an integral approach to Knowledge Transfer, Enterprise Partnership and Entrepreneurship Innovation

The Maynooth University 2018 knowledge transfer metrics are outlined in detail in this report. Against national and international standards and normalised to research expenditure, Maynooth University continues to rank in the top percentiles. This performance is down to the outstanding research and the desire of our researchers to see their work make both a scientific and an economic impact.

Up until 2021, MaynoothWorks will continue to lead the Enterprise Ireland funded Technology Transfer Strengthening Initiative (TTSL) phase 3, in partnership with Waterford Institute of Technology (WIT), Athlone Institute of Technology (AIT), and Institute of Technology Carlow (ITC). We continue to work with the excellent academic community at MU and our partner institutes on this programme.

**John Scanlan**  
MaynoothWorks Director



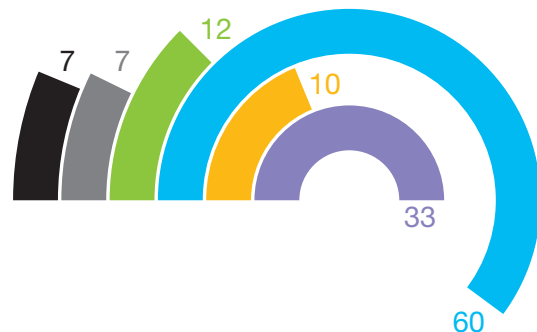


The metrics outlined below include various knowledge transfer metrics such as invention disclosures recorded, new patents filed and licence deals created. Our enterprise partnership metrics comprise consultancy and industry collaboration projects and finally we report the number of clients supported in the business innovation centre.

The impact of these metrics and wider knowledge transfer activities are key drivers in generating economic and social returns on State investment in knowledge transfer in the form of economic growth and jobs.

## 2018 Knowledge Transfer Metrics

License agreements	7
Patents filed	7
Invention disclosures	12
Industry collaborations	60
Consultancy projects	10
Innovation Centre client companies	33



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# 01/ Knowledge Transfer

We executed 7 licensing agreements with companies during 2018. Some examples of the deals completed include:

## Licensing Activity

**Qualflow Systems** is a leading provider of automated beer-line cleaning equipment and high-speed beer dispensing solutions to brewers and the hospitality industry. The company collaborated with Professor Kevin Kavanagh, Biological and Biomedical Science Programme co-ordinator, Maynooth University via an Enterprise Ireland Innovation Partnership. The collaboration resulted in the development of a novel method to remove biofilms from beer lines. This has led to better cleaning and slower re-growth of biofilms, a significant breakthrough for the company. The know-how developed was exclusively licensed to the Company for productisation and commercialisation.

**Alltech** helps farmers feed the world and raise healthy animals through nutritional innovation. More than thirty years of research in animal nutrition and health have allowed them to develop and manufacture innovative natural feed supplements that improve animal performance, the feed industry and the farmer's bottom line. The company collaborated with Professor Paul Moynagh, Director, Human Health Institute, Maynooth University via an Industry funded scholarship funding a research student. The data generated during the project was assigned to the company.

**Avectas** is a cell engineering company, enabling the manufacture of novel cell therapies. Avectas' technology, Solupore®, allows the design of bespoke primary cell types, including T cells for immuno-oncology, and other gene editing applications. Solupore® is a simple, rapid and non-destructive process that yields superior engineered cells relative to viral vectors and electroporation, leading to

a more cost-effective optimisation process. The company collaborated with Dr Andy Hogan, Human Health Institute, Maynooth University in an industry funded research collaboration. The data generated during the collaboration was assigned to the company.

**Jomakol Representação e Serviços** (Brazil) funded Dr. Rafael de Andrade Moral (Dept. of Mathematics and Statistics) to carry out a statistical analysis of risk assessment data. The raw data was gathered during field trials of new animal feed supplements. Dr. Moral's analysis of the data was used by Jomakol as part of their submission to the Brazilian National Biosafety Committee seeking a commercial license to use these new animal feed supplements.

**The European Forum for Restorative Justice** (EFRJ), funded Dr. Ian Marder (Lecturer in Criminology, Department of Law) to create short briefings on the forthcoming Council of Europe recommendation concerning restorative justice in criminal matters. Dr. Marder delivered 53 (representing each of the Council of Europe jurisdictions), 2-page briefing documents which the EFRJ distributes to each justice ministry in support of the recommendation and its implementation.

