



# INNOVATING INSIDE AND OUTSIDE THE UNIVERSITY

2016 Australian Higher Education and Research Study Tour

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## About this report

This report captures observations from a study tour to Denmark and Sweden in 2016. The tour was attended by 17 executives from Australian universities from New South Wales, Victoria, Western Australia, Queensland and South Australia. The Australian Ambassador to Denmark, Norway and Iceland, Damien Miller, attended the welcome reception and attended a separate briefing at Cisco's offices to provide a backdrop to the Scandinavian innovation model and system. The format for the tour was:

### Two days in Copenhagen, including visits to:

- Cisco.
- The Danish Outdoor Lighting Lab (DOLL).
- Technical University of Denmark (DTU).
- State of Green.

### Two days in Malmo, Sweden, hosted by Malmo University.

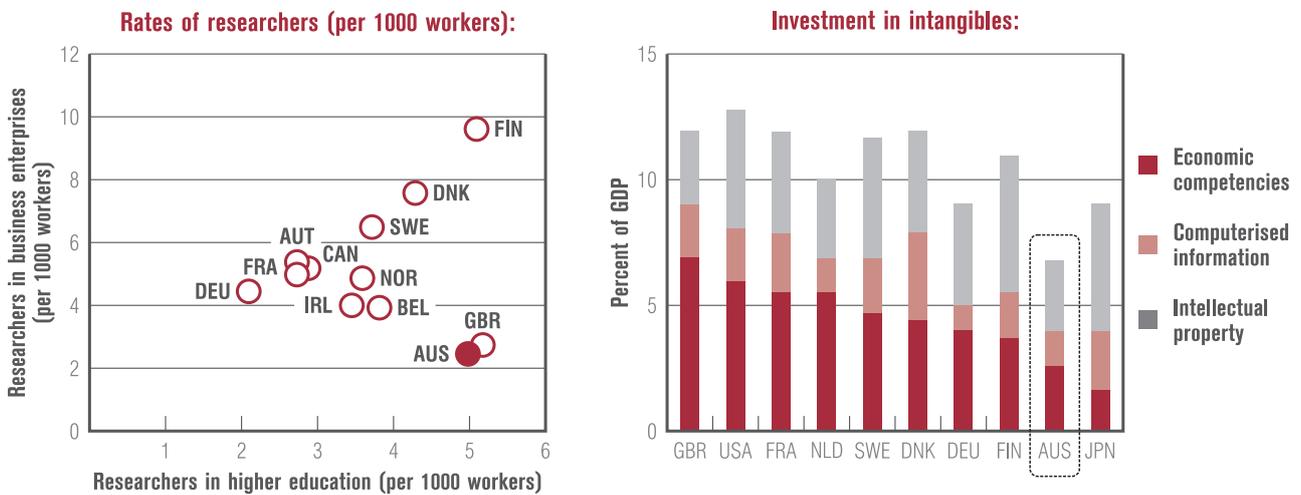
# 1. Innovation at work in Scandinavia

## Context for the study tour

The 2016 Australian Higher Education and Research Study Tour took place against a backdrop of the National Innovation and Science Agenda (NISA). The intense focus on innovation in Australia reflects the fact that Australia's economy needs to change, and universities need to change with it. In fact, universities are in a position to (and in some cases are) lead that change. The study tour was intended to identify potential models, approaches and mindsets that could be adapted from Scandinavia to an Australian context.

## Innovation as an economic and social driver in Scandinavia

Innovation is a major focus for Australian universities, its industry partners, government and the broader economy. Australia's capacity to transition to an advanced services and knowledge-driven economy will depend substantially on its capacity to innovate, and to scale that innovation. Scandinavian countries consistently rank among the most innovative.



On a per capita basis, Australia produces twice the citable research as the US, but only half the number of patents.

Figure 1: Scandinavia outperforms Australia in terms of output from innovation

Figure 2 further demonstrates that Australia's strong research capability is not matched by its innovation performance.

