Higher and Further Education
An ICT Blueprint for Teaching, Learning and Research
Successive governments have re-stated the critical importance of education to the health and economic wellbeing of the nation, while at the same time introducing far-reaching changes to the funding regimes for higher and further education. These changes are challenging institutions to conduct their business differently and transform the provision of teaching, learning and research.

Recent measures to create a student-funded model have put the quality of teaching and learning, and the overall student experience, at the top of the agenda. Students are now perceived as consumers of education. If institutions are to maintain student numbers and develop their businesses, they must meet students’ expectations in a number of areas, including the availability and exploitation of technology.

At Cisco, we have also faced financial challenges and made fundamental changes to our business. The ‘One Cisco’ programme created real, measurable efficiencies and drove cultural and process change in our business. We achieved it by focusing on a small number of technology-enabled projects to radically change how people access information, how they interact and work together, and how we provide skills development.

The Cisco Education Team has created this paper to help CIOs and senior management teams incorporate technology into their business plans. We hope you find value in the paper, and look forward to meeting you to discuss its recommendations.

Rod Halstead
Managing Director
Public Sector
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About Cisco and Education

Cisco is a major supplier of computing, communications and collaboration technology. It has a global education practice and a long-standing commitment to education in the UK, US and worldwide. Cisco’s dedicated UK Education Team has strong relationships with many UK higher and further education institutions. For many years, we have promoted the beneficial use of technology to change the way we live, play, work and learn.

The Cisco UK Education Team has prepared this paper based on its in-depth knowledge of the education sector, and experience of working with customers to deploy business- and education-led ICT solutions. The paper is intended to provide CIOs and senior management teams with a better understanding of the role of communications and collaboration technologies in education today, and why these technologies should be at the heart of an institution’s business plans.

Government Education Policy

The recent Government Mid-Term Review\(^1\) restated the importance of education to the health and economic wellbeing of the nation.

The Mid-Term Review also summarised the Government’s progress on, and future plans for, placing HE and FE on a ‘secure and sustainable financial footing’

Central to this new financial footing is a shift from central funding to student funding. The shift has already led to a reduction in student admissions in 2012, and applications for 2013 are only recovering slightly. This has a direct impact on revenues and creates business uncertainty. It requires institutions to focus on two key business challenges:

- Maintaining admission levels through the international education market and by providing the very best student experience
- Maximising business efficiency to reduce the cost of providing education.

Business Requirements and Technology Investment

To meet these challenges, an institution’s business plans must address a number of key challenges, from the student experience to regional partnerships. Cisco recommends technology investment in nine key areas to allow institutions to address these challenges (Figure 1).

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Business Plan and ICT Strategy

Technology is a critical business asset for any modern institution, and this must be reflected in its business plans.

Each institution has different needs, and business plans must localise requirements and priorities. Every business plan should be supported by an ICT strategy, developed by the CIO in consultation with, and endorsed by, the senior management team. All technology investments prompted by the ICT strategy should be implemented on a consistent, institution-wide basis.

Cisco Logical Architectures

Cisco recommends that ICT strategies adopt an architectural approach. Architectures are extremely important. They can reduce both cost and risk by providing blueprints, that remove technical complexity, and proven implementation roadmaps, that explain how to evolve ICT to deliver enhanced features and performance.

Cisco has developed three logical architectures which many of our customers are incorporating into their strategies. The Borderless Network Architecture covers networks and security; the Data Centre Virtualisation Architecture covers utility data centres; and the Collaboration Architecture covers communication and collaboration technologies.

Each of the architectures offers technical blueprints and roadmaps and, importantly, each is supported by Cisco Validated Designs that offer proven implementation templates.

Lower-cost ICT Consumption Models

The development of an institution’s ICT strategy is the perfect opportunity to assess lower-cost consumption models for infrastructure and applications.

Cloud and managed services are now becoming readily available from commercial service providers and, as shared services, from peer institutions. They are being widely adopted across the public sector.

However, a decision to adopt cloud and managed services can have a significant business impact, both financially and organisationally, and should only be taken after a thorough business review.

