



2015 HIGHER EDUCATION AND RESEARCH STUDY TOUR

Driving innovation, collaboration and the renewal of cities through a Smart Campus mindset

UK, DENMARK AND SWEDEN

dandolopartners



Background to the tour

The 2015 Higher Education and Research Study Tour focused on the disruption being caused by technology in UK and Scandinavian universities and how universities were helping to transform cities. Of particular interest were the changes being forced on universities by new economic, demographic and technological conditions. This was the fifth annual global study tour program sponsored by Cisco and facilitated by Brad Davies from consulting firm dandolopartners.

Participation in the tour

Study tour participants were drawn from a range of senior executive positions in administration, teaching and learning and research.

Eight Australian universities were represented on the tour:



THE UNIVERSITY OF
SYDNEY



THE UNIVERSITY
OF QUEENSLAND
AUSTRALIA



Curtin University



THE UNIVERSITY
of ADELAIDE



University of the
Sunshine Coast
Queensland, Australia



The following institutions hosted visits or sessions as part of the study tour:



1. The role and influence of universities is changing, and being elevated

Higher education and research is increasingly considered a major driver of economic growth

The importance of higher education and research has never been greater. Economies globally are becoming increasingly challenged competitively and are more dependent on innovation and high-value skills to differentiate. Universities play a pivotal role in creating and disseminating intellectual property to cultivate innovation, as well as educating and helping to train the changing workforce of the future. As countries re-evaluate where future sources of economic advantage will come from, the role of universities as providers of skills, intellectual property and information comes into sharper focus. Economic growth and prosperity is increasingly driven by the capacity of economies (and regions) to renew themselves and diversify. Economic complexity – rather than gross domestic product growth – is increasingly used as a predictor of future prosperity. A country is considered ‘complex’ economically if it exports a wide variety of highly complex products and services. Universities, as major sources of IP, innovation, technology and skills, are capable of significantly lifting a nation or region’s economic complexity.

Universities are experiencing a period of immense change

Economic power is shifting: Not only is global competition intensifying, but developed economies are having to make the transition from low to high value-added activity. In Australia the downturn in the resources sector has placed greater emphasis on the nation’s capacity to innovate and capitalise on innovation, including the specific role and value that universities bring to increasing Australia’s innovation performance. These changes are also occurring at a regional level, with cities such as Malmo in Sweden working closely with universities to attract ‘wealth creators’ and employment generators.

Delivery and business models are changing: To date, university delivery and business models have been relatively stable. However, the impact of digitisation and new consumption models are creating pressure to reconfigure the way they operate. This mirrors what is happening in industry more generally, including the emergence of disruptive players in industries as diverse as transport (Uber), recruitment (Seek) and travel (Airbnb). While MOOCs (massive open online courses) have not necessarily been the threat that universities first imagined, they have forced universities to think more deeply about the student experience they are providing and how the best elements of MOOCs might be extracted to improve university delivery and performance (e.g. the use of analytics for teaching and assessment).

Jobs are evolving: In Australia, we know that up to 44% (or 5.1 million) of jobs are at risk from digital disruption.¹ These pressures place a major strain on the economy as a whole, but particularly on the workforce that supports it. The future market for jobs in STEM (science, technology, engineering and mathematics) – including specific opportunities in areas such as cyber security and data analytics – are expected to explode, creating significant opportunities for universities in the supply of skills and knowledge. The demographics of the workforce are also changing; consider that by 2025 almost 75% of the workforce will be ‘millennials’.²

Pedagogies are adapting: Traditional methods of teaching and learning are now proven to be less effective. One study found that traditional lecture techniques were likely to increase failure rate by a factor of 1.5 compared with more active learning techniques.³ Flipped learning and blended learning are almost universal, in part driven by the expectations of the millennial cohort who insist on instant access to information.⁴

Globalisation is changing student demographics: Globally it was estimated that the number of higher education students would increase by 21 million between 2009 and 2020⁵ (there were 170 million international students in 2009), with Australia predicted to have the fastest-growing international student enrolments (per capita) in the same period. Australia is expected to add an additional 50,000 international students by 2020 to its already significant overseas cohort. The rise in enrolments is also being driven by the move to ‘mass education’ in developed economies.

1 PwC, *A smart move* (2015), p. 1.

2 Defined as the generation that grew up with Internet as part of their daily lives (generally came into adulthood around the turn of the century)

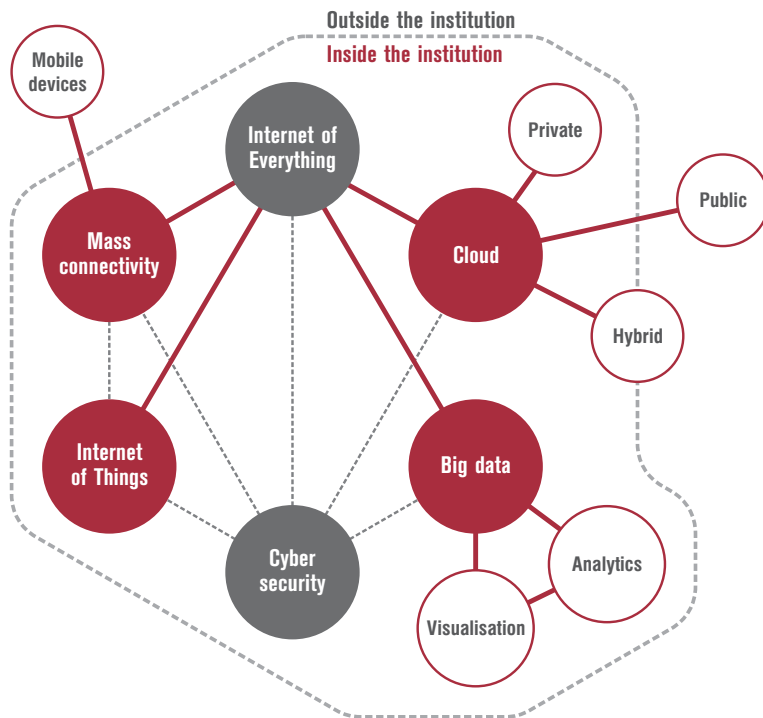
3 Freeman S et al., *Active learning increases student performance in science, engineering, and mathematics* (2014), available at: <http://www.pnas.org/content/111/23/8410>