**Aeronet Communications** has a long term partnership arrangement with Maynooth University and the SFI funded CONNECT Centre. Prof Ronan Farrell and Aeronet's Brian Russell have worked closely to develop a high speed land to ship/airplane data transmission apparatus. The phase of the project covered by this agreement included the development of the fundamental operating principles and intellectual property needed to describe the systems operation. Further collaborative projects will develop these ideas into a proof of concept demonstrator.



## Future Pipeline

We expect 2019 to be another good year for knowledge transfer at Maynooth University. There are several projects which we expect to mature this year:

### Geophysical Mapping

AIRO is a leading spatial analysis and planning unit within MU. They specialise in socio-demographic analysis, spatial analysis, spatial planning and data analytics. AIRO provides a suite of public mapping and data visualisation toolkits aimed at improving evidence informed planning and also undertakes contracted applied research and consultancy projects in the area of socio-demographic and economic analysis, spatial planning and environmental analysis.

### Food Additive Discovery Service

Researchers at Maynooth University have created a novel chemistry structure database for the identification of food additives with undiscovered health benefits. The end-to-end service will allow for chemically-guided searches and evaluation of food additives in the database with the added benefit of supporting biological investigations.

### Novel Physical Layer Encryption Scheme to Counter Eavesdroppers

Networked systems can be secured in many different ways, while in-wired system physical access is required, however, in wireless systems bit or packet level encryption does not secure the air interface (once a signal is transmitted from the antenna). These interfaces are then directly susceptible to “interception” and eavesdropping.

Maynooth University researchers working in the SFI CONNECT Centre have developed a scheme for concealment of the signal modulation constellation with non-

linear group delay. The proposed technique provides a low complexity viable scheme of encrypting the physical layer in wireless communication equipment. The scheme requires no additional RF power or bandwidth. The scheme can be used alongside any of the existing published physical layer security techniques to complement their capabilities.

### Method for Characterising an RF Signal

Modern wireless communications involve transmission of data through wide bandwidth modulated Radio Frequency (RF) channels. The quality of the transmitted signal is affected by the characteristics of each stage in the transmitter. Thus, its response over the intended bandwidth is critical. Imperfections in each component contribute towards the degradation that a modulated RF carrier undergoes as it traverses through each stage of the transmitter. This can be mitigated by estimating the extent of degradation caused at each stage and attempting to pre-compensate the signal for the degradations through calibration. This is a complex task particularly where the bandwidth of interest is large and where the number of frequency points to be swept is high.

Maynooth University researchers working in the SFI CONNECT Centre have developed a method to accomplish this task in a quick and efficient manner exploiting the merits of Digital Signal Processing for the generation of a test signal whose bandwidth is to cover a wider bandwidth of operation in comparison to conventional techniques. The technique involves a combination of time domain and frequency domain analysis of the impairments and imbalances that a wideband signal experiences along a chosen path. It then generates a correction co-efficient matrix which could be applied to the input signal such that the desired output signal is obtained after the altered input signal undergoes the amplitude and phase distortions at each stage in the transmit chain.

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# 01/ Knowledge Transfer Continued

## **Pathogen Responsive Biosensors**

A research group at Maynooth University led by Dr. Rob Elmes is currently developing a highly sensitive and selective approach to the quantitative visual detection of E coli using a responsive fluorescent biosensor platform. The team is currently evaluating a range of lead compounds that will potentially allow real-time, in situ determination of E Coli contamination without the need for expensive equipment or highly trained personnel.

## **Biomarker Sensors**

We have developed novel biosensors to selectively monitor neurochemicals in the living brain on a timescale from milliseconds to days. The sensors are used to understand the complex functioning of the brain in terms of behaviour and disease. One of the major hurdles to the discovery of new medicines to treat psychiatric and neurological disorders is the paucity of suitable animal models capable of predicting clinical benefit. This is particularly true of disorders associated with cognitive disturbance such as schizophrenia and Alzheimer's disease. The sensor monitoring concept provides a solution to this deficit in pre-clinical drug discovery in that it enables the recording of continuous signals, in freely-moving behaving animals, of the haemodynamic and metabolic consequences of neuronal activation that form the basis of functional brain magnetic resonance imaging in man. The work also has significant potential clinical applications.

