Trinity College Dublin
Coláiste na Tríonóide, Baile Átha Cliath
The University of Dublin

School of Engineering Research Strategy 2025-2030

‘Our planet and mankind are continuously shaped by engineering advances across several disciplines. For the greater good, we seek to engineer solutions for current and future challenges’

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‘Together with key stakeholders, we will co-create our research questions and define outcomes that are truly impactful.’

Foreword

The School of Engineering at Trinity College Dublin, the University of Dublin, is a vibrant research-led School with strong industrial and clinical partnerships and an international perspective. The connection to translation inspires our researchers to reach for improved insight and enhanced solutions that can benefit our society, humanity, and natural world at the national and international scale. Our international collaborations and esteemed reputation in the field help to drive the excellence for which our researchers are regarded.

In a rapidly changing and ever challenging world, we are facing many new challenges. Our researchers continue to show great agility in adapting their research to meet the immediate challenges of global needs. However, many new challenges will persist such as impact on an ageing and growing society, climate change and digital interactions.

In the context of these challenges, we are delighted to present the School of Engineering Research Strategy 2025-2030. Together with our academic partners, research institutes, researchers, and professional services, we will combine our engineering mindset with new tools, technologies and data that will be transformative leading to engineering solutions to meet the challenging current and future demands. We will do this through strategic investments in infrastructures and by expanding our collaborations within Trinity College Dublin and beyond.

We will leverage sufficient investment through exchequer and non-exchequer funding and by giving our researchers the supports that they need to succeed. The actions planned under the key priority areas are ambitious but achievable and, as they are implemented, will collectively enable the School to deliver significant impacts on national and international needs and developments.

Our research will be embedded within a framework of demonstrating impacts that go beyond conventional metrics. Together with key stakeholders, we will co-create our research questions and define outcomes that are truly meaningful.

Professor Michael Monaghan
Director of Research
School of Engineering 2022-2025

School Research Strengths

'Improving our world, society and interactions across traditional and emerging research areas.'

Transport

Systems and Hardware

Resources

Neural Engineering

Communication

Communities

Tissue Engineering

Additive Manufacturing

Sustainability

Environment

Structures

Energy

Biomechanics

Materials Science

Digital Media

Climate

Medical Devices

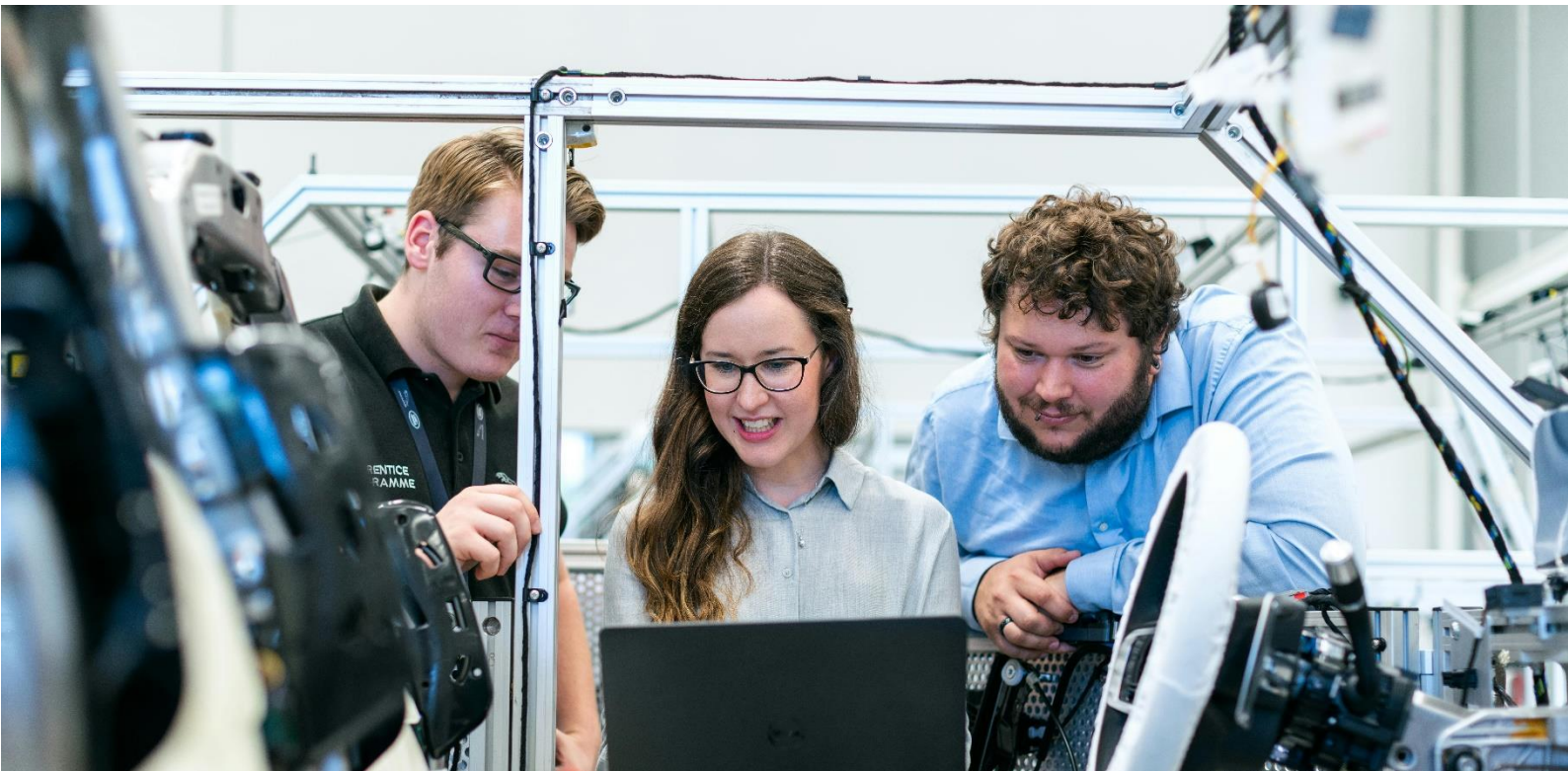
Production

Acoustics and Vibrations

Biomedical Imaging

Scale of Research at School of Engineering 2023/2024

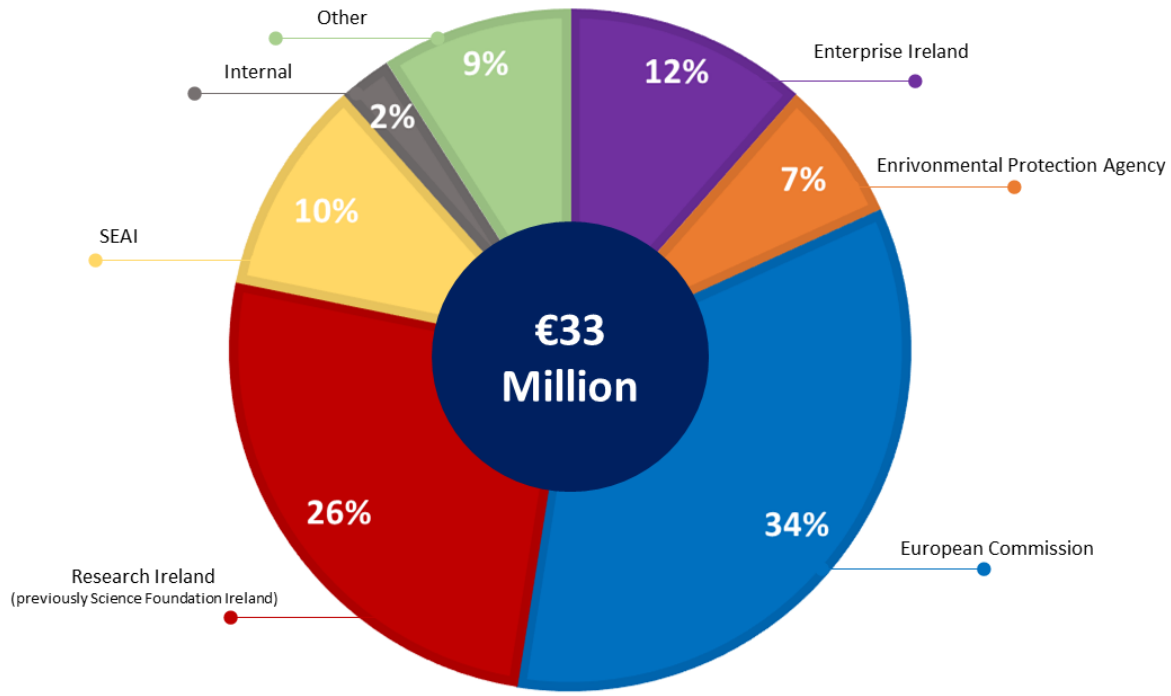
The School of Engineering is Ireland's leading Engineering School and ranks as one of the world's top engineering schools (2024 QS world rankings #158, 50th in Europe). It is a leading research school in Trinity, home to over 82 highly diverse researchers and spanning eight scientific disciplines. The School is multidisciplinary; comprising civil, structural, environmental, biomedical, mechanical, manufacturing, and electronic engineering. Most academic staff are highly active in research, with several senior principal investigators having industry projects and/or spun out their own companies. The School of Engineering research income comprises around 11% of the total research income of Trinity College Dublin. We are a research-led school that values cutting-edge innovation and leverages local, national, and international collaboration. Multidisciplinarity is one of our great strengths. Partnerships between our researchers, industry and policy makers generate unique synergies to advance basic and translational research at every stage of the life cycle.