Recommendations for Action

Cisco recommends a structured six-step approach to the definition and deployment of technology within an institution:

1. **Prepare the institution’s business plan** with technology at its heart.
2. **Prepare the supporting ICT strategy** using an architectural approach.
3. **Deploy the ICT service delivery platform** to provide end-to-end infrastructure.
4. **Implement unified access** for Bring Your Own Device (BYOD) and secure mobility support.
5. **Introduce tools** to provide a rich mix of unified communications, real-time and Show and Share video, and collaboration technology.
6. **Investigate how to provide ICT more cost-effectively** through the use of Cloud and managed service models, and shared services partnerships.

How Cisco can Help

Cisco has a long-standing tradition of working with institutions to deploy business- and education-led ICT solutions. It is ideally placed to assist business plan and ICT strategy development, and to support technology deployments through its services groups: Cisco Consulting Services provides business consulting, Cisco Advanced Services provides design, build and operate services, and Cisco Technical Services provides on-going technology support.

Conclusion

We hope the contents of this paper prove valuable and assist you in developing and executing the right plans for your institution. Please contact your Cisco representative if you would like to discuss the paper and our recommendations. We look forward to working with you to help you achieve your business objectives.
Key Developments in Education Thinking

Technology is just one of many disruptive influences on HE and FE. However, the unprecedented developments in technology over the last five years or so have made it a key factor in any education innovation strategy.

**Background**

We live in an era where the wealth of data and exponential growth in the development of new knowledge are challenging institutions to rethink teaching, learning and research for delivery to a global marketplace. Additionally, there is a need to prepare students for increasing competition in the workplace by developing distinctive skills that will help them to succeed. This all needs to take place in the face of significant financial challenges and business constraints, as well as growing competition in the education marketplace.

With technology as a catalyst, education is moving from a transmission model of knowledge transfer, to one in which learning is collaborative, active, self-directed and engaging. This new model helps to develop soft skills and knowledge building, and prepares students for the ‘learning society’.

**Borderless Access to Education**

In bricks-and-mortar universities, the campus environment has gained increasing relevance in the support of student learning. The best universities are trying to develop a ‘sticky campus’ for informal and social learning. And they are trying to ensure that accompanying online spaces provide equally supportive environments, with a seamless interface between real and virtual.

For any university seeking to offer virtual or distance learning, either with or without a traditional campus offering, the online experience has to be particularly robust to compensate for much less frequent face-to-face interaction.

Informal learning is recognised as a vital factor in student success. There is now a range of possibilities for embedding collaboration opportunities into course planning. Additionally, the development of learning analytics tools makes it possible to analyse and assess the nature and quality of social interactions around different education models. The ability to assess the quality of online collaboration will ensure that theory can be more easily assimilated into practice, turning information into robust knowledge.

**Independent Learning**

With a wide array of social networking and collaborative technologies now readily accessible, distance and virtual learning need not be solo activities.

As distance and virtual learning become increasingly collaborative, the old models of static text and online multiple-choice assignments will start to disappear. They will be replaced by multimodal content and new opportunities to demonstrate understanding, both collectively and individually, through selecting the tools and resources that best demonstrate their understanding of that subject. This might be a wiki, essay, animation, set of images, podcast, video, or a web page that combines a range of media.

Another major catalyst for learning is video – both recorded and live – which is transforming the way learners engage with academics, experts, peers and the world around them to provide a more collaborative, informed and authentic education. It does not preclude solitary working but, instead, offers the learner a choice as to whether they learn on their own or with others, either close by or at a distance. Learners can choose whether to attend in person, from their home or from another location via virtual classrooms or...
videoconference, or to catch up later with a podcast or video of the session.

Additionally, students can select resources in the formats that suit them best. Some may prefer to read, think about what they have read, and then discuss it, in real time through text, voice, video or in person; or asynchronously in a discussion forum. Others may prefer to discuss ideas first to clarify their thoughts and then follow up with readings and more discussion. Others again may prefer to watch or listen to a lecture on the subject before doing any of the above.

There are many ways in which learners can access and assimilate knowledge. The use of more engaging and authentic pedagogy such as role-play, problem-based learning and serious games are demonstrating improvements in learner success.