4 PwC, *Millennials at work: Reshaping the workplace in financial services in Asia* (2012), p. 6.

5 http://www.britishcouncil.org/sites/britishcouncil.uk2/files/the_shape_of_things_to_come_-_higher_education_global_trends_and_emerging_opportunities_to_2020.pdf

2. Technology is causing major disruption, and creating opportunities

Many of the changes in the macro environment discussed above are being accelerated by disruptive technologies. The collision of these technological disruptions is creating opportunities and risks for universities. Two major technology shifts received particular focus as part of the study tour: the Internet of Everything (IoE) and cyber security. IoE, in particular, is not a technology in its own right but rather brings together a number of major disrupters: mass connectivity (mobility), the Internet of Things (IoT – machine-to-machine connectivity), big data / analytics, and cloud. While these individual technology shifts are significant in their own right, it is the convergence of all of these technologies (i.e. the IoE) that is contributing to the magnitude of the disruption.



The technology changes are having an impact on two levels: the operations of universities themselves and the industries that universities supply skills and IP to. From an internal university perspective, new technologies are impacting the way students are taught, how students interact with the institution and how back office functions are organised. From an industry perspective, disruptive technologies are changing delivery models, business models and the skills profile of almost every sector in the economy.

“I believe we don't understand what is coming. What we think is going to happen is probably too conservative.”

– WILLIAM CONFALONIERI,
CHIEF DIGITAL OFFICER AT DEAKIN UNIVERSITY

IoE is allowing universities to move from human to machine scale

Even though IoE is relatively new, it is clear that the notion of mass connectivity has already moved from ‘human scale’ to ‘machine scale’. The next wave of innovation will be propelled by the ability of humans to connect to machines, and for machines to connect with other machines. IoE describes the interaction between things (or sensors), systems, processes and people. While adoption of the IoE is in the early stages (only 2% of all things that will be connected to the Internet by 2020 are currently connected), institutions are beginning to understand its potential impact. The connection of ‘things’ does not necessarily create the value, but rather the data that can be collected, analysed and used to inform business decisions or enable services. Cisco estimates that the IoE Value at Stake for Australia is \$93 Bn and 240,000 jobs over 10 years. For the University Sector, the Value at Stake across Australia is estimated to be \$1.1 Bn excluding the impact on student outcomes. Given the dollars at stake, the next wave of economic growth could well be IoE-driven.

IoE and the word ‘smart’ are being used almost interchangeably. There is significant global interest in IoE to make cities, institutions and systems ‘smarter’ by tapping into the power of machine-to-machine and human-to-machine technologies. Scandinavia is considered a leading-edge adopter of IoE, particularly Denmark, which has declared its aspiration for Copenhagen (and other centres) to be ‘smart cities’. IoE is being applied in a variety of ways in universities. It is providing opportunities for efficiencies and revenue generation (smart parking, smart waste, smart security and smart traffic management), transforming the learning experience (particularly use of predictive analytics to forecast and enhance student outcomes) and creating a multitude of opportunities that had not been contemplated.

Cyber security represents one of the greatest strategic challenges to universities

Universities must now be capable of operating in a digital world where security breaches are a constant threat. The challenge for institutions is to maintain security in a borderless and porous environment – and to keep it simple. A recent survey of Australian university

Chief Information Officers cited, for the first time, cyber security as their number one priority.⁶ The bulk theft of intellectual property – including personal, financial and competitive information – is now a genuine threat. In 2013 more than 500 million personal data records were stolen, with an average \$145 cost per record and the average cost of a single breach hitting \$3.5 million, according to IBM.⁷

The study tour offered three perspectives on cyber security:

1. The crime fighter perspective

Policing traditionally follows a standard process, though the effectiveness is different in a cyber context. The standard policing process is prevention, disruption and enforcement. But as City of London Police Detective Superintendent Pete O’Doherty emphasised, enforcement is not particularly effective for cyber crime. He estimated there were more than 20,000 victims of cyber crime every four weeks in the UK. However, as little as 20% were reported and only 5% get investigated. A major reason for the low investigation rate is a) people are often too ashamed to report the crime and b) the perpetrators of these crimes are generally offshore and difficult to prosecute. The focus in cyber policing is disrupting the business models of cyber criminals. The same philosophy, he argued, needed to be applied in universities. Protecting against cyber crime needed to be both sophisticated (i.e. not simply following a procedures manual) and proactive. Relying on a response after an attack / crime had been committed was destined to fail.