Global Collaborations in Engineering Research 2024

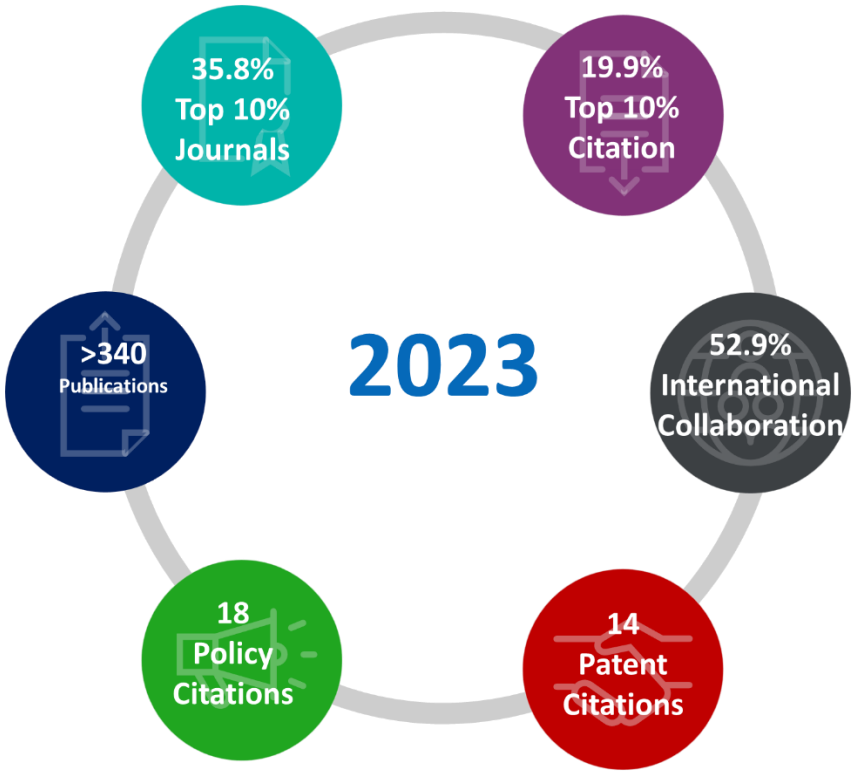
The School of Engineering has an extensive international network of active research collaborations that extends across the Globe. The largest is European-centric stemming from EU Commission funding and geographical proximity.

Research Funding 2023-2024



Overview of funding sources of research in the School of Engineering of currently active grants awarded ***since November 2021 and active until December 2027***. 'Other' represents funding from industry, local authorities, philanthropic funding, and charities.

Research Outputs

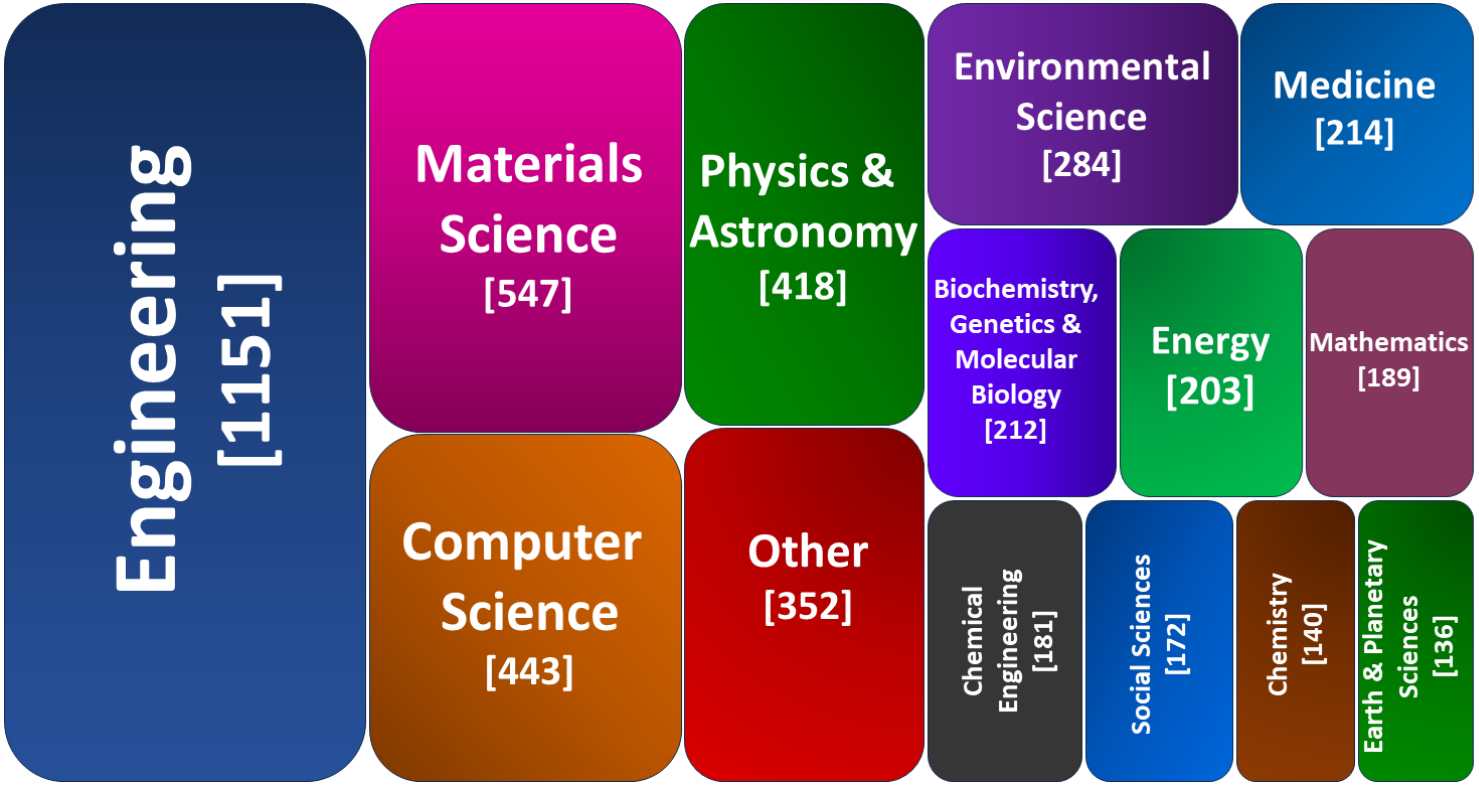


- Publications in Top 10% Journal Percentiles: The percentage of publications in 2023 that have been published in the world's top journals.
- Output in Top 10% Citation Percentiles (%): The percentage of publications that are highly cited in 2023.
- International Collaboration (%): The extent of international co-authorship in 2023.

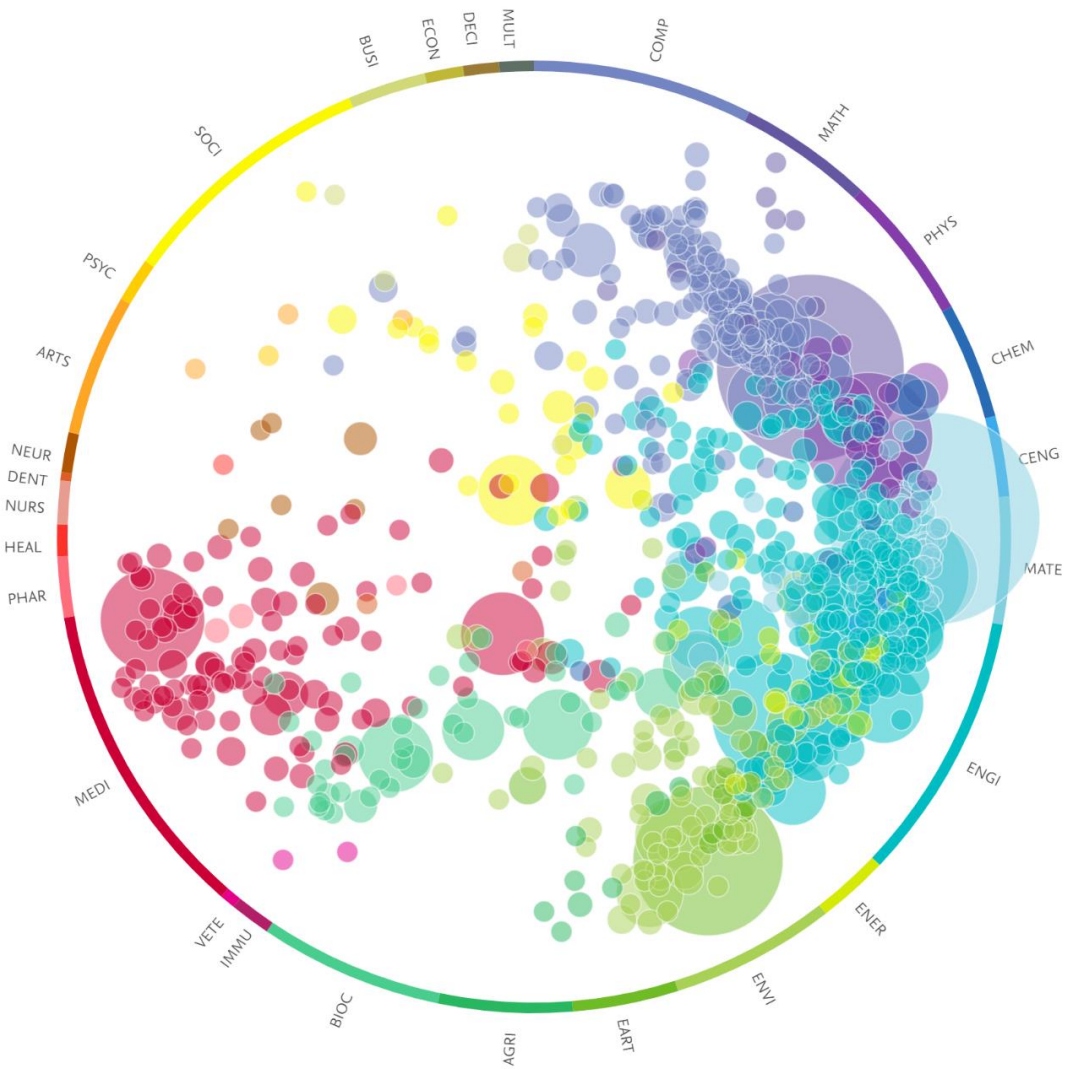
Publication Subject Areas/Research Topic Clusters

The diagrams in the next pages use SciVal data to visualise the relative publication share per subject area within the School of Engineering in Trinity between 2019 and 2024 inclusive. It shows a balanced portfolio among a broad range of scientific enquiry.

Publications by Subject Area: 2019-2024



Data source: Scopus, October 2024



Showing **914 Topics** for **School of Engineering**

Applied filters:

Year range	2019 to 2024
Subject area	All subject areas

Bubbles represent Topics

Bubble size: Scholarly Output of this Researcher Group

Bubble position is based on dominant ASJC categories.

COMP	Computer Science
MATH	Mathematics
PHYS	Physics and Astronomy
CHEM	Chemistry
CENG	Chemical Engineering
MATE	Materials Science
ENGI	Engineering
ENER	Energy
ENVI	Environmental Science
EART	Earth and Planetary Sciences
AGRI	Agricultural and Biological Sciences
BIOC	Biochemistry, Genetics and Molecular Biology
IMMU	Immunology and Microbiology
VETE	Veterinary
MEDI	Medicine
PHAR	Pharmacology, Toxicology and Pharmaceutics
HEAL	Health Professions
NURS	Nursing
DENT	Dentistry
NEUR	Neuroscience
ARTS	Arts and Humanities
PSYC	Psychology
SOCI	Social Sciences
BUSI	Business, Management and Accounting
ECON	Economics, Econometrics and Finance
DECI	Decision Sciences
MULT	Multidisciplinary

Significance and Impact of Research Outputs

Policy Impact

Of the publications from the School of Engineering 2019-2024 to date, 90 have been cited by 199 policy documents in 21 countries. 42.5% of these publications are cited more than once in policy. The map below highlights the source distribution of these policies, including Intergovernmental Organisations (IGO) such as the United Nations and the World Health Organisation.