**Personalised Learning**

The explosion of resources on the Internet has enabled students to go beyond course resources and become digital scouts, finding resources that add value to the already rich repository made available by academic course tutors. These resources might offer alternative pathways though materials, but will probably require high-quality semantic analysis so that they can be catalogued for easy access, use and re-use.

Students want more choice in where, when and how they learn. Institutions are already exploring possibilities for allowing students to select the mode of learning that suits their lifestyles and learning preferences. However, there must be similarities between face-to-face and online learning experiences: they cannot be fundamentally different. For example, if all face-to-face classes are lectures with a one-way transmission of knowledge, it will be difficult to engage students in a debate on an online forum. It’s even harder to engage students in an online webcast when it is simply transmission of information, as they become more easily distracted.

**The Impact of Video Technology**

Video is now accepted as a key vehicle for teaching. The challenge remains to integrate video more fully into the learning experience.

Video has the potential to become the primary medium for dialogue between students and academics.

In the past, infrastructure has been a barrier to the use of video, but, with modern network technology, this is no longer the case.

‘Flipped’ or ‘inverted’ classrooms, in which lectures take place online instead of in a room – usually via streaming video or through a range of resources in the institution’s virtual learning environment (VLE), have been shown to give students a positive attitude towards co-operative learning and new teaching methods. Students access the lecture material prior to the lesson and the lecture time is used for other forms of learning, such as group work, class discussion and project work. It is essential that coherence is maintained between online and face-to-face teaching.

Another manifestation of the rise in Internet-based video streaming is Massive Online Open Courseware (MOOC), which has caused huge waves in the US and which is receiving significant press here in the UK.

MOOC may be perceived as a threat by institutions with a more traditional view of teaching and learning. However, with the cost of education significantly higher in the US than anywhere else in the world, it offers many US learners their only opportunity to access higher education.
As the cost of higher education in the UK rises, MOOC is likely to become more widespread.

**Barriers to the Use of Technology**

There is still considerable resistance by academia to the integration and effective use of technology for teaching, learning and research. In the past there have been practical barriers - insufficient investment in infrastructure, a lack of trust in the reliability of technology, and the usability and affordability of some end-to-end solutions.

These barriers have now largely been eradicated with major advances in the cost-effectiveness, availability and usability of modern systems. However, many academics still do not want to fully embrace the possibilities of technology, while others believe that learners are succeeding very well without technology. The reality is that these academics are reluctant to embrace change that students, on the whole, are demanding. And do not fully realise that this will impact the student experience and, ultimately, the financial prospects of their institutions.

Assessment structures often fuel this reluctance to embrace technology. In the future, they should take full cognisance of technology, and students should be able to select the media through which they want to demonstrate their knowledge and understanding of a subject. The value given to assessment using online collaboration, forums and critiques should be equal to that using essays and reports.

Validation processes are one route to change, but so are the recognition of other forms of assessment, sound change management strategies and good professional development. Only then will the full potential of technology be reached.
Business Requirements

Each institution should have a business plan that clearly sets out its requirements and assigns local priorities. Cisco believes that the CIO, working with the senior management team, should ensure that technology is at the heart of the business plan and is recognised as a critical business asset.

In this section, we summarise the key business requirements and explain where we believe technology has a role to play in realising them. The recommended technology is detailed in the next section.

The Student Experience

The new sustainable financial model replaces central funding with funding directly from students. As a result, revenue from student admissions is essential to financial stability.

The student experience, alongside education outcomes, continues to be central to maintaining admissions, and is therefore a top priority.

The Cisco definition of ‘student experience’ comprises four elements, each of which has a significant dependency on the use of technology (Figure 2).

Of the four, environment is perhaps the most important, although it is often taken for granted by students. Campuses, buildings and halls of residence should be comfortable and physically attractive.

They should include spaces designed specifically for each activity. There should be no physical or technological barriers to students who wish to use multiple devices (laptops, tablets and smartphones) wherever, whenever and however best suits their individual needs. All buildings should be fully networked, with ubiquitous connectivity for every type of device. Cisco refers to this as ‘the borderless campus network’. Non-intrusive security should ensure that access to the borderless campus network is controlled and that the confidentiality and integrity of student information and intellectual property is maintained.

“Language is the principal tool we have for bringing minds together. But technology can amplify the power of language and bring more minds together, in more ways.”