Country	Rank	Country	Rank
Switzerland	1	Denmark	10
United Kingdom	2	Hong Kong	11
Sweden	3	Germany	12
Netherlands	4	Iceland	13
United States	5	Korea	14
Finland	6	New Zealand	15
Singapore	7	Canada	16
Ireland	8	<b>Australia</b>	<b>17</b>
Luxembourg	9		

### Driving innovation

- Recognition that innovation critical to knowledge-based, high-value, high-tech industries of the future.
- Australia produces 3.9% of the world's research; 9th in the OECD, with only 0.3% of the world's population.
- Australia improved its global share of the top 1% of highly cited publications by 75% from 2005 to 2013.
- But, on the comprehensive Global Innovation Index, Australia ranked 17th globally in 2015.

Figure 2: Australia's position in the Global Innovation Index

## Factors contributing to Scandinavia's success

Several factors contribute to Denmark and Sweden's status as innovation hot spots; fundamentally, limited natural resources leave the countries with little choice but to trade on their knowledge and skills.

Industry policy is oriented towards sectors being disrupted, including financial technology (fintech) – where Scandinavia has 20 of the world's top 100 companies – cleanTech and agritech. Allied to this, flexible workforce policies, such as Denmark's 'flexicurity', allow organisations (including government) the necessary agility to meet the rapid changes in skill demands and maintain a competitive edge.

Government, meanwhile, tends to be more interventionist than other countries, including Australia.

Significant government incentives encourage industry investment. European Union funding Horizon 2020 is the biggest EU research and innovation program, with nearly €80 billion of funding available over seven years (2014 to 2020) in addition to private investment. It promises more breakthroughs, discoveries and world-firsts by taking ideas from the lab to the market.

A strong track record of design excellence translates to the built environment (Smart Cities) and to design thinking, which is considered an important input into innovation.

There is also a strong commitment to environmental sustainability, including aggressive targets that have created a 'burning platform' for innovation and a focus for society, industry and government interests. These countries' strong social conscience and deep commitment to collaboration and collective action also translate well to innovation.

## Innovation is accelerating as new technology and partnership models emerge

Rapid advances in technology have opened up a range of opportunities to innovate at scale and speed. The Internet of Things (IoT), in particular, is creating new possibilities for universities, companies, governments and individuals. It is estimated that up to 50 billion devices will be connected to the Internet by 2020, each generating data and the potential for new insight. The Internet of Things is driving innovation in digital services to make cities and university campuses 'smarter'. As an example, sensors embedded in lamp posts allow lights to be automatically turned off when not required to save money, or turned up when a vehicle or person passes beneath to improve safety. Given Scandinavian countries' track record as innovators it is not surprising they also lead the world with regard to research and application of Smart Cities. Denmark in particular sees investment in smarter, more efficient cities as critical to meeting its ambitious environmental sustainability targets and creating economic value in clean technologies. Social innovation – described by Malmö University as addressing social challenges with creative business logic – also features prominently in Scandinavia, driven by the confluence of:

- Massive upheaval on the edge of the European Union, including an influx of more than 170,000 Syrian refugees in Sweden, including a large number to Malmö in 2015; and
- The region's natural instinct to respond collectively to crises.

## Universities play a major role in the innovation ecosystem

One of the striking features of Scandinavia's innovation story is the prominence of universities. As part of the study tour we observed universities playing a variety of roles in the innovation ecosystem, both inside and outside the university. In some cases universities anchored entire innovation ecosystems; in others they played lesser but important roles. One of the major objectives of the study tour was to observe different innovation models in action, and the breadth of roles that universities can play in contributing to the economy and society.

## 2. Major observations from the study tour

Eight major themes emerged from the study tour:

### 1. A 'change' mindset and innovation are symbiotic

One of the most striking observations about Scandinavia is that change is embraced, not resisted. This is particularly true in an environmental sense, where Scandinavian countries were among the first to recognise that a sustainability agenda offered the prospect of economic growth, not just environmental benefits. Denmark leads the world in thinking about and innovating around Smart Cities in part because the technologies that make cities more livable also make them more environmentally sustainable.

The Danish Outdoor Lighting Lab (DOLL), for example, is focused on applied research related to smart lighting but its genesis is the environment. Outdoor lighting is a major contributor to Denmark's energy consumption and DOLL's formation was an attempt to find ways that Denmark could meet its sustainability targets – including an aspiration for the country to rely exclusively on renewables by 2050. Due to the success (realisation of value) of the initial lighting program, this has expanded to incorporate other Smart City (SC) concepts such as parking, waste and water management and other smart applications.