The table below also compares the research areas, sources and related SDG categories of the citing policies and publications. Those highlighted in the table are new among the most recent publications and may represent emerging areas of interest.

The above policy data was collated from Overton.com using DOI publication data from Scopus.

Top topics of the citing policy

- Greenhouse gas emissions
- Nature
- Natural Environment
- Sustainability
- Air Pollution
- Climate change mitigation
- Infrastructure
- Economy
- European Union
- Earth Sciences

Top sources citing policy

- Irish Environmental Protection Agency
- Publications of the European Union
- ESRI
- EU Joint Research Centre
- Climate Change Advisory Council
- Government of Catalonia
- Swedish National Road and Transport Research Institute
- Food and Agricultural Organisation of the United Nations
- Government of Finland
- GOV.IE
- OECD
- Think-tank for Action on Social Change

Top journal subjects of the publications

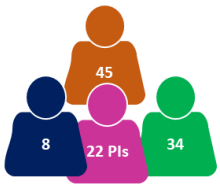
- Renewable Energy, Sustainability and the Environment
- Geography, Planning and Development
- Transportation
- Water Science and Technology
- Civil and Structural Engineering
- Environmental Science (All)
- Industrial and Manufacturing Engineering
- Environmental Engineering
- Aquatic Science
- Building and Construction

Top UN SDG categories citing policy relates to

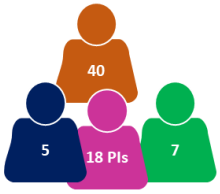
- SDG 4: Quality Education
- SDG 5: Gender Equality
- SDG 6: Clean Water and Sanitation
- SDG 7: Affordable and Clean Energy
- SDG 8: Decent Work and Economic Growth
- SDG 10: Reduced Inequality
- SDG 11: Sustainable Cities and Communities
- SDG 13: Climate Action
- SDG 15: Life on Land

People

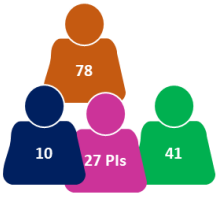
Our Researchers are a vital asset to our School, led by Academic PIs, supported and executed by our skilled technical staff, PhD candidates and Research Fellows/Assistants. Their work enriches our teaching programs to educate the next generation of engineers, meets today's global challenges and positions our School as a leader of Research Excellence in Engineering



Civil, Structural & Environmental Engineering



Electronic & Electrical Engineering



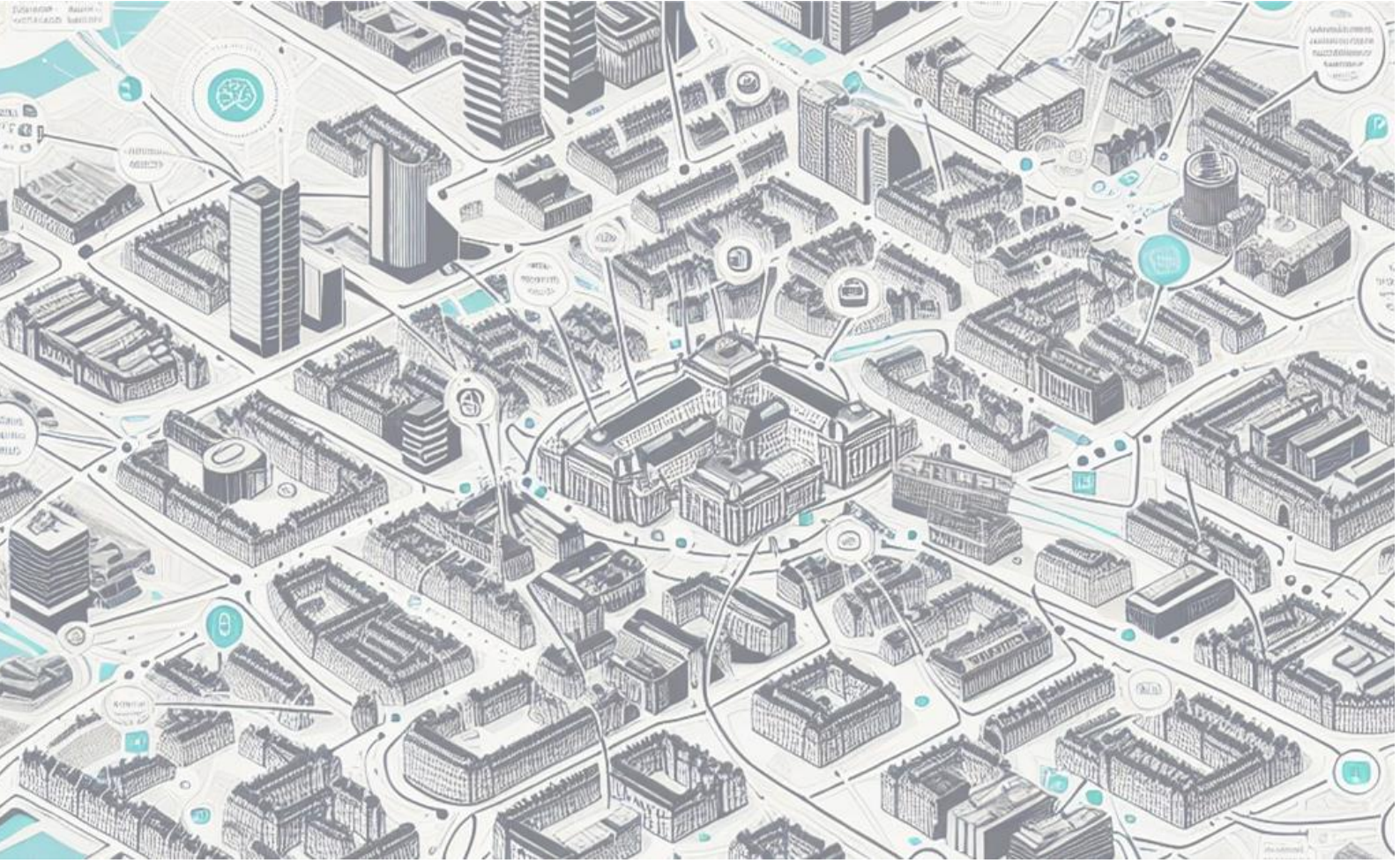
Mechanical, Manufacturing & Biomedical Engineering