Richard Brodhead, President, Duke University

“Our Cisco wireless network is helping students discover new ways to develop and enhance their creative thinking and support their hands-on projects, while giving lecturers a powerful set of tools to aid new ways of teaching.”

Stephen Reid, Deputy Vice-Chancellor, Strategic Development, University of the Arts London

The wellbeing of students is also extremely important. Institutions should do everything possible to ensure that campuses and buildings are made physically safe and secure through the use of CCTV and access control. They can differentiate themselves by providing a range of support services and facilities. In particular, career support and ICT services are critical to student wellbeing. They should, where possible, be fully integrated and co-located for easy access.

Finally, high-quality teaching and learning should be at the heart of the student experience if desired outcomes are to be achieved.
Many of the changes to teaching and learning have only been made possible because of network connectivity and communications technologies.

The pervasive use of video, the development of peer-to-peer learning groups, remote teaching across campuses and to the home, and techniques such as the flipped classroom, are all good examples of the role of technology in the evolution of education. And Generation Y students have a presumption for the use of technology that needs to be satisfied before they would report a high-quality student experience.

To help meet student needs and deliver a quality experience, Cisco recommends investment in: borderless campus network, unified access, information and infrastructure security, and CCTV and access control.

Teaching, Learning and Research

Independent and personalised teaching and learning

Traditionally, teaching has been delivered face-to-face in a classroom setting, supplemented by face-to-face tutorials and project or practical work. In order to benefit, students had to be in the room to receive information, gain context, ask questions and test assumptions. In contrast, modern education places the emphasis on independent and personalised learning. Formal teaching still plays an important role, but may be delivered virtually using real-time or stored video. Formal instruction, via video, may take place ahead of, and be used as the basis for, a subsequent face-to-face discussion and debate (in what is referred to as the flipped classroom, described earlier).

The teacher-student relationship is becoming less formal, and is increasingly supplemented by collaborative peer-to-peer and group learning and access to external experts.

These new ways of learning are conducted in a variety of settings that require effective communications, collaboration and information sharing. Cisco recommends investment in: unified communications, presence and messaging, real-time and show and share video, and conferencing and collaboration applications.

The research environment

Research is essentially a collaborative venture, requiring successful industry, public sector and education partnerships.

Increasingly, research partnerships are international, often linked to institutional partnering for teaching and learning, and the development of international branch campuses.

We believe that first-class research environments depend on four key factors:

- A supportive, safe and secure environment with the right facilities to attract and retain the very best academics
- Strong collaborative partnerships with peer research institutions, industry and funding bodies
- Successful knowledge-transfer capabilities, to allow research findings to be disseminated for ‘public benefit’ and to raise new lines of funding
- Business and knowledge incubation hubs within, or supported by, the institution.
Technology has a key role to play in research success – by providing essential computing and networking infrastructure and delivering the communication and collaboration tools to support partnership and knowledge transfer. Nowadays, this includes the ability to support projects with Big Data requirements that mandate flexible and capable compute and storage. There is also an increased focus on information and infrastructure security for sensitive research projects.

We recommend investment in borderless campus network and unified access, utility data centres, unified communications, presence and messaging, conferencing and collaboration applications, and information and infrastructure security.

**Streamlining Administrative and Business Processes**

The shift to student funding has had a direct impact on revenues. Institutions now need to maximise business efficiency to reduce the cost of providing education.

Much work has been done within the wider public sector on business efficiency, beginning with a review by Sir Peter Gershon in 2004 and concluding with HM Treasury’s Operational Efficiency Programme in 2008–2009. This body of work has fostered widespread acceptance that technology has a key role to play in driving down costs and creating efficiencies.

Cisco has published separate advice and guidance on operational efficiency², based on our experience of working with customers and on our own business transformation. We recommend that organisations focus on their main areas of cost (workforce, offices and buildings, and utility resources) through a phased adoption of technology:

- Build out end-to-end ICT infrastructure to provide a secure platform for introducing technology into the business
- Deploy unified communications, presence and messaging to enable smart and mobile working
- Provide video and collaboration technology to virtualise face-to-face meetings and information sharing.