The human dimension to cyber security vulnerability was identified as particularly critical. Up to 80% of banking trojans were deemed preventable, and it is estimated 95% of security incidents involve human error.⁸ Not surprisingly, a major focus of cyber security is behaviour and attitude change management to ensure system users comply with policies, which is particularly pertinent to universities where faculty members have traditionally had significant autonomy in the way they manage their ICT environment.⁹

2. The cyber security architect perspective

At the last count there were 10 million known virus signatures. Educational institutions need to assess their own vulnerability to attack, but think laterally when doing so. Cisco security specialist Paul King reminded university executives that a university was potentially attractive to cyber attackers for counter-intuitive reasons. He cited one example where a law firm was compromised not because the attackers wanted its data or IP, but rather the data and IP it held about one of its clients. The law firm – and potentially a university – could be seen as providing a ‘hole’ through which an attacker can enter a third party’s environment. The threat, therefore, is not just of losing data, but of compromising someone else’s private information: students, staff or industry collaborators. King estimated that up to 70% of fraud was cyber-enabled, and traditional methods of fraud were moving online.

“It’s too convenient to dismiss universities as not attractive to attackers. Imagine you are a cyber attacker with an interest in biological weapons looking for the latest technology. A university doing interesting work in a particular science – or one with links to a target firm – can look like an attractive way in.”

– PAUL KING, CISCO SECURITY SPECIALIST

3. The ‘cyber as opportunity’ perspective

The increased prevalence and sophistication of cyber security also creates opportunities. An entire industry has emerged around cyber crime and security fighting, creating a market opportunity for universities. Consider, for example, that an estimated 47% of today’s jobs will be automated in the next 10-20 years.¹⁰ So what will replace those jobs? Consulting firm McKinsey estimates that by 2020 employers worldwide could face a shortage of 85 million high – and medium-skilled workers, particularly in emerging fields such as cyber security.¹¹ So, where are information security skills shortages most acute? A recent study asked IT professionals this question and shortages were reported across the board: cloud computing and server virtualisation security skills (43%), endpoint security skills (31%), network security skills (31%), data security skills (30%) and security analytics / forensic skills (30%).

“Australia’s future is digital, hyper-connected and critically dependent on technology, making a strong cyber security capability crucial to navigating the associated risks and opportunities ahead. Cyber security incidents can lower investment and confidence in Australia. This is a long-term national campaign to reposition Australia in the world economy, where cyber security will be a key differentiator.”

– CISCO RESPONSE TO AUSTRALIAN CYBER SECURITY REVIEW

6 Computer Daily News, *Cyber attacks now No 1 issue in Aust boardroom chatter* (26 Jun 2015).

7 IBM, *IBM Security Services: Cyber Security Intelligence Index* (2014), p. 2.

8 IBM, *Cyber Security Intelligence Index*.

9 Barbier J, Bradley J and Handler D (Cisco), *Embracing the Internet of Everything To Capture Your Share of \$14.4 Trillion* (2013).

10 Frey C B and Osborne M A, *The future of employment: how susceptible are jobs to computerization?* (2013).

11 BHEF, *The National Higher Education and Workforce Initiative* (2013), p. 3.

3. Universities are being forced to change in response to economic and technological disruption

There are three major areas of change that are emerging as a result of technological disruption and trends in the macro environment. These areas of change are forcing universities to rethink the way they operate, including becoming more innovation-driven and embracing disruption.

Change 1: Universities are being forced to become more open, collaborative and strategic

In responding to these challenges universities are being forced to change what they do, whom they target and how they do it. Consider, for example, the high value that is now placed on innovation. Universities are increasingly recognising that success is confined to the creation and citation of knowledge and IP. An innovation-driven university is increasingly focused on the impact that the IP / knowledge has on society and the economy more broadly. This has significant implications for the type of research projects a university chooses to support, whom it partners with and how performance is assessed.

“Big change happens when people do many small things”

– JOAKIM JARDENBERG, HEAD OF INTERNET, CITY OF HELSINGBORG

Universities are increasingly expected to be more open, collaborative and strategic. A major area of focus for the 2015 higher education study tour was to observe innovation and partnerships in action. Consistent themes from institutions visited as part of the study tour included:

- **Innovation is not something that happens by accident.** While serendipity occasionally delivers unexpected results, sustained innovation is planned and calculated. Universities that manage innovation effectively tend to understand the need for a clear vision and well-defined roles within a collaborative process. Attempting to manage innovation by strictly compartmentalising roles (i.e. universities as the creator of knowledge and industry as the applier of knowledge) are not effective.
- **Students can be catalysts for innovation in the university.** Innovation maturity is often measured by an institution's comfort with dissenting or unexpected voices. The student body is a powerful, under-utilised resource for universities.
- **The need for contemporary industry partnerships** are based on a deep sense of mutual reciprocity rather than an underlying transaction. The move towards Smart Campus, which is explored in greater detail in this report, is an example of how industry and universities are collaborating in unexpected ways to create mutual value.

In 2015, reputations (and rankings) remain the currency of universities. However, a shift is occurring as students become more mobile and more discerning. Students may, in time, make enrolment decisions based on what kind of learning outcomes will be realised (e.g. exposure to innovation) and job outcomes a course can provide. In the future a university's quality may be judged by students for its reputation for innovation rather than the quality of its research.

DOLL (DANISH OUTDOOR LIGHTING LAB) CASE STUDY

High-level vision: To play a major role in helping Denmark meet ambitious greenhouse emissions targets (including a 75% reduction in outdoor lighting energy costs).