Technical Support

PhD Candidates

Principle Investigators

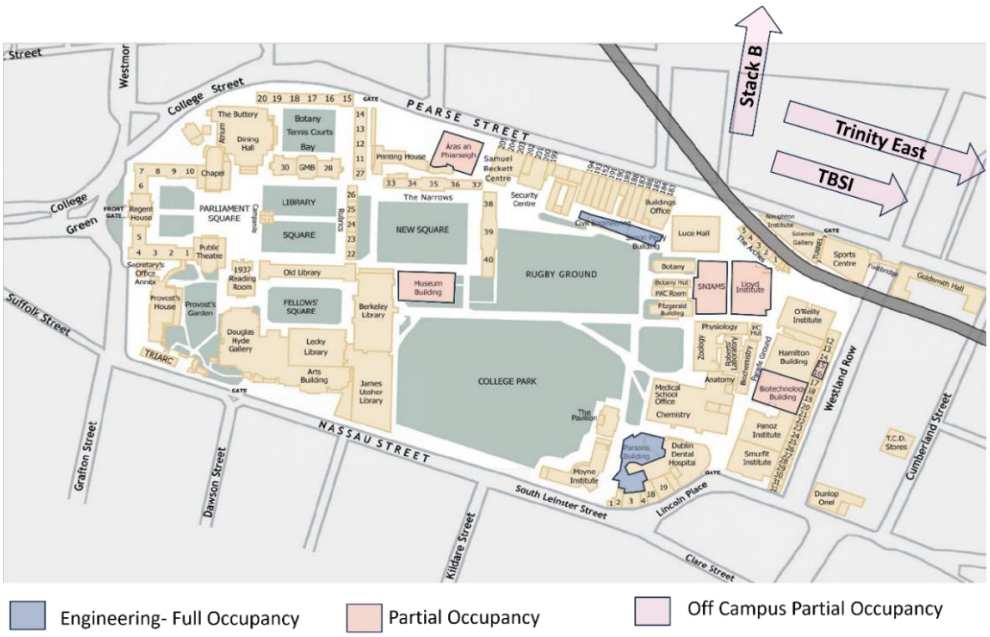
Research Fellows/Assistants



Research Infrastructure and Connections

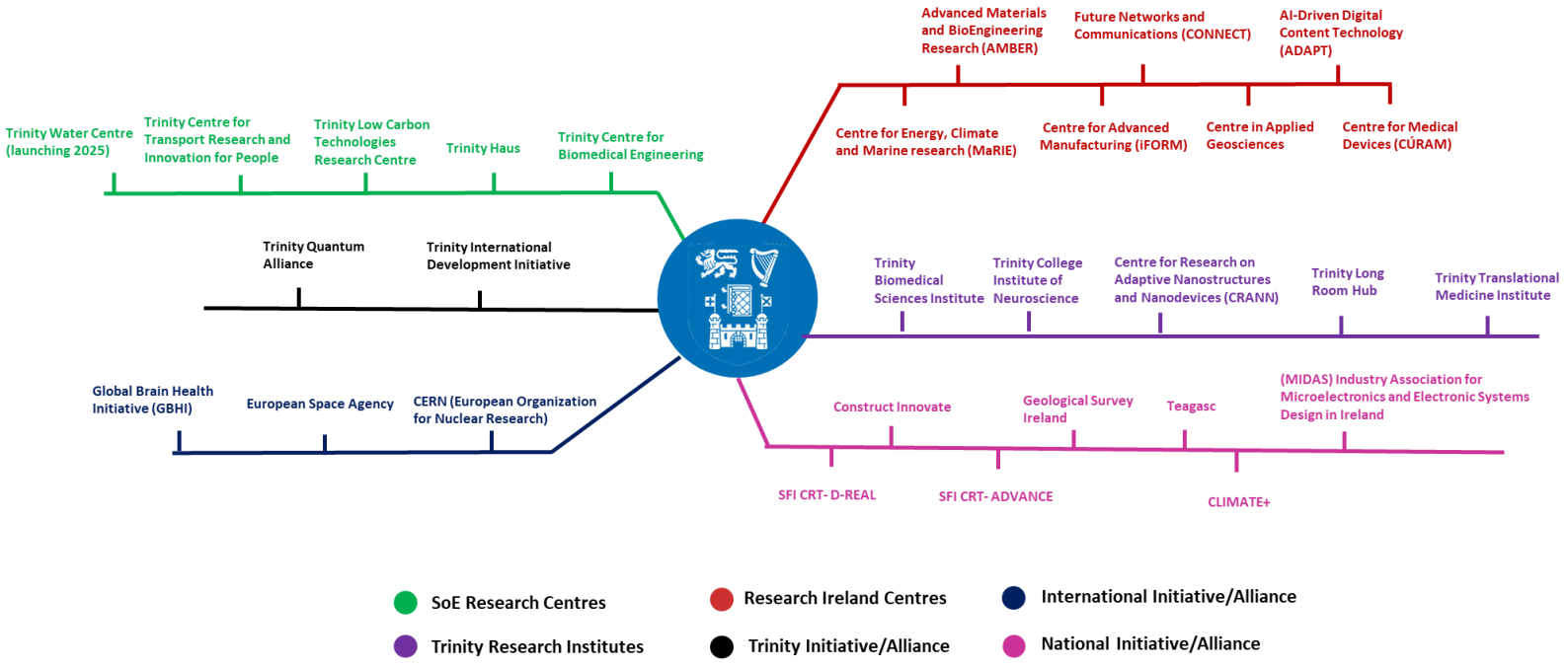
The School of Engineering is committed to finding real-world solutions to today's global challenges and conducts research across a highly diverse portfolio of research areas that cross discipline boundaries. Each discipline within the School: Civil Structural & Environmental Engineering, Electronic and Electrical Engineering, and Mechanical, Manufacturing and Biomedical Engineering, is very research active, with research occurring as part of world leading individual academic research groups as well as in the five College research centres head-quartered within the School; the Trinity Centre for Biomedical Engineering (TCBE); the Centre for Transport Research and Innovation (TRIP); TrinityHaus, Trinity's Research Centre for Construction, Innovation and Sustainability; the Low Carbon Technology Research Centre and the recently launched Trinity Water Research Centre. Much of the research is collaborative with other Schools in College and with national and international partners, including as part of four national SFI Research Centres to which staff from the School of Engineering also contribute significantly.

The School of Engineering is physically located across 14 separate locations that are spread across the main campus, Trinity East, and Stack B (located north of the river at Custom House Quay) According to the 2024 Space Planning Report, the School occupies approximately 7,962m^2 of space which is of varying quality and is split between the Disciplines as shown below.



Trinity is a research-intensive university, and the School of Engineering is the top ranked in its discipline nationally for research. Key research spaces include the laboratories on the ground and first floors of the Civil Engineering Building, the basement and ground floor of the Simon Perry Building, the second floor of the Watts Building, the Sigmedia labs on the third floor of Aras an Phiarsaigh, MMT labs in the basement of the IFSC Stack B, laboratories and workshops in the Parsons Building (Fluids and Heat Transfer, Materials Testing, Mechantronics, bio and nanomaterials), the Trinity Biomedical Sciences Institute (Medical Device Design, Biomechanics, Tissue engineering and regenerative medicine), Lloyd Building (Neural Engineering) and Trinity East (low carbon technologies).

Research in the School of Engineering is operated at 9 different locations – SNIAM, Civil Engineering Building, Simon Perry Building, Watts Building, Lloyd Building, Aras an Phiarsaigh, IFSC Stack B, Parsons Building, Trinity East, and Trinity BioSciences Institute. According to discipline, this space is occupied by MMBE at 56% (1622 m^2), CCSE at 23% (652 m^2) and EEEN at 21% (602 m^2).


Trinity Water Centre (launching 2025)
Trinity Centre for Transport Research and Innovation for People
Trinity Low Carbon Technologies Research Centre
Trinity Haus
Trinity Centre for Biomedical Engineering
Trinity Quantum Alliance
Trinity International Development Initiative
Global Brain Health Initiative (GBHI)
European Space Agency
CERN (European Organization for Nuclear Research)
Advanced Materials and BioEngineering Research (AMBER)
Future Networks and Communications (CONNECT)
AI-Driven Digital Content Technology (ADAPT)
Centre for Energy, Climate and Marine research (MaRIE)
Centre for Advanced Manufacturing (iFORM)
Centre in Applied Geosciences
Centre for Medical Devices (CÚRAM)
Trinity Biomedical Sciences Institute
Trinity College Institute of Neuroscience
Centre for Research on Adaptive Nanostructures and Nanodevices (CRANN)
Trinity Long Room Hub
Trinity Translational Medicine Institute
Construct Innovate
Geological Survey Ireland
Teagasc
(MIDAS) Industry Association for Microelectronics and Electronic Systems Design in Ireland
SFI CRT- D-REAL
SFI CRT- ADVANCE
CLIMATE+
SoE Research Centres
Research Ireland Centres
International Initiative/Alliance
Trinity Research Institutes
Trinity Initiative/Alliance
National Initiative/Alliance

Research Vision

School of Engineering research will be internationally respected and will lead transformation at the heart of Irish Technology and Innovation, delivering improved quality of life of Irish and global citizens.

Our Research Values

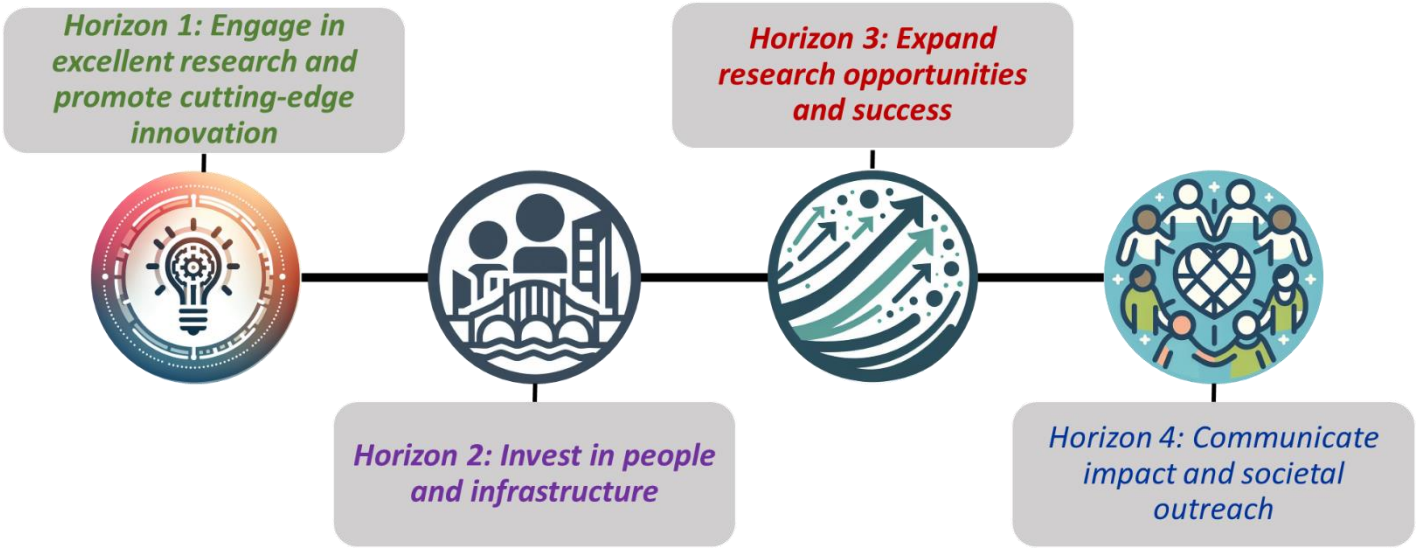
We are a research-led school that values cutting-edge innovation, leverages local, national, and international collaboration, and is focused on engineering solutions to the challenges in today's society while safeguarding for the future. We believe that this can be achieved through a blend of curiosity-driven and theme-focused strategies that address both fundamental engineering questions and challenges in all aspects of humanity and nature. All our research is performed with the highest integrity and ethical values.

We value the contributions of all stakeholders, industry partners, policy makers and the public to guide our research towards meaningful impact.

Research Mission

- **Support excellent and impactful research to improve humanity and nature**
- **Attract and grow innovation and a diverse multidisciplinary Faculty**
- **Invest in the quality and sustainability of our infrastructures**
- **Stand up for research and diversifying our funding**
- **Engage meaningful and moral-based partnerships with industry to create impact for society**
- **Train the engineering research leaders of tomorrow**

Strategic Plan 2025-2030



Horizon 1: Engage in excellent research and promote cutting-edge innovation

In the next five years, we will capitalize on our strengths, on our motivated and innovative faculty and on new funding opportunities to increase the impact of our research.

'Our ambition is to face future global engineering challenges such as energy, sustainability, production, climate, transport and engineering solutions in health.'

We will support our researchers to engage in excellent and impactful research that adheres to the highest standards of ethics and research integrity, pursuing greater innovation and entrepreneurship with curiosity and impact. We will focus on our existing and emerging strategic research strengths. Our researchers will lead national and international research activities in these strategic areas and will improve societal outcomes for communities and habitats. We build these activities through strong relationships between our research institutes, centres, industry collaborators, Hospitals and National Research Centres.

Strategic Actions

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- **Nurture existing, and establish new TCD research centres based on emerging clusters of excellence**
- **Protect time to do excellent research through a fair balance with other responsibilities**
- **Transparently invest and resource fairly in the sustainability of our infrastructures; standing up for research and diversifying our funding**
- **Engage meaningful and ethical partnerships with industry to enhance excellence**
- **Champion the modernization of administrative processes within our institution and implement internally.**
- **Capture internal and philanthropic opportunities to run proof-of-concept studies and bridge gaps in current resources.**
- **Streamline the translation and commercialization of research**
- **Continue and grow our research-led activities in undergraduate and postgraduate education**

Horizon 2: Invest in people and infrastructure

Strategic hires are required to provide the necessary expertise in computational modelling across all disciplines of research in the School of Engineering, medical device engineering and climate engineering to take on the challenges of our future and the growing fields of research in the School.

A diverse and innovative faculty is core to our research mission. We recognise the contributions of researchers at every stage of the research trajectory and the necessity for a viable and sustainable career pathway.

We will attract world leaders through prestigious schemes such as the SFI research professorships, European Research Council, Wellcome Trust and the Royal Society University Fellowships. We will prioritise research areas for future Trinity assistant professorship schemes to provide career progression for our early- to – mid- career researchers and engage with industry to support posts that will educate our students and promote research that is pertinent to the needs of their industry and markets.

