ÓPC SNAPSHOTS 2015/2016



Leaders in research and teaching

Community Engagement

Robotronica Festival, 23rd August 2015

A spectacular display of international and QUT grown robots, drew a massive response from the community with over 18,000 people participating in a range of robotic activity from workshops, demonstrations, games performances and talks.



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Science and Engineering at QUT

We are renowned for providing high-quality, real world-focused teaching across the fields of science, technology, engineering, mathematics (STEM) and urban development

- Australian Research Council (ARC) Australian Centre of Robotic Vision
- ARC Centre of Excellence for Mathematical and Statistical Frontiers
- 21 disciplines in 6 schools
- 11,400 students, and growing
- Real-world learning
- Cutting-edge courses
- Professional recognition
- Scholarships and development
- Global opportunities



Foreword

The new global economy is growing, led by smart companies with innovative technologies. The engine room for growth is STEM: science, technology, engineering and maths. STEM is delivering innovative solutions, creating new sources of wealth and bringing new skills to our workforce. It's an exciting time and the Science and Engineering Faculty at QUT is perfectly placed to bring STEM skills and solutions to our students, industry and government. In the last year, the Science and Engineering Faculty created Vision 2020: a strategic plan for delivering the STEM education and research needs of our partners. You can read more about Vision 2020 on page 5.

SEF's reputation for STEM education continues to grow. 2016 saw the highest demand on record for our courses, with our student numbers passing the 10,000 mark. Beyond our enrolled students, we delivered STEM education around the State and across the globe. On page 25, you can read more about our two Massive Open Online Courses (MOOCs) that connected to more than 40,000 participants. We delivered hands-on STEM programs to more than 30,000 Queensland school students on campus and reached out to another 22,000 through our Widening Participation Program.

Our research delivers real world impact, ranging from submersible autonomous robots that eradicate the devastating Crown of Thorns Starfish to new species of crops that can withstand drought, pest and disease. The ability to deliver STEM solutions is underpinned by the strong disciplinary research across the Faculty. The Excellence in Research for Australia benchmarks for research quality rated 100 per cent of SEF's research as world standard or above.

Our researchers and educators continue to attract international acclaim. 13 SEF staff were recognised as Fellows by the UK Higher Education Academy in the last year and we have 3 Australian Research Council (ARC) Laureate Fellows (see page 8).

I'm delighted to bring you this issue of Snapshots and hope this gives you some insight into how we are changing the world through education and research.

Professor Gordon Wyeth Executive Dean QUT Science and Engineering Faculty

Vision 2020

Our Mission is to be the partner of choice for STEM education and research.

SEF's ambition is bold. Quite simply, we want to change the world, make it a better place. Our tools to deliver change are education and research – and our vision is to develop a reputation as being the best in these areas when it comes to Science, Technology, Engineering and Mathematics (STEM).

By 2020 we will create positive change by educating people about the STEM fields and placing quality, QUTapproved, STEM practitioners into the world to make a real difference across the community, the environment and the economy. QUT graduates will be equipped with the knowledge and skills to address real industry challenges and government objectives that lead to an improved way of life for Australia and the world, enhancing QUT's reputation as a partner of choice and a provider of quality.

Our research in STEM disciplines will lead to new knowledge and innovation that is evidenced not only in print, but in practice. We will create research outcomes that are heard and adopted, and that change the way people live.

Vision Statements

SEF will achieve the above stated mission by doing the following:

- creating highly valued STEM learning experiences
- building authentic assessment based on Real World STEM practice
- creating new research at the frontiers of STEM knowledge
- delivering innovative STEM solutions that have real world impact.

ARC Future Fellowship and Training Centre

Dr Tim Dargaville received an \$812,460 Australian Research Council (ARC) Future Fellowship grant to develop bio-inks that supply nutrients and remove waste products from 3D printed body organs. The ARC awarded 50 Future Fellowships in 2015 in a competitive round of approximately 300 applicants. Dr Dargaville said the fellowship recognises of the importance of bio-fabrication to the future of medical treatment, and Australia's economy.

While bio-fabrication researchers around the world has managed to grow 'human' organs using 3D printing techniques, long-term survival of the organs remains a major problem.

"The artificial pancreas is a perfect example of a great idea for curing diabetes, but once implanted inside the body it works for only a short time. To address this problem we aim to develop a new 3D moulding process for generating soft materials containing the micro-channels needed to enable blood supply to an entire organ," Dr Dargaville said.

QUT has also received \$3.73 million under the ARC's Industrial Transformation Training Centres scheme to establish an ARC Training Centre in Additive Biomanufacturing, to make Australia a world-leader in the 3D-printing of body parts. Research undertaken at the training centre, led by Professor Dietmar Hutmacher, will change the fields of science, health and biotechnology. The training centre aims to bring together leading researchers and industry to develop and translate key technology platforms for personalised treatments of challenging medical conditions.

ARC Linkage Projects

QUT has also received ARC Linkage Projects scheme funding for the following research projects:

- Professor Margot Brereton (Science and Engineering Faculty, SEF) and team - \$235,000 to co-design a social, interactive and visual internet search interface for people with intellectual disability. Partnering with Endeavour Foundation.
- Associate Professor Adrian Bridge (SEF) and team \$391,000 to develop a whole-of-life procurement decision-making framework so schools can make delivering better education more cost effective. Partnering with various government and private organisations.
- Associate Professor Scott McCue (SEF) and team \$412,000 to build interactive software that simulates agrichemical spraying for multiple virtual plants reconstructed from scanned data. Partnering with Plat Protection NZ, Syngenta and Nufarm Australia.
- Professor Lidia Morawska (Institute of Health and biomedical innovation, SEF, Institute for Future Environments) and team -\$445,000 to develop innovative, cost-effective, high resolution air quality networks. Partnering with various government organisations and Beijing's Tsinghua University.