**Smart and mobile working**

Smart and mobile working becomes possible when a borderless campus network and real-time communications applications are combined. If adopted, it permits staff and students to access all their applications and information from any location. They can also communicate as effectively as if they were based at a single fixed location.

This approach can have a profound effect on the efficiency of work patterns. Institutions benefit from increased productive time, improved team and project engagement and reduced expenses. Staff benefit from the flexibility of home-working, reduced travel and the opportunity for an improved work-life balance. Smart and mobile working also enables institutions to update their estates strategies to ensure they have the right amount and types of campus accommodation.

Cisco’s Operational Efficiency Paper, mentioned earlier, provides examples of the potential cost savings available through smart and mobile working, and recommends investment in: borderless campus network and unified access, unified communications, and presence and messaging.

**Collaborative business processes**

Traditional business processes are paper-based, require face-to-face interaction, and are based on physical information sharing. In many cases, they are not cost effective and do not scale well as institutions grow and establish external partnerships with other institutions, the private sector and public sector agencies.

New collaborative business processes are proven to create efficiencies, reduce costs and deliver work environments that motivate and retain staff. Of course, technology investment is required, but new business processes can only deliver their full benefit if supported by a programme of cultural change. Culture is often the greatest barrier to change and the active participation of staff should be sought to ensure that the need is understood and its nature fully appreciated.

To realise these benefits, Cisco recommends investment in: borderless campus network and unified access, unified communications, presence and messaging, and conferencing and collaboration applications.

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“...The Cisco network is crucial to virtually all aspects of the University’s business. It is essential that we have a reliable and highly available network to support teaching, learning, research and administration. A considerable proportion of the communication between the University staff and students is now carried out via e-mail. Nearly all teaching materials and learning resources are online and making these available when and where they are needed is crucial to how the students work.”

Professor Morag Bell, Pro Vice-Chancellor for Teaching, Loughborough University
Next-generation education campuses

The introduction of smart and mobile working, collaborative business processes and independent teaching and learning will, over time, have a significant impact on the role and strategic value of campuses and campus buildings.

Institutions should respond to these changes by evolving estates strategies that align accommodation closely to business and education needs, and realise the potential cost savings.

An estates strategy is key to establishing flexible, adaptable spaces, and should:

- Identify the optimum number and location of buildings on the campus
- Ensure that buildings are designed to meet the needs of students and staff
- Minimise operating costs
- Reduce carbon footprint.

The power of computing and networking is now available to monitor, control and secure buildings on-campus.

On a smart and connected campus, all building information (from heating, ventilation and air conditioning, to energy consumption, CCTV and access control) is network-based and is therefore accessible in a location-independent manner by staff. The borderless campus network becomes a ‘fourth utility’ for campus and building services as shown in Figure 3. This affords greater flexibility, particularly important in emergencies when individual locations may not be available.

The smart and connected approach is important for business efficiency and carbon footprint because it reduces the:

- Capital cost of new and refurbished buildings through the use of shared infrastructure
- Operational cost of building management by streamlining monitoring and maintenance activity
- Use of energy and resources because of proactive, policy-based building management.

The extent to which this approach is possible depends on the mix of new, to-be-refurbished, and older buildings in an institution’s estate. For new and to-be-refurbished buildings, the cost savings are immediate and can be significant. But early engagement with architects and engineers is essential to ensure that the right technology is incorporated at the building design phase.

Cisco, working with its partners, is the only company that is able to offer a truly integrated approach to building management, physical security and ICT infrastructure.

We recommend investment in: borderless campus network and unified access, CCTV and access control, and building management and automation systems.

Educational and Business Partnerships

Internationalisation

Teaching and learning is fast becoming a global business. This reflects wider changes in the business world, where projects increasingly rely on cross-border, cross-cultural collaboration.

Most UK universities have strategies to maximise international student admissions, to develop partnerships with peer international institutions and, in certain cases, to build international (‘branch’) campuses. Teaching and learning partnerships often expand into research, including industry partners within the target geography.

There is a long history of international students coming to the UK for education. This is now being encouraged more strongly because of the new student funding model.
Many international students wish to participate in both formal and independent learning, and enjoy the same student experience, from their home country.