Strategic Actions

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- **Appoint a world leading Research Ireland Research Professor in a strategic research area linked to a new AP hire simultaneously in a similar area.**
- **Increase research-focused training positions and new tenure-track engineering pathways, like the USSHER Assistant Professorship**
- **Champion for better PhD student stipends (25€k+).**
- **Establish annual prizes that recognize outstanding contributions to research and the achievements of our researchers, post-graduate students and**
- **Audit, review and modernise the quality of all our research spaces to enhance the researcher environment and ensure effective research**
- **Position our research infrastructure to meet the current and future needs of digitalisation and high performance computing**
- **Promote an ethos of diversity and ethical responsibility in our people**
- **Facilitate mentorship of early/mid-career academics with established senior academics in both the School and related disciplines**

Horizon 3: Expand research opportunities and success

We have an excellent and ambitious high-quality research and funding record to date, as Ireland's leading Engineering School. Strategically we have aligned our funding objectives to the future vision and investment made by the European Commission, and national and international funding agencies.

Securing continuous improvement and breakthroughs in societal and earth challenges is at the centre of the School's commitment to research and innovation within and beyond the context of the current global challenges.

By promoting early dialogue between entrepreneurs, innovators and industry, clinical and humanities-based researchers, and informing and engaging with policy makers, the school will accelerate the impact of its basic, translational, technology driven and challenge-based research with a view to achieving sustainability, impact, and climate neutral content. This will provide the opportunity to apply for Enterprise Ireland (EI) and Research Ireland funds and several schemes under the EU Horizon Europe (e.g., Pillar 1: European Research Council; Marie Sklodowska-Curie Actions, Pillar 2: Health, Digital, Industry & Space; Climate, Energy and Mobility; Food, Bioeconomy, Natural Resources, Agriculture & Environment, Pillar 3: European Innovation Council (EIC), European Institute of Innovation and Technology (EIT) EU4Health; LIFE Climate Change Mitigation and Adaptation, Digital Europe Programme (DEP), InvestEU, European Regional Development Fund (ERDF), European Social Fund (ESF+), Structural Reform Support Programme (SRSP) funding schemes.)

Strategic Actions

- **Accelerate the commercial impact of our research with frequent brokerage and showcasing events between entrepreneurs, innovators, and industries**
- **Host and inform quarterly training, information, and mentoring workshops to inspire our researchers to secure prestigious funding Research Ireland, the European Research Council, Wellcome Trust, the Health Research Board and global charities and foundations**
- **Build a substantive relationship with Trinity Development and Alumni to amplify our achievements and pivot funding towards impactful research.**
- **Extend the School's translational and multidisciplinary innovative research environments through engagement across several international and European-funded research networks.**
- **Support and protect time for research development and execution in a balanced and transparent workload model**

Horizon 4: Communicate impact and societal outreach

Societal outreach and communication of our impact is the cornerstone of our research communication strategy. Key to the successful implementation of improved research communications will be the development of new processes to explore, define, capture, and communicate our research achievements that broadly reflect the societal impact of our engineering research, within and beyond academia.

'Our supports for capturing and communicating impact and societal outreach will continue to build in the School of Engineering '

The School's Research Projects Officer (a key role jointly shared with the School of Natural Sciences), together with the School of Engineering's Marketing and Communications Officer and Executive Officer for Research, will continue to build capacity to measure and communicate our School of Engineering research impacts.

Strategic Actions

- **Optimise the reach and impact of the School's communication strategy, in co-ordination with the Office of the Dean of Research, the Trinity College Dublin Public Affairs and Communications (PAC) team, School of Engineering Media Relations Officer and Alumni Office.**
- **Promote and disseminate the scale and scope of our research impact through qualitative and quantitative research performance reports, School of Engineering Trinity Research Centre Annual Reports, and School of Engineering research metrics.**
- **Train and support our researchers to engage with knowledge users in framing research questions and approaches, and media training.**
- **Qualitatively and quantitatively evaluate our ability to set the policy agenda; decide how issues are framed, perceived, and represented in public documents and presentations, and have a definitive influence on policy.**
- **Cultivate a culture of communicating our engineering research impacts through showcasing projects that are making demonstrable positive differences to the humanity, society, and nature.**
- **Ringfence finances to facilitate open-access publishing costs to be distributed in an informed, fair, and transparent process.**

Implementation of the Research Strategy

This 2025-2030 School of Engineering Research Strategy leads us towards clear and tangible goals to achieve in the next five years. Several opportunities have been recognized during this process, not all of which could be distilled within this document but will be carefully included during this project. Aside from the Horizons described in the previous section, our School has ambitious targets in the next five years:

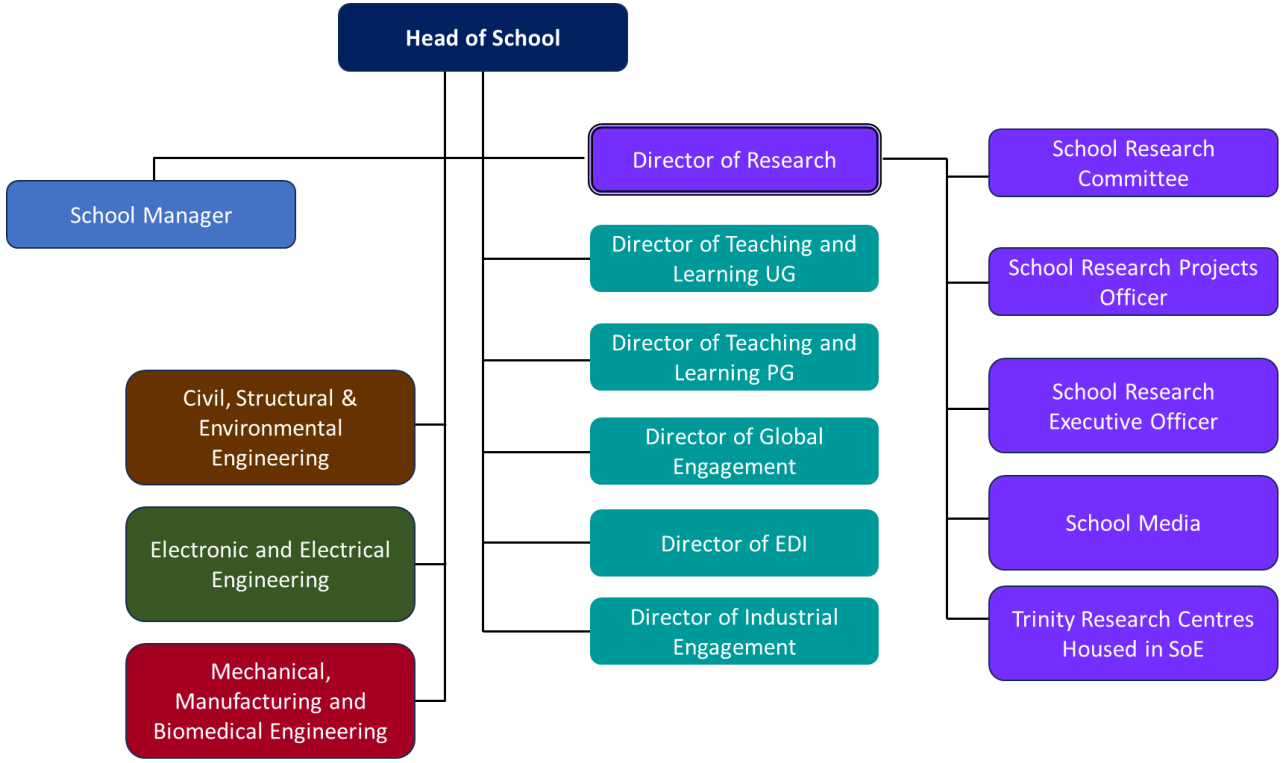
- Raising our annual research income to €20 million by 2030
- Securing much needed capital investment for building new state-of-the art research space and modernizing current space
- Doubling the citation number of School publications in policy and patent documents
- Increase our QS World University Ranking in the Subject of Engineering and Technology from 158 back to within the top 100 by 2030.

Although daunting, these targets are essential if the Trinity School of Engineering is to continue to play a leading role in Europe and the World.

Following this Research Strategy, all objectives will be categorized into priority, short-term and long-term tasks and a plan developed over the next five years.

‘Understanding our current excellence and opportunities gives us the opportunity to excel even further with a strategy’

School of Engineering Research Governance



The School of Engineering Research Committee is committed to maintaining high standards of governance and reporting and has put in place the appropriate structures consistent with this objective. Reporting lines for the Director of Research within the School and overall college structure are clearly defined and in place. This allows for School involvement in decision-making processes at school and college level. The Director of Research reports directly to the Head of School and provides information to the School Executive Committee and the School Research Committee. The Director of Research is a member of the College Research Committee, an academic committee which reports directly to Council.

Strategy Development

The School of Engineering Research Strategy 2025-2030 is the first Strategy Document from the School of Engineering solely focused on research and follows the School of Engineering Strategy Plan 2010-2020, and a disruption to normal operations during the COVID-19 Pandemic.

The new strategy has been designed and agreed following a detailed and inclusive consultation process undertaken between January 2024 and December 2024. The Director of Research, Professor Michael Monaghan, in partnership with the School of Engineering Research Committee, oversaw the project. Substantial input was also received from the School Executive Committee and senior management team in the School.

A fundamental objective of the process and the resulting document is to capture the breadth of research activity in the School and to formulate a new strategy aligned to Trinity research strategy in the context of the Irish University System and funding environment over the next five years. To underpin the strategy, the School undertook a comprehensive SWOT analysis, which has served as an important and valuable source of information and data to inform the strategy.

Strategy Development

The new strategy involved a detailed bottom-up and top-down consultation process, from the level of School Executive Committee right down to the individual researcher in each of the three disciplines. The results of the SWOT analysis provided an important and valuable source of information and data for the development of the strategy.