## **Crohn's Disease Diagnostic**

Inflammatory bowel disease (IBD) splits into 2 major types of disease; Crohn's disease (CD) and ulcerative colitis (UC). The definitive distinction between CD and UC is challenging and generally relies on a combination of inputs including clinical presentation, results of radiography, endoscopy and histological findings. We have assessed the levels of expression of Pellino3 protein in colonic biopsy samples from healthy, CD and UC patients. The data demonstrates that the levels of Pellino3 protein are strongly reduced in colonic tissue from CD subjects relative to control or UC subjects. These data suggest that the protein expression levels of Pellino3 may be a strong diagnostic indicator of subjects with Crohn's disease and we propose a Pellino3-based test as the basis for a diagnostic.

## **Improving Base Station Amplifier Performance**

A signal processing stage for a base station amplifier was developed that operates on the principle that it is better to avoid non-linearity rather than the more complex process of correcting it. This invention addresses two key issues with current outphasing amplifier designs:

- 1)** rapid rate of change of input signal phase and
- 2)** input signal dynamic range.

Rapid changes in phase can cause bandwidth expansion (BER). In the invention, signal phase in the amplifiers non-linear region at lower amplitudes is modified, to create a more gradual rate of change of phase.

## **Ocean Energy Technologies**

The Centre for Ocean Energy Research (COER) at Maynooth University has core strengths in mathematical modelling, control systems, prognostics and optimization – all focused on ocean energy research. The Centre collaborates with several major players in ocean energy and makes available modelling and control technology to these partners under licence.

## **Small Molecule Therapies for Inflammatory Bowel Disease**

The incidence of inflammatory bowel disease (IBD) is rising globally with an especially large increase in children. We have developed small molecules with strong anti-inflammatory effects in cell based models, with potential for treating IBD. We propose to further define their therapeutic potential by evaluating their efficacies in preclinical models of inflammatory diseases and in ex vivo clinical samples.

## **UniDoodle**

Unidoodle is a Multi-platform Smart Device Student Response System that provides a freeform sketch-based input mechanism so that students can input diagrams, equations, annotations, etc. using students' own devices (smartphones and tablets – both IOS and android operating systems supported). Responses are collected and presented to the teacher/lecturer in real-time in a gallery-style format for ease of viewing. Provides in-depth insight to where and how the students are making mistakes. Allows a decision to be made there and then whether the topic needs to be covered again to reinforce learning.





## Commercialisation Award

Each year MaynoothWorks (formerly the Commercialisation Office) recognises excellence in knowledge transfer and industry engagement at Maynooth University.

### The 2018 Annual Award was presented in two categories:

1. Commercialisation of Intellectual Property; and
2. Industry Engagement activity.

**Dr Jennifer McManus**, Head of the Chemistry Department, was awarded the Industry Engagement Award. Jennifer, who leads the Soft Matter and Biophysical Chemistry research group and her team have been working collaboratively with a number of companies in Ireland, the UK and Italy. The primary research focus of the lab is understanding protein-protein interactions and assembly pathways. This is very important for the biopharmaceutical industry, where protein and peptide-based drugs are formulated to keep them stable for as long as possible. Three postdoctoral researchers and one Ph.D. student have been funded through these partnerships.

**Dr. Bryan Hennelly**, jointly of the departments of Electronic Engineering and Computer Science, was awarded the Commercialisation of IP Award. Bryan is developing IP on label free life science imaging.

Traditionally biologists are required to chemically stain cells/tissue samples with fluorescent chemicals that bind to sub cellular features and to use specialised imaging techniques such as fluorescent microscopy or phase contrast microscopy for visualisation. His research group is developing several methods to achieve this without the use of labels. In 2018 Bryan was awarded an SFI TIDA to help commercialise this technology, and also filed a number of invention disclosures and patent applications.

Dr Karen Griffin of MaynoothWorks continues to work with Bryan and Jennifer to help commercialise their research.



Dr Karen Griffin, Prof Ray O'Neill and Dr Jennifer McManus



Prof Ray O'Neill, Dr Bryan Hennelly and Dr Karen Griffin

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# 02/ Enterprise Partnership

## Industry Links

Maynooth University formed 60 new partnership agreements with industry contacts in 2018. These links are based on research collaborations and range from working relationships with SME's under the Enterprise Ireland Innovation Voucher Programme to collaborations with multinational companies on specific issues for which Maynooth University has research excellence. Maynooth University and its Institutes now have over 175 ongoing industry collaborations across all disciplines which are an indication of the outward facing culture at the University.