The PowerLab at Technical University of Denmark (DTU) is another example of successful innovation with both economic and environmental drivers. The facility includes partnerships with industry and government and is a truly multi-disciplinary approach to energy management. The research themes at Energy Lab covered the full supply chain, from energy generation through to the sale of energy, drawing in expertise from the sciences and business. They are:

- Power components and energy grids.
- Distributed energy resources and control.
- System operations and management.
- Electricity markets.

DTU Skylab also benefits from the industry connection by bringing in business leaders as mentors, customers and investors in student and researcher base innovations. An open stance to how these groups can interact to create new value is particularly important in considering the broader return on investment from these types of facilities/mechanisms.

Embracing change extends to universities as institutions. At Malmo University, for example, there is a strong focus on challenging legacy models of pedagogy and structure. All faculties at Malmo University are multidisciplinary, and all students have a genuine influence over pedagogy and curriculum. This shift towards student involvement reflected the need for universities to be able to more quickly adapt to the communities around them. Malmo, like many Australian regional cities in particular, has undergone significant economic and demographic change and having a direct channel into the student voice was seen as critical to helping universities remain vibrant and relevant.

#### **A case study of change: The transformation of Malmo**

Former Malmo Mayor Ilmar Reepalu presented to the delegation and told the story of Malmo's incredible transformation from a declining industrial town to one of Sweden's most diverse, innovative, vibrant and growing cities. He played a major part in the establishment of Malmo University – and its downtown location – and was an enthusiastic proponent of the bridge that links Malmo to Copenhagen. The city's transformation involved many difficult decisions, including closing down the industrial port facility to make way for new industries and invest significant council resources to secure the university project. Reepalu believes the university was one of the most significant factors in the city's turnaround: it attracted young people and migrants to the region, facilitated the importation of knowledge and innovation and – most importantly – provided the region with an economic springboard.

## 2. Don't underestimate the value of unintended consequences

Innovation has taken a long time to be accepted in the mainstream of industry, government and higher education in Australia. There are a number of reasons for this, including initial cynicism about the business case for investments in innovation, the limited impact of the Global Financial Crisis (2008) and a sense of invisibility created by the sustained resources boom of the first and second decades of the 21st century. As part of the tour, delegates heard from Swedish ICT multinational Ericsson, which is considered a major global player in the IoT. One of the strong themes was that investing in technology and smart applications was likely to result in much more than initially anticipated by the driving business case. One company had identified 10 possible 'use cases' for a new network in its factory as part of a brainstorming exercise with senior management. Once in place, employees found innovative applications for the network, and within a fortnight another 10 unintended use cases had been identified that then enabled bottom-line improvement to be realised. It is important to note that the cultural willingness of organisations to innovate is critical in ensuring competitive businesses in the future and reducing the risk of total business disruption from new entrants such as Uber, Amazon, Airbnb and others.

The story was similar at DOLL, which was originally conceived as a specialist in outdoor lighting. Using its physical infrastructure, and deep photonics expertise provided by partner universities, DOLL began experimenting with new lighting applications including:

- **Healthcare:** Automatically adjusting lighting in wards to assist post-operative recovery examples.
- **Mental health:** Experimenting with different light colours to aid recovery (e.g. use of blue light in the mornings to simulate the colour and effect of being outdoors).
- **Education:** Investigating how lighting might improve short-term memory and learning.

In time, the unintended consequences of DOLL's work may be as compelling as the intended ones.