A distillation of the SWOT analysis produced the following key issues to address over the next five years and beyond:

STRENGTHS	WEAKNESSES
• Research reputation, especially in thermal-fluids, wireless communications, neural engineering, energy, biomedical engineering, networks & communications, transport • Clustered excellence of our Trinity Research Centres, brand identity and TCD as the premier national institution • Emerging areas; water, low carbon	• Bureaucracy of antiquated research financial accounting and HR processes • Government research spend declining and average value of grants decreasing • Bottlenecks in research space availability to facilitate growth • Lack of clear strategy and implementation for future opportunities • Lack of mutidiciplinary research with arts, humanities and social sciences
OPPORTUNITIES	**THREATS**
• Collaborative work with psychology, linguistics, law and other areas • Environmental issues, Sustainable Energy • Targeting specific themed calls • Artificial Intelligence and machine learning • Enhancing research-led activities in our undergraduate programs	• Administration, bureaucracy and undergraduate commitments increasing workloads and compromising time dedicated to research excellence • Falling rankings • Decline of national funding opportunities • Cost of living in Dublin • Limited capital investment into state of the art infrastructure and research spaces • Staff demotivation due to lack of recognition and bureaucratical hurdles

Research Impact Stories

How our research is making a positive impact on society and nature

The reduction of environmental noise and carbon emissions related to transport and in particular aviation has a clear policy and economic imperative. Air transport moves over 3.5 billion passengers annually and generates a total of 63 million jobs globally. It has a predicted 20-year growth forecast of the equivalent of 1300 new international airports and over 32,000 new aircraft. **The challenge facing aviation is to meet the predicted growth in demand for air travel while minimising negative impacts on the environment.** The International Civil Aviation Organisation's Committee on Aviation Environmental Protection (CAEP) and, in Europe, the Advisory Council for Aeronautics Research in Europe (ACARE) have set targets to reduce the environmental damage caused by aircraft due to fuel emissions and noise pollution. For example, ACARE's Strategic Research and Innovation Agenda (SRIA), or Flightpath 2050, has set goals for a 75% reduction in CO_2 emissions by 2050 and a 65% reduction in perceived noise emission of flying aircraft.

'Modern Ultra High By-Pass Ratio (UHBR) aeroengines reduce carbon emissions but generate difficult to attenuate noise. Our research into additively manufactured acoustic metamaterials is leading to novel sound absorbing technologies to reduce this noise.' Prof. Gar Bennett

Advances in material science and manufacturing has enabled Ultra High Bypass Ratio (UHBR) Aeroengines to be developed which will be implemented on aircraft in the near term. These advanced aeroengines will reduce fuel consumption and carbon emissions. However, as the engine ratio increases, the space available for noise absorbing materials called "liners" decreases. In addition, the noise signature changes, becoming more broadband and lower in frequency. It is an intractable challenge to absorb low frequency noise with thinner liners of current designs and so Acoustic Metamaterials (AMMs) have been investigated as an alternative to the traditional approach. Building on a Fulbright Scholarship of Prof. Gareth Bennett's, research collaborations between NASA Glenn, the University of Notre Dame and TCD have been established. Thanks to a benefaction from the Martin Naughton Foundation, with additional funding from NASA, research has resulted in the design, manufacture and testing of a novel AMM sound-absorbing liner for aeroengine noise reduction.

PhD students: Eoghan Ross (TCD) supervised by Prof. Gar Bennett, and Kelvin Figueroa-Ibrahim (University of Notre Dame, USA), have completed aeroacoustics tests on the NASA Glenn ANCF Fan Rig. The liner concept consists of approximately 250 3D printed parts and reduced noise output from the engine by up to 12 dB at some tonal frequencies.

Each square metre of a room on the third floor of the Trinity Biomedical Sciences Institute is linked with €5m in investment and approximately five full time jobs in the Irish economy. This room is the Medical Device Design lab in the Trinity Centre for Biomedical Engineering. The lab was established by Prof Bruce Murphy and its focus is on developing new medical device technologies that improve healthcare outcomes for patients. Companies that have spun-out of the lab include: Proverum Medical, CroíValve, Selio Medical and OneProjects (LUMA Vision). These companies are all developing next generation medical devices, their fundraising efforts have resulted in approximately €150m in capital being raised to support their development activities. The companies are all pre regulatory approval, while several of the devices are advancing through clinical trials and producing positive clinical data in patients. The CroíVlave DUO system has been through an early EU feasibility trial and has demonstrated transformative outcomes for patients. Patients' quality of life has been vastly increased post the procedure, while the principal investigator of the clinical trial has stated that the DUO system "offers new hope for patients suffering from severe tricuspid regurgitation". The DUO system continues to advance through the regulatory process and is now currently enrolling patients in a US FDA early feasibility trial.

'The future looks bright for the Medical Device Lab with projects in the gastrointestinal space (PLIO Medical) and the Mitral Valve repair space (MitrAdapt). A strong foundation for medical device development is now established in the School of Engineering and the Biomedical Engineering discipline in TCD. Trinity is now seen as a global leader in this field because of the activities of the 30 square metres on the third floor in the Trinity Biomedical Sciences Institute.' – Prof Bruce Murphy

Proverum's ProVEE treatment for the symptoms of Benign Prostate Hyperplasia, is further along in the development path, at present the ProVEE system has completed enrolment in its FDA approved pivotal trial. The company is awaiting the results of this trial, which should be reported in the first half of 2025. Both above devices went through the early development cycle in the Medical Device Design lab in TCD, under the guidance of Prof Murphy. The concepts were developed and proven in relevant environments in TCD, which allowed the company leaders, Lucy O'Keefe (CroíValve) and Conor Harkin (Proverum) to raise their initial capital that enabled further development work.

KineMo leverages artificial intelligence to meticulously monitor and analyse over time, the three-dimensional movement of athletes' joints during exercise and rehabilitation, using just a single mobile device. This innovation addresses a critical gap in athletic development and physiotherapy by providing accurate insights into movement competency, thereby enhancing performance, supporting rehabilitation, and reducing the risk of injury. Initially identified by Leinster Rugby, the need for such technology sparked the research efforts at Trinity College Dublin, resulting in the creation of KineMo. From the outset the emphasis of the team has been on accuracy, consistency, and ease of use, backed up by academic rigour, peer reviewed publications and case studies with clients. This TCD spinout now begins customer trials in April 2024 with a waitlist of sports, fitness, and rehabilitation organisations ready to incorporate it into their athlete development and rehab pathways.

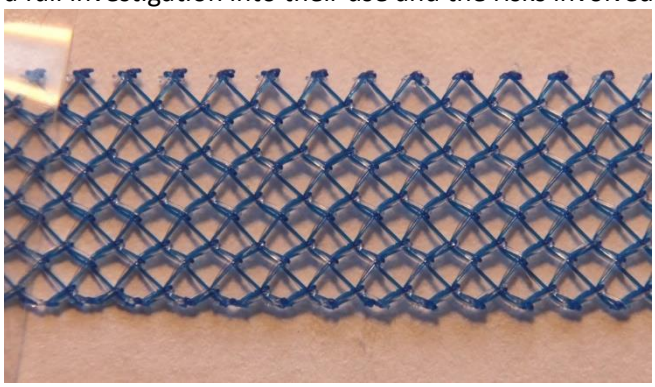
'As Professor in Biomechanics at Trinity College Dublin doing research related to injury biomechanics, a focus has been on how equipment design and impact configurations relate to injury outcomes in pedestrian and cyclist collisions, but also in sports. I have collaborated since 2016 with Leinster Rugby and their lead physiotherapist (Garreth Farrell), particularly relating to head injuries in rugby. In around 2018 we started thinking about automated video analysis of sporting collisions, this was the start of the KineMo journey.' -Prof. Ciaran Simms

Many of KineMo's features were previously only available within a biomechanics lab, which included an array of motion capture cameras and a team of specialists. KineMo endeavours to democratise this technology through its application's user-friendly interface and scalability, making it accessible to a wide range of users, from elite athletes to grassroots sports organisations. By delivering accurate, actionable metrics and data on movement competency, KineMo empowers teams, athletes, and professionals to optimise performance and minimise the risk of injury. Its adaptability makes it suitable for use in various environments, both indoors and outdoors, revolutionising the way movement is accurately tracked and analysed.

Since its inception KineMo has gone from strength to strength, increasing its multidisciplinary team to include Leo Peyton as the Commercial Lead, who brings a wealth of sports technology and commercial expertise to the project. KineMo is also honoured to be joined by Garreth Farrell, the Lead Physiotherapist at Leinster Rugby, whose insights and experience have proven invaluable in the development of KineMo. In addition, KineMo is also extremely fortunate to include among its advisors, Des Ryan, Director of Coaching and Performance at Setanta College, one of the leading youth coaches and performance managers in sport and a world-renowned practitioner and speaker in the field of youth athletic development and Lara Coyne, Chartered Physiotherapist PhD, MSc Sports & Exercise Physiotherapy and PhD Evaluating markerless motion capture systems in Premier League Football Academies

Prof David Taylor's research group works on the strength and fracture of biological materials and medical devices. In their work they often interact with the medical profession and with the Courts as a result of litigation for medical negligence and defect products. One such product is surgical mesh (see photo below) which has been used in transvaginal operations including vaginal prolapse and stress urinary incontinence. These products were banned when they were shown to cause organ damage. Surgical mesh is a fabric-like material which has been used, successfully, for over 50 years in the repair of hernias. In recent years, however, medical companies developed new products using this same mesh, for operations involving organs in the pelvic region. Many patients, the great majority being women, were implanted with pieces of mesh in operations to correct urinary incontinence and prolapse of organs such as the vagina, which frequently occurs after childbirth.

Many of these women have been condemned to a lifetime of pain and discomfort because the mesh has caused damage to surrounding organs and tissues, and it cannot be removed. As a result, the use of these products has been banned or restricted in many countries including the US, UK, Australia, and New Zealand. In Ireland we have been slow to realise the extent of the problem, but in July this year the Minister for Health announced that a pause had been placed on the use of these products pending a full investigation into their use and the risks involved.



The underlying causes of this damage were unclear until Prof Taylor's group developed experiments which showed that the mesh material, moving in the body, was able to cut and erode human tissue. They were not only able to explain the fault in these products but also to compare different products.

'The use of surgical mesh to treat pelvic organ prolapse and urinary incontinence seems to provide another example in which new products have been developed that expand the use of existing materials without conducting the necessary experiments to properly understand the material, and how it will react in its new application.'- Prof David Taylor

This work has been extensively referred to in legal cases, and Prof Taylor has been asked to assist as an expert witness, testing new products and examining explanted mesh samples. Melanie Power of Power Solicitors, experts in medical negligence litigation, said "Prof Taylor's work has been invaluable to us in developing our legal arguments and giving assistance to many women who have suffered as a result of these products".

TrinityHaus has become one of Ireland's leading research centres working in the area of Universal Design (UD). Enshrined in Irish legislation, UD is the "design and composition of an environment so that it can be accessed, understood and used to the greatest extent possible by all people regardless of their age, size, ability or disability". With this statutory basis, UD is key to Irish policy ranging from housing and transport, to education, health, and social care.

TrinityHaus has built a strong relationship with Ireland's national Centre for Excellence in Universal Design (CEUD) resulting in numerous UD built environment research projects across various sectors from housing to health. In this work, TrinityHaus collaborates with government departments (e.g. DHLGH and DCEDIY) and a range of Irish organisations such as the Housing Agency, the HSE, Age Friendly Ireland, among others.