World leaders in research

Under the QS World University Ranking by subject 2016, QUT disciplines ranked in the top 100 universities for Architecture/ Built Environment and Civil/ Structural Engineering; and in the top 150 universities in the Mechanical/ Aeronautical/ Manufacturing Engineering and Computer Science/ Information systems category.

> 2015 ARC Australian Laureate Fellow, Professor Kerrie Mengersen's project uses statistical knowledge to help solve real-world challenges including monitoring the health of the Great Barrier Reef.



Australian Research Council (ARC) Laureate Fellows

Professor Kerrie Mengersen, 2015

Professor Kerrie Mengersen (pictured page 7) was awarded \$2.4 million over 5 years for her project, Bayesian Learning for Decision Making in the Big Data Era. The project will transform the way in which Australia is equipped to prosper in the Big Data Era by translating statistical knowledge to real-world challenges in industry, environment and health - from mapping cancer to monitoring the health of the Great Barrier Reef.

Professor Peter Waterhouse, 2016

Professor Peter Waterhouse (pictured) received \$2.7 million to overcome a key barrier to future-proofing the world's crops. Professor Waterhouse's ARC project aims to fully understand how a plant's genes are distinguished, and to develop ways of precisely enhancing, repairing, updating and/or redirecting genetic traits in harmony with the genome. A crop plant's genes determine its growth, development, survival and agronomic fitness. The ability to precisely edit genes in crop plants is tantalizingly close but significant barriers must be overcome. Anticipated outcomes are safer, higher yielding and more sustainable crops.

Professor Dmitri Golberg, 2016

Professor Dmitri Golberg has received \$2.6 million to develop new ultralight and super-strong structural composites and 'green-energy' nanomaterials, such as solar cells, touch panels, batteries, supercapacitors, field-effect transistors, light sensors and displays. He will use spatially-resolved, dynamic in situ transmission electron microscopy to research fundamental mechanical, electrical, thermal, optical, optoelectronic and photovoltaic properties of diverse nanostructures. Anticipated outcomes are new ultralight and super strong structural composites and 'green-energy' nanomaterials, such as solar cells, touch panels, batteries, supercapacitors, field-effect transistors, light sensors and displays.



New species discovery

Researcher Dr Andrew Baker (pictured with a threatened Black-tailed Antechinus) and his team have named two new species of Dusky Antechinus. One new species was discovered in remote, south-eastern Tasmania and another mainland form was raised to species status.

The team has now discovered five new species of antechinus in the past three years, a fifty per cent increase in diversity within this long-known genus of Australian mammals. The discoveries have garnered worldwide coverage in outlets including The Washington Post and Discovery Magazine.

"Uncovering new mammals in developed countries like Australia is pretty rare and the fact we've found even more antechinus species hints at the biodiversity jewels still waiting to be unearthed," said Dr Baker.



Cutting-edge research and teaching facilities

Students, industry and staff have access to world-class facilities in Brisbane and across distributed research precincts around Queensland. Our Science and Engineering Centre houses the very latest in teaching spaces, high performance computing and visualisation facilities, and advanced scientific instruments for research. Within the centre is The Cube, one of the world's largest digital interactive learning and display spaces, dedicated to providing an inspiring, explorative and participatory experience of the world of STEM (science, technology, engineering and mathematics).

The Science and Engineering Faculty delivers capability into QUT's transdisciplinary research institutes, which collaborate with industry and government on large-scale research and innovation projects. The Institute for Future Environments studies our natural, built and virtual environments, and finds ways to make them more sustainable, secure and resilient. Our researchers working in the Institute of Health and Biomedical Innovation deliver research outcomes across three broad health areas: prevention, mind and body health, and recovery.

The quality of our research attracts significant external funding. We headquarter the Australian Centre of Robotic Vision (ACRV) as part of the Australian Research Council (ARC) Centre of Excellence program, and play a major role in the ARC Centre of Excellence for Mathematical and Statistical Frontiers (ACEMS).

2016 Australian Research Council Discovery Grants

Professor Tommy Chan (pictured) received an Australian Research Council grant to further his research into transforming traditional civil structures into smart structures that can accurately identify conditions like earthquakes – and automatically notify the infrastructure management for timely maintenance.



ARC Discovery Early Researcher Awards (DECRA)

Dr Cara Mortimer - develop methods to improve plant natural product yields and diversify the products manufactured from a wide array of plants - \$352,000.

Dr Mary Tate - understand customer quality perceptions of digital services and factors such as customers' own skill levels that help people optimise their experiences - \$298,000.

Dr Jingsan Xu - develop novel photocatalysts for reducing carbon dioxide to useful products using solar energy - \$375,000.

Associate Professor Zuduo Zheng (pictured) - address the challenge of efficiently operating mixed traffic flow of traditional, connected and automated vehicles - \$336,000.

Dr Christopher Drovandi - Computationally efficient and scalable Bayesian algorithms. Potential outcomes of the project include new algorithms to significantly economise computations and improved understanding of the mechanisms of experimental data generation. Improved models of wound healing, skin cancer growth and heart physiology supported by these algorithms could improve population health - \$382,000.

2016 Australian Research Council Discovery Grants

Professor Tommy Chan (see page 11)

Professor Gerard Ledwich - develop a new framework to support the successful deployment of resilient 'prosumer-based' energy systems such as solar photovoltaics, wind turbines, and battery and other energy storage - \$435,000. Professor Ledwich was also awarded funding to develop an electrical network costing framework that appropriately rewards customers who act to reduce network stress - \$390,000.

Professor Mahen Mahendran - develop novel cold-formed, light-gauge steel frame wall systems with superior fire resistance - \$310,000.

Professor Greg Marston - identify policy synergies between environmental, economic and social policies to move Australia toward a low-carbon economy and model of sustainable prosperity - \$210,000.

