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AUSTRALIA 2025: SMART SCIENCE

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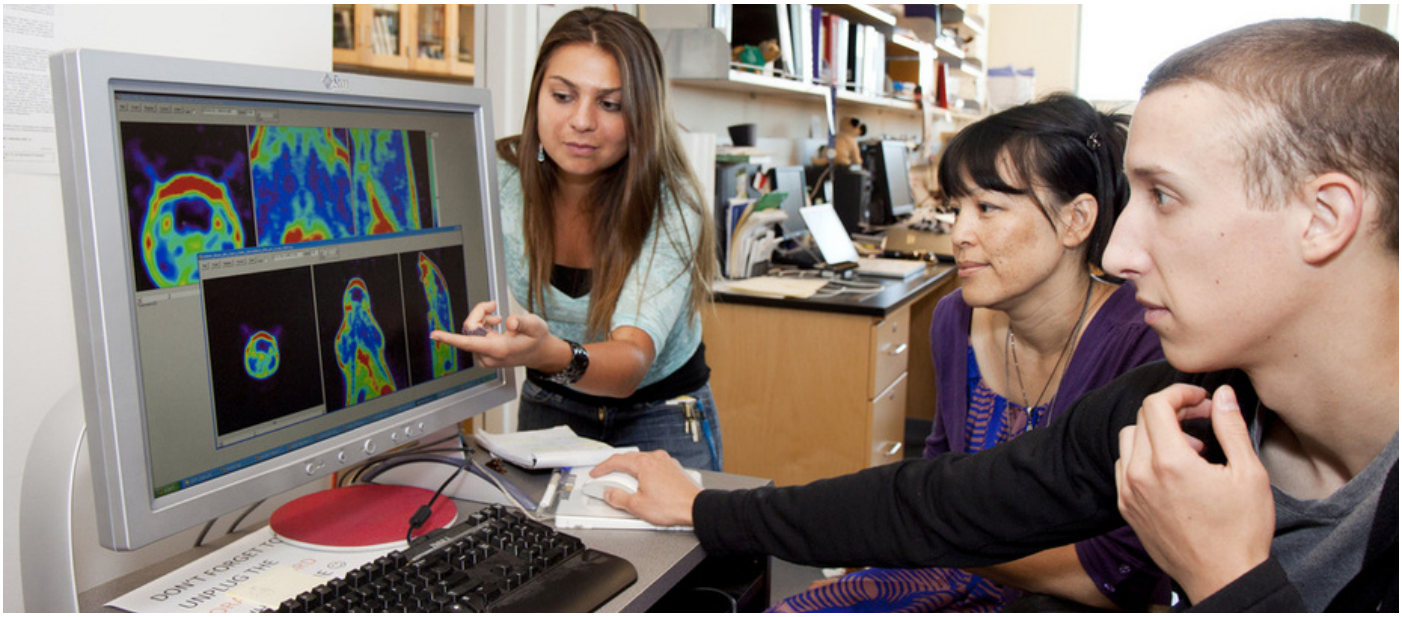

As an enabling technology, ICT reaches into many fields including health, cybersecurity and engineering (shown here).
Kevin Tong/Flickr, CC BY

Australia's got ICT talent – so how do we make the most of it?

Author: Professor Brian Anderson

Further comment: Associate Professor David Glance and Professor Toby Walsh

AUSTRALIA 2025: How will science address the challenges of the future? In collaboration with The Conversation, we're asking how each science discipline will contribute to Australia now and in the future. Written by luminaries and accompanied by two expert commentaries to ensure a broader perspective, these articles run fortnightly and focus on each of the major scientific areas. This instalment takes a look at ICT's role.

It's finally dawning on private and public sectors that information and communications technology (ICT) is an enabling technology. ICT is relevant to companies – whether making drugs, mining coal, building a bridge or providing banking services – and government agencies, such as the Australian Taxation Office (ATO), operators of an urban railway systems and (obviously) Social Security and Defence Science and Technology Organisation (DTSO).

One or two decades ago, it was common for casual commentary to suggest that Australia had missed the ICT bus:

- ICT multinationals, almost all foreign-owned, generally weren't interested in doing more than selling in Australia
- ICT-based small and medium enterprises (SMEs) faced the usual challenges impacting all SMEs, and the additional one – their ICT specialist R&D staff were less qualified on average than R&D staff across other disciplines
- CSIRO was perceived – perhaps unfairly – as not having significant impact in the area
- international rankings of Australian computer science publication citations showed us a long way behind even the world average.