Drawing on expertise in UD, planning, architecture, engineering, engagement, and co-creation, TrinityHaus works closely with TCD schools of Medicine, Natural Sciences, Business, and Social Sciences, along with institutes such as GBHI to develop transdisciplinary projects and research areas.

This includes the development of UD guidelines for Dementia Friendly Dwellings, and UD guidelines for hospitals, both of which have recently been approved by the WHO for their Global Dementia Observatory Knowledge Exchange Platform. Further work includes research and development of Government of Ireland UD guidelines for Early Learning and Care Settings, currently being converted into online learning modules, a communication strategy, and website.

TrinityHaus has also conducted research funded by the SFI, HRB, and CEUD investigating long term residential care (LTRC) settings as part of the centre's Healthy and Inclusive Places research theme. Based on which, the centre is being consulted by the Department of Health around their LTRC policy, and by the Commission on Care for Older People.

TrinityHaus members take leading roles in several NSAI committees, including chairing NSAI/TC 023/SC 01 "Accessibility in Built Environment", which enhances the impact of their UD work.

More recently, TrinityHaus has used their UD and people-centred lens in Horizon Europe projects examining climate adaption and resilience, and initiatives looking at brain health, urbanisation, and climate change, the nexus of the built environment, ageing, and urban ecosystems. This work not only reinforces the importance of UD for a holistic approach to the built environment, but also supports the integrative philosophy behind the UN SDGs or the EU New European Bauhaus.

The Trinity Water Centre Prelaunch event on September 30, 2024, provided Trinity staff with an in-depth view of the Centre's progress and vision. Bringing together over 25 principal investigators (PIs) from 9 different disciplines, spanning across 5 schools within Trinity College Dublin, the Trinity Water Centre serves as a collaborative platform fostering interdisciplinary research on water-related issues. Beginning with a screening on the global water crisis from the Water Economic Forum, the event emphasised the critical need for research in water and climate adaptation. This introduction paved the way for an overview of the Centre's foundational work, its mission and goals, and its strategic path forward, grounded in dedicated expertise, key partnerships, and impactful research initiatives.

The event also spotlighted some of Trinity's most innovative water research projects, covering areas from ecological impacts to engineering solutions that advance water sustainability. These projects underscore the university's commitment to tackling pressing water-related issues through cutting-edge research.

The Climate & Water Panel offered a broader lens on these topics, facilitating an engaging discussion on the connections between climate change and water management. Panellists shared actionable insights on resilience, sustainable water practices, and adaptive strategies, with a focus on how the Trinity Water Centre is positioned to address these global challenges effectively.

DigiAcademy, a groundbreaking initiative from Trinity College Dublin (TCD), is poised to revolutionize digital inclusion for individuals with intellectual disabilities (ID). DigiAcademy originated as a interdisciplinary pan EU programme funded by EIT Health, who continue to support. DigiAcademy is now a recognised Trinity Campus Company and has recently received funding from Enterprise Ireland HPSU. Spearheaded by Dr. Esther Murphy, a Principal Investigator at TCD's School of Engineering and a collaborator with the SFI ADAPT Centre. DigiAcademy embodies a transformative vision: equipping individuals with ID with essential digital skills while fostering pathways into education, employment, and community participation. The startup, which spun out in 2024, has already been recognized as a European Commission Best Practice Model.

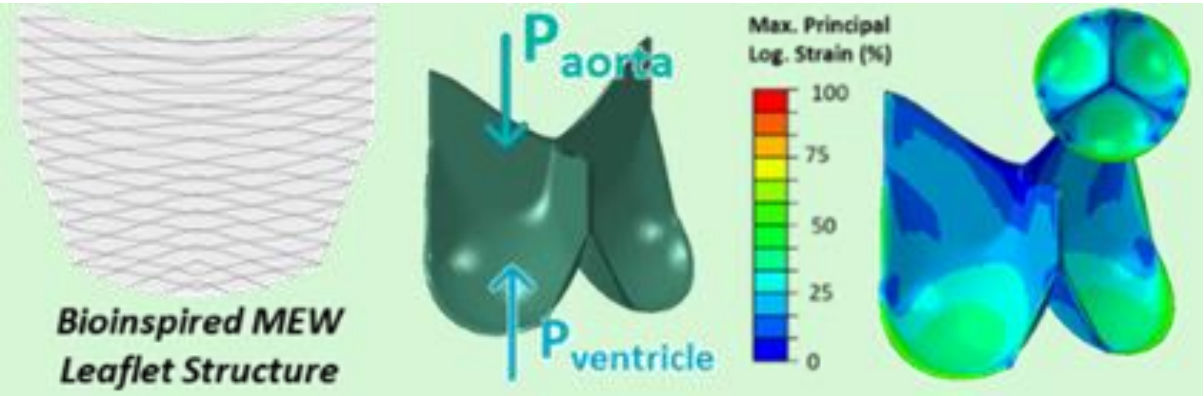
A Transformative Approach to Digital Literacy : At its core, DigiAcademy is a co-designed platform led by individuals with ID, leveraging their lived experiences to create accessible, impactful digital education. The ethos, "*If you can see it, you can be it*" drives its mission, with Citizen Advisory Panels instrumental in providing employment and shaping the platform. These advisors, many now trained and hired as digital tutors, support peer learning, reducing the reliance on one-on-one teaching and enhancing scalability. By focusing on mainstream tools like Microsoft Office and online safety, DigiAcademy equips learners to navigate the digital world confidently.

Impact and Societal Reach: The platform's influence extends beyond education, challenging societal norms about the capabilities of individuals with intellectual disabilities/autism. Through strategic partnerships with organizations and employers, DigiAcademy creates inclusive work experiences, paving the way for learners to contribute meaningfully to the workforce and in parallel empowering workforce to meet digital accessibility compliance. Dr. Murphy's innovative efforts were recognized with the Societal Impact Award from TCD, acknowledging the transformative power of her work and Audience Choice Award at Disrupt by the Sea 2024 investor pitch event. The Digi-ID research has been recognized as a significant contribution to the field of intellectual disability, featuring among the most cited articles in 2023.

Harnessing AI for Greater Impact: DigiAcademy's ambitions extend into AI, aiming to ensure that the ID community benefits from emerging technologies. Personalization through AI will allow learners to progress at their own pace, tailoring content to their unique needs. Furthermore, machine learning will identify effective teaching methods and areas for improvement, enhancing the platform's reach. AI tools also promise cognitive support, empowering learners to overcome barriers and participate fully in society.

Towards a More Inclusive Future: As DigiAcademy enters an exciting phase of growth, with paid pilot programs and corporate collaborations underway, its mission is clear: to build a more equitable future through technology and empowerment. By unlocking the potential of learners with ID, DigiAcademy not only enriches lives but redefines what inclusive digital education can achieve.

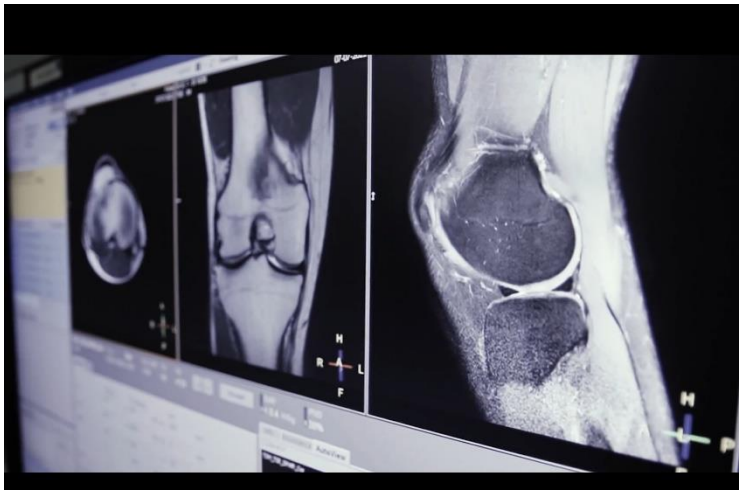
Aortic stenosis (AS) affects about 4% of people over 70 and has a 50% chance of mortality within 2 years when left untreated. Bioprosthetic heart valves are used to treat AS and can be delivered through minimally invasive surgery but their lifespan is often compromised by the long-term performance of the heart valve leaflet material, This is due to both structural damage and/or calcification in the leaflets. Prof. Lally's research group has been working with Boston Scientific in Galway for nearly a decade to better understand the mechanisms of structural damage and calcification in bovine and porcine pericardium, the main materials used in commercial bioprosthetic heart valve leaflets. Using experimental and computational approaches, they have identified the complex relationship between leaflet material damage and calcification and established a non-destructive means of screening these leaflet materials to improve their long-term performance. In addition, they have developed a novel in-silico framework for creating 3D-printed, bioinspired polymer leaflets which have the potential to have superior durability to pericardial leaflets. Informed by imaging and mechanical characterisation of native porcine aortic leaflets, they have created a novel preclinical design tool to inform and optimise material selection and leaflet structure for different valve leaflet shapes and varying clinical cases. This work has the potential to inform the design of bioinspired polymer heart valves that can outperform current commercial devices and improve patient outcomes.



This collaboration with Boston Scientific in Galway has also resulted in a new collaboration with Boston Scientific in Clonmel in the Urology area supported by the SFI AMBER centre, with the aim of creating *in-silico* and bench-top models for the design and optimisation of urological medical devices.

Osteoarthritis is one of the leading causes of disability worldwide. Damage to articular cartilage, whether from trauma or degenerative changes, significantly accelerates the onset of osteoarthritis. Since cartilage lacks the innate ability to heal or regenerate, finding a solution to restore native cartilage is considered one of the "holy grails" of orthopaedics today.

Co-founded in 2022 by Prof. Conor Buckley, Prof Daniel Kelly, and Dr. David Browe, Altach Biomedical, a spinout from Trinity College Dublin is at the forefront of developing off-the-shelf cartilage scaffolds to support the regeneration of damaged knee joints. Altach is dedicated to pioneering regenerative cartilage technology to address the significant problem of untreated cartilage defects, which affect one in four adults and can lead to osteoarthritis. Altach's goal is to set a new standard in cartilage repair by creating biomimetic 3D scaffolds made from Type II collagen, the primary component of natural cartilage. These scaffolds facilitate the migration of the body's own cells to effectively regenerate cartilage. Altach's technology aims to improve long-term outcomes in cartilage repair procedures, which are often constrained by current methods.