Professor Kostya Ostrikov - develop novel plasma-enabled processes for low-cost, energy-efficient and scalable growth of high-quality graphene films for applications in touch screen, solar cell and other devices - \$430,000.

Professor Jan Recker - develop and validate a new theory for how information systems can be designed to assist organisations in becoming innovative - \$380,000.

Professor Mahinda Vilathgamuwa - develop an improved battery management system to smooth the intermittent contribution of renewable energy sources to the grid - \$290,000.

Professor You-Gan Wang - develop novel statistical tools for more accurate prediction by taking account of model complexity and uncertainties associated with the fitting procedure, contributing new knowledge to the field of statistical data analysis - \$305,500.

Global Leaders



Professor Prasad Kanaka Yarlagadda was awarded a Medal of the Order of Australia for service to the Indian community in Queensland, and to engineering. Prof. Yarlagadda has been Professor in Smart Systems at the Queensland University of Technology's Science and Engineering Faculty since 2005, and Project Director, Airports of the Future. He has also held positions at the Centre for Built Environment Engineering and Research, and at the Manufacturing Systems Engineering Research Concentration.

Professor Michael Rosemann is the new German Honorary Consul for southern Queensland. Professor Rosemann is a leading global expert in innovation and disruptive technology, an area that is extremely important for the future focus for the State and Federal Governments. Leading one of the most exciting and future-oriented teams in Queensland, the Information Systems School within the Science and Engineering Faculty, Professor Rosemann is a renowned global thought leader, author and keynote speaker on digital mindfulness, process design and innovation systems. His new role will provide opportunities for continued promotion of STEM (Science, Technology, Engineering and Mathematics) within Queensland, as well as fostering German-Australian collaborative research and technology relationships.



Magic plant discovery could lead to growing food in space

Our researchers have discovered a plant gene that could speed up plant genetics research and pave the way for growing food on a space station.

QUT plant geneticist, Peter Waterhouse, discovered the gene in the ancient Australian native tobacco plant Nicotiana benthamiana, known as Pitjuri to indigenous Aboriginal tribes.

Professor Waterhouse made the discovery while tracing the history of the Pitjuri plant, which for decades has been used by geneticists as a model plant upon which to test viruses and vaccines.

"This plant is the 'laboratory rat' of the molecular plant world," he said, "we think of it as a magical plant with amazing properties.

"We now know that in 1939 its seeds were sent by an Australian scientist to a scientist in America and have been passed from lab to lab all over the world.

"By sequencing its genome and looking through historical records we have been able to determine that the original plant came from the Granites area near the Western Australia and Northern Territory border, close to where Wolf Creek was filmed.

"We know, through using a molecular clock and fossil records, that this particular plant has survived in its current form in the wild for around 750,000 years."

Lead researcher Dr Julia Bally said determining the exact species had led researchers on a quest to find out how the plant managed to survive in the wild for such a long period of time.

"What we found may have a big impact on future plant biotechnology research," Dr Bally said.

"We have discovered that it is the plant equivalent of the nude mouse used in medical research.

"The plant has lost its "immune system" and has done that to focus its energies on being able to germinate and grow quickly, rapidly flower, and set seed after even a small amount of rainfall.

"Its focus is on creating small flowers but large seeds and on getting these seeds back into the soil in time for the next rain.

"The plant has worked out how to fight drought - its number one predator - in order to survive through generations."



New technologies to eliminate fossil fuel use in the sugar industry

Professor Ian O'Hara, from QUT's Centre for Tropical Crops and Biocommodities is leading the way in developing and testing new technologies as part of a \$5.7 million three-year project with the potential to eliminate the use of fossil fuels in the sugar industry. New technologies will be developed and demonstrated to turn sugarcane trash into renewable fuels for use in sugarcane farming, processing and transportation. The project has received funding from the Australian Renewable Energy Agency (ARENA), and partners including Griffith University, Sunshine Sugar and Utilitas Pty Ltd.

"While the sugar industry produces large amounts of bioenergy from sugarcane bagasse with surplus electricity exported to the grid, significant quantities of fossil-based fuels are used in the growing, harvesting and transport of sugarcane, and in certain factory operations," Professor O'Hara said.

"This project seeks to reduce or eliminate the use of fossil fuels in sugarcane production by developing technologies for biogas production from sugarcane residues that convert the residues to renewable fuels suitable for farming use and transportation.

"The major sources of fossil fuel use in the sugar industry are diesel use for planting, cultivation, harvesting and transporting sugarcane, and coal use in factories."

Leading Australia's robotic surgery

Hand in hand with QUT researchers and robots, Prime Minister Malcolm Turnbull launched a new robotic arm that allows surgeons to perform more accurate hip and knee replacements.

Australia's first robotically assisted hip replacement operation was performed at Brisbane's Holy Spirit Northside Hospital under the leadership of QUT Professor of Orthopaedic Research, Ross Crawford.

Professor Crawford and his colleagues Anjali Jaiprakash (Post-Doctoral Research Fellow, Medical Robotics) and Professor in Robotics Jonathan Roberts detailed the benefits of robotically assisted hip surgery in an article for The Conversation: "The MAKO robotic system is a carefully controlled robotic arm that aids surgeons in placement of the components of a total hip replacement. It makes the operation more accurate and safer for surgeons, regardless of their experience."

"Though the robot is constraining the surgeon to execute the plan, the surgeon remains in charge at all times. The surgeon continues to carry all responsibility for the success of the operation and any complications."

Experts now predict that robot-assisted hip replacements will soon become just as popular as robot-assisted knee operations, which only started in Australia in 2015.



Controlling the pests of the Great Barrier Reef

Our roboticists have developed the world's first robot designed to seek out and control the Great Barrier Reef's crown-of-thorns starfish (COTS), which are responsible for an estimated 40 per cent of the reef's total decline in coral cover.