## Market Partners

Successful technology transfer or commercialisation is based on the execution of three key tasks; **selection of projects with good commercial potential, execution on those projects and securing sufficient capital funding to bring the technology to market.** Getting the first two right tend to make the last one easier, and we therefore focus most of our efforts on the first two. Given that we have a relatively small commercialisation team, having expertise in multiple fields and staying market informed is practically impossible, so we must rely on external partners to help in the selection and execution of worthwhile projects.







Our extended team of market partners continues to be a vital part of our commercialisation process. The team now includes **more than 100 professionals** in various roles such as **product development, marketing, legal, IP, business owners, clinicians, investors** from organisations of all sizes from small companies to multinationals.

This group remain our sounding block to help ensure the commercialisation projects we focus on are “market-informed” and we continue to deliver solutions to “problems that are worth solving”.



## 02/ Enterprise Partnership Continued



### Expanding Enterprise Engagement

In an attempt to further develop Maynooth University industry collaborations, MaynoothWorks undertook a pilot business development project to actively approach industry to understand their current roadmaps and needs, to discuss future challenges and discover mutually beneficial opportunities.

#### **This pilot project had two main objectives:**

- 1) To increase the number industry engagements based on the needs identified by our potential Industry partners.
- 2) To highlight industry needs and facilitate introductions to MU researchers.

During the project 300 companies were contacted initially by phone, email or in person. This created 44 follow-up conversations, which resulted in 7 new research collaboration projects being completed. The conversations were a project scoping exercise, which included a deep dive into the

company's requirements and challenges. Other outcomes included the development of an extensive pipeline of potential projects, including a potential spin-out opportunity.

#### **What we have learned so far:**

- 1) Industry highlighted needs that required combinations of academics in small strategic groups pulling together to provide platform solutions to solve problems. Such teams included groups outside the core STEM academic groups e.g. Design Innovation, Anthropology, Law.
- 2) Small SME's do not always have resources and bandwidth available to focus on what long term products/innovation will look like. There are opportunities for MU and our TTSI partners to help future-proof these companies through collaboration.

Our initial success demonstrates that opportunities exists to further develop this business development activity, expanding its scope nationally into a compelling cross academic discipline industry research collaboration service.





## Networking Event

Each year the Commercialisation Office hosts a showcase or networking event for industry, opening up the University to stakeholders interested in collaboration with our researcher expertise. In 2018 we hosted a different type of event, to discover how we could develop and celebrate our links with France.

In collaboration with France Alumni and the French Embassy, MaynoothWorks hosted an “Apéro universitaire” on the evening of December 11th. The evening was opened by MU president Professor Phillip Nolan and His Excellency the French Ambassador Mr. Stéphane Crouzat (photo above). Speaking in French, Professor Nolan emphasised the importance of international collaboration for MU and how the University has always enjoyed close scholarly links with France. The Ambassador reinforced this closeness, mentioning that MU was the first Irish university he visited upon his arrival in Ireland. He later commented that he was impressed by the attendance and the very broad collaborations across several disciplines that exist between MU and French universities.

Seven researchers from MU presented five-minute vignettes of their research and links with France. Prof. John Ringwood spoke about his research in ocean energy and his close ties with French universities and how French collaborators have been instrumental in the development of his group.

Dr Emmanuelle Graciet (photo above), originally from Paris, spoke about her work on plant biology and mechanisms and models for understanding crop resilience to climate change. Dr Patrick Rigot-Muller spoke about his work on the modelling and optimisation of global shipping routes. Dr Kathleen Shields entertained the audience in her presentation about language translation, and how English words used in every day French have changed meaning. Dr Fabrice Rousseau, who collaborates with the University of Toulouse, spoke about high speed trading on international markets. Prof. Thomas O’Connor spoke about his personal experiences in Paris Sorbonne and his work on the history of migration between Ireland and France. And finally Prof. Damien Woods introduced us to his work on molecular computing and his team which comprises almost entirely of French postdocs and postgrads.

Dr Marc Daumas, the attaché scientifique from the French Embassy spoke about how the possibilities of developing broader and deeper research links. Knowledge transfer links that MU has with French universities were discussed and in particular, how the Irish system is similar to the French system of consortia managed knowledge transfer.

# 03/ Entrepreneurship Innovation

## MaynoothWorks Business Innovation Centre

The MaynoothWorks Business Innovation Centre (BIC) is a supportive and flexible environment for start-up companies. Managed by Joe Moore, it facilitates a community of companies on the journey from business ideation through to scaling. Companies enter as a spin-out from the university or as a spin-in fledgling business with an interest in leveraging university knowhow, research capabilities and intellectual property.