Peering between international educational institutions is not new, but is growing fast, facilitated by the Internet and pervasive connectivity. The availability of video and collaboration tools allows effective remote learning and permits institutions to scale their resources globally. A number of universities have now established branch campuses, including the University of Nottingham (with campuses in Malaysia and China), and Middlesex University (with campuses in Dubai and Mauritius). There are now more students studying UK programmes outside the European Union (EU) than non-EU students studying in the UK – the latest figures are 340,235 against 280,760.

International campuses present a number of ICT design and operational challenges, as well as teaching and learning challenges. On the design side, the biggest challenge is to provide a global network with the performance, reliability and scalability to deliver a rich mix of data, voice and video traffic at the required service levels. On the operations side, there are a number of challenges to maintaining service levels on a genuine 24/7 basis. Careful resource planning for operations and management for both infrastructure and applications can meet these challenges. Cisco has a wealth of experience in designing and operating global networks, and has a ‘follow-the-sun’ support model for our business and our customers. We would be happy to provide you with further advice and guidance.

These developments require institutions to invest in: borderless campus network and unified access, unified communications, presence and messaging, and conferencing and collaboration applications.

**Regional partnerships**

Education institutions have a number of very important roles to play in regional partnerships.

In many UK regions, public and private sectors are beginning to partner to create the right environment for economic development and prosperity.

Regional economic partnerships are nothing new, but they have increased in number significantly since the economic downturn of 2008. They are usually established to provide the necessary conditions for a new business to establish itself and thrive (something that a single body cannot do alone):

- A pleasing location and environment
- The availability of small and medium size business units
- Good telecommunications facilities, including super-fast broadband
- Highly-skilled workers, particularly for the knowledge economy
- Good housing and transport
- Good healthcare.

The essential role for educational institutions is to help provide skilled staff and deliver supporting education and skills programmes to regional partnerships. They may also provide business accommodation and services (such as in science parks) and help develop business incubators to transfer research knowledge into the economy.

**“The University of Wolverhampton has set its sights on being more than a higher education establishment. It wants to help raise the level of education attainment for the whole region, particularly for those people who would not normally consider higher education. The use of technology from Cisco is having, and will continue to have, a significant impact on our ability to achieve that goal.”**

Director of IT Services, The University of Wolverhampton

Institutions must supply new businesses with staff that have practical experience of modern ICT-based tools and processes, as well as the necessary education. A proactive lead on smart and mobile working and collaborative business processes will help facilitate this and ensure they are able to provide staff with the right profile.

Cisco has been active in city and regional partnerships through our National Virtual Incubator programme, which promotes the use of video and collaboration technology to link education institutions, industry stakeholders and public sector bodies. This programme is part of a substantial package of business sponsorship – the British Innovation Gateway – which Cisco is providing to the UK Government, and which has already established incubators in Greenwich, Manchester, Birmingham, Sunderland and Oxford.

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3Cisco National Virtual Incubator – Cisco, 2012 - http://www.ciscobig.co.uk
Technology Investment

The previous section identified key business requirements and the beneficial links to technology investment. Figure 4 summarises these links, highlighting the nine areas we believe institutions should consider for technology investment.

These nine areas are described below: (links to more information can be found in the appendix; a separate annexe to the paper describes Cisco solutions in more detail):

1. **Borderless campus network**
   A pervasive network comprised of wired, wireless and remote-access components, to provide anytime, anywhere access for students, academics and staff. This is critical to the student experience, and essential for controlling access to infrastructure, applications and data.

2. **Unified access and BYOD capability**
   Secure, policy-based access to the borderless campus network providing BYOD support for all student devices.

3. **Unified data centre**
   Secure, flexible, scalable and energy-efficient delivery points for applications, services and information assets. This is critical to all aspects of teaching, learning and research, and for business operations. Essential for reducing the total cost of ownership (TCO) of ICT operations. This may be one of the first services considered for delivery using a managed service or cloud model.

4. **Information and infrastructure security**
   Layered security to protect network infrastructure from attack, and information assets from unauthorised access. This is critical to safety and security, and to all aspects of teaching, learning and research, as well as business operations. It is increasingly important for gaining security assurance to allow participation in sensitive research partnerships.