Louise Billeter/Flickr, CC BY-NC-SA

These days, public perceptions of ICT's importance are far more developed. Almost every day, we interact with a supermarket scanner, we check our email, we pass under a motorway toll point, we download our power bill or we check what our friends on Facebook are doing.

There is Australian software in more than a billion mobile phones worldwide. And while just a small fraction of those phones are in Australia, there are certainly enough that the community at large appreciates the transformational power of ICT and how pervasive it is, even if it is often behind the scenes.

The National Broadband Network (NBN), an ICT construct if ever there was one, has been the subject of significant political controversy and raised public awareness of the pervasiveness of ICT.

What's down the track, then?

Our everyday lives are going to be affected in an extraordinary number of ways, most involving the coupling of ICT ideas with technologies with which we are familiar. Likely scenarios include:

- instead of swallowing pills or receiving injections, devices in our body may administer drugs automatically, at times and dosage levels tuned to our body's requirements
- firemen will be equipped with micro airborne vehicles to search a burning building for survivors
- all road vehicles will be fitted with sensors and devices to communicate with other vehicles and roadside infrastructure, to lessen collisions, and to reduce congestion through the provision of real-time advice; in due course, traffic densities on freeways will be increased through automated control of vehicles

- the ATO website will accept queries on curly tax issues and provide an answer via an automated service which the taxpayer can rely on in meeting his or her tax obligations
- partial sight will be restored through a bionic eye to people who have become blind through diseases such as macular degeneration
- people will improve their qualifications through enrolment in massive open online courses (MOOCs), receiving a grade after automated processing of their assignments and examination papers
- many farm fences will be eliminated; farm animals will be provided with sensors designed to localise the animal's position and deliver an electric shock when it strays from a defined region
- people will discuss contracts with a non-English-fluent Korean businessman using a two-way, unobtrusive real-time translation phone app, or via an add-on to a three-dimensional Skype system
- robot floor cleaners in the home will be as fast and as efficient as vacuum cleaners pushed by a human.

This list highlights the pervasiveness of ICT applications, and no doubt countless more examples can be advanced. Almost everyone would agree too that we would be better off with such advances (though with qualifications with issues such as privacy and security). So what is involved in getting there?

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A passive approach is to imagine that using money earned from trade in agriculture or mining or education, we could simply buy tasty ICT morsels catching our fancy in the international market. But this won't work.

We must have ICT skills: if we don't, not only do we miss out on the pots of gold associated with the different business opportunities, but we will be ill-informed purchasers of sophisticated products.

If buying internationally, we could be as much victims of a ruthless vendor as the Icelandic bankers who purchased foreign financial products that ruined their country in 2008. Imagine trying to decide what is the best technology or technologies for an NBN with little or no expertise.