### **Unintended consequences in a networked world**

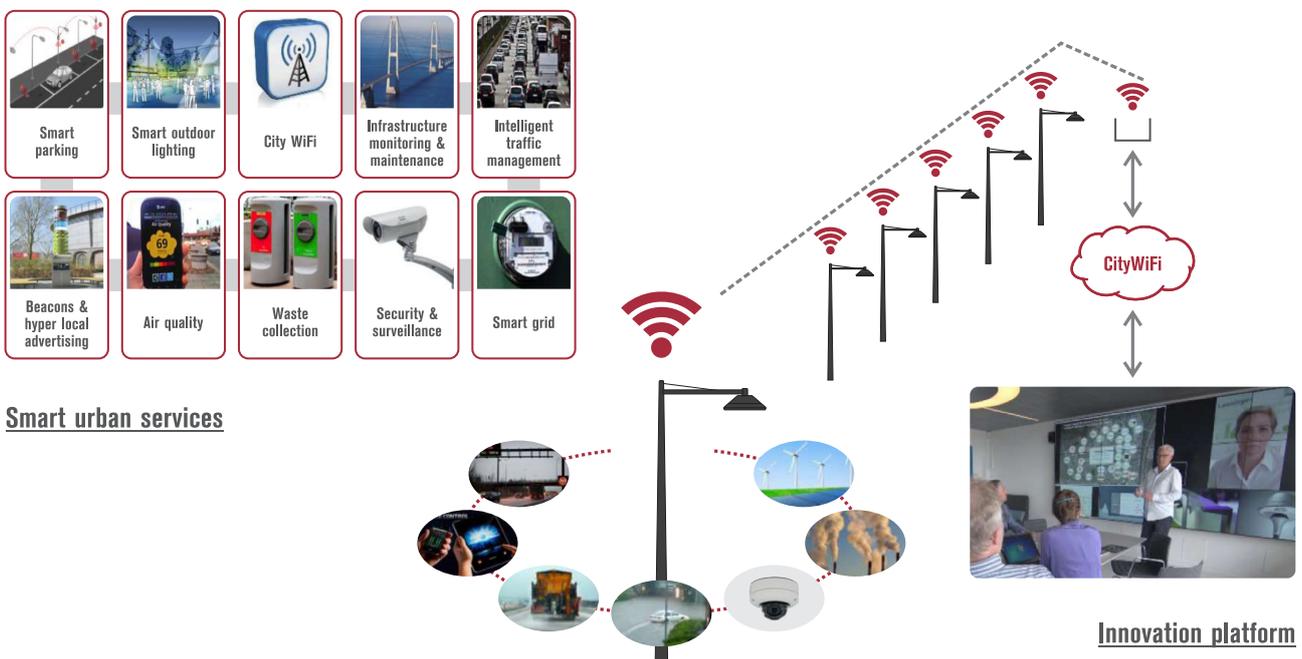
One of the recurring themes on the study tour was the notion of unintended consequences. The internet, as an example, was seen as an information repository tool initially but has since metamorphosed into something much more profound. The Internet of Everything needs to be treated the same way. While the known benefits of IoE are potentially compelling, the true value probably lies in something that has not yet been contemplated. A presentation from Ericsson demonstrated this phenomenon through a number of specific use cases. In one example a series of brainstorming sessions were held at a logistics company to identify the potential use cases once the factory floor was equipped with high-speed wireless and sensor technology. 10 potential use cases were identified and the list was considered exhaustive. Within a month of the technology being deployed a further 10 use cases were identified, demonstrating that access to the technology is likely to spark new lines of enquiry and consideration of new possibilities.

## 3. Impact – not activity – drives Scandinavian universities

The role of universities in promoting economic and social opportunity was discussed at length. Malmö University and DTU are both enthusiastic advocates for their communities to become Smart Cities, and see the university playing an important role on a number of fronts: providing research that helps to develop new solutions and applications, developing the talent needed to sustain Smart Cities and educating young people to be socially responsible in their outlook. While Scandinavian universities have some of the same pressures to commercialise research as Australian universities, it is not a driving force. Impact is the primary driver, which is reflected in the vision statements of the two universities visited as part of the tour.

<b><u>Malmo University:</u></b>	<b>Vision:</b> A world where diversity, knowledge and creativity are transformed into action for a sustainable society <b>Mission:</b> Education and research for a sustainable society
<b><u>DTU:</u></b>	<b>Vision:</b> Research and education for the benefit of society

The importance of impact was evident at Malmo University's new research centre loTAP (Internet of Things and People). loTAP's aspiration wasn't necessarily to have the best science in relation to IoT (although they would try), but to be the best in the world at applying IoT. It also appeared that academics were actively encouraged to contribute to social innovation as part of their roles.