It has completed its third year in operation and comprises early to mid-stage spin-out clients such as GeoAerospace, AccessEarth and Avectas plus spin-in companies such as Beauty Buddy, Tixserve and Swiftqueue and others. Early stage spin-in companies tend to graduate from New Frontiers and European Space Agency programmes. All companies

have the objective to rapidly develop their new business concept to a stage where it has been tested and undergone a degree of market validation and business scrutiny.

The first university spin-out (from the Biology department) into MaynoothWorks BIC was Avectas. It is actively pioneering the development of a new technique for cell engineering, helping to advance the delivery of personalised cancer treatment. It is making substantial technological progress combined with market validation. “MaynoothWorks provides excellent access to talent, to researchers and excellent laboratory facilities” stated Dr Shirley O’Dea (CTO in Avectas), in a recent company video profile.

## Balanced Innovation Model



## Client Supports

As MaynoothWorks BIC looks to boost its ability to support its clients and attract new ones, it has embarked on the development of a unique approach to assessing company capabilities and in turn provide empowering interventions to company founders, as they face into their unique business challenges. It has developed a company capability assessment model specifically for start-up companies of varying degrees of maturation. This Balanced Innovation Model (BIM) is a method of assessing the strengths and weaknesses of company capabilities on three dimensions; Management, Market and Technology. This new approach is effective in assessing capabilities and identifying appropriate supports. Rather than rely on generic business education modules MaynoothWorks is developing a suite of executive education modules that meet the skills needs of founders as they progress through the start-up journey. It is a 'personalised' approach rather than a one-size-fits-all approach, currently available to startups.

## Outreach

As part of its strategy to extend its influence with industry, MaynoothWorks BIC has embarked upon a programme to connect with industry sector bodies and thereby seek out ways to engage with industry, creating better awareness for the incubation centre and university at large. In the current year it has made the following connections to promote innovation, entrepreneurship and employment:

European Space Agency: MaynoothWorks participates on the Tender Evaluation Board to assess potential ESA start-up candidates and technology transfer programmes.

Microelectronics Industry Design Association (MIDAS) Ireland's semiconductor representative body: Joe Moore participates at board level to broaden the scope of the organisation and make it more appealing to indigenous SMEs and foster better engagement with academic institutions.

Joe Moore also represents Maynooth University as a director on the board of the new MERITS Centre based in Naas. MaynoothWorks has partnered with mid-eastern local enterprise offices (Kildare, Meath and Wicklow). MERITS will act as a knowledge conduit for enterprises, start-up or established companies, providing access to university knowledge assets and facilities.

Through the BIM initiative, MaynoothWorks has partnered with the University of South Florida (USF), to deliver a standardised approach to supporting start-ups. USF has adopted the BIM approach to assessing potential spin-ins and spin-outs. We plan to cooperate in deploying the BIM model and use the transatlantic experiences to refine and optimise the executive education modules and generate a benchmark platform for our mutual benefit.

MaynoothWorks also seeks to encourage student entrepreneurial initiatives by participating in competition judging and event hosting. This year MaynoothWorks has hosted a visit for participants in the Entrepreneurship Summer School organized by the university's Business School and the Leinster West Final of the Foroige Entrepreneur programme. The latter is a programme designed for DEIS school students, encouraging innovation and enterprise. The winners of this competition progress to the national finals.





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## 03/ Entrepreneurship Innovation Continued



### Entrepreneurship Training

MaynoothWorks hosted its annual entrepreneurship programme in Innovation and Research Commercialisation as part of the Graduate Studies programme. The participants included research students from our technology transfer consortium partners, Athlone Institute of Technology and Institute of Technology Carlow. The aim is to equip PhD students with the skills required to commercialise the outcome of their research, to provide them with the ability to interact with industry and to improve their skills to innovate and act with an entrepreneurial mindset.

The course covers the basics of intellectual property, technical marketing, product development, spin-out company formation and research commercialisation contracts. Also included are workshops and exercises, including preparation of a marketing pitch, culminating in a group business plan presentation. These are very useful in informing the student how to present their ideas as a business opportunity rather

than as just interesting science, a practical approach which then complements their academic training.

Current focus on research impact requires that graduates have the same knowledge of the competencies needed to explore and develop commercial opportunities. Our detailed case-studies and practical workshops facilitate this in a relaxed hands-on environment.

Participant feedback has confirmed that the programme creates an awareness of commercial opportunities from the early stages of research and identifies/ promotes aspirations of creating start-up ventures in the future.



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