Its creator, Dr Matthew Dunbabin from QUT's Institute for Future Environments, said the COTSbot was equipped with stereoscopic cameras to give it depth perception, five thrusters to maintain stability, GPS and pitch-and-roll sensors and a unique pneumatic injection arm to deliver a fatal dose of bile salts.

"We see the COTSbot as a first responder for ongoing eradication programs - deployed to eliminate the bulk of COTS in any area, with divers following a few days later to hit the remaining COTS.

"The COTSbot becomes a real force multiplier for the eradication process the more of them you deploy - imagine how much ground the programs could cover with a fleet of 10 or 100 COTSbots at their disposal, robots that can work day and night and in any weather condition."

The COTSbot is designed to search the reef for up to eight hours at a time, delivering more than 200 lethal shots. Key to the autonomous underwater vehicle is its new state-of-the-art computer vision and machine learning system. QUT roboticists have spent the last six months developing and training the robot to recognise COTS among coral, using thousands of still images of the reef and videos taken by COTS-eradicating divers.

Dr Feras Dayoub, who designed the COTS-detecting software, said the robot would continue to learn from its



Front (L-R): Dr Feras Dayoub (QUT); Professor Denzil Miller, Director Antarctic Tasmania, Science and Research (Tasmanian Government); Dr Grahame Webb, Managing Director, Wildlife Management International (Northern Territory); Professor Peter Klinken, Chief Scientist of Western Australia; Professor Gordon Wyeth, Executive Dean, QUT Science and Engineering Faculty; Ms Leonie Walsh, Victoria Lead Scientist; Dr Leanna Read, Chief Scientist of South Australia; Professor Peter Coaldrake, Vice-Chancellor of QUT.

Back (L-R) QUT roboticists, Dr Matt Dunbabin; Professor Jonathan Roberts; Associate Professor Ben Upcroft and Professor Tristan Perez.

experiences in the field. "Its computer system is backed by some serious computational power so COTSbot can think for itself in the water," said Dr Dayoub, from QUT's Science and Engineering Faculty and Australian Centre for Robotic Vision.

"If the robot is unsure that something is actually a COTS, it takes a photo of the object to be later verified by a human, and that human feedback is incorporated into the robot's memory bank.

"We've now trained the robot using thousands of images of COTS collected on the reef and the system is proving itself incredibly robust at detecting the COTS."

This has proven to be quite an accomplishment given the complexity of underwater environments, which are subject to varying visibility as well as depth-dependent colour changes. It's also designed to operate exclusively within a metre of the seafloor, one of the most dynamic and challenging environments for any robot.



100000

Women in Research



Dr Lyndall Bryant (pictured) won the Planning Institute of Australia Award for Excellence in Outstanding Research (Tertiary) for 2015. Dr Bryant also won the Australian Property Council Institute Award for Excellence for Early Stage Academic in 2015. In addition, Dr Bryant won one of two Women in Research awards. Dr Lyndall Bryant is an expert in real estate development and finance and has a special interest in infrastructure financing, supply chain cost analysis and housing affordability. Her research has had broad impact, for example, in influencing the Queensland Government's housing affordability strategy, the Federal Government's infrastructure funding and cities policies, and a model to disrupt housing supply markets. She is currently working on a model for repurposing not-for-profit assets to provide affordable housing in the community.

Dr Robyn Araujo, recipient of a Women in Research award, is a mathematician and theoretical biologist. She has a special interest in cancer research, particularly cancer signal transduction and anti-cancer therapeutic strategies. Her mathematical models of the intracellular control circuitries within tumour cells are helping to generate novel therapeutic strategies against cancer, with the aim of achieving higher efficacy at lower drug dosages, and with a reduced possibility of drug resistance development.

Dr Stephanie Lowry won the 2015 Siganto Foundation Medal in recognition of her outstanding PhD – Visual place recognition for persistent robot navigation in changing environments (see page 33).

Professor Lidia Morawska and the members of the Australia-China Centre for Air Quality Science and Management received an Australian Research Council Linkage Projects Grant. The ACC-AQSM, a partnership with Beijing's Chinese Research Academy for Environmental Sciences, is led by Professor Morawska, building on QUT's strong air pollution research program.

2016 Advance Queensland Research Fellowships



Scientists and researchers were recognised in the inaugural Queensland Government Advance Queensland initiative. Their projects will help drive innovation and collaboration in new and existing industries and solidify the state's capability and reputation as a global science and research leader. QUT recipients:

- Dr Mariam Darestani Water purification pipes for irrigation using poor quality water resources
- Dr Anjali Jaiprakash Robotic leg-holding device making keyhole knee-surgery easier and safer (pictured)
- Dr Azharul Karim Intelligent microwave assisted convective dryer for agricultural products, and
- Dr Yateendra Mishra (pictured) Maximising renewable energy penetration through smart inverter deployment and control.

Researchers of distinction



- Professor Anthony O'Mullane (pictured) received a Royal Australian Chemical Institute Award for his contribution to Chemistry and the Chemistry Profession.
- Professor Troy Farrell awarded the E.O. Tuck Medal for outstanding research and distinguished service to the field of Applied Mathematics.
- Professor Peter Bartlett elected as a Fellow of the Australian Academy of Science. This prestigious
 appointment recognises his outstanding contributions to statistical learning theory.
- Adjunct Professor Adekunle (Kunle) Oloyede, appointed incoming Vice Chancellor of Elizade University in Ondo State, Nigeria which focuses on engineering, business and entrepreneurship. Adjunct Professor Oloyede is a member of the Institute of Health and Biomedical Innovation (IHIBI).
- Adjunct Professors Fawang Liu, Vo Anh and Professor Ian Turner, all from the School of Mathematical Sciences have been recognised by Thomson Reuters Provisional 2015 Highly Cited Researchers.
- Professor Clinton Fookes awarded a prestigious Fulbright Senior Scholarship to travel to New York to
 investigate large-scale video surveillance systems and explore the practical and policy reasons for the lack of
 adoption of large-scale video analytic systems for monitoring our cities.