**Figure 3:** What started as a lighting project at DOLL has morphed into something much bigger

#### 4. Living labs have application on and off campus

The living lab model has been embraced across Scandinavia. A living lab is defined as a user-centred, open-innovation ecosystem, often operating in a city or region. The living lab integrates research and innovation processes within a public-private-people partnership. Perhaps the most insightful example of a living lab is at DOLL, formed only 18 months ago. The DOLL living lab is on the outskirts of Copenhagen, in Albertslund, and includes partners from industry, government and academia. The world's leading lighting manufacturers and designers are part of the project, which allows new products and applications to be tested in a 'live' environment. The most striking aspects of DOLL's living lab model are:

- DOLL is completely self-sustaining (based mostly on membership contributions).
- DTU researchers work in the living lab alongside industry, providing deep photonics expertise and research rigour to what are essentially commercial or public sector projects.

### **DOLL case study: Self-sustainability in 18 months**

DOLL was formed in 2014 and supports municipalities, regions and private companies, in co-operation with scientists, to develop new and improved lighting solutions. LED lighting is a promising technology that can lead to major cost reductions, and the transition to more sustainable illuminates offers new opportunities to overlay smart services to improve quality and energy efficiency. DOLL operates three laboratories, including a living lab, and has a large number of industry partnerships and a critical relationship with DTU. Remarkably, in less than two years DOLL is self-sustainable (its primary revenue streams are from industry memberships and contract projects) and has a waiting list of industry partners wanting to collaborate.

DTU is also an enthusiastic supporter of the model, and its ambition is for the entire DTU campus to serve as a living lab where industry, government and other universities are able to collaborate on real-world problems. DTU has created a Skylab facility on campus that allows students to experiment and collaborate in a mini living lab environment. The Skylab has no classrooms and space cannot be booked. The intention is for students to congregate in the Skylab and collaborate in cross-disciplinary teams that often form serendipitously. A number of Australian universities on the tour recognised that the living lab was entirely transferable to an Australian context.



## 5. Collective action is faster, better and cheaper

Collaboration was described as a word that conjures up positive feelings but also cynicism. The question for many people is whether all collaboration is good. While the answer from delegates was 'mostly yes' there was much discussion about what made an effective collaboration. A representative from DOLL noted that one of the reasons their model had been successful was that collaboration did not necessarily mean consensus, or equitable distribution of benefits. DOLL worked with a collective of municipalities and insisted that no proof of concept could be run in more than one municipality. By collaborating they had the advantage of not having to duplicate effort, although the onus was on the council running the proof of concept to share all knowledge and IP with the collective. In essence, collaboration made sense because it was cheaper and faster, not necessarily because it was better.

## 6. Teaching people how to innovate is critical

Malmo University is committed to a challenge-based pedagogy, characterised by collaborative learning – teachers and students working together to learn about compelling issues, propose solutions to real problems, and take action. It acknowledges that learning is broader than the formal curriculum. At both DTU and Malmo University there is a strong focus on embedding core competencies beyond the technical requirements of programs: social responsibility, entrepreneurship and the ability to innovate. Presentations from students at Malmo University demonstrated the importance placed on giving students opportunities to work and innovate with industry. Students were also actively involved in topic design and provided feedback on whether the pedagogical design was meeting the needs of the current generation of learners. One of the motivations for this, according to graphic design teacher Christel Brost, was that industry exposure upped the ante in terms of expectations and urgency. One of the important by-products of having close relationships with industry was that students were able to form professional networks long before they needed to enter the job market. These networks are likely to be equally as important to students as the technical skills they learn as part of their course.

### **DTU Skylab: A new model for student collaboration**

DTU Skylab is an innovation hub located at the main campus of Technical University of Denmark (DTU). The experimental space is intended to support student innovation and entrepreneurship at DTU by enhancing co-operation between students, the business world and other external partners. It has three focus areas:

- 1. Startups:** DTU Skylab is a place to test ideas and get fast feedback from peers and professionals. The many workshops and laboratories make it possible to use rapid prototyping to develop and test ideas. DTU Skylab offers free assistance to all relevant projects and welcomes everything from the concept stage to established start-ups with market-ready products.
- 2. Real-world projects:** The 'wall of opportunities' in Skylab presents a collection of projects, which students can choose to work on as part of their studies, for example as a final bachelor's or master's thesis, in courses or as extra-curricular experience such as a student job. DTU Skylab continually hosts events such as case competitions and workshops.
- 3. Academic projects:** The facilities give students hands-on practical experience by alternating between theory, experiments and prototyping and where mistakes are seen as opportunities to learn.