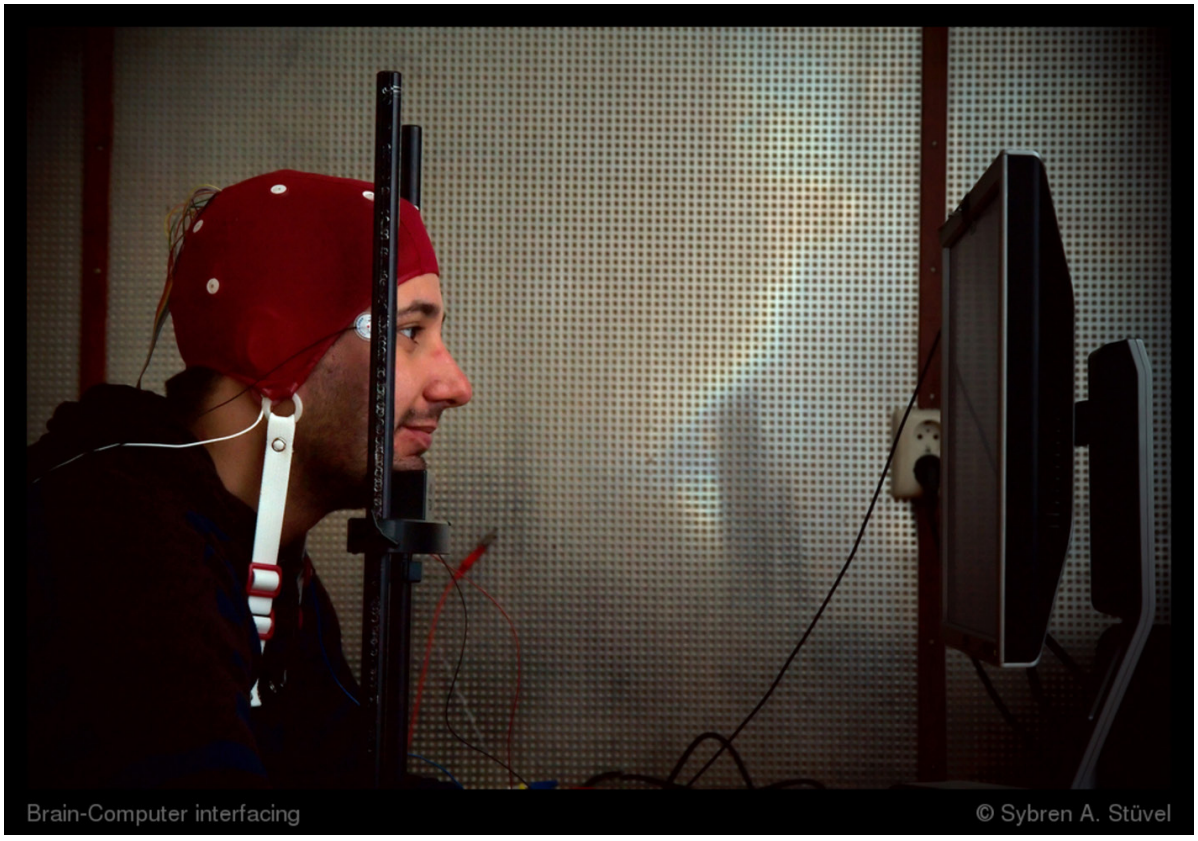
The required human capital clearly must come from universities, and will only be up-to-date if the universities have adequately resourced staff of international standard.

Three simple steps to maximise ICT talent

First, it needs to be very easy for ICT researchers to collaborate with researchers in other disciplines; so many future applications will rest on a further disciplinary pillar besides ICT, precisely because it is an enabling technology.

Of course, institutional players such as the universities and the Australian Research Council (ARC) will sign on to this proposition, but giving effect to it can be still very challenging.

Fundamentally, prestige for an academic grounded in his or her achievements is generally seen as easier to attain when a single discipline is involved. Those crossing two (or more) disciplines are more likely to be considered as not making it well in either rather than achieving a high standard in more than one discipline.



An example of cross-disciplinary research: brain-computer interfacing. Sybren Stüvel/Flickr, CC BY-NC-ND

Then there's the question of money: if discipline-based panels allocate research funds, such researchers can lose out.

The second qualification is that the route to commercialisation of ideas needs to be straightforward.