Vice Chancellor's Research fellowships

Science and Engineering Faculty's five Vice Chancellor's Research Fellowships were awarded to the following recipients:

- Dr Cara Mortimer Bio Products
- Dr Peerapat Vithayasrichareon Sustainable Power Engineering
- Dr Neha Gandhi Data Science Computational Modelling and Simulation Science, and
- Dr Liao Wu Medical Robotics.

Outstanding Alumni

Alumnist Dr Abigail Allwood (pictured), Astrobiologist and Co-Leader of the Mars 2020 rover mission was named 2015 Outstanding Alumnus of the Year. Dr Allwood graduated from QUT in 2002 with a Bachelor of Applied Science and first class Honours in Geoscience.

Dr Allwood is the mission's principal investigator for her Planetary Instrument for X-ray Lithochemistry (PIXL), one of seven sophisticated scientific instruments that will be packed onto the rover. Operated remotely by her team back on Earth, it will analyse the chemistry of Martian rocks in finer detail than ever done before.

Andrew Northcott (pictured) was awarded Young Alumnus of the Year, 2015. In just over a decade Andrew Northcott went from being a teenage drover to founder and CEO of Labour Solutions Australia (LSA), one of the fastest growing blue collar online hire organisations in Australia, with a \$100 million annual turnover.

Andrew graduated from QUT with a Bachelor of Applied Science (Property Economics). In his first year of studies Andrew founded LSA with \$800 and a laptop computer. Andrew hired out himself and his university mates to construction firms and the business turned over \$55,000. The second year he turned over \$550,000.

Within eight years, through the implementation of an innovative suite of technology platforms and an absolute focus on customer service, LSA developed into a market leader with an annual revenue of over \$45 million.



Teaching honours



- Professor Peter Corke, Associate Professor Jennifer Firn (pictured) and Professor Doug Hargreaves were all awarded Citations for Outstanding Contributions to Student Learning through the Australian Awards for University Teaching.
- Professor Dann Mallet has been recognised as one of Australia's most outstanding university teachers with Teaching Excellence award in the Australian Awards for University Teaching.
- Professor Peta Wyeth was awarded an Office for Learning & Teaching Grant for "Framing Authentic Assessment of Service Learning within an IT Curriculum".
- Professor Christine Bruce was awarded Principal Fellowship of the Higher Education Academy through the ANU Educational Fellowship Scheme.
- The SEF Vacation Research Experience Scheme (VRES) enabled over 110 graduates to have the opportunity to experience research practice. VRES is a positive engagement and real world learning initiative for both students and supervisors and a recruitment avenue for future Higher Degree Research (HDR) students.
- The Information Systems School developed the "Brain Gear Mobile App" to support multi-channel learning experience based on video artefacts (eg 3 minute videos describing essential theories) which has attracted over 32,000 views on YouTube in 2015 and has gained positive student satisfaction.
- Fellows of the UK Higher Education Academy. The QUT Educational Fellowship Scheme supports staff to apply for this international, peer recognition of teaching. Thirteen staff have been recognised:

Professor Christine Bruce – Senior Fellow	Joshua Buru – Associate Fellow
Professor Dann Mallet – Senior Fellow	Jason Chia – Associate Fellow
Dr Connie Susilawati – Senior Fellow	Dr Alexander Malaver Rojas – Associate Fellow
Dr Keyvan Ansari – Associate Fellow	Dr Karlah Norkunas – Associate Fellow
Ravihansa Bandara Rajapakse – Associate Fellow	Katrina Raynor – Associate Fellow
	Dr Coralie Siegel – Associate Fellow
Dr James Brady – Associate Fellow	Venkat Venkatachalam – Associate Fellow



Associate Professor Michael Milford (pictured), robotics and neuroscience specialist at the QUT-based headquarters of the Australian Research Council Centre of Excellence in Robotic Vision, received the Queensland Young Tall Poppy Scientist of the Year award from the Australian Institute of Policy and Science (AIPS) for his stealth mission to teach science and mathematics to the masses, without them realising. Dr Milford received funding approval to develop a workshop program to create more entertainment products and complementary teaching resources that use concepts from books, games and videos.

Massive Online Open Course (MOOC)

QUT's first Massive Online Open Course (MOOC) Introduction to Robotics, was successfully delivered through the university's own MOOC platform to more than 15 000 participants. The follow-up Robotic Vision MOOC had more than 20 000 participants, with approximately 1000 certificates issued. Both robotics MOOCs were repeated later in 2015 and attracted 6238 and 3662 participants respectively. International participants came from India, United States, Egypt, Germany, Brazil, United Kingdom, Canada, Mexico and France. The global nature of participation enabled access for students who would not normally have access to these higher education courses.

"Thank you Prof. Peter Corke in cooperation with the Queensland University of Technology for providing this opportunity for students in developing nations, especially Papua New Guinea, where robotics is not taught as a course in computer science and engineering." (IR, forum post)

"Another great aspect is seeing people from all over the world participating and helping each other. Amazing to be able to participate in a global course in robotics from all the way up in the woods in Norway." (IR, post-course survey)

Professors Marcello La Rosa and Marlon Dumas also led the development and launch of the Fundamentals of Business Process Management MOOC in October 2015, which has attracted 6,992 participants.

Student Leaders Awarded

2015 Student leadership award recipient, Amy Gunnell (pictured with the TeamArrow solar car) graduated with a degree in Engineering majoring in Mechatronics. She was a student ambassador, delivering robotics workshops for high school students, and for the past three years has been an active member of QUT Motorsport. As the project manager of QUT Motorsport she led the concept development for the QUT electric vehicle which, under her leadership, changed from a petrol-driven engine to a four wheel drive electric vehicle. Separately through QUT Motorsport, Amy helped establish a partnership with Clenergy TeamArrow, a Brisbane-based solar car racing team, of which Amy and other QUT students were the first Australian team to cross the finish line in 2013 after completing the gruelling 3,000km Bridgestone World Solar Challenge.