Specific objectives: To create energy-efficient and intelligent indoor and outdoor lighting solutions, promote innovation and generate jobs.

Description: The Danish Outdoor Lighting Lab (DOLL) consists of three laboratories: a living lab, a virtual lab and a quality lab, focused on developing smart outdoor lighting applications. The project is collaborative in nature with representation from local government, universities, utilities and industry. DOLL supports the development and testing of new products focused on outdoor lighting. Universities bring deep knowledge of photonics and other relevant sciences to the collaboration.

Rationale for establishment: DOLL is partly a regional renewal project. Much of the DOLL activity is located in the Hersted Industrial Park in the city of Albertslund. The intent was to move Hersted from an industrial park to a 'living lab', where products could be tested in a live environment (DOLL has access to the city's lighting grid).

How is it organised?: DOLL is a true collaboration. The organising body is Gate21.

Outcomes it is delivering: More than a dozen major companies are participating in projects at DOLL and more than 50 products are being tested. The applications include:

- Lighting control solutions: A major area of research relates to delivery of light to where it is needed. A range of technologies are being trialled including infrared, radar and other motion-sensing applications to ensure that lights are illuminated when only people or vehicles are present. To demonstrate, products are being tested at DOLL that allow a vehicle to travel inside a 'light box'. Rather than having all street lights turned on at night, these applications ensure that only the street lights immediately in front of and behind the vehicle are illuminated. The same type of technology is also being trialled on bike paths in Denmark.
- Specific industry applications: One area of focus is the role of lighting in patient wellbeing in a health context. Experimentation is under way to assess what type of light promotes recovery in a hospital setting, with a range of other niche industry products likely to be tested in future.
- Lighting management systems: Not all the technology being trialled is focused on the lights themselves. A market is likely to exist in lighting management systems and vendors are currently testing different applications.

Future aspiration: When DOLL commenced there was no sense of where it might lead. One of the most exciting applications of DOLL's work is in 'smart cities'. Given that outdoor lights will be connected to the Internet, there are a range of other possibilities being explored using the lighting infrastructure. For example, Wi-Fi-enabled lights can also be used to support security and parking applications.

Work is under way to explore how LED infrastructure could deliver Internet connectivity, offering the potential for an entirely new communications technology, 'Li-Fi'.

Change 2: Universities are becoming agents of social and economic renewal in communities / regions

Universities have always been important institutions in their local communities. Not only are they significant employers and direct economic contributors in their own right, they are also important enablers. Consider, for example, the role that universities play in generating creativity, knowledge and energy in their communities. In periods of economic transition, local communities and industry rely on a thriving university as a mobilising force. One of the areas where universities can play a positive role is as a convenor and honest broker. Universities are well placed to create mechanisms that promote collaboration and innovation. New research partnerships are emerging as traditional models of engaging with industries (and individual firms) lose relevance.

Universities are increasingly recognising the pivotal role that they play in supporting local innovation and fuelling the growth of local start-up ecosystems. For example, the start-up ecosystems of Silicon Valley and Boston are anchored by Stanford University and MIT. Start-ups are not just new, small businesses. Start-ups are anchored by some form of innovation (whether it be a disruptive idea, technology, process or business model). Start-ups tend to operate at the 'dynamic edge' of economies and have the potential to be a (hopefully positive) disruptive force on established players. The National Virtual Incubator (NVI) project in the UK – which was the focus on one of the study tour sessions – is an example of a new model for engaging universities, start-ups and governments in innovative projects. The NVI connects incubation centres, research facilities, science parks and academic institutes through its growing number of national bases. The initiative's aim is to link new research with new business innovation using technology as the primary platform.

The importance of start-ups was also discussed at DOLL in Denmark. An aspiration for DOLL (and Denmark more broadly) is to exploit the country's competitive advantage in photonics to drive activity and potential opportunities for start-ups in areas as diverse as sensors, displays, lasers and photovoltaics (harnessing solar power).

But more broadly, the role of universities goes much deeper than its role as a large community stakeholder. King's College spoke of the university's role of contributing to London life for all citizens by opening its doors to the broader community and encouraging students to make an impact on the city in which they lived. At Malmo this sense of the university playing a lead role in the community was even more acute and compelling. Malmo's core objective was not the accumulation of knowledge, but its impact. 'Research leading to a sustainable society' is the mantra that drives Malmo's research effort, sending a powerful message to researchers and the broader community that research has the greatest value when it is applied.

Malmo University played a pivotal role in the regeneration of its community (see case study below). Other universities that attended the study tour spoke of the resonance of Malmo's story with their own. Deakin University in Geelong, for example, sees itself as partly responsible for helping the region transition from its automotive and manufacturing past to a different but vibrant future.

MALMO CITY CASE STUDY

High-level vision: To regenerate the city and attract a new (younger) demographic.

Objective: To transition Malmo from an industrial city (with a history in textiles, print and manufacturing) to an innovative and cultural hub.

Rationale for establishment: Malmo faced rising unemployment, low levels of community resilience and was poorly positioned for industries and jobs of the future.

How organised?: While the vision came from the city, the university was identified as the anchor tenant and force for change. The university has 'turned itself inside out' to ensure local firms, government and citizens view Malmo University as a community asset. The university has invested in establishing (mostly face to face) platforms to link firms, start-ups and other institutions. The university has strong relationships with local industry groups and encourages firms to 'connect and think new'.