"Our solution is unique in that it uses type II collagen which is found in native healthy cartilage as the building block to promote tissue regeneration"- Prof. Buckley

Following successful preclinical trials at Trinity College, Altach is now working towards achieving CE marking. Altach recently secured €1.2 million in funding to advance its innovative treatment for cartilage injuries. The funding round included participation from various investors, such as NLC Health Ventures, the Stepping Stone Fund, and individual angel investors. This investment will enable Altach to scale up its manufacturing capabilities and validate its product ahead of clinical use. The company has already made significant progress, achieving key development milestones, including the granting of a U.S. patent for its technology. According to CEO Tomir Kosowski, the scaffolds developed by Altach represent a significant advancement in cartilage repair treatments, with the potential to reduce recovery times and enhance the quality of healing. This innovation comes at a crucial time, as the demand for cartilage repair procedures is substantial, with over 600,000 performed annually in the U.S. alone. The market for cartilage repair is projected to grow to approximately $5.9 billion by 2031.

For more information, please visit: https://altach.health/

Engineering better pictures for the future- Sigmedia and Trinity College Dublin School of Engineering join The Alliance for Open Media

Video entertainment took off during the pandemic and hasn't looked back since. When we were all stuck at home, TV watching and online streaming surged over 30% compared to the months before lockdown. Real time video communications tools became so popular that some of the company names became nouns and verbs, think of Zoom. It was only because of those applications that many of us could continue to work, and economies did not shut down entirely. This success was in a very real sense the culmination of decades of development by thousands of researchers in the area of video compression. Without the technology of video compression nothing could be streamed to anyone because the data rates would be too high for the internet or digital television. The big problem though is that highly compressed pictures look pretty bad compared to the original material. Netflix, YouTube, and others spend a great deal of effort figuring out how to make the pictures look good despite that.

"The technology for making pictures look great is the invisible magic powering cinema, streaming and TV worldwide. We are honoured to be invited to join the Alliance for Open Media and sit alongside Netflix, YouTube, Meta, Apple, Amazon and so many others." Prof. Anil Kokaram

The Sigmedia Group at the School of Engineering has been working on technologies to improve picture quality for more than 25 years. During a career break with YouTube, Prof Kokaram was part of pioneering efforts that developed a Neural Network to automatically control a video compression system so that it produces high quality pictures. Since then, researchers at Sigmedia have been working on AI algorithms which enhance picture quality using an understanding of human perception. PhD student Darren Ramsook won a prize at an international competition at the 2023 Data Compression Conference in Utah, at the same table as influential companies like ByteDance (who make TikTok). PhD student Vibhoothi and Julien Zouein working with the open-source broadcast community won a prize at the international broadcasting convention in Vegas in 2024 for efforts to change the way encoders were being used.

Sigmedia
Signal Processing for Media Applications

Alliance for Open Media
An Alliance of Global Media Innovators

Because of these long running efforts, the Sigmedia group has been invited to join with teams at Netflix, YouTube, Apple, Google, Meta, and others to shape the future of video compression. We look forward to collaborating with this Alliance for Open Media (aommedia.org) to develop the next generation of video compression technologies.

Efficient, clean, safe, and reliable transport systems are the backbone of cities, towns, and villages. While they are vital for our society to function, they can come with several negative consequences. Transport is the second largest producer of emissions in Ireland and one of the largest contributors to emissions globally. Transport also has a large impact upon air quality in our communities. Congestion in Dublin was estimated to cost the cities economy €336 million in 2022 and will grow to €1.5 billion by 2040 without action. **The challenge that has been set for the transport sector in Ireland is to reduce emissions in the sector by 50% by 2030**.

Research being conducted in the School of engineering is examining means to achieve these emissions goals. Several research projects are currently underway using a variety of approaches which include modelling of traffic movements in towns and cities, testing new vehicle technologies and piloting sustainable mobility solutions. Much of the research that is being conducted is done using an interdisciplinary approach and researchers from the school are working with psychologists, economists, computer scientists and geographers.

"The challenge of reducing transport emissions while still maintain high levels of mobility, with an increasing population, is a large task. Our research is examining pathways to reduce these emissions by making our transport networks more efficient and safer". Prof Brian Caulfield

The SEAI funded TRACT & ROBUST projects are both examining how new modes of mobility could be adapted in urban and rural contexts. The research in partnership with the ESB will trial the use of shared electric vehicles, e-cargo bikes, and electric bikes in five locations across Ireland. Insights from these studies will inform national policy on the rollout of hundreds of similar shared mobility hubs. Research informing policy and making impact is a theme of the transport research that Prof Brian Caulfield is producing in the School. He was the lead author of the transport chapter in the EPA's 2024 State of the Environment Report and he was a lead author of Irelands first Climate Change Assessment report. Work produced by his team has been cited in many international climate reports including the UN IPCC 6th Assessment Report in 2022.

When you watch the latest blockbuster in cinema, you are not only watching the actors but also the work of thousands of motion picture engineers working on set and in post-production. Their job is to make their work invisible. This allows you to suspend disbelief and watch a feather take an impossible path onto the lap of Tom Hanks in Forest Gump (1994) or Brendan Gleeson remonstrate with missing fingers in The Banshees of Inisherin (2022). The tools behind these tricks are the result of decades of research into the behaviour of light, cameras, and the interaction between individual picture elements (pixels) within a frame and between frames.

For over 25 years the Sigmedia team has been improving the understanding of the science of motion pictures. The academics in the group working on visual media quality have been interfacing with the cinema industry for quite some time. Our work on automated colour grading helps reduce the time and effort needed by colourists to match the colour of two scenes shot at different times of the day. These algorithms, amazingly based on 19th century mathematics on the problem of "mass transportation", mathematically transform the colours in one shot into that of the other shot. Most famously, our collaboration with world renowned VFX software manufacturer Foundry, on modelling motion between frames, led to an Oscar back in 2007.

"For over 25 years the Sigmedia team has been exploring the science of motion pictures. The EU funded research project Emerald is allowing us to work with the best people in the industry to push the boundaries of what is possible." Prof. Anil Kokaram

Our recent EU funded collaboration has the group working with Emmy and BAFTA winning teams from Disguise and the BBC on the use of AI and Virtual Production (VP) in TV and cinema production. Pioneered in the making of The Mandalorian (2019), VP employs huge LED walls to immerse an entire set in a projected simulation of a real, remote location. It reduces the need for people to travel to shoots on-location and enables the realistic representation of imaginary worlds. The pictures used in VP consume a lot of storage space: each frame could contain 48 million pixels. That means it takes hours to transport pictures between sites, making it hard for teams to iterate quickly on picture quality. We are trying to make this faster by developing algorithms to compress the pictures and reduce transport times by a factor of 10. To do that we need a way to measure the impact of compression on picture quality. In October we presented the first such process at a conference of the Society of Motion Picture Engineers in Hollywood California. Together with our partners at Disguise, we are working to change the industry with these ideas once again.

The increasing integration of weather-dependent renewables (WD-RES) like wind and solar raises concerns about grid stability in severe weather. While some studies link renewables to grid instability, others find them reliable even in adverse conditions. The lack of understanding of RESs' impacts on power system blackouts raises doubts about RESs, potentially hindering climate goals. Understanding renewables' role in outages is essential as the ambitious high-RES targets and carbon emission goals advance.

By combining regional weather data, WD-RES penetration levels, and outage statistics, our recent research uses statistical analyses to compare outage intensity (number of affected customers, demand loss, and duration) across different WD-RES penetration levels. Additionally, causal inference methods explore the relationships between weather, WD-RES penetration, and major outages, and deep learning clusters weather data to identify typical severe outage.

"In the process of global energy transformation, the challenges of achieving ambitious low-carbon energy goals fuel my passion for advancing sustainable, resilient, and intelligent electricity systems."- Prof Jin Zhao

According to U.S. large-scale outage data from 2001 to 2020, higher WD-RES penetration does not increase outage vulnerability. Instead, grids with more WD-RES tend to experience lower outage intensities. The influence of WD-RES on outages diminishes as penetration increases, especially in severe conditions. Although extreme weather raises outage risks, higher WD-RES penetration does not amplify this vulnerability. Under extreme conditions, WD-RES is not a primary driver of outages; weather's direct impact on outages is greater than its indirect impact via WD-RES.

At the large grid level, WD-RES appears less vulnerable than commonly perceived, with no long-term evidence indicating the unreliability. In fact, high WD-RES levels may be associated with systems featuring advanced planning and resilience, linking WD-RES with reduced outage impacts and lower weather-related vulnerability. However, extreme weather remains a risk for all power systems. Enhancing grid resilience and weather monitoring is crucial for reducing outages in high-RES systems.

The study mainly based on the U.S. database, and the next step research of our IResX lab is to specifically focus on our Irish power systems which is different from the large interconnected U.S. or continental Europe power systems.

ARTSFORMATION (2020-2023) was an EU Horizon project exploring the role of arts in the digital transformation of society. Dr Harun Šiljak was a PI on this project from 2021 (the original PI was Prof Linda Doyle), leading the Trinity team in their investigation of structures of engagement between arts, communities, and enterprise. When an artist enters an organisation, how do they do it, and what sort of power relationships are formed? What is the history of art residencies in tech companies, research centres, and beyond? How should policy be shaped to ensure fairness, mutual understanding, and achievement of goals for the artist and the organisation? These were some important questions in their focus. The project dealt with emerging technologies in real time: during the project's duration, artists engaged with the rise and fall of non-fungible tokens (NFTs) and made first steps at quantum technology art.

"The word technology is so often linked with future. What futures do we imagine with technology, and how does art support, subvert, or interrogate those imaginaries?"- Prof Harun Šiljak

Over the course of the project, Dr Šiljak worked with Dr Tom O'Dea, Dr Fiona McDermott, and Dr Radek Przedpełski to map out the complicated relationships, classify and categorise them, and extract useful guidelines for policy. This work was directly used to inform The Arts Council in Ireland in the process of devising their digital policy. At the same time, Goethe Institut was developing their new artist-in-residence programme Studio Quantum at the intersection of art and quantum technologies. The Trinity Artsformation team had important inputs to provide in this process. Not only did they provide the systemic understanding of art residencies, but also the expertise in quantum technologies, as they were all part of SFI CONNECT centre during its intense growth in quantum communications research area.

While engaging actively with the arts policy, Trinity's Artsformation team recognised an important role they can play in policy framework for emerging technology. Dr Šiljak once again brought Dr McDermott and Dr O'Dea into a pioneering research project on Irish and international policy interventions in quantum technology, named Not A Space Race. This project, funded by SFI CONNECT Centre now serves as a core of Dr Šiljak's wider research programme on technological policy and politics of technology, a focal point of critical technology studies in the School of Engineering.

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