Team Arrow Success

Clenergy TeamArrow participated in the 2015 Bridgestone World Solar Challenge, a race of solar powered vehicles from Darwin to Adelaide. The 2015 team of 9 QUT students and 4 QUT graduates placed 8th out of 29 entries in the Challenger category. Earlier in 2015 TeamArrow competed in the Abu Dhabi Solar Challenge where they placed 5th out of 15 entries and won the Mechanical Design Award.

Dean's Scholars

Our Dean's Scholars Program offers leadership development for outstanding students undertaking any single or double degree offered by the Science and Engineering Faculty. Dean's Scholars are an elite group of students who have demonstrated high academic achievement and aspire to be future leaders. QUT Science and Engineering fosters leadership in STEM-linked careers through industry experience, international exchange programs, professional development and mentoring.



Adam Hibble (pictured with Assistant Dean - International and Engagement, Science and Engineering Faculty, Deryn Vahl Meyer and Nicholas Johnson), Excellence Award winner, is studying a Bachelor of Information Technology/Bachelor of Mathematics and is involved in the coding community at QUT and in the wider community.

Nicholas Johnson (pictured), 2016 Student Leader of the Year is currently studying a Bachelor of Business/ Bachelor of Mathematics. He is an elite athlete, dynamic student leader and active contributor to the local community.



International mobility



The Science and Engineering Faculty is actively encouraging students across all SEF disciplines to consider undertaking an international experience, whether it is an exchange semester (or year) at a partner university, a short-term program, an internship, or a combination of these. Short-term programs may be for academic credit and often their value is in a broader / experiential sense e.g. intercultural, language preparation or exposing students to industry and lab facilities. International internships with industry or university partners are another way for SEF students to strengthen their practical skills, research capabilities and international competencies.

Volvo Group Trucks internship, Sweden

Two electrical engineering undergraduate students (Joshua Crawford and Jordan Simpson) undertook an internship with Volvo Group Trucks, Sweden, at the start of 2016 as part of a linked exchange program with Chalmers University of Technology. The internship's focus was on developing and integrating Automated Subsystems in a heavy vehicle workshop.

University of Washington research internship, USA

Elaiza Luker (Mechanical Engineering Dean's Scholar) and Charlie Shaw-Feather (Computer and Software Systems Engineering) were selected to undertake a research internship with the Department of Aeronautics and Astronautics at one of the top universities in the US, the University of Washington, Seattle.

Mitsui & Co. internship program, Japan

Joining fellow students from other Faculties, Jerome Bernard (IT), Ben McGhee (Engineering/IT dual degree), Kaitlyn Sapier (IT/Business dual degree) and Daniel Stevenson (IT/Law dual degree) from the Science and Engineering Faculty were selected for this exciting short-term program with one of Japan's leading industrial corporations. This program's aim was to provide students with an in-depth introduction to business, information technology and law in the Japanese context. This program was generously supported with sponsorship by Mitsui & Co. and the Australian Government's New Colombo Plan.



International Scholarships

The Science and Engineering Faculty offers international merit scholarships to eligible high achieving students based on their entry scores, providing a 25 per cent tuition fee sponsorship for undergraduate and postgraduate coursework programs. We have welcomed international merit scholars from 25 countries across the globe.

SEF also offers the Merit Plus scholarship for Sri Lankan students offering a total 50 per cent tuition fee sponsorship. The successful candidate is chosen based on criteria of academic and nonacademic achievements in their prior studies. Since its inception we have awarded five of these competitive scholarships to aspiring individuals.

Biological sciences student Ishrath Irshadeen (pictured) is one of our Merit Plus scholarship winners.

Huawei Seeds of the Future - China experience

Lachlan Gepp (IT/Maths dual degree) and Leon Pearce (IT), undertook the Huawei Australia-supported program, Seeds of the Future, facilitated through the Australian Technology Network, providing them with a range of experiences in the global telecommunication giant's facilities in China in addition to enhancing their intercultural skills and perspectives.

Mitacs research internship, Canada

Lachlan Gepp was QUT's inaugural participant in the prestigious Mitacs Globalink research internship program. The Mitacs organisation invites high achieving undergraduate students from around the world to experience Canada as a leading destination for research and innovation. This competitive program pairs top-ranked students and faculty at Canadian universities for a 12-week research project University/Institution. Lachlan was selected to undertake his internship at Athabasca University, Edmonton, where his research project focuses on Traffic Flow Optimisation.

Mini, United Kingdom

Kelvin Choi (Mechanical engineering Dean's Scholar), undertook an internship with Mini, Oxford, U.K., by virtue of QUT's close association with Mini's parent company, BMW. "The chance to be able to travel abroad and work in a field I want to graduate into, at a large multinational company, has been an unforgettable experience which has allowed me to greatly develop professionally and personally."

Engineers without Borders (EWB)

Engineering students from a range of majors (Process, Civil, Medical and Mechanical) participated in a range of EwB short-term programs in Malaysia, Cambodia and India, providing them with diverse and highly-rewarding experiences and opportunities to apply their skills to contribute to and learn from developing communities.

Schools engagement

The four-year STEM High School Engagement strategy is a \$3.2 million investment by the Vice-Chancellor, which showcases QUT's leadership in STEM through a targeted program for high school students and teachers. The Science and Engineering Faculty places high value on the provision of hands-on experience in showing students what is possible through science, technology, engineering and mathematical applications, and informing their decisions about future studies and careers. SEF is committed to developing skills to support invention and innovation, as well as new and emerging industries. To illustrate this SEF engaged about 30,000 Queensland students in experiential STEM programs this year.