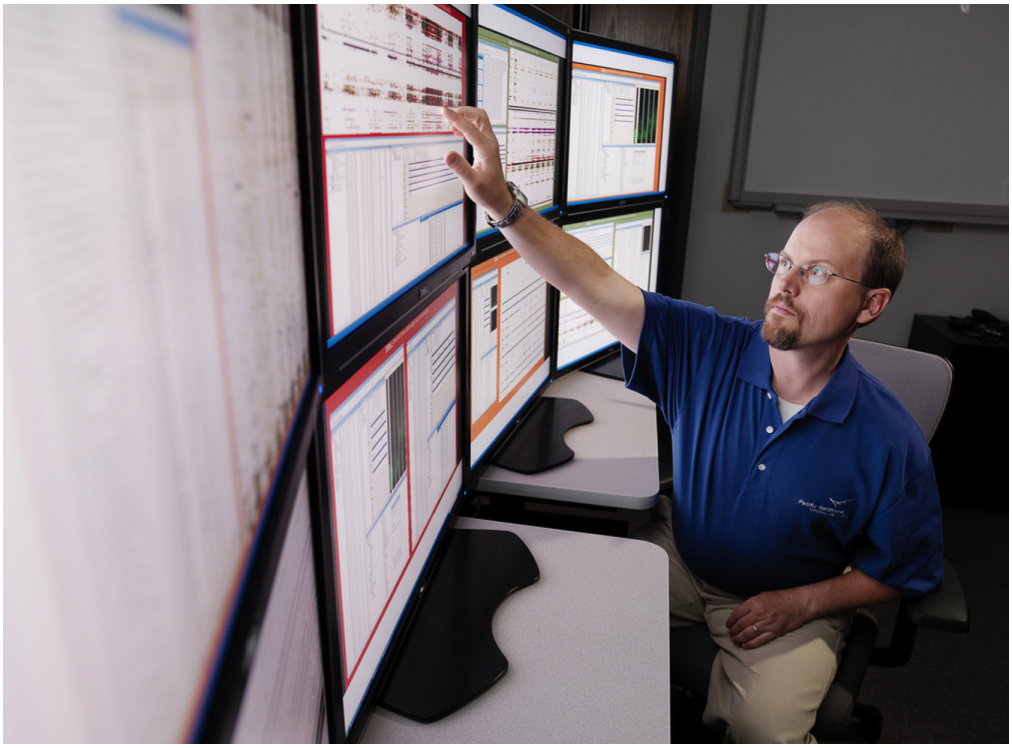
In the ICT area commercialisation has been hugely assisted by the creation in 2002 of NICTA. This organisation has provided a bridge not only between its own researchers and the commercial world (including business creation with start-ups) but also between affiliated ICT researchers in universities and the commercial world.

Commercialisation is less the core business of universities than it is of NICTA, and most universities have less depth of ICT-relevant commercialisation skill set than NICTA has.

A third requirement is that it must be possible to pursue large-scale research ideas with public sector finance. With the limited exceptions provided by Cooperative Research Centres (CRCs) or ARC centres and defence-oriented work in DSTO, CSIRO and NICTA are probably the only examples.

A healthy coupling of the university sector to the commercial world is certainly not the whole story. That coupling needs to be grounded in a solid disciplinary base where the individuals can match it with the best in the world.

Specialists are needed in subdisciplines such as cyber security, machine learning, computer and communication networking, large scale and distributed systems, mobile communications and computing and big data, to name a few.



The science of cyber analytics supports better predictions and guides adaptive responses of computers and computer networks.
PNNL - Pacific Northwest National Laboratory/Flickr, CC BY-NC-SA

But without our ICT experts, we'll be left behind the wayside – and catching up will be more difficult than ever.

David Glance, Associate Professor at the University of Western Australia

It is easy to confuse Australia's passion for being users of the latest technology with a passion to be involved in creating them.

In fact, as the US continues to see a rise in enrolments in computer science degrees, Australia has seen a continuous decline.

It is not that Australians are less bright or resourceful or less hard working. It is not even a tyranny of distance because if there is one thing you can do remotely, it is develop and sell technology, especially software.

No – it may simply be the fact that on the whole, Australians are just not interested in developing ICT.

This is not a particular problem in a globalised world in which the ways of doing things in Australia are not that different to how things are done in the US or in Europe.

We can possibly rely on others to produce the technologies that we will need to drive a growing economy past the mining phase.

What will be vital as a minimum, though, will be the ability and desire to utilise ICT to support innovation in everything else that we actually do.

So even if being a primary provider of ICT is not in Australia's future, being expert at using them will be.

Toby Walsh, Research Leader at NICTA

ICT has been a great driver for change over the past 10 years – and, as illustrated by Brian's examples above, it is sure to continue being one of the most important drivers over the next decade.

So let's not forget the immense environmental, societal as well as economic pressures that are building across the globe.

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Australia, the lucky country, has escaped many of the troubles so far, but our luck can only last so long, and ICT is one of the few hopes we have to mitigate the problems that lie ahead.

We already work closely with our mathematician colleagues to develop equations to help government and business optimise their activities, and do more with less. It's computers that ultimately solve these problems.

As the recent debate over tax bills of multinationals demonstrate, nations must produce – not consume – intellectual property in the ICT space to reap the rewards.

Take Google, for example. Google sits on around US$60 billion – not bad for a company founded on the back of a computer algorithm. But those rewards don't go to the users of Google. They flow back to the producers.

For this reason, Australia must produce ICT to ride the coming wave of change.