## 7. Partnering is critical for success

Scandinavia has demonstrated that economic and social value can be unlocked by combining the expertise of industry, government and universities (described in Scandinavia as the triple helix). In a competitive global economy collaboration is recognised as the most efficient and effective way to tackle problems. A large part of the reason the living lab model has been enthusiastically embraced is its appeal to industry. The applied nature of living labs – as well as the tendency to focus on a higher number of shorter-term projects – tends to be much more sympathetic to the time constraints and outcomes that are the focus of industry. The presence of industry also makes it more attractive for governments to collaborate on projects.

## 8. The Digital Campus is a high-impact, low-risk opportunity for universities to turn innovation on themselves

Universities from Australia and Scandinavia spoke of the importance of innovating from the inside out. It is not enough to talk about innovation with external collaborators; opportunities to innovate within universities pervade all functions (teaching, research and administration). DTU spoke of its decision to issue 1000 smartphones to students for a year with one condition – they had to agree that all of their activity (including location) would be logged and analysed. The project turned up some interesting results, including that students who participated in group work got better grades, and that students tended to gravitate towards students with similar grades. Perhaps more important than the results was the fact that DTU was prepared to invest in its own innovation (as part of its broader innovation strategy). The interest in Smart Campus initiatives in Scandinavian universities is partly driven by a 'change from within' mentality. By leveraging their own infrastructure and expertise (e.g. around IoT) universities are experimenting with smart applications to improve the student experience and drive efficiencies. At Malmo University much of the focus has been on social innovation, embodied by its response to a rapid influx of refugees to the city from Syria.

### **Case study of collective action: Malmo University response to Syrian refugees**

The sudden arrival of more than 100,000 Syrian refugees, displaced by fighting in their home country, had a profound impact on the City of Malmo. The train station was transformed into a makeshift re-settlement centre, and the sense of desperation among refugees was palpable. Malmo University – among other universities across Sweden – recognised that it had an obligation to fulfil its broader remit of 'a positive impact on society'. Faculty and students were convened and support provided, including for Syrian academics in exile. Malmo University executives spoke of the university's immense power as a unifying force in the community, and the fact that at a moment of crisis its true mission became clear.

## 3. Next steps

Delegates were canvassed about what they would take away from the tour, and suggestions for follow-up actions – a number of which will be pursued:

### Digital Campus initiatives

A number of universities are interested in pursuing Digital Campus initiatives individually. It was also suggested that the formation of an informal 'collective' would be attractive to some. A collective approach would likely allow universities to find a faster, cheaper and potentially better path to implementation. The collective approach could be facilitated by Curtin University through the Cisco IoE Innovation Centre and for those that want to opt in, the principles are simple: all knowledge, data and tools acquired in developing and testing projects would be made available to other members (Newcastle, Wollongong and Adelaide universities indicated initial interest). Similar to the DOLL model, it is envisaged that no single use case for Smart Campus would be trialled in more than one location.

### Pedagogy for the digital economy

The potential exists for an Australia-Malmö collaboration related to changing pedagogies. The specific focus of the project would need to be defined, but there is strong interest in understanding how teaching and learning models need to change to equip people for life in a digital economy. This is likely to include the role that technology plays, but also thinking more deeply about the primary purpose of universities or, as Cecilia Christersson from Malmö University describes it, answering the question, "What are we for?"

### Smart Cities/Digital Campus summit in Australia

There was interest in convening an event in Australia focused on Smart Cities and the Digital Campus. This could include representatives from industry and government (Commonwealth, state and local), as well as universities. Cisco will explore potential involvement of DOLL and DTU, among others, in the program.

### Presentations to the university executives

While there is no substitute for seeing and hearing about the Scandinavian innovation approach first-hand, a number of delegates identified the value in having their own staff and executive provided with a briefing. This will be extended to all universities that participated in the tour.

### Return study tour to the region in 2017 supported by all the universities

The selection of Scandinavia as a destination for the 2016 study tour was a popular one. Not only is the region leading the world in Smart Cities and innovation, its universities are highly regarded and thought-provoking. A return trip to Scandinavia (albeit with a different program and a different set of delegates) is likely.

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