Outcomes it is delivering: Malmo is now the fastest-growing city in Sweden, has one of the youngest demographics (half the population is under 35) and the highest proportion of foreign-born residents of any city in Sweden. Malmo ranks fourth of European cities in terms of patent applications (a patent for every 10,000 residents).

Future aspiration: To become an innovation hotspot of Europe and a place where entrepreneurs and young people want to come to learn to manage innovation.

Change 3: Universities are being challenged to embrace disruption with its core functions

The capacity of universities has become increasingly important. Universities as institutions have operated in a reasonably consistent manner over centuries, and business, delivery and funding models until recently had been remarkably consistent. But the pace of economic and technological change has forced universities to critically examine their core functions, including teaching and learning. It was observed on the study tour that the current (and future) cohort of students have higher expectations of universities and less patience for outmoded teaching methods. Specifically, learners are characterised by:

- **An explorer's attitude.** Young learners (including those in the early years of schooling) exhibit a fierce lack of intimidation when it comes to learning. While this has arguably been true in the past, today these learners also have access to technology that feels like it fits them, as demonstrated by the way a five-year-old is able to interact intuitively with an iPad.
- **An expectation of 'zero friction'.** Young people have no patience for technology or processes that are 'clunky', including those related to their consumption of services, media and learning. There is a significant challenge for universities to provide access to materials and experiences in flexible and engaging forms.
- **A preference for digital communication channels.** As in life, digital tools and delivery methods are no longer a 'nice to have' optional extra. Just as important for students is the capacity to share and collaborate with teachers and peers using digital methods.

“We tend to get comfortable with technology after it's been around 10 years. In education that represents a generation of learners – we cannot afford to wait 10 years to take advantage of what's available.”

– JOAKIM JARDENBERG, HEAD OF INTERNET, CITY OF HELSINGBORG

King's College London reported significant challenges responding to the needs of contemporary learners. The university has experimented with a range of new engagement tools to create effective mechanisms for students to share experiences and connect. A major challenge for King's College was simply 'catching up to the current generation' of students. One example of a core university function that has been transformed by student expectations is the library. King's College previously operated its library during extended business hours but was forced to change. Students increasingly wanted access to the library late at night and early in the morning and the university responded by opening its library 24 hours a day and during the full calendar year (not just during semester). The configuration of the library has also changed as demand for physical assets declines by 6-8% annually and students insist on more quiet study spaces (but not desks).

The disruption being embraced at Malmo was even more significant. Malmo recognised that equipping young people for life outside of university meant a fundamental rethink of the pedagogy. This included a greater emphasis on the use of team-based, collaborative learning models and greater flexibility for students in terms of timetabling. There is also a significant emphasis on the co-design of education, which has the dual benefit of giving students greater ownership of their education while improving the relevance and effectiveness of the teaching.

Achieving this type of cultural shift has not been without its challenges at Malmo. While faculty have generally embraced the vision for innovation in learning, implementation often takes more time, effort and patience than first anticipated. The Global Classroom project (described below) is being used as a lightning rod by Malmo to experiment with 'convergence pedagogy'. The project is providing an opportunity for new and old media – and new and old teaching methods – to collide and create positive change.

MALMO UNIVERSITY: CHANGING THE FACULTY THROUGH THE GLOBAL CLASSROOM PROJECT

Objective: Drive pedagogical change to improve the student experience and outcomes.

Rationale for establishment: Malmö University does not necessarily consider itself an early adopter of technology, in part due to fiscal constraints. However, the university recognises that the media consumption habits and expectations of learners is changing rapidly and it cannot afford to wait until all the technology is in place to begin 'reforming' its pedagogy and learning models. By investing in change management now, the university is ensuring it can extract benefits quickly after technology investments are made.

How organised?: Global Classroom is a collaboration between four universities on four continents (including Malmö and Flinders University in Adelaide). The focus of the project is to develop and apply new pedagogies using technology.

As part of the project, two-year project teams focused on specific cross-border projects about designing education differently.

The Global Classroom model is also being applied in microcosm within the university, with cross-disciplinary teams established to drive university projects. Teams include representation from ICT, the library, administration and faculty, with students encouraged to 'drop-in' rather than be forced to participate. Participating students are allowed to leave early and come late to create a cafe experience and create the right conditions for effective collaboration.

The emphasis is on real challenges, collaboration with society, and critical decision making, not just thinking.

Outcomes it is delivering: Improved staff and student engagement and motivation, and the promise of improved student outcomes.

Future aspiration: Malmö wants to be known globally for its innovation related to pedagogy, and to have access to a broad and diverse set of collaborators.

4. The emergence of a Smart Campus mindset in universities

While technology is the cause of significant disruption in universities, it is also a potential antidote. The concept of a Smart Campus – and the IoE in particular – has the potential to deliver a new wave of innovation across universities by allowing more and richer data to be harvested, analysed and applied to critical business decisions. Universities now have both the motivation and the technological means to become smarter.