5. **Unified communications**
   Suite of voice applications, including presence, instant messaging and Single Number Reach, which allow students, academics and staff to communicate effectively — independent of location. This is critical for smart and mobile working, and is essential for supporting effective student-academic communications, and independent and group learning.

6. **Real-time video**
   Suite of conferencing, distribution and communications capabilities that place video at the heart of education. This is critical for the dissemination of richer information and content to students, and is essential for remote learning, group learning and for enriching communications both locally and internationally.

7. **‘Show and Share’ video**
   The ability to capture, transform and share lecture, group or personal video content is critical for the recording and distribution of content. It is essential for enriching all types of academic-to-student and student-to-student communication.

8. **Collaboration and information sharing**
   Tools to develop and share information and content across teams of location-independent students, academics and staff. This is critical for developing new business processes, and is essential for effectively virtualising all aspects of teaching, learning, research and business operations.

9. **CCTV, access control and building management systems**
   Network-based equipment to converge building management and safety and security onto the borderless campus network. This is required for cost control and the management of carbon emissions. It is essential for the wellbeing of students and staff, and for the protection of physical assets.
The Importance of ICT Strategy and Architecture

The survey found that organisations where there are strong collaborative relationships in place are four times more likely to be top performers.

In order to achieve this, an institution’s business plan must have a supporting ICT strategy, developed by the CIO and endorsed by the senior management team. The strategy should regulate all technology investment within an institution, to ensure it is consistent and in line with operational best practice. It should identify the technology required to support the business plan and how it can best be sourced. It should explain which projects need to be established and funded, providing a pathway to implementation.

Cisco believes that an architectural approach will deliver particular benefits. ICT architectures provide structured, best practice blueprints that remove complexity and offer roadmaps to increased functionality and performance. They also help identify reusable technology building blocks that are available to build new services. In this way architectures reduce business risk, increase agility and help deliver investment protection.

We recommend that strategy development be structured into four distinct, but linked, areas:

1. End-to-end ICT infrastructure – the critical business asset for running the business
2. Unified communications, video and collaboration applications – the applications that will create business efficiencies and support new ways of teaching, learning and research
3. Line-of-business and back-office applications – the applications, such as VLEs, that will run the business
4. Lower-cost ICT consumption models – how to consume infrastructure and applications to reduce costs while maintaining operational flexibility.

An approach based on the principles set out in The Open Group Architecture Framework (TOGAF), may be adopted. Current ICT assets (the ‘as-is’ architecture) are identified, and those required to run the business in the future (the ‘to-be’ architecture) are specified. The strategy should define the incremental steps, based on architectural roadmaps, that may be taken to transition from as-is to to-be environments.

Cisco supports the adoption of an architectural approach, and has developed its technical capability around three logical architectures:

- **Borderless Networks** – covering network infrastructure and security
- **Data Centre Virtualisation** – covering utility and cloud data centres
- **Collaboration** – covering unified communications, video and collaboration applications.

We encourage institutions to gain the business benefits of adopting these architectures. Doing so also affords access to Cisco Validated Designs<sup>5</sup> – the how-to guides for deploying Cisco technology using tried and tested laboratory templates.

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The Importance of ICT Strategy and Architecture

Technical Reference Models

The Cisco Public Sector Team has developed a Technical Reference Model (TRM) to assist with visualising existing and planned ICT environments and services. The TRM, shown in Figure 5, has a layered structure, based on the principles set out in TOGAF.

The TRM can be used to provide a structured view of ICT components and sub-systems within an institution, and offers a way of representing the needs of users and services.

The TRM can also help to identify reusable building blocks; those technology components (such as identity management services) that can be reused to build new services.

“Cisco’s networking technology is the cornerstone of our IT infrastructure. Virtualising our servers saves us around £320,000 a year in equipment and electricity costs, and reduces the college’s carbon footprint by 860 tonnes per year. And it all relies on a network that can deliver exceptional performance every time without fail and Cisco hasn’t let us down yet.”

