AT THE CUTTING EDGE
Technologies fast-tracking UTS research

IMPACT OF LAW
The research infrastructure enabling free legal access

THE FUTURE IS GLOBAL
Why Australian unis need overseas investment and partners
2013 is an important anniversary for UTS, it marks the fourth annual U: magazine research edition (oh, and yes, it is also our 25th anniversary).

As we embark on a year of celebrations, it is important to reflect and recognise how much we have achieved in such a relatively short period of time. A few of our very notable highlights include consistent top rankings for teaching and learning, having all our broad areas of research rated as world class or above and being recognised, for the last 12 consecutive years, as an employer of choice for women.

However, I believe that we must always look to the future. Education, research and innovation don’t stand still, and neither must we. UTS must continue to innovate and implement as we strive to produce the graduates and leaders Australia, and the world, needs.

Our recent Excellence in Research for Australia results, which I alluded to above, are a watershed moment for UTS – we can now truly be considered a ‘research intensive university’; a not inconsiderable feat for such a young institution.

Since our establishment in 1988, UTS has been recognised as having a close reputation with industry and government and of producing relevant, practical research. That ethos of research impact remains central to our approach, and always will, but this is now augmented by our international reputation for research quality. In fact, the two often go hand in hand.

As the higher education and research environment continues to change and evolve, those pillars of impact and excellence will remain central – regardless of the government policy, or other countervailing trends.

The fact that we have a clear research vision, focused on impact and excellence, is why UTS is so well placed to build on our progress to date and work towards becoming a world-leading university of technology.

This forward-looking edition of U: magazine outlines the latest initiative in our researcher development program, explores the future trends in research and examines the impact that technology has had, and will continue to have, on research.

UTS is uniquely placed to leverage our position as a creative, technology-driven university. The university’s City Campus Master Plan, which includes the development of cutting-edge research spaces, simply underpins this.

Likewise, the UTS Research Strategy 2010-2015 is delivering increased research capability and capacity. However, we cannot rest on our laurels. We have an ambitious vision and targets and need to build on our reputation that has been 25 years in the making to continue to create a vibrant future for our students, staff, graduates and community partners.

I am determined that our focus on research with impact, research that is integrated with our teaching, developing our researcher and research support staff capability and collaboration focus, will help ensure the next 25 years are even more successful for UTS.

I look forward to working together to ensure UTS continues to produce research that delivers real benefits for the professions, industry and communities of the world.

Professor Attila Brungs
Deputy Vice-Chancellor and Deputy Vice-President (Research)

The University of Technology, Sydney aims to be a leader in collaborative research and a preferred research partner for industry, business and the professions.

We are committed to supporting our researchers, research students and industry partners. We achieve this through our innovative research approach which combines technology and creativity.
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Professional development, career progression and skills development were once concepts rarely considered necessary in a traditional academic career path. However, the importance of networking, building a profile, people management and communicating research outcomes are increasingly part of the demands placed on academics.

UTS’s researcher development focus is being led by the Graduate Research School (GRS). Their aim is to ensure all researchers, from students to distinguished professors, can access the right development tools at the right time.

Graduate Research School Dean Professor Nicky Solomon says, “Many other universities offer career development and planning opportunities, but what I think is unique to our approach is that we see researcher development as being much broader than the traditional focus of concentrating efforts on only grant writing or publication writing skills.”

Recent initiatives, including the Early Career Researcher Connect (ECR Connect) program – which helps equip researchers with the skills and knowledge that are central to a successful research career – research student summer and winter schools and leadership master classes, have proved a hit.

GRS Research Development Officer and researcher in the Faculty of Arts and Social Sciences Dr Hilary Yerbury, hopes GRS’s newest initiative – the Mid Career Researcher Development Program (MCRDP) – will follow suit.

“When we were developing the ECR Connect program there was a conscious decision to focus on creating an ECR cohort, both with the group at UTS and looking outside UTS. Whereas with mid career researchers (MCRs), they have already established these networks and are now looking at how to put the finer touches to their reputation.

“Essentially MCRs are established in their research career and are ambitious; they want to, and are ready to, take the next step in terms of developing their reputation and gaining recognition. So the program is actually aimed at people who, in the next two to three years, are thinking about making the first move towards promotion or wider academic recognition,” says Yerbury.

MCRDP will launch later in Spring semester. Yerbury says, “At the heart of the program is a recognition that each individual has their own career program, we want to make sure we can support them to achieve their development needs and aspirations.

“MCRDP will include a mix of career planning and more general skills development workshops that focus on areas including people management or project management alongside intensive, strategic programs that not everyone will want or need.

“GRS provides much of the academic expertise in developing these initiatives, but also draws on the professional expertise around UTS, including the Human Resources Unit, Institute for Interactive Media and Learning, Marketing and Communication Unit, as well as others,” explains Yerbury.

For Solomon, this new program sums up the ethos of UTS’s approach to researcher development. “MCRDP, and all the other programs we’ve developed, are aimed at equipping people with the skills to build their research reputation and ensuring that reputation for research quality is recognised.”

For more information on MCRDP, email Hilary.Yerbury@uts.edu.au or visit grs.uts.edu.au.

Michelle Callen
Marketing and Communication Unit
Photographer: Joanne Saad

Comment on this article at UTS:NEWSROOM
newsroom.uts.edu.au/news/2013/07/researcher-boost
Technology, data analytics, elite athletes and research that is rated as world-leading. It’s an odd combination, but to Associate Professor Aaron Coutts, and his colleagues at UTS’s Sport and Exercise group, it’s all in a day’s work.

Coutts is an expert at balancing teaching, supervision and research alongside working with leading professional football clubs, including the AFL’s Carlton Football Club. His latest research is making use of technology to focus on developing methods to quantify training and manage fatigue and recovery sessions, all to deliver improved performance for team sports athletes.

“There has been a micro-technology boom in sports, including GPS and accelerometers to track athletes movements, distance covered and speed as well as measuring how their body responds to training and competition. We also assess various physiological and psychological responses to determine how the players are coping.

“We can use these tools to measure and quantify their performance in all settings, training and gym sessions, as well during the pressure situation of game time,” says Coutts.

“Our team can use this information to not only measure and assess what individuals are doing but also use the results to assess and plan what needs to be done to improve performance. Importantly, we can also plan and model what an individual needs to do next to continuously improve.

“Interestingly,” says Coutts, “we have consistently found the best performers are not necessarily the ones who work hardest, but the ones who work smartest.”

The team’s research in this area is almost entirely industry funded, either by football clubs or sporting bodies and organisations. That funding, says Coutts, tends to be a mix of contract, cash-funded research, or PhD scholarships.

“Our industry partners come to us because we have the expertise in this area. They have the technology and of course the athletes to collect the necessary data, we provide the ability to unlock the potential of this information to improve performance.

“As technology has improved it’s enabled us to capture more and more data – you just need to know what to do with it,” explains Coutts.

The partnerships mean students, both undergraduate and beyond, benefit from teaching that is directly influenced by research.

“Our second-year students are using GPS data that’s obtained from elite athletes in class, it’s a unique opportunity and helps ensure they are equipped with the skills and knowledge our industry partners need.”

“UTS research in the human movement and sports science field was rated as world-leading; effectively this is a quality badge for our work.

“Our partners obviously value our research, but to be assessed in terms of research outputs like publications and citations and be top-rated has given us academic recognition. That’s really significant and clear evidence that we are a research force.”

Michelle Calien
Marketing and Communication Unit
Photographer (A Coutts): Fiona Livy
Runner and graph images: Thinkstock

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UTS:NEWSROOM
newsroom.uts.edu.au/news/2013/07/accelerated-learning
THE FUTURE IS GLOBAL
Australia has enjoyed a boom period in terms of research investment, but this golden age is coming to an end. One of Australia’s leading research strategists Thomas Barlow explains why universities must look to overseas investment and partners.

Since the end of the 1991 recession, Australia has experienced a remarkable economic boom. This has not only generated wonderful prosperity for Australian society, but has led to huge growth in research and development (R&D) investment.

One observes this most tangibly in Australian industry. Since the early 1990s, Australian business investment in R&D has grown at twice the rate of the Organisation for Economic Co-operation and Development region as a whole. In 2001, for the first time in Australian history, private sector R&D activity actually exceeded public sector R&D, and Australian business investment as a share of gross domestic product (GDP) has been steadily converging with that of other developed nations.

But universities, like UTS, have also been beneficiaries of the boom. Today our national investment in university R&D as a share of our economy is at a record levels – equivalent to more than half a per cent of GDP. Universities have also superseded government agencies as the dominant sector performing publicly funded research. Our universities now dominate the public research landscape in the same way that government agencies like the CSIRO did during the 20th century.

There are many reasons for the latter transition. In the past 20 years we have seen a global movement away from large-scale, mission-directed research projects, back to a renewed belief in the investigator-driven model that is more typical at universities. Australian universities have substantially increased the scale of their undergraduate teaching operations, including their international activities, thus growing their capacity to invest in research.

A thriving, innovative economy also needs a large talent pool, and universities have been better placed than government institutions to train Australia’s expanding research workforce. To an extent too, business leaders have realised that universities can give them a different, more flexible partnership than may be found with government agencies. The result is that businesses now spend more of their collaborative R&D dollars with universities than with government agencies.

These trends have been tremendously beneficial. They have enhanced the quality of intellectual enquiry in Australia. They have helped to improve the rankings of universities, like UTS, in global league tables. They have provided Australian institutions with significant global visibility. They have moved higher education in Australia much closer to the frontiers of global knowledge.

However, it looks now as if the momentum is slowing. Australian R&D investment is stalling. Business investment in R&D has been flat since the financial crisis in 2008 and while higher education R&D investment has continued to grow, it is increasingly clear this trend cannot continue.

Australian universities remain overwhelmingly dependent upon the Federal Government for the bulk of their research income; but after several years of spending well in excess of revenues, our Federal Government’s scope for expanding outlays on anything, let alone university research, now looks limited.

Universities, as a consequence, are facing a challenging financial environment, one which will require them to maximise existing assets, seek new non-governmental revenue streams and compete fiercely for what may prove a stagnant pool of resources.

This represents a significant shift, to which all institutions will need to adapt. Most will tend to focus on their strengths and will become increasingly cautious about diversification. Some will respond to tightening budgets by investing heavily in government lobbying. Others may find philanthropic donors to help keep them competitive. The big question for an institution like UTS though is how, in such an environment, it continues to nurture its global standing in research.

Australian universities have been thinking globally for some time. International education is critical for most Australian institutions, and an important part of Australia’s export economy. In recent years though, most Australian institutions have learned to think in global terms about their research portfolios too. This is partly because performance in international rankings is having an impact on their international education business, but there is more to the situation that this.

Academic recruitment is now a global activity. The competitive nature of Australian funding and assessment processes increasingly requires global benchmarking.

There is also a growing awareness that international connectivity helps to produce outstanding results. Internationally co-authored papers tend to be more significant and tend to be published more frequently in high impact journals than papers with only domestic authors.

In this context, Australian institutions have an ongoing incentive to internationalise their research activities – and even though the domestic resources available for them to do this are beginning to tighten, in some ways, the opportunity for Australian institutions to integrate with global research networks has never been more tangible.

The fulcrum of global intellectual development is now shifting from the Atlantic to the Pacific. Across the Pacific, to our east, the US remains the world’s leading producer of knowledge and the world’s most innovative economy, while to our north there is a rapidly growing intellectual community in East Asia. As UTS commences its next 25 years, its most important challenge, in my mind, will be figuring out how it can grow its collaborations and funding arrangements with partners in both these regions.

Thomas Barlow
Barlow Advisory Pty Ltd, and author of Between the Eagle and the Dragon (2013)

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newsroom.uts.edu.au/news/2013/07/the-future-is-global
It gets over 750,000 hits daily, has more than four million searchable documents and has helped develop similar systems in countries like the United Kingdom, Hong Kong, New Zealand, Liberia, Samoa and India. The team behind the Australasian Legal Information Institute (AustLII) reveals how its site has become the most popular online free-access resource for Australian legal information.

“Ignorance of the law is no excuse,” says Co-Director of AustLII Andrew Mowbray. “Philosophically, we believe the public has a right to access public legal information.”

AustLII, now in its 18th year of operation, was set up in 1995 by Mowbray and the University of New South Wales’ (UNSW) Graham Greenleaf, thanks to an Australian Research Council (ARC) grant.

Mowbray details how, at the time, online legal information was being provided by a government-endorsed, commercially run service at a cost of up to $720 an hour.

“The government had given the commercial operator a monopoly to be the only source of legal information online in Australia. Yet they were peaking at about four simultaneous users. There was no concept of free access to law at that time. The web had just come along and we felt from a practical point of view that things needed to change.”

With a decade’s experience in computerised law systems and building large-scale hypertext systems, Mowbray set about writing the software. Greenleaf was responsible for acquiring data for the launch of what was to become the AustLII facility.

Mowbray says, “In that first year we had to do a lot of things very quickly, at a time when government believed that they should be making money from selling the law. Some of the technology we’d been developing flowed naturally into the web when it became available, and the web provided the delivery platform that had been missing up to that point.”

The pair, together with initial staff members Geoff King and Philip Chung (now a Co-Director himself), managed to launch the service with Commonwealth legislation in mid-1995. On the strength of that, the High Court supplied AustLII with their data. By the end of the year AustLII had 17 databases.

Today, AustLII publishes over 530 Australasian legal databases, including decisions from over 100 courts and tribunals. It is regarded as the broadest national service that exists anywhere in the world.

“About half of our main users are practising lawyers. The rest are a mix of academics and students, government departments and commercial organisations. Ten per cent are probably regular members of the community trying to resolve a dispute particular to them,” says Mowbray.

“We publish primary and secondary legal materials, predominantly legislation and case law in a common law system like ours. We also have the largest collection of Australian law journal articles of any online source – currently over 50,000 articles.”

With AustLII’s services setting such a high benchmark, Mowbray says commercial operators have to work harder to give their products a viable market advantage. “Australia is very fortunate in that not only do we have possibly the world’s best free service, we also have some of the best commercial services.

“For a small country like Australia, that wouldn’t necessarily have happened unless there was the competition that AustLII provided. The legal information sphere is a space where we all have our own place, and we think that’s a healthy way to be.”
"FREE ACCESS TO LAW IS NECESSARY IN SUPPORTING THE RULE OF LAW AND FOR MAINTAINING CIVIL SOCIETY."

The charity model of AustLII as a foundation means it relies on donations from as little as $10 to as much as $50,000. Generating about $1 million a year, the donations cover the database’s upkeep and maintenance and enables it to stay a free service.

“The people who can afford to chip in help make a service that’s available to them, but also to those who can’t afford to pay,” says Mowbray. “That’s a really good outcome for a very small amount of money. $1 million a year is not very much money when you think about what we’re actually doing and the fact that the usage of it is so extensive.”

Chung, who moved to UNSW from UTS last year, became AustLII’s Executive Director in 1999. He says, “The strong collaboration between UNSW and UTS has resulted in over 20 shared ARC research and infrastructure grants as well as other competitive funding.

“Besides establishing free access to law in Australia, a major impact of AustLII has been to influence the development of similar research infrastructure facilities internationally. Free access to law is necessary in supporting the rule of law and for maintaining civil society.”

The team has played a major role in establishing the Free Access to Law Movement (FALM). There are now 48 FALM members, many of whom AustLII cooperates with internationally to help establish and maintain systems similar to AustLII.

“In particular, we do a lot of work in the Pacific where we assist with the operation of the Pacific Islands Legal Information Institute (PacLII). We also do quite a lot of work in Africa, particularly working with the Southern African Legal Information Institute (SAFLII),” says Mowbray.

“In the past few years we’ve also set up systems in Liberia and Samoa. More generally, we’ve helped to establish and promote the idea of free access to law in common law countries around the world.

“This has been particularly significant in developing countries. Providing free and public access to legislation and decisions of courts supports the operation of the rule of law. This transparency also helps to promote business confidence and potentially increases international trade and other external interactions.”

Last year, AustLII’s research impact was recognised when they were selected by the Australian Technology Network of Universities (ATN) and the Group of Eight (Go8) as one of the case studies used to highlight the impact of research produced by the Australian university sector.

“The Excellence in Innovation for Australia (EIA) exercise was a major undertaking of the ATN and most of the Go8 to develop a complementary measure to Excellence in Research for Australia, which basically focuses on publication and more traditional outputs,” says Mowbray.

“Universities were asked to put forward up to 20 case studies each, with a panel of experts ranking them based on research impact in Australia. Out of that exercise they chose four to showcase in their report, and one of them was AustLII.”

The EIA trial helps recognise projects that have high social impact but don’t necessarily fit into the existing measures, says Mowbray.

“AustLII is an efficient research infrastructure facility. We’re producing a resource and conducting research that is designed to produce social good as much as it is to provide research infrastructure supporting academic research. Introducing the idea of impact into the agenda is a very positive initiative in our view.”

Katia Sanfilippo
Marketing and Communication Unit
Photographer (A Mowbray and P Chung, and computer users): Joanne Saad
Globe image: Thinkstock

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UTS:NEWSROOM
What do a robot concierge, improved antibiotics, older Australians' access to health care and sustainable housing have in common? They're all potential outcomes of current UTS research projects that are being fast-tracked by new technologies.

At UTS, technology is one of the foundations that underpins much of our research. From bridge robots to autonomous wheelchairs, hybrid cars and building information software, technology has paved the way for many of our most meaningful discoveries. Many of these have had the added bonus of fast-tracking the research to which they're being applied, which means discoveries in a range of fields are being made far more rapidly than ever before. As a result, business, government, the community and the environment are reaping the benefits, including novel solutions to infectious diseases and more efficient approaches to wireless communication.

UTS researchers, in a multitude of disciplines, are harnessing new opportunities that weren’t available just a handful of years ago. Five of them tell us how technology is transforming the way they work.
Open source software for the advancement of robotics

A friendly robot with a penchant for cuddling staff is at the forefront of UTS robotics research.

Gutsy is a PR2 – a personal robot purchased from Silicon Valley start-up Willow Garage. Now firmly ensconced in the Faculty of Engineering and Information Technology, Gutsy is being tended to by a team of robotics researchers who are developing him to become a personal assistant in the new Broadway Building.

“The ultimate goal is to create a robot that can assist as a concierge, a tour guide, a security guard, a cleaner,” says Dr Benjamin Johnston, a robotics expert in the Quantum Computation and Intelligent Systems’ Magic Lab.

As a Willow Garage PR2, Gutsy has been built on a standard platform that allows PR2 users to share their findings and results with one another through open source software. UTS can share software code with top universities and research laboratories, including Stanford, MIT, Berkeley and Bosch in the US, as well as Japan’s University of Tokyo.

“Open source can serve as a multiplier of research and development effort. We can download and modify the work of other universities, while also making our discoveries available in return,” Johnston says.

This approach is allowing the field of robotics to move forward at a rapid pace; rather than every lab having to program their robots to perform the same actions – for example grasping and navigation – researchers can focus on their areas of interest and share their outcomes.

“Basically, you take advantage of what other people have done, and then explore and advance the research in the area of your interest, rather than having to build the whole infrastructure from scratch, which takes a lot of effort,” Johnston says.

“Robotics is so challenging that there is no single research lab which could produce a complete robotics system. Without sharing and collaboration through open source software, it wouldn’t be possible to do significant research in robotics – it can take years simply to get the hardware working, let alone the effort required to solve real-world problems.”

Super resolution microscopy reveals new weapons to fight infectious diseases

The UTS purchase of the DeltaVision OMX super resolution microscope and the upgrade to its successor, the first-ever commercially installed Blaze SIM Module, has changed the face of microbiology research at UTS.

Researchers in the ithree institute are using these technologies to capture images and movies of live microbial cells, something considered impossible before the advent of super resolution microscopy only a handful of years ago.

According to the UTS Microbial Imaging Facility’s super-resolution imaging specialist Dr Lynne Turnbull, the new possibilities are the result of bringing together new thinking about the design of how a microscope lights up the sample with improved speed and sensitivity of the microscope cameras. “These sorts of technological improvements mean we can ask new questions,” she says.

New questions lead to new answers, as the ithree team has discovered, with a series of breakthroughs in the years since the OMX was installed. Most recently ithree researchers used the technology to achieve a world-first breakthrough in contemporary understanding of the way bacterial cells divide, capturing movies of individual bacteria dividing in real time at a level of detail not seen before. These insights could lead to the development of new types of antibiotics that target the cell division process.

“We had tried to do this project before but we couldn’t until the advent of the Blaze, all of our previous attempts killed the bacteria before we could study them fully,” Turnbull says.

Earlier this year, a research team from the University of Sydney and UTS showed the changes inside a virus during the exit of a viral particle from a host cell, an amazing achievement in such a tiny entity. This was the first sub-viral imaging obtained with a light microscope and opens up exciting new avenues for virology research.

The use of super resolution microscopy in microbiology research is now becoming more widespread, thanks largely to the exciting results that UTS has produced. In fact, ithree researchers remain the world’s major microbiology users of the OMX today.

“People are adopting the technology, but we were first.

“UTS has pioneered this technology in Australia, enabling Australian science to move forward and with the potential to improve the health of all Australians.”
New horizons for architectural design

The advent of basic computing had a profound impact on the architecture discipline, moving the profession from drafting by hand to a system of electronic imaging and modelling. The change has transformed the way buildings are drawn. For many architects though, that’s where the flirtation with technology stops. But, according to Senior Lecturer in the Faculty of Design, Architecture and Building Iain Maxwell, those who choose to engage with it can extend their architectural practice in two explicit ways.

“One is ‘I have an aspiration and I need to now invent a technology through which I can realise that aspiration’. The second is to be opportunistic with existing or emerging technologies by re-imagining their potential,” Maxwell says.

Maxwell and fellow Senior Lecturer David Pigram embrace both modes in their research, and are using their work to push the boundaries of a very traditional profession.

They’re currently working on a demonstration apartment in Zurich with Swiss research company EMPA. Rather than being asked to find appropriate technologies to meet the needs of the architectural process, they’re being asked to demonstrate and test the potentials of new construction industry technologies in an architectural context.

“One is a new system for floor construction, which reduces at least 80 per cent of the concrete content required for a flooring system,” Pigram says.

The others include photovoltaic solar panels that are used to manage occupant privacy, views and energy generation; and an undulating concrete roof structure with a thin shell that manages the apartment’s insulation, heating and cooling, and energy generation at 1/6 the thickness of available Swiss roof systems. Together, these technologies represent the future of sustainable housing construction, where hyper-efficient material usage and energy harvesting amplifies architectural innovation.

This cutting-edge research sits at the intersection between architecture and technology, simultaneously inventing new systems and demonstrating their worth so that ultimately such technologies can benefit all homes.

Claire Thompson

Noeline Monaghan

Big data yields new questions in health care law

Data held in publicly available databases is reshaping traditional approaches to research, says PhD student in the Faculty of Law Noeline Monaghan. Monaghan is investigating the role of the law in bridging service gaps for older people seeking access to health care.

Early in her PhD, Monaghan was struggling to gather enough information to support her project hypothesis. But a session at UTS Research Week on how to access public data provided her with a vital change of direction; she uncovered over 100 000 clinical trials records that had the potential to provide in-depth insights into the possible exclusion of older people from medical advances.

“It changed so much about my research,” she says. “To begin with, it eliminated the need to re-survey and re-collect data that already exists online. The sheer volume of information also increases the precision of my research when it comes to accurately analysing how older people are being serviced by clinical trials in Australia.”

The online data has also allowed Monaghan to vastly expand her lines of enquiry; rather than only looking at survey responses from doctors about the treatment of older patients, the clinical trials data paints an unbiased picture about whether older Australians are given equal representation in major health care initiatives, and depicts how well Australian health care law is supporting this vulnerable group.

“Accessing the clinical trials data means I can now put together a proposal and accurately test it against the evidence that is available,” she says. “Because there is so much data out there, the only limits are the questions you ask.”

Claire Thompson

Noeline Monaghan

New horizons for architectural design

David Pigram and Iain Maxwell

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UTS:NEWSROOM

newsroom.uts.edu.au/news/2013/07/at-the-cutting-edge
Digital content aimed at preschool-aged children is leading to a contemporary conundrum for parents and early childhood teachers, according to Dr Sumin Zhao.

The linguist and Chancellor’s Postdoctoral Research Fellow in the Faculty of Arts and Social Sciences, says, thanks to the digital revolution, children are being exposed to digital technology earlier in life. Educators are also being encouraged to incorporate new modes of learning into early childhood classrooms.

As a result, parents and teachers need help determining how to pick and choose the tools that will be beneficial to children’s learning. It’s a big job, particularly given the sheer volume of digital content that is now available for young children.

“What parents and teachers are facing is that they don’t know how to choose. What are the guidelines for what is working, what isn’t working, what is actually good for children?” Zhao says.

Her particular area of interest is in mobile apps, or web applications that are accessible via tablets and other smart devices. She and her colleagues are seeking to understand how the introduction of apps has changed family literacy practises and how their use can maximise literacy learning for children aged three to five. They are also seeking to build a series of guidelines to help parents and teachers select and use apps more effectively.

Originally from Shanghai, Zhao came to Sydney 10 years ago to complete her postgraduate studies. A PhD at the University of Sydney, followed by a research position at UTS, led to a UTS Chancellor’s Postdoctoral Research Fellowship that commenced in early 2013.

Her interest in linguistics, particularly when it comes to digital content, is part passion for “nerdy” subject matter and part personal belief in the importance of positive educational experiences for children.

“The nerdy reason is that analysing digital texts is more challenging for linguists than just analysing plain text,” she says.

“The other reason, I think, is that I’ve always been interested in early childhood education.”

Research has shown family literacy practises, like bedtime stories and parents and children reading together, have a profound impact on how well children do at school. Students whose learning at home is poorly matched to school curriculum, or disadvantaged students who don’t have access to the same resources as their peers, tend to fall behind.

“You reflect back and you realise your friends are just as smart as you but because what they were taught at home was so different to what the school did, they were kind of being filtered out of the school system,” Zhao says.

In the digital era, being able use digital technologies effectively is not a given for all children, despite a widespread belief that kids today are ‘digital natives’ who have been brought up on a diet of iPads and smart phones. Zhao cautions being able to access digital content is not the same as being able to extract valuable information from it that impacts learning in a positive way.

“It’s the same as whether you use a book as a brick, or whether you use a book to learn things,” she says.

“There are also lots of children who’ve never touched an iPad at home, and they don’t know how to engage these apps.”

While her research is still in its early stages, Zhao hopes the outcomes will be useful both in the home and in the classroom. For teachers, she wants the guidelines to be instructive both in terms of helping them choose useful apps to use in class, and in showing them how to integrate the apps into their teaching to enhance learning outcomes.

Claire Thompson
Photographer: Joanne Saad

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newsroom.uts.edu.au/news/2013/07/appy-learning
shared control

Robotic butlers, à la *The Jetsons*, may be some years away, but “robotic colleagues”, who work with humans and not in place of them, are closer than you think. Researchers at UTS’s Centre for Autonomous Systems (UTS CAS) reveal how, in as little as two years, their work could transform the civil infrastructure maintenance, aged care, agriculture and manufacturing industries.

“The emphasis is more about keeping the human intelligence and using the strengths of the robots to achieve joint tasks more effectively.”
"It's all about shared control", says Director of UTS CAS Professor Gamini Dissanayake.

"The emphasis is more about keeping the human intelligence and using the strengths of the robots to achieve joint tasks more effectively.

"For two people to ever be able to put something together; they have to have an understanding of what each is trying to do. To get that same understanding into a robot is the research challenge, but I think we're getting there.”

It's a challenge Dissanayake and his team have been working on for over a decade. It all began in 2002 when Dissanayake came to UTS and, together with colleagues at the University of Sydney and the University of New South Wales, applied to establish the Australian Research Council-funded Centre of Excellence for Autonomous Systems (ARC CAS).

"The idea was to bring together a large enough team that could make an impact on the world stage. So, we put a bid in and it was successful.”

The focus of the centre was in understanding how to build intelligent machines that can operate in difficult and unknown environments. Their work was divided into four areas – perception, learning, control and systems.

"Perception is about interpreting information from senses. Learning is about how to improve your understanding based on what you’ve observed in the past. Control is about how you act, how you go about doing things. And then systems is about how you actually build and engineer the machine; and that’s not just a simple matter of gluing things together,” explains Dissanayake.

The grant guaranteed funding for eight years and, Dissanayake says, “made it possible for us to look into the long term and to exploit each other’s strengths.”

At UTS, those strengths were perception and control. And they led to the development of a robotic navigation algorithm Dissanayake calls SLAM – simultaneous localisation and mapping.

Three years after funding finished and ARC CAS officially closed, SLAM is still a key strength of the centre’s UTS descendant: UTS CAS.

"We knew that, in the end, the ARC’s not going to fund us forever. So before that happened we were already identifying our niche areas in order to make this impact and the transition to sustaining the activity.

“We recognised one of the areas we wanted to push ahead with is robots with people. That’s one of the big emerging challenges in the research sense,” says Dissanayake.

“So the university provided funding for us to strengthen that part of the work and we continue to get funding from research and development projects which are based on our old strengths.”

UTS CAS is also actively constructing new strengths in civil infrastructure maintenance, aged care, agriculture and manufacturing. They’ve even developed a robot that can collect crucial information to help human first responders in disaster scenarios.

However, one of the biggest growth areas, says Dissanayake, is infrastructure maintenance. "We have two very big projects in that space – one is a robot to clean steel surfaces, the other is centred on inspecting large diameter water pipes.”

Aged care is also offering the centre opportunities to develop commercial-grade products with substantial community benefits. Currently UTS CAS, in collaboration with the Faculty of Health, is developing robotic prototypes of a wheelchair, walker, hoist and telepresence device, which "is like Skype on wheels”, says Dissanayake. The project is being funded by the IRT Research Foundation, which specialises in seniors’ lifestyle and care solutions.

Unlike other care devices that are fully automated, the machines being developed by UTS CAS are “sharing the control with the person. The amount of autonomy the machine has depends on the capability of the person.

"It’s no different to the way your ABS or electronic stability system works in a car – you hit the brake, or you turn the steering and the car goes in the direction you want.”

At the moment, the machines are undergoing a phase of user-centred design. “So we’re trying to pull out what is actually required by the users,” says Dissanayake.

“The expectation is that in the near future we convert that into a specification. Within the next nine months we’ll build these devices and deploy two of them – the hoist and walking frame, which the staff and residents at an aged care home in Woonona prefer – and, then we’ll trial them.”

If all goes to plan, commercial versions of the products should be available within two to three years.

While careful planning of research investment has been key to UTS CAS’s success, Dissanayake is quick to add their most valuable asset is people.

“I think really our strength is people. We’ve got a great team; all sorts of young researchers gradually growing through the ranks to become professors and associate professors, and I’m very proud of that.”

In addition to 25 PhD students, UTS CAS is also the part-time home of renowned American robotics researchers Professor Ken Waldron from Stanford University and Professor Tomonari Furukawa from Virginia Tech.

In May, the centre also signed an agreement to open a joint robotics research centre with China’s Zhejiang University. Dissanayake says the move is set to be a boon for both staff and students.

“We have an undergraduate mechatronics program that gives us access to very smart students, we have a reputation that attracts excellent PhD students from all around the world, and we have staff who are 100 per cent committed to robotics research. Above all else, we have great support from both our faculty and the university. And because of that I’m confident robotics at UTS will keep growing for many years to come.”

Fiona Livy
Marketing and Communication Unit
Photographer (G Dissanayake): Joanne Saad
Hand image: Thinkstock

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UTS: NEWSROOM
newsroom.uts.edu.au/news/2013/07/shared-control
UTS itself may only be 25 years old, but our research expertise dates back much further. The School of the Environment’s Distinguished Professor Graham Pyke, Professor David Booth and Chancellor’s Postdoctoral Research Fellow Dr Jennifer Donelson, reveal how a chance meeting in 1980 set the foundation for some of today’s leading research into the long-term effects of climate change on fish.

PROFESSOR GRAHAM PYKE

As a child, my parents read me Doctor Dolittle and as a result I became fascinated with animals. From the age of five I was keeping and breeding birds. I did an undergraduate with honours degree, then commenced a PhD in mathematical statistics. Then I thought, ‘It’s time to do biology’. I spoke with my mentor, Professor Charles Birch, who was a very famous Australian ecologist, applied to do a PhD and got a Fulbright Scholarship to the University of Chicago where they had a program in mathematical biology.

I was scared ‘shitless’ to be quite honest; I had never left the country before, never been on a plane, never left home. I ended up doing research on the foraging behaviour of bumblebees and hummingbirds and then went onto pollination of the plants they visit. In 1977, I decided it was time to come back to Australia. I successfully applied for a Queen Elizabeth II postdoctoral Fellowship and chose to take it to the University of Sydney, again under Charles Birch’s wing.

Then along came Dave Booth; he wanted to do an honours project on the foraging behaviours of fish using an approach I had been developing called optimal foraging. Dave did his honours in 1980, my last year at Sydney uni. I then moved to the Australian Museum and Dave went overseas to do his Masters, then PhD. In 2007 I retired. But I didn’t really – I kept my office, I kept doing my research. The source of my income just changed from the museum to a pension. I rejoined the UTS faculty in early 2012.

If you want to understand how the world works, you need to include foraging behaviour as it is at the base of every interaction between species. It has been applied to a number of situations – human archaeology, medicine, gambling. One of the things I’m doing at the moment is writing a review, well two reviews, of all of this.

When I began as a researcher we didn’t have computers; we wrote things out long hand and exchanged 'snail' mail. Things took forever. Now, it’s a whole different ball game. Those doing an honours year are expected to get one or two publications. In my case I was three years in to my first job, post-PhD, before I had my first publication. That became the highest cited in all of ecology for a while; so I had a big splash.

Dave is fond of mentioning either that his claim to fame is being one of my honours students, or my claim to fame is being one of his supervisors. Now, we are colleagues. He has some good attributes – like me, he enjoys a glass or three of red wine. I guess we’re kindred spirits.

I’m really, pleased to be here at UTS and next door to Dave. I couldn’t ask for a better situation.

PROFESSOR DAVID BOOTH

Graham was my honours supervisor, but at the start he wasn’t the official one. I had another mentor, Lanzing, who was a wonderful old guy, but had no concept of the cutting-edge of science or getting something done in a limited time. Luckily, I met Graham. I remember sitting on a ladder watching birds in a waratah nursery, at Pearl Beach in NSW, and Graham, who I’d just met, asked me to explain what I was doing. He put everything into the perspective of optimal foraging and made the things I was looking at much more rigorous.

My thesis was put on paper by my mother on her typewriter – she still remembers the scientific names of my fish, that’s how painful it must have been for her! And of course diagrams were done with a thing called Letraset; painful for a left-hander!

In some ways technological changes are good, but I think we’ve dropped a lot of our compulsion to really study how animals and plants work in nature. We’re more concerned about publishing papers, being technologically savvy, doing a wonderful PowerPoint presentation.
There was a gap of 20 years or so where we didn’t contact each other, but that’s what makes it so exciting to get back together. Graham really inspired me to travel – he’s an Aussie who went to the US, did his time and came back. I headed to Canada, the US, Hawai’i and the Caribbean for my studies. Graham coming to UTS was just very good timing. He was scaling back from the museum and, personally, I think more of his talents will be of use here.

I’m interested in how optimal foraging fits with climate change – when you change the temperature in an environment an animal’s foraging usually changes too. I think as Graham’s thoughts enter into what we do, we’ll start to see more collaborations. Graham’s also very good at thinking about the big picture. We’ll use him mercilessly for that!

You always look back and think, ‘Gee, if I was doing my postdoc now I wouldn’t get a look in’. I feel sorry for new students, they’ve got to be so cutting-edge, but do they get a chance to sit back and reflect on what they’re doing? One of our roles is to make sure they do. And still publish all those papers.

Jennifer’s a fantastic scientist, she’s really charismatic, a really good speaker, good in the media and publishes in high impact journals. To become a Chancellor’s postdoc you need many things apart from a great track record; you actually have to show you will enhance research at UTS. In Jennifer’s case she has enough overlap that we talk the same language but she has another sphere: she’s more into the physiology of fish and how climate change will affect them. She’s looking to see if the next generation of fish is better adapted.

**DR JENNIFER DONELSON**

Supervisor, mentor, boss; Dave is probably all of the above. Most importantly he’s my mentor, assisting me in moving from being an early career researcher that has only just completed my PhD to a more confident and fully independent postdoc. After my three-year Chancellor’s Postdoctoral Research Fellowship I hope to be moving towards having my own research lab.

The first word that comes to mind when I think of Dave is generous. He gives as much time as he possibly can to his students, post docs, colleagues, media outreach, board memberships and associations. It’s a good quality to have in an academic researcher.

Dave is challenging me to think beyond the questions I have previously been asking and to see the questions from a new angle. I’ve only been working with him since January, so I think most of the impact is really yet to come. Unfortunately, I haven’t worked with Graham. Yet. He’s an influential scientist, in both quality and quantity of research publications, in terms of understanding the behavioural ecology of animals.

I think multiple generations working together is essential for getting the most out of research. It’s important to have a range of ideas and experience levels because the same question can be approached from so many different directions. Dave and I have already discussed opportunities for me to co-supervise future postgraduate research students. I think that supervising is an important part of being a successful researcher.

My research investigates how marine fish can cope with increases in sea water temperature. Over the next few years I’ll be collecting a range of species up and down the east coast of Australia and then testing their performance under different future temperature predictions. I’ll be able to compare how fish respond to temperature when they’re held under the warmer conditions for months, years and across generations.

As a child I always enjoyed searching through rock pools and finding interesting things washed up on the beach. After I finished high school in Melbourne, I headed to James Cook University in Townsville for an undergraduate degree in marine biology. After I completed my studies I wanted to diversify my research. I had met Dave at conferences and thought our research complemented each other’s. So when the opportunity to work with Dave came up, I jumped at it. UTS also offered me access to essential facilities I require for my research, including the Sydney Institute of Marine Sciences aquarium facilities.

**Fiona Livy**

Marketing and Communication Unit

Photographer (D Booth and G Pyke): Joanne Saad
Photographer (J Donelson and D Booth): Katia Sanfilippo

*water image: Thinkstock*

Comment on this article at [UTS: NEWSROOM](http://newsroom.uts.edu.au/news/2013/07/generational-change)
Teaching styles come and go, but basic teaching stays the same, says Emeritus Professor and Professor of Quantitative Finance Carl Chiarella.

Chiarella speaks from 40 years’ experience at UTS alone. His research into heterogeneous agent modeling and American option pricing is perhaps his most important contribution to the field of quantitative finance, but when it comes to teaching, he says it’s all about making the theory accessible to students.

“I just try to break it down into small digestible chunks. I also use my own notes more so than textbooks.”

Now 69 and with over 150 publications to his name, Chiarella no longer teaches but is still supervising PhD students. “My wife wants me to do some travel now with her so I’ve reduced my hours. Though I’m not interested in retiring quite yet; I just like the place, the informality. It’s what’s kept me here for so long.”

‘Here’ was previously the NSW Institute of Technology, when Chiarella first started in 1971, and later became UTS in 1988. He cites late Vice-Chancellor Gus Guthrie as being instrumental to the success of the subsequent merger with Kuring-gai College of Advanced Education in 1990.

“That worked quite well, and I think had a lot to do with Gus. It’s regarded as one of the more successful mergers.”

Chiarella’s decision to focus on economics was made following his return home from France in 1971, where he’d been a 26-year-old postdoc student looking at numerical methods.

“I then began a master’s degree at the University of New South Wales (UNSW). After finishing that in 1975 I decided to do a doctorate, which took 10 more years. I was also teaching at the time; the teaching load increased a lot in the 80s. UNSW then offered me a position in their School of Banking and Finance and after three years there, I came back here as a Professor in the then School of Finance and Economics – now the Finance Discipline Group in the UTS Business School. I’ve been here ever since.”

With his current research focus being derivative securities pricing and Keynesian economics, Chiarella says the need for research funding is perhaps the most important change he’s noticed over the years. “You have to get grants; luckily I’ve been able to get many.

“My first was in 1988 around interest rate derivatives; I have subsequently won many grants, in fact about 28 in all, mostly large Australian Research Council, or ARC, and Discovery grants, but also including a few small ARC grants and a few Dean’s awards as well.”

He says the changes in his field over the last 20 years have been somewhat predictable.

“There’s a lot more numerical work. The low-lying fruit has been picked; you have to reach a bit higher up the tree now, but there’s still a lot of fruit to be picked.”

Chiarella’s most recent ARC grant, researching electricity derivatives, is timely considering last year’s introduction of Labor’s carbon tax. “The aim is to translate to Australia the emission trading scheme which already exists in Europe.

“The emissions trading scheme is basically where everyone is given a right to pollute up to a certain quantity, then they have to trade those emission trading rights. So you may have less than you need, or more than you need, and people would trade those; that’s the basic idea.

“The issue is, how much does the government give people the right to pollute? There are many technical issues related to that. They’ve gone the carbon taxation route at the moment but they’re talking about introducing a carbon emissions trading scheme. Whether it will happen, I don’t know – depends on politics, I guess.”

Katia Sanfilippo
Marketing and Communication Unit
Photographer: Joanne Saad

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newsroom.uts.edu.au/news/2013/07/on-the-money
"Cancer is a master manipulator programed for survival," says Associate Professor of Pharmacy and Pharmaceutical Sciences Mary Bebawy.

Bebawy knows cancer intimately – for the past 18 years she has been researching multi-drug resistance in cancer. Funded by the Cancer Council NSW and National Health and Medical Research Council, her research is re-positioning the fight against cancer.

Instead of looking at curing patients through medication alone, Bebawy and her UTS team of seven PhD students and two postdocs are unlocking the code that prevents cancerous cells from passing on their dangerous resistance ‘knowledge’ to other cells.

Bebawy and her collaborator – Sydney University Medical School’s Professor Georges Grau (Chair of Vascular Immunology) – have discovered tumours spontaneously shed tiny sub-micron elements (vesicles), called microparticles, which carry resistance proteins with them as part of their cargo.

“These vesicles act as a vector carrying these proteins and then they deposit the proteins onto a drug responsive cell, and in a matter of hours, that cell becomes absolutely multi-drug resistant and unresponsive to treatment,” says Bebawy.

The vesicles also carry genetic material which they transfer to other cells, re-configuring their genetic landscape and recruiting them into the army of drug-resistant cells.

“The original cell completely changes to look like the resistant one, and we’ve confirmed this by doing really crazy experiments where we’ve taken vesicles from breast and put them on leukaemia cells, vesicles from leukaemia put them on breast, and we find a complete re-templating of the transcriptional landscape. This has really serious implications in conferring harmful traits within a cancer cell population.”

Cancer is one of the leading causes of death in Australia. At current rates, it is expected one in two Australians will be diagnosed with cancer by the age of 85. Cancerous cells act like ants: when one route is blocked, they find an alternative, and Bebawy says, “multi-drug resistance is a huge problem for cancer patients because tumours can evade chemotherapy and it affects the success of the patient’s treatment.

“There’s a lot of research into drug development and there are thousands of molecules out there with anti-cancer properties, but really when it comes down to it, these molecules will work for a short period of time and then the patient relapses. It’s for that reason, amongst others, we cannot kill cancer.”

Bebawy says we need to find a new angle of approach, and that’s what her research is delivering.

“You have to be one step ahead of cancer, but it’s difficult. I’m forever grateful to the Cancer Council for seeing the importance of this type of research. I approached them with a very crazy idea that cancers shed vesicles and the vesicles act as vectors, and initially we struggled to get that work published, but now it’s just opened up a whole new area of research.

“This is an essential area because there’s no point making drugs if the cancer is just going to change and cleverly adapt. We need to better understand drug delivery pathways and that’s what I’m committed to.

“As scientists, if we can at least contribute a little piece of knowledge that could then be built upon in future years, I’d be very happy.”

Izanda Ford
Marketing and Communication Unit
Photographer: Joanne Saad
Over the last 25 years, research has quickly become the foundation of many UTS activities; it has shaped our teaching programs, built our graduates’ capabilities, fostered academic and student exchanges and delivered real benefits to society, industry and the environment. Research has also been integrated into our City Campus Master Plan. Unlike the comparably conventional construction of the Tower, sensors have been placed in the new Broadway Building. They will capture a range of data including monitoring the buildings downward weight and movement as well the chloride ion levels in the concrete, which causes steel to rust. This will allow UTS researchers to gather information builders consider for future designs.

Tower foundations (1973): unknown
Broadway Building foundations (2011): Claire Sargent

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