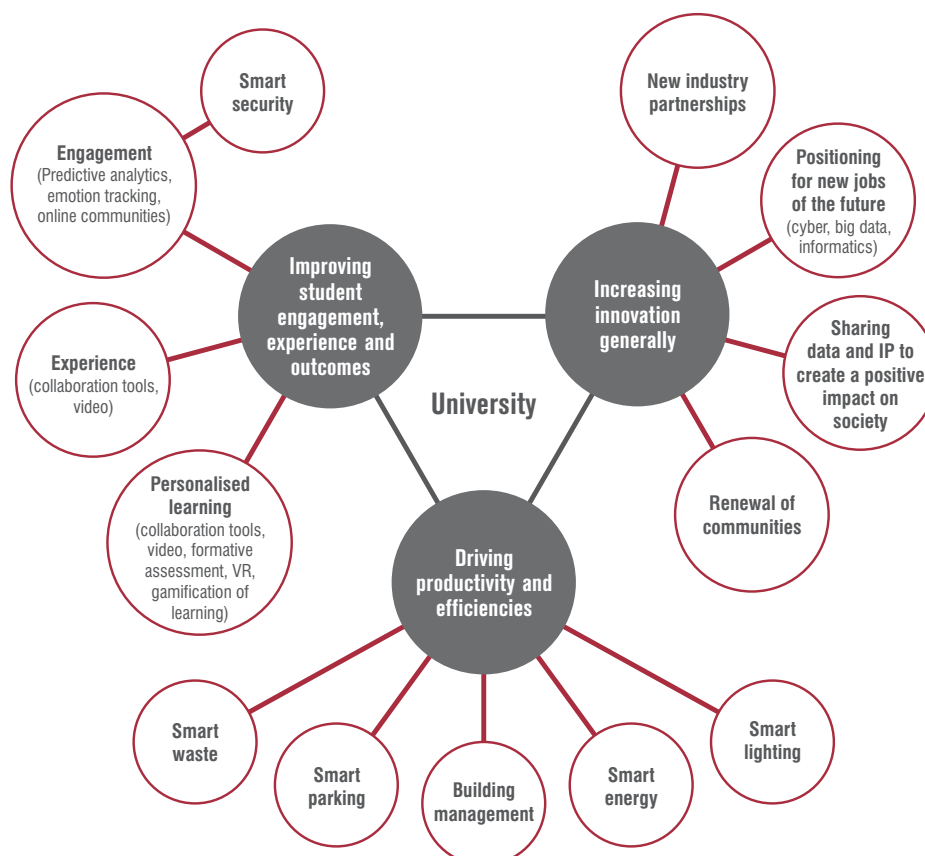
So what is a Smart Campus? The term has come to encapsulate a broad range of digital technologies that can be applied to teaching and learning, administration and research functions. It builds on the strong interest in ‘smart cities’ globally, where information is being collected to influence transport, environmental and citizen services. One of the major conclusions arising from the study tour was that a Smart Campus was a mindset rather than a ‘solution’. Universities with a Smart Campus mindset were motivated to use sensors, analytics, visualisation and other technologies to deliver immediate and longer-term benefits.

There are three broad motivations for adopting a Smart Campus mindset

The reasons for embarking on a Smart Campus approach vary from university to university. A Smart Campus is reflective of the context within which it operates, and three broad motivations for exploring Smart Campus have emerged:

1. Driving productivity and efficiencies.
2. Improving the student engagement, experience and outcomes.
3. Increasing innovation capability generally.

These motivations should not be considered in isolation as many are mutually reinforcing.



Driving productivity and efficiencies

The primary reason most universities exhibit an interest in the Smart Campus in the first place is related to productivity and efficiency. The IoE is creating opportunities to automate the collection of data that has genuine utility from a cost and revenue perspective. For example, by equipping car parks with networked sensors universities are able to receive – and display to students – information about car park use. This information can be used by students to decide which car park to enter, or whether to drive to university at all. The issue of smart parking was discussed at length as part of the visit to DOLL, which is working with the City of Copenhagen to consider the range of applications that could be enabled by smart outdoor light poles. Recent modelling by the city suggested that up to 30% of Copenhagen's traffic congestion was due to drivers searching for a parking space. A smart parking application had the potential to make significant reductions in congestion as well as improving the citizen experience.

A range of other 'utility' services have also emerged in universities, many with compelling business cases. These include smart energy management (including real-time tracking of energy usage), smart waste management (where rubbish bins will signal to collectors only when they are full) and smart lighting. Another major area of focus is on building utilisation management where sensors can be used to determine the actual utilisation of university spaces (not just the forecast class sizes).

Improving student engagement, experience and outcomes

A Smart Campus mindset has significant potential application around student engagement and outcomes. Universities are coming to recognise that students (and people more generally) are social beasts who want to collaborate and share. Digital tools have the potential to:

- **Understand and track student engagement:** The potential to collect information about students is increasing exponentially. Predictive analytics, in particular, is creating opportunities to harvest new information and make sense of it in a contracted timeframe. As an example, institutions are now experimenting with technology that can track real-time engagement in a classroom (e.g. through facial recognition software to track emotional responses to training) and engagement with broader university assets (e.g. attendance at the library, accessing of course materials). Given that engagement is a leading indicator of retention, universities are investing significantly in this area.
- **Improve the student and learning experience:** Students increasingly operate in a blended construct. The challenge for universities is how to ensure that the online and offline (on campus) experience is positive. The use of augmented and virtual reality – along with the gamification of learning – is transforming the classroom experience. Students now have access to tools that can represent complex content in new and compelling ways, making the learning experience richer in the process. Simulators in fields such as dentistry are providing students with access to learning experiences that were previously confined to work on human patients.
- **A range of new applications are emerging that harness the potential of IoE.** For example, smartphone tracking can help an institution collect and analyse information about human traffic flows on campus and create a basis for a response. Information about overcrowding in one cafeteria could be used to update digital signage and direct students to alternative outlets. With student permission, it is also possible to detect a student walking past a digital sign (using a digital beacon) that could be used to provide specific information to the student such as directions to the next class. Major investments in Wi-Fi technology are being anchored by the desire to provide students with high speeds of connectivity that allow them to move seamlessly between the online and offline dimensions of their course while on campus. The potential to use sensors to improve campus safety is an increasingly powerful tool for universities who wish to safeguard students against harm.
- **Better student outcomes and personalised learning:** The ultimate aim of a university from a teaching perspective is to maximise the educational outcomes for young people. This in turn will help to prepare young people for life and a productive career. Analytics and visualisation tools are becoming increasingly commonplace in institutions as universities seek to capture more, and earlier, data

about student performance. To demonstrate, institutions are now able to use online formative assessments to capture rich data about a student's progress. The results of these assessments can be analysed and used as a basis for designing future learning programs for individual students.

Increasing innovation generally

Innovation is central to a contemporary university. The notion of a Smart Campus mindset is appealing to universities who want to push the boundaries in all aspects of their business, and open themselves up to possibilities that they haven't even conceived of. In this way a Smart Campus can be a useful narrative and vehicle for a university to apply innovation across its operations. There are a number of longer-term, innovation-related benefits that universities are reporting from embarking on the Smart Campus journey:

- **New and more sustainable industry partnerships:** Realising a Smart Campus vision cannot be done in isolation from industry. Smart Campus discussions and projects are creating opportunities for stronger and more contemporary industry partnerships to form. Initiatives such as the National Virtual Incubator project in the UK or Gate21 in Denmark, through to collaborative projects in individual institutions, are forcing universities and firms to contemplate what they can offer each other beyond products, services and revenue. Perth's Curtin University, as an example, is drawing on its formidable industry links to consider compelling digital mechanisms to match industry to students (described as 'LinkedIn meets eHarmony').
- **Proximity to skills / research of the digital economy:** Research suggests that up to 40% of jobs in Australia are at risk of digitisation. The big question is what will they be replaced with? While there is no sure way of knowing, it is clear that significant industries are already emerging in fields such as big data science, cyber security and data visualisation (as well as ICT more generally). Beyond specific vocations, King's College referred to the growing market for skills related to computational thinking, cognitive load management, collaboration and informatics. Universities that embrace Smart Campus activities will necessarily interact with emerging companies and start-ups, positioning them favourably to understand the future skill demands and a ready supply of potential industry collaborators.
- **The renewal of communities through innovation:** Smart Campuses can be important anchors for smart cities, particularly those in regional locations. A vibrant, future-looking university can change the outlook of an entire city as well as positioning it for economic growth and social change. As was demonstrated at Malmo, a smart university with a sustained commitment to innovation can be an incredibly powerful force for renewal. As Cecilia Christersson, Deputy Vice-Chancellor at Malmo University, stressed, it is important for a university not only to be smart (in the sense of developing IP) but also to ensure that 'smarts' are widely disseminated.

5. What it takes to become a smart campus and innovation-driven university

In the same way there is no 'template' for a Smart Campus, there is no checklist for what it takes to become an innovation-driven university. However, based on observations from the study tour and subsequent discussions, there are five clear contributors.

1. A tangible vision and a challenge mentality

Innovation for innovation's sake is not likely to generate results. The existence of a tangible vision that people can rally behind is absolutely crucial. Perhaps the best example of a tangible vision was the Danish Government's ambitious target of a 40% reduction in carbon emissions by 2020. But a vision – no matter how compelling – is not sufficient. A challenge mentality – including a preparedness to look outside the institution for inspiration and answers (e.g. industry) – is also important. A university needs to both think big and act big. Universities with a challenge mentality also tend to have a global outlook and a highly international student experience, recognising that the benchmark for comparison is not just the institution in the immediate vicinity.

The leadership of executives is also fundamental. Leaders in the context of a Smart Campus need to live the objectives and values of the university in their quest to be smarter. Leaders also need the capacity to embed a culture of shared accountability rather than treating specific issues as 'the CIO's job' or 'faculty's responsibility'.

2. Tapping the student voice in making decisions

Students can be a powerful positive force when applied to university challenges. A number of institutions visited as part of the tour described the focus on trying to mobilise the student voice to enliven the student experience but also reform the institution. Too often, it was remarked, students were taken for granted, though it was becoming increasingly difficult to do so with the prevalence of social media. Engagement with students can even occur before they start. One revealing statistic quoted on the tour was that up to 50% of students in the UK are not happy with the course they have chosen and that universities had a role to play in better expectation management. Perhaps even more important is the interaction with students once they have enrolled. Malmo described the need to tap the wisdom of students and engage with them in authentic and dynamic ways.

"It's not about the university inviting students in – they have a right to be engaged."

– CECILIA CHRISTERSSON, MALMO UNIVERSITY

3. A fit-for-purpose pedagogy

Technology is no longer just an augmentation tool in the teaching and learning process – it is fundamentally impacting on pedagogy. There is widespread recognition that some traditional pedagogies are becoming less effective. As an example, the traditional 'sage on a stage' model of lecturing could increase failure rates by up to 50% compared with more active, progressive techniques.¹² Increasingly employers, students and universities are realising that it's not just what you learn, but how you learn that sets you up for future success. Faculty engagement and change management is naturally critical to Smart Campus success.