Dr Daniel Hidlebaugh, Network Services Director, Hertford Regional College
The TRM comprises four functional layers, with an added fifth layer that allows different user and service requirements (contexts) to be modelled. It can be used in a number of ways within an institution:

1. To show current (as-is) and future (to-be) architectures.

2. To support strategy execution by showing migration paths.

3. To identify the capability required for new user or service requirements.

The TRM is very powerful for modelling particular stakeholder needs – for example, traditional workers, smart and mobile workers, and digital learners – and new service requirements. To do this a ‘plan down, build up’ approach should be used. Figure 6 provides an example of how it might be used by an institution to model the requirements for a new Show and Share video service for lecture capture.
The Importance of ICT Strategy and Architecture

The ICT Service Delivery Platform

Cisco uses the term ‘ICT service delivery platform’ to refer to business-critical, end-to-end ICT infrastructure. Institutions can construct the platform using Cisco’s two infrastructure architectures: the Cisco Borderless Network Architecture and the Cisco Data Centre Virtualisation Architecture, as shown in Figure 7.

Physically, the platform comprises a borderless campus network providing wired, wireless and remote-access connectivity; virtualised data centres delivering applications and services in a secure, energy-efficient manner; user device support services; and an important envelope of layered security provision.

Logically, the platform provides a rich set of features to support applications and services.

In addition, the platform provides policy-based secure mobility and BYOD support, ensuring that authorised users and devices can access the network with no restriction.

The platform provides support for all the business applications (back-office, line-of-business and real-time) essential for a modern institution. We refer to the combination of Cisco end-to-end infrastructure and Cisco real-time applications technology as our ‘One Architecture’, as shown in Figure 8.

Figure 7 – The ICT service delivery platform
The Importance of ICT Strategy and Architecture

Figure 8 – Cisco’s ‘One Architecture’, end-to-end infrastructure and real-time applications
New ICT Consumption Models

Cloud can help reduce ICT costs and provide the flexibility to enable business process change and streamline the delivery of teaching, learning and research – helping institutions to realise direct cost savings and deliver business efficiency.

Institutions should use ICT strategy development to look at existing ICT consumption models, and ensure that they are still cost-effective and offer the required business flexibility.

At the moment, the majority of institutions provide ICT using in-house teams, sourcing technology using capex-based finance models. However, Cloud and managed services are now becoming readily available from commercial service providers and also, as shared services, from peer institutions. They are being widely adopted across the public sector.

A decision to adopt cloud and managed services can have a significant business impact, both financially and organisationally. Before any decision is taken, we recommend a thorough review to identify the infrastructure and applications that might be consumed as services, and to ensure that adoption is right for local conditions. Any such review should be supported by contact with Cabinet Office and wider public sector agencies, in order to benefit from the growing body of experience of using cloud, managed service and shared service models.

The Cloud Approach

Cloud computing (Cloud) is an established industry paradigm for providing business computing using a managed-service delivery model. Institutions should develop a strategic vision for Cloud and incorporate that vision into their ICT strategy. This vision must be based on an assessment of the suitability of Cloud for meeting local business requirements, the institution’s appetite for business change and the options available for peering with education or public sector bodies.

In the cloud approach, a service provider delivers infrastructure, or a computing application, as a pre-packaged service to agreed service levels. That service provider may be a private sector provider, a peer education institution or a public sector agency. The service provider, rather than the end-user institution, is responsible for all aspects of delivering the service, signalling a fundamental shift in responsibility from the end-user institution to the managed service provider. In addition, cloud services use opex-based finance models which, in the future, will be available on a metered and billed-by-use basis. This signals a second fundamental shift in business models.

The above reasons highlight why Cloud must be considered to be a ‘business’ not ‘technology’ change and any adoption decisions should be fully endorsed by the senior management team.

The UK Government has adopted the US National Institute of Standards and Technology (NIST) definition of Cloud computing (the NIST standard)\(^6\). The NIST standard (detailed in the annex) provides an analysis of Cloud for potential implementers.

Cisco has drawn upon its experience of technology and the education sector to make the following recommendations. We believe that, in combination, they will provide for the structured deployment of technology, fully aligned to business requirements:

1. **Prepare the institution's business plan** with technology at its heart. This will highlight the role of technology in meeting key business requirements

2. **Prepare the supporting ICT strategy** using an architectural approach. This will uncover what technology is needed to meet business requirements, how it should be implemented, and the service and contract management needs

3. **Deploy the ICT service delivery platform** to provide end-to-end infrastructure (borderless campus, utility data centres, