2014 EUROPEAN HIGHER EDUCATION STUDY TOUR
Using Disruptive Technology to Deliver Sustainable Innovation

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About the 2014 Study Tour

The exchange of ideas and knowledge is at the heart of higher education. Universities regularly collaborate on research, but less so on important operational and strategic matters. The Higher Education & Research Study Tour program was conceived by Cisco to remedy this by providing opportunities for exchanges between Australian and overseas university partners, insight into technology roadmaps, market trends and innovation. The 2014 University Study Tour, which was open to all Australian universities and facilitated by dandolopartners, had four primary objectives:

- Understand how European institutions are responding to challenges in administration, research and teaching.
- Enable participating universities to interact with their European peers on technology and business issues.
- Assess the relevance of emerging technologies in response to those challenges.
- Capture and disseminate findings to higher education and government executives.

“The study tour provided an excellent insight into perspectives of university CIOs, as well as the challenges for universities in use of technology to support learning and teaching and research. I was impressed with the opportunities to network and to meet with representatives from both vendors and institutions.”

- 2014 STUDY TOUR PARTICIPANT

Study tour sponsors

The 2014 Higher Education Study Tour was sponsored by three technology companies, all with an interest in encouraging discussion about technology’s current and potential impact on universities.

All university participants in the tour paid for their own travel and accommodation.
The 2014 European Higher Education Study Tour

Universities are now operating in a hyper-competitive market

The business of higher education has never been this competitive, or complex. New competitors are emerging, bringing new pedagogical approaches, business models and pricing to a traditionally predictable, stable market. The intense competition for students is creating upward pressure on service levels and the ‘student experience’, and downward pressure on revenue.

The exchange of knowledge, ideas and capability is fundamental to what universities do. These exchanges generally take place in learning spaces, research laboratories or online, but less often among university executives. The higher education study tour format provides university leaders globally with the capacity to engage in peer-to-peer discussions, recognising that many of the challenges are shared. The role of technology served as an anchor for these discussions, in part due to the profound impact that it has on all aspects of higher education.

Exploiting technology in a fiscally constrained environment insists that universities embrace disruptive innovation, recognising that incremental improvement is unlikely to be sufficient. The theme for the 2014 study tour was ‘Disruptive Innovation that is Sustainable’. The study tour focused on how universities were using technology both offensively (as an expansion/acquisition/retention tool) and defensively (to mitigate new competitive threats).

Specific topics explored for the 2014 European study tour included:

- Big data and analytics for monitoring and, increasingly, predictive modelling.
- Changing consumption models including cloud and ‘as a service’ models.
- The Internet of Everything, including challenges and opportunities that the connection of myriad devices and objects bring to education.
- The consumerisation of ICT, including the challenges in keeping pace with learners’ and researchers’ ICT demands.
- Cyber security.
- The exponential rise in the use of video for education, administration and social applications in higher education.
- Research technology platforms.

Study tour participants were drawn from a range of executive functions

Eight Australian universities were represented on the tour, including a Provost, Deputy Vice Chancellor, Pro-Vice Chancellor, three CIOs from Group of 8 universities and two infrastructure directors. Participating universities in the 2014 Higher Education Study Tour included:

European universities and research institutions involved in the study tour

The following institutions hosted visits or sessions as part of the study tour:
Universities are under constant pressure to do more with less

The pace of economic, societal and technological change is impacting universities in fundamental ways. Regions, cities and countries recognise that their sustainability will depend on the extent to which they can drive competitive advantages in high value areas, and to operate as productively as possible. The same is true of universities. In the face of immense change universities globally are contemplating what’s required to ensure they continue to thrive as institutions, and to provide a steady flow of talented people, technologies and intellectual property into the communities they serve. Universities must do all of this against a backdrop of wicked supply and demand side problems, primarily constrained and less predictable funding. The scale and imminence of these issues is depicted in Figure 1.

Figure 1: High level view of major short and long term challenges in higher education

While these issues are individually important, collectively they represent a perfect storm. In essence, the expectations of learners, funders and industry are increasing, and complexity is rising, but revenue is declining. While the core goals of universities remain unchanged – teaching and research excellence – these are no longer sufficient. The objectives for universities, from a teaching perspective, are increasingly focused on:

- Differentiation from current and emerging competitors, with a critical focus on the campus experience.
- Closer monitoring and individualised intervention and responses to student performance to improve retention.
- Growing revenue, including a specific focus on student loyalty providing additional services/courses over a student’s life.
- Improving the efficiency of back office operations, while preserving the flexibility to scale.

From a research perspective, advancing knowledge and humanity drives the researcher, but funding constraints cannot be ignored. Universities are increasingly focusing on tracking and improving the productivity of individual researchers, including streamlining administrative processes so researchers can focus on research rather than grants management.
Three major imperatives are emerging for universities wanting to respond

Universities globally are exposed to these challenges in varying degrees. In the UK, for example, the impact of reduced government funding is more acute than in Australia. The UK Government’s decision to transfer the cost of education to students – by allowing universities to charge higher fees to domestic tuition – provides a potential window into Australia’s future. In Germany, where state Government funding has remained consistent, declining industry revenue in the shadow of the Global Financial Crisis has left a significant gap in research funding.

The UK experience was particularly instructive – and analogous – for Australian universities. In the UK it was reported that the deregulation of higher education funding (as recently announced in the Federal Budget) had a number of impacts:

- Universities tended to price at the higher end of the anticipated range.
- Government funding reduced to the extent that for some Arts courses there was almost no Government contribution.
- Student debt increased significantly, though demand was not reduced substantially from school leavers (who were potentially less sensitive to a price change) but did for mature age students.

Participants on the tour concluded that there were (at least) three imperatives for universities if they were to manage supply and demand side challenges (see Figure 2).

Figure 2: Major imperatives for university in a funding-constrained, high complexity environment

- Treat students as customers
  - Hyper-competition for students
  - Higher returns on investment to retain a new student (for life) than recruit a new one
  - The expectations of students themselves
- Increase the productivity of individual researchers
  - Greater competition for funds
  - Loss of international students who have traditionally subsidised research through their fee contributions
  - More powerful analytic tools
  - The expectation of funders
- Take cost and complexity out of administration
  - Scarc funding for teaching and research
  - New business models (e.g. cloud and as a service pricing models)
  - Requirement for systems to scale quickly in a context of unpredictable demand

“Treat students as customers should not imply that it’s all about dollar signs. It’s not. When we think about a student as a customer it means focusing on our offer, involving students in decisions that are material to them, tracking their satisfaction in meaningful ways and constantly thinking about what else we can be providing that student which has value for them and the institution. By treating students as customers we both should win.”

- MIKE ROBERTS, CIO, WARWICK UNIVERSITY
1. Treat students as customers

Students have never had greater choice when it comes to study, or more bargaining power. Not surprisingly, students in 2014 expect to be heard by their institution and have influence on all aspects of their education experience. The process of exerting this influence manifests in myriad ways, including the right to comment (in forthright style) on social media about their university and their experience, through to ‘voting with their feet’ in demand-driven systems.

Universities visited as part of the 2014 European Higher Education Study Tour reported that they were increasingly having to adopt more commercial practises across the student lifecycle. Students could no longer be treated as passive consumers of an institution’s courseware and teaching. Institutions in the UK — where market forces were more powerful — were coming to understand that students increasingly needed to be treated as customers. They needed to be attracted, serviced, monitored and retained. The notion of retention was not confined to the students’ undergraduate studies, but is increasingly thought about over the student’s academic life. To achieve this universities reported making significant investments in forming and maintaining relationships with students (Figure 3).

Treating students as customers involves sophisticated approaches to a range of management and administrative issues:

- Segmentation, including a deeper understanding of different cohorts that make up the student body and as a basis for individualised responses to the way they are taught and serviced.

- Students’ needs, recognising that universities draw on their own experiences as well to deliver excellent learning and life outcomes.

- Monitoring and tracking of satisfaction, performance, future intentions and outcomes.

- Product portfolio management and cross promotion (for example the role of MOOCs as feeders for other courses).

- Channel management including self service provisioning.

- Strategic alliances with other learning institutions and providers in hospitality, technology and other services.

One of the most significant challenges for universities in moving to a customer-centric model is developing a single view of the student for administrative, education and alumni purposes. Implementing hard-edged commercial disciplines also involves universities entering into a different type of relationship with its students, with active listening and feedback loops as standard.
A focus on the student as customer should not overshadow the university’s core mission

Treating students as customers is critical, but not sufficient

The focus on students as customers is recognised as a necessary response to tightening fiscal conditions and new competitive threats. The role of big data and analytics, in particular, is critical if universities are to better predict and respond to students’ changing preferences and to improve retention rates. The capacity to derive value from big data has traditionally been limited by the excessive time taken to analyse data. Analysis that once took hours to complete can now be done in seconds, increasing both the capacity to analyse more data but more importantly the ability to respond quickly and genuinely use analytics as a management tool. The investment in student engagement and retention tools also recognises the cost effectiveness of retaining an existing student versus recruiting a new student.

“*When it comes to customer management – and particularly Customer Relationship Management Systems – we are 10 years behind the banks in terms of the maturity of our thinking and systems.*”

While business disciplines are critical, the primary objective of universities remains unchanged: to advance knowledge, to teach people to think and to help learners reach individual potential. The Khan Academy is recognised as a pioneer in the Massive Open Online Courseware (MOOC) market. Study tour participant Colin Stirling observed that what was noteworthy about the Khan Academy was the pedagogical ideology that underpinned it, not necessarily the technology it was based upon. The Khan Academy acknowledges that in some courses students need to master a limited number of fundamental concepts, and that learners should be encouraged to repeat an assessment until mastery is achieved. This contrasts with the traditional educational approach which is to ‘test’ a student’s understanding of a concept, and assign a grade. Should a student fail they are forced to repeat a course, or transfer, and if they pass (first time) they advance.

“The role of universities, surely, must be to give the learner every opportunity to succeed. There has been a lot of interest in the use of analytics to monitor student engagement in order to focus efforts on improving student retention. Yet retention alone represents a fairly modest target. Instead we should grasp the opportunity to apply learning analytics more broadly, using technology to personalise the learning experience and improve educational outcomes for students.”

- Colin Stirling, Provost, Curtin University

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1 As an example, predictive analytics are central to the University of Kentucky’s aspiration to lift retention from 60-70%.
2. Increase the productivity of individual researchers

Competition for research funding is also rising

Declining government revenue, compounded by the Global Financial Crisis, has created challenges for institutions wanting to build on their research strengths or create new ones. With a shrinking pool of research funds universities are having to become more efficient, strategic and sophisticated in the way they apply for, administer and track research expenditure. Not only are institutions expected to collaborate (in some cases with traditional competitors) for research funding, the productivity of individual researchers has also become a major focus.

The financial challenges associated with sustaining high-quality, comprehensive research programs are forcing universities to:

- Invest in commercial ventures which offer the potential of long-term revenue streams to support research. Examples of this include investment in conference facilities and accommodation, which Warwick University embarked upon more than three decades ago as a response to declining government revenues.

- Invest in productivity tools. The challenge for many institutions is to ensure that their best researchers are as productive as possible. While time spent on grant applications by senior researchers is necessary and desirable, there are diminishing returns beyond a point. The same is true in research grant administration, where researchers can become unnecessarily burdened with administrative tasks that can be avoided or simplified (for example through grant management tools).

- Creating opportunities for efficient collaboration between researchers in pursuit of multi-disciplinary, multi-institutional research.

- More effectively track the performance of individual researchers, including more rigorous examination of research output and performance evaluation.

- Simplify the process for provisioning of researchers with technology. Universities visited as part of the study tour spoke of the challenges for CIOs in encouraging uptake of centralised ICT.

Equipping researchers to succeed, from a technology perspective, is not always straightforward. Traditionally a tension exists between the researcher’s desire for freedom (including the technology they use) and the central IT division’s desire for cost efficiency, visibility and security. Discussions with German universities in particular revealed that researchers had far fewer restrictions when it came to procurement of technology, but operated in less secure ICT environments.

“After years of trying different strategies to drive uptake of our services by researchers I now know that I have to make technology cheap, simple and easy to consume.”

- MIKE ROBERTS, CIO, WARWICK UNIVERSITY
Optimisation of research is about people, not just technology

Darmstadt University Professor Christian Bischof spoke of the need for human and ICT elements to be considered in lifting researcher productivity. Professor Bischof operates Darmstadt’s High Performance Computing Centre (HPC) and cautioned against the relentless pursuit of more computing power to improve research output. He said that while computing power was necessary, it was not sufficient. This was particularly true in a constrained funding environment where computing power has traditionally been ‘free’ in German academia (i.e. if an academic wanted it, they generally got it within reason).

Far greater returns on investment could be achieved by investing in the ‘brainware’ of people to optimise technology, not just software and hardware itself. He used the example of ‘software stewards’, whom he had appointed to continually optimise applications running on the HPC, with astounding productivity results. For an investment of half a million Euros per year – less than one tenth of the annual operating cost including hardware, software and electricity – the computing power for the facility could be improved by a multiple of that number.

“It’s time we understood that we need to invest in carbon brains as well as silicon brains.”

- PROFESSOR CHRISTIAN BISCHOF, DARMSTADT UNIVERSITY

Improving the productivity of infrastructure could also be achieved by greater sharing of resources. In both the UK and Germany there was an increased focus on providing broader access to scarce research infrastructure, including between institutions. Darmstadt University, for example, provides a range of services to other institutes and Warwick University collaborated regularly with other universities in the Russell Group (of research-focused universities). This includes infrastructure sharing arrangements in areas such as mass spectrometry, HPC, electron microscopy and biomedical facilities.

The same was true of video technologies, which offered significant potential for researchers and universities more broadly to forge and maintain international partnerships. Warwick’s successful strategic relationship with Monash University in Australia, for example, depended heavily on video to facilitate authentic, regular and affordable collaboration.
Complexity – not cost – is the enemy of scale

The focus on reducing administrative costs is acute, and understandably so. Universities are facing stark choices about whether to cut from research, teaching or administration budgets. One of the challenges associated with cuts to the administrative budget is that it has downstream impacts on other functions of the university. For example, investments in learning management systems underpin teaching, and building management services directly impact on research conducted within these buildings.

Perhaps one of the most compelling arguments for why administrative budgets should be reducing – not increasing – is the impact of new technologies. ICT has created opportunities for efficiencies in areas such as virtualised storage and data management (avoidance of costs associated with owning and operating your own infrastructure) and the capacity to utilise students’ own consumer devices for learning purposes. It has also improved the effectiveness of some functions, for example the use of video technologies has displaced telephone-based interactions (particularly among researchers) and created a higher quality collaborations. Despite the opportunities presented, anticipated benefits have not always been realised.

Discussions with UK and German universities revealed a range of reasons for this, including:

- Unrealistic forecasts, particularly around the speed at which savings could be realised. The fact that benefits are often spread across disparate groups such as Schools/Faculties makes this particularly relevant in universities.
- Human factors, including lower than anticipated uptake of technologies and change in general.
- The rate at which demand for administrative support is growing, driven by increased compliance and reporting as well as the need to reduce the administrative burden on teachers and researchers so they can focus on core priorities.
- The complexity associated with provision of administrative support, particularly when variant business processes exist across the university.

The issue of complexity was discussed at length. University of the Arts London’s development of an online assessment tool took many years, and was complicated by a steady stream of new requirements. It was a constant challenge to balance the need for a tool which was context-aware and a project that was contained enough to be delivered.

The theory of Glass’ Law was developed to illustrate the relationship between complexity and cost. It posits that for every 25% of functionality added to a solution (e.g. software) there is a 100% increase in the complexity of that system. Complexity and cost are clearly relational.

The objective for many universities is not just containing cost, but reducing complexity. This includes a focus on standardisation, but also investing strategically in platform infrastructure and systems that will reduce downstream complexity. To demonstrate:

“The investment case for Flinders University to invest in network infrastructure was simple. There was a lot that we needed to do as a university that was not possible without a robust, scalable infrastructure or that would have been very complex to deliver with significant workarounds. I was focused not only on the cost of upgrading our infrastructure, but also on the cost of not doing it.”

- PROFESSOR RICHARD CONSTANTINE, PRO VICE-CHANCELLOR (INFORMATION SERVICES) AND CIO, FLINDERS UNIVERSITY
Significant opportunities were identified to reduce costs and complexity, and realise benefits quickly

“Financial constraints in the sector dictate that universities seek to cooperate where it makes sense. The U-Cloud concept is based on the notion that there are a range of utility services that could be delivered more cost effectively across multiple institutions. U-Cloud is not intended to be a mandated shared service, but rather a group of institutions potentially getting together to drive economies of scale in areas where universities do not differentiate. The benefit of doing this in a cloud environment is that we can take complexity - not just cost - out of some of these services.”

- SENDUR KATHIR, CHIEF INFORMATION OFFICER AND HEAD OF INFRASTRUCTURE, UNIVERSITY OF MELBOURNE

Students themselves offer potential efficiencies

Taking cost and complexity out of university administration is not always possible, or desirable. However, a range of practical examples were raised by overseas universities that could be adopted in Australia. These include:

Unrestricted bandwidth at Brunel University

The approach to student bandwidth consumption had been traditionally restrictive at Brunel, recognising that the cost of bandwidth was significant. Over time two things have changed: the cost of bandwidth has reduced significantly and the value that students place on bandwidth has increased exponentially. Brunel also recognised that the administrative burden associated with capping/restricting access could be avoided, and a decision was taken to allow virtually unrestricted access (to appropriate content), including downloading of audio and video files.

“We used to take the attitude that this is what we expect to provide, and this is how we expect you to consume it. Our focus now is on providing fastest, least restrictive Internet in the UK.”

- SIMON FURBER, INFRASTRUCTURE DIRECTOR, BRUNEL UNIVERSITY

Forwarding to student’s personal email at Warwick University

The management of university-issued student email addresses continues to be a university responsibility. Recognising that students bring their own email address to the institution, Warwick University recently started assisting students to ensure that their official email account was forwarded to their personal email addresses. This not only has the advantage of increasing the likelihood that emails are read, but potentially enables the university to contact students when they leave the institution (ie well after they have stopped checking their university email address).

University of the Arts London and Buckinghamshire: use of portfolio blogs and new ways to tap into the student voice

The London College of the Arts has a thriving fine arts program, and students’ work is often visually represented. The university established the Workflow platform, which enables students to store their work, share it with other students, and export it when they leave the university as an active portfolio. The online portfolios hosted on the platform have become an important mechanism for students to crowdsourced the skills/views of other students. The platform has important student benefits – including providing opportunities for much more effective peer review – but was administratively simple and inexpensive to create and manage.

Buckinghamshire University has successfully implemented a platform that supports electronic submission of assignments, online marking and electronic return of feedback. Buckinghamshire has also created the Student Voice, a service where students can text or email the Vice Chancellor with specific concerns or queries. These might include late cancellation of a class, late or non-attendance of a session leader or overcrowding. The feedback is analysed and acted upon by the university, and is considered more cost effective than trying to capture this data from a range of disparate sources. It also has the intended benefit of improving student satisfaction and engagement.
A comparison between Germany, Australia and the UK

German and the UK universities differed significantly in their strategic foci and approach to IT

The operating environment — and responses to their environment — vary significantly between Australian, German and UK universities. The purpose of Figure 4 is to synthesise these differences and provide context for the pages that follow.

![High level depiction of differences between the UK, Australian and German higher education contexts](image)

**Figure 4: High level depiction of differences between the UK, Australian and German higher education contexts**
European perspectives on Australia’s CAUDIT top 10

The Council of Australian Directors of Information Technology (CAUDIT) publishes an annual ‘top 10’ list of its strategic priorities. The ‘CAUDIT top 10’ was shared with international universities visited as part of the study tour to determine degrees of alignment between Australian executives and their overseas counterparts. The CAUDIT Top 10 served as a framework for the discussions and to elucidate the differences and similarities between Australian and overseas institutions. Major observations are summarised below.

The CAUDIT Top 10 resonated strongly with universities, particularly in the UK

The CAUDIT top 10 issues were provided to overseas institutions in advance of site visits. The issues that resonated most strongly as priorities included supporting and enabling research, enabling teaching and learning and ensuring anywhere, anytime availability.

A number of priorities were mentioned by overseas institutions that were not necessarily acknowledged as burning issues for Australian universities

Perhaps most instructive observations were the number of priorities for overseas institutions that were not necessarily acknowledged as burning issues for Australian universities. These included:

- **Student engagement** – UK universities spoke of their determination to more effectively engage students in campus life, not just study. Wi-Fi bandwidth, for example, was virtually unrestricted and used as a tool for attracting students to the campus.

- **Social media monitoring** – many overseas institutions invested in active monitoring of social media commentary about their institution. This capability was considered necessary as an input into student satisfaction reporting, but also to ensure that potential issues were identified (and responded to) early.

- **Industry engagement** – recognition of a university’s role in its local community was an acute focus in the UK. At Warwick University in particular, the relationship with industry was critical to ensuring students had market-relevant skills and providing a basis for more productive research partnerships.

Australian universities considered themselves ahead of the UK and Germany in a number of CAUDIT priority areas

While there was much to learn from overseas institutions, Australian universities considered themselves to be more advanced in a number of areas, including the deployment of cloud services (where Australia is an acknowledged early adopter), managing security and privacy and IT governance where Australian universities have reasonably mature shared services arrangements. There was also strong interest from UK universities in Australia’s track record of benchmarking, particularly for technology functions.
Achieving these imperatives requires management of a range of ICT issues

The complexity and volume of university business requirements is putting pressure on underpinning platforms and systems

Achieving universities’ ambitions in teaching, research and administration depend heavily on the extent to which the right technology is in place. Three technology issues singled out as potential enablers/obstacles to universities’ ambitions were cyber security, cloud and big data/analytics. Each presents unique challenges for universities and CIOs, as depicted in Figure 5.

Figure 5: Major technology challenges for universities and CIOs

The management of these issues is no longer the exclusive domain of the CIO. University executives in Australia and overseas acknowledge that all need to be treated as strategic priorities. The value of analytics in particular, has become crucial to student administration services, institutional development, research and innovation management and campus operations.

A window into the future of security threats

Cyber threats are evolving rapidly, in terms of their prevalence, methods and potential to do harm. Emerging threats include:

- **Ransomware**: encrypts a university’s data and only releases that information on basis of a ransom being paid
- **Contract hacking**: a market has emerged for aggressive States to contract with third parties to hack specific systems / sites
- **Data on-selling**: compromised data is increasingly sold in open markets, with universities representing major targets
The role of the CIO function in universities is changing

ICT is becoming more embedded and strategically important across all functions of the University

It is hard to imagine a single function within a university that isn’t dependent on technology. In administration, ICT is critical to the collection, storage, analysis and management of student records. In teaching, ICT is increasingly critical to the delivery, capture and storage of learning materials, as well as underpinning student collaboration. And in research, ICT is vital to discovery, as well as research dissemination.

The pervasiveness of ICT means there is more at stake when things go wrong, and larger dividends for universities that get it right. Technology is increasingly a source of competitive advantage, innovation and productivity. It remains, however, complex to manage. The contemporary CIO – like the contemporary university – must manage the tension between value for money and a high quality experience. Increasingly, they will need to focus on transforming the business, not just running the business. Gartner research from 2013 shows the current balance in terms of IT budget distribution is skewed towards utility functions or business as usual (BAU), rather than higher value growth and transformational activities.

A question for universities is what proportion is ideal, particularly in a context where disruptive and sustainable innovation is required for differentiation. Some universities described the need for 50% of their technology budget to be spent growing and transforming, including ensuring that the right infrastructure and foundational systems were in place to promote innovation.

The role of central ICT is changing from implementers to facilitators and service brokers

Business as usual (BAU) activities, in particular, are increasingly outsourced or consumed as a service. This potentially reduces the need for implementation capability, but increases the requirement for change managers. The Office of the CIO at Warwick, for example, employs academic technologists who work with researchers in the development of their research grants, to more accurately specify and modify technology requirements. The university has also insisted on higher quality technology plans to mitigate the risk of under-specifying or over-specifying.

Equipping researchers, academics, students and administrative staff to excel remains the prime objective. More often this involves making calculated, strategic bets to ensure a university is positioned to meet future as well as current challenges. An example, technology has a significant role to play in facilitating the move to treating students as customers, from the establishment of systems to underpin analytics, to incorporation of MOOCs as a feeder for a university’s more fee-generating programs, and the capacity to track and interact with students over their life. The same is true of technology’s role in the research process, where ICT can help make researchers more effective and productive.
Outlook for innovation in universities

If the past three years are to be predictors of the future, it is clear that:

- **Everything will be connected:** the Internet of Everything is a term coined to describe the proliferation of networked technologies, beyond devices to consumables such as light bulbs and appliances. 99.4 percent of physical objects that may one day be part of the Internet of Everything are still unconnected. The pace of change will accelerate, rather than slow; the pace of technology uptake is exponential and keeping pace with consumer technology will be a challenge particularly if technology is going to be secured, and scalable.

- **Choice for students will increase:** technology will force established institutions to change and create space for new entrants. Students will have more power than before to exercise choice in where, how and at what pace they learn. They will expect to have a high quality experience – on and off campus – and will expect to be actively engaged with their university.

- **The pace of change will accelerate:** the demands on institutions, staff, structures and systems are likely to increase. Change will be a constant, rather than a temporary state, and technology represents part of the challenge and part of the solution. The capacity to be able to analyse information quickly, and respond appropriately, will become increasingly important.

- **Students will expect individualised responses to their issues (learning, administrative and social):** having an accurate, single view of the student will be critical if universities are able to genuinely support students across their lifecycle.

- **The university technology environment will need to be more flexible, scalable and efficient:** maintaining an accurate, single view of the student before, during and after their enrolment will be a critical enabler for institutions. This extends beyond the capture of information to the rapid analysis of big data and generation of genuine insight that improves learning outcomes, retention and the student experience.

Responding to these challenges will require universities to embrace disruptive innovation and invest in appropriate infrastructure, systems, processes and people. Incremental improvement is unlikely to be sufficient for most institutions, particularly in a demanding fiscal context.

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2 Cisco, Embracing the Internet of Everything To Capture Your Share of $14.4 Trillion, 2013.