4. Industry partnerships based on shared value, not transactions

The objective of a contemporary university is to drive value for society, not just the university. Partnerships with industry are increasingly being viewed the same way. While there are natural restrictions related to supply arrangements, the most progressive

¹² Freeman S et al., *Active learning increases student performance in science, engineering, and mathematics* (2014), available at: www.pnas.org/content/111/23/8410

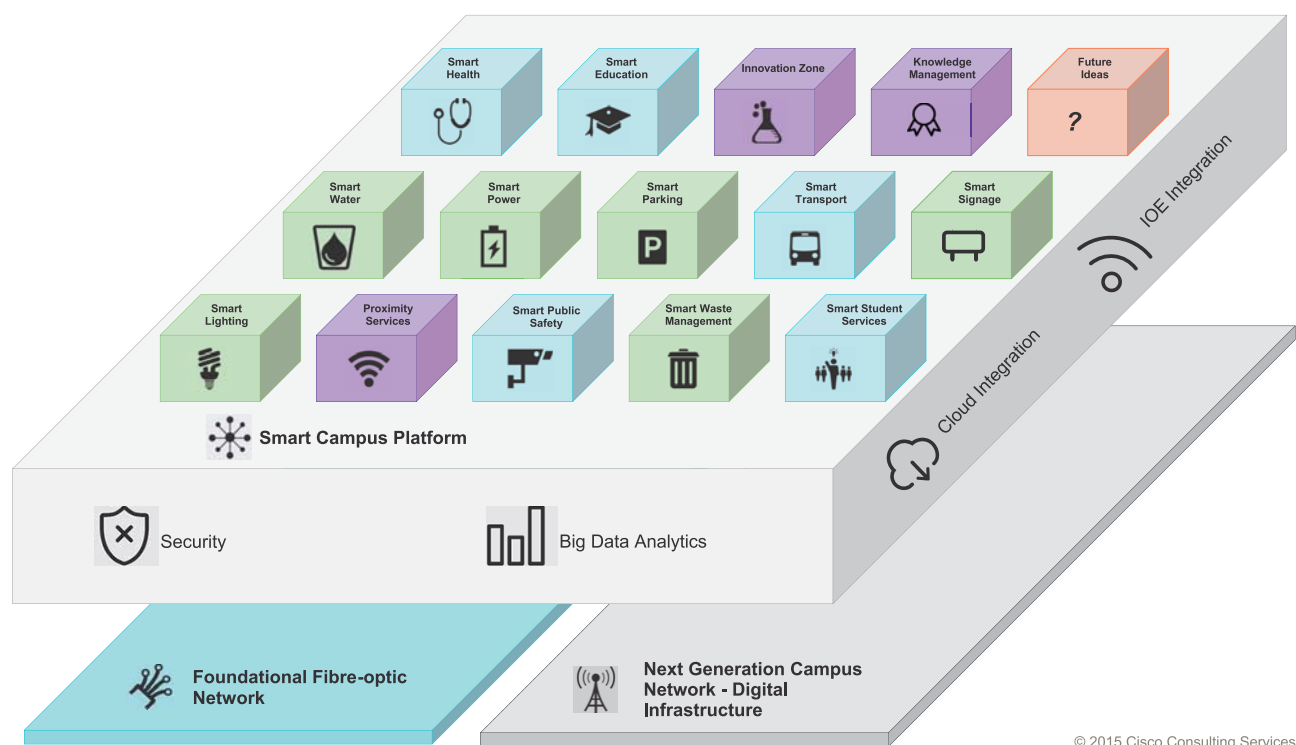
universities are investing heavily in strategic relationships with innovation-driven firms. While these firms may be suppliers of goods and services, their contribution can be much greater. The DOLL project, as an example, demonstrates that collaboration with industry can lead to much greater and broader benefits than additional research funding. The study tour concept itself is an example of industry playing a role in brokering discussions between universities, not necessarily positioning itself to provide the answer.

5. Future-proofed infrastructure, systems and processes to ensure future benefits can be captured

A Smart Campus is built on a robust physical infrastructure. Many universities have high-quality infrastructure in place that is not being fully utilised. Others have under-invested in infrastructure over a sustained period of time, which creates issues in implementing a Smart Campus vision. Universities need an underlying physical infrastructure that is able to support contemporary applications related to the network, cyber security, cloud and data analytics. Network infrastructure will underpin a range of known use cases (e.g. Copenhagen traffic management, given 30% cars looking for a parking space; smart lighting) plus many more. In Copenhagen every third street light will have not only power but also be data connected, creating significant new possibilities for businesses and citizens.

“You cannot expect to do innovation at scale without an intelligent network infrastructure.”

– CARSTEN BLUHME, ALBERTSLUND COMMUNE



© 2015 Cisco Consulting Services

Up-to-date infrastructure alone is not sufficient. It must be enabled by effective processes and systems that ensure data collected at the infrastructure level can inform broader decision-making. The adoption of new styles of management – and new talent to drive change – is an emerging area of focus. A truly Smart Campus is one that is highly capable in managing creativity, networks (of people and things) and innovation.

Conclusion

Universities are recognising that their relevance to students, industry and communities increasingly depends on their capacity to innovate. Some of the most progressive universities in Australia and overseas are taking a broad view of technology rather than treating it as a ‘means to an end’. The notion of a Smart Campus has come to mean much more than a ‘connected’ university. Smart Campuses are not only taking advantage of productivity benefits (from applications related to parking, waste, energy and building management) but also positioning the institution and their surrounding communities for the long term.

DANDOLO.COM.AU

CONTACT DETAILS

Brad Davies

Level 1, 155 Queen Street, Melbourne, Victoria 3000

E: braddavies@dandolo.com.au

M: 0412 256 004