STEM Highlights

- Google granted Dr Erica Mealy \$10,000 to run a series of Computer Science for High School Teachers professional development workshops.
- STEM Teacher in Residence, Anne Brant was awarded Science Champion by the QLD Government for her teaching and leadership in the delivery of science programs which help to connect secondary students with QUT and industry.
- QUT's STIMulate Team, which runs a program in which students support thousands of other students by helping develop skills in maths, science and IT, has won the Australian Outstanding Peer Educator category of the Australasian Peer Leader Awards.
- QUT IT students won the Young Innovator Award at the Unearthed Brisbane Hackathon competition in May. In a 54 hour event over 75 software developers, designers and industry insiders worked in teams to develop prototype solutions to resources sector problems using industry and government data.





The Widening Participation Program (WPP) provides specialised workshops for selected schools in regional and disadvantaged areas of South East Queensland. The program aims to demystify university for students in these areas, with an emphasis on STEM studies and careers. It has strong learning partnerships with primary and secondary schools in Caboolture and areas in the Brisbane North Corridor.

The Widening Participation Program reached over 22,000 students through the Extreme Science and Engineering Van in-school program, Explore Uni workshops, specialised STEM events and a broadening of community engagement activities.

The SEF Widening Participation program is supported through QUT's Higher Education Participation and Partnership Program (HEPPP) allocation. In 2015, the QUT component of the Queensland STEM Education Network (QSEN) – a consortium of five Queensland universities funded under the Australian Maths and Science Partnership Program – began work alongside the existing faculty-based HEPPP activities to build STEM capacity in middle-school students in low-income high schools.

In addition to contributing to joint 'influencing the influencers' STEM career initiatives, QUT's QSEN project focuses on delivery of maths and information technology activities, including the full-day Imagine IT event at Caboolture campus, development of after-school maths clubs, and collaboration with local schools in the Moreton Bay STEM Fest.

As well as the WPP, there are a number of programs SEF runs which target school-aged science and engineering enthusiasts in schools. These include the Power of Engineering, The Science and Engineering Challenge, ConocoPhillips Science Experience, Go4ITGirl BiG Day In, QMEA Science Olympiad, the Australian Youth Aerospace Forum and Wonders of Science.

Celebrating our donors



Philanthropy unlocks the knowledge we need to solve the world's most pressing challenges. Our donors are playing an increasingly important role in advancing QUT's Science and Engineering research, education and community outreach programs. Donors support our students to realise their potential to contribute as engaged and active citizens, progress research to fast-track ground breaking solutions, and ignite in young Australians the desire to make a real difference. Over the past year QUT alumni, staff, friends and industry supporters have generously donated to a range of initiatives, including:

- Siganto Foundation Medal This special award recognises outstanding QUT engineering PhD graduates. The \$10,000 award is funded jointly by The Siganto Foundation and QUT's Institute for Future Environments to allow the medallist to undertake multidisciplinary professional development and research activities both locally and internationally. In 2015 the Medal was awarded to Dr Stephanie Lowry, now a Postdoctoral Research Fellow with the Mobile Robotics and Olfaction Lab at Örebro University in Sweden.
- Laurie Cowled Learning Potential Fund PhD Scholarship QUT donor Dr Laurie Cowled (pictured) is on a mission to support female students from rural or remote backgrounds to excel in their studies and aspire to make an outstanding difference to the future of Australia. The 2016 recipient of this visionary scholarship is Erica Mulowayi whose PhD research aims to establish a framework that will provide practical guidelines to enhance reconstruction and rehabilitation processes for post disaster recovery projects;
- Bhutan Siphons project This program of on the ground, applied research is investigating the use of siphons
 to drain glacial lakes in Bhutan to prevent devastating inland tsunamis that are being triggered by global
 warming. Donations from alumni and community supporters are enabling the 2016 expedition to Bhutan to
 test the siphons and micro hydro power generation at a remote glacial lake;
- Crown-of-Thorns Starfish robot (COTSBot) (see pages 18-19) Gifts from alumni and friends through the 2016 Tax Appeal and a \$20,000 donation from the Eldon and Anne Foote Trust will enable testing of the robot among non-tech savvy users, a key stage in readying the technology for wide-spread adoption to control COTS;
- Oracle Labs Australia is supporting a research project, 'Scalable software code representation, search and classification', by Professor Shlomo Geva to help identify vulnerabilities in software source code. The project aims to ultimately enhance the productivity of developers internationally and has been facilitated by QUT Adjunct Professor Cristina Cifuentes, who is also Director of Oracle Labs Australia.

- Westpac Young Technologists Scholarships Nine QUT students are among Australia's first 100 Westpac Scholars recognised as having the drive to shape the future prosperity and growth of Australia, with each receiving up to \$25,000 from the Westpac Bicentennial Foundation to support their degrees;
- John F Lynch Memorial Scholarship Donations from the family of John F Lynch, QUT alumnus and eminent engineer, created an endowment that annually enables a \$5000 scholarship to be awarded to a QUT engineering student with an interest in water management to progress their studies. The 2015 recipients were Brendan Coulter and Jonathan Whitcombe;
- Rod Walker Memorial Award A national award hosted by QUT to commemorate Queensland aerospace visionary and founder of the Australian Research Centre for Aerospace Automation (ARCAA), Professor Rod Walker, aims to encourage university students into long-term careers in aerospace industries. Rod passed away at only 42 years of age, but his passion for technology that helps people lives on through the award, established through the support of the Queensland Government, CSIRO, Boeing, Rotary Club of Brisbane Airport, the Association for Unmanned Vehicle Systems International (AUVSI), QUT and our staff through payroll donations. The inaugural Rod Walker Memorial Award was presented to UTS graduate, Ben Barnes;
- Extreme Science and Engineering Van program 2016 marks a special birthday for this unique QUT program, which is passionately supported by QUT staff, graduates and the community. The program, which started in 2001, has spent the past 15 years inspiring 135,000 school students to engage with and consider careers in STEM. Donations through payroll giving and the alumni appeal have given students access to state-of-the-art microscopes and brought the program to many Queensland schools.

Vale Dr JJW (Bill) Siganto AM: 2016 Queensland Community Philanthropist of the Year

QUT Science and Engineering celebrates the recognition of the late Dr JJW (Bill) Siganto AM being named 2016 Queensland Community Philanthropist of the Year. The announcement by the Queensland Community Foundation in June acknowledges Bill's outstanding decades-long philanthropic leadership and community service for many charitable, education, health and community organisations. A mechanical engineer by trade who established his company Siganto and Stacey Pty Ltd in 1967, Bill had a long association with QUT and its predecessor institutions, including as a QUT Council member and then Deputy Chancellor from 1989 to 1994. His enormous contribution to vocational and university tertiary education was recognised when he received an honorary doctorate from QUT in 1995 and he became a Member of the Order of Australia in 1997.

Bill was one of the best known figures in the Australian heating and air conditioning industry before he passed away on 18 September 2015. The Siganto Foundation Medal was established at QUT in 2011 through the generosity of Bill and his wife, Dr Marie Siganto AM, to recognise outstanding PhD graduates in engineering. The Medal will be a lasting legacy of Bill's contribution to education in Queensland.

Laurie Cowled Learning Potential Fund PhD Scholarship, awarded to a SEF PhD student, Erica Mulowayi, here with Dr Laurie Cowled and Nicole Mulowayi (L-R))

Real World Engagement

QUT offers strategic partnerships across research, consultancy and expert witness services, professional development and student programs. We have longstanding relationships with leading industry partners like Shell, Technology One, SAP and Boeing.

These connections offer students outstanding exposure to real-world experiences, and mentoring, including internships locally and internationally, group tours, work experience placements and site visits (see pp 28, 29). QUT has exchange agreements with more than 100 partner institutions around the world, including institutions that are renowned for their excellence in STEM fields.

QUT Science and Engineering, alongside the QUT Institute for Future Environments and the Institute for Health and Biomedical innovation's global research and innovation partnership networks leverage our combined strengths.

Shell

Our relationship with the Shell Project Academy has just reached its 10-year anniversary and we have just renegotiated and commenced a further 3+2 year partnership. This global activity is with partners Royal Dutch Shell, University of Texas (Austin, USA), Technical University of Delft (Netherlands) and Cranfield University School of Management (UK). QUT's contribution sees us deliver 20 to 30 courses annually in Asia, Europe, the USA (and a limited number in the Middle East, China and India) to Shell's global engineering skill pool.

TechnologyOne

The Science and Engineering Faculty has forged strong links with TechnologyOne, Australia's largest enterprise software company and one of Australia's top 200 ASX-listed companies. The company joined the Dean's Scholars program in 2016 as an Industry partner. The program develops the leadership skills of our high performing students in science, technology, engineering mathematics (STEM) and urban development.

TechnologyOne has become an integral partner working closely with QUT on a number of initiatives. The company also supports students through the QUT Code Network and TechnologyOne's annual gaming decathlon. TechnologyOne's R &D Group Director and QUT Alumnus, Brett Hooker said the tournament and associated networking is a key part of TechnologyOne's commitment to engaging with local STEM students.

"Australia's knowledge industries will be the future of our economy, and it is vital that businesses invest in the industry, universities and young talent," said Mr Hooker.

The networking event is an opportunity for students to meet software experts at TechnologyOne before applying for the company's graduate intake at the end of each year. The company currently commits to bringing on board at least 20 new STEM graduates as part of its graduate program, as well as endeavouring to fill all open R&D positions throughout the year with graduates.

SAP

QUT's productive partnership with SAP provides opportunities for international internship placements, as well as essential solutions for teaching and research purposes within our undergraduate and post-graduate courses. QUT Science and Engineering faculty has hosted a collaboration with SAP and The University Competence Centre Asia Pacific Japan (UCC APJ) since 2008. The UCC APJ was established as an Application Hosting Centre (AHC) for the Australian New Zealand region a decade earlier, in 1998. Demonstrating considerable reach, the UCC APJ provides services to over 160 SAP University Alliances Program members within 18 countries across the Asia

Pacific Japan region. In a new development for QUT, SAP has introduced specific European agreements for the benefit of QUT SEF students, in the form of a large number of internships in Germany. Our ongoing relationship with SAP continues to deliver important outcomes for the university, its staff, and students.

Federal Government

Exemplifying the high calibre of QUT staff expertise and the roles they play in designing and implementing real world solutions, Professor Alistair Barros from the School of Information Systems is working closely with the Department of Human Services. Professor Barros is driving innovation in the delivery of the Australian welfare system. The Welfare Payment Infrastructure Transformation program (WPIT) that he has been responsible for, will transform the 30 year old system that runs Australia's payments system. Professor Barros is providing thought leadership and IT solution architecture specifications on the system that delivers \$110 billion of payments to over 4 million households. The project is one of the most significant spends undertaken on the machinery of Federal Government.

Boeing

Boeing and QUT have had a long standing relationship which spans the promotion of STEM via schools outreach and scholarship programs, growing the talent pipeline through extensive student engagement, supporting students through mentoring and work placements, and developing technology together through joint research initiatives. More recently the relationship has been invigorated to expand the student placement opportunities both locally and overseas, as well as exploring research ideas as a combined force.

Industry funded research can help industry stay competitive and grow. Industry can partner with us in collaborative research, potentially involving consortia with government (local, state and federal) and community organisations.

Contact the Science and Engineering Faculty at QUT to discuss a partnership.

Phone +61 7 3138 8822 Email sef.enquiry@qut.edu.au www.qut.edu.au/science-engineering



QUT Science and Engineering

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Cover image: Dr Feras Dayoub, Dr Matthew Dunbabin, Professor Peter Corke (L-R) and COTSBot (see pages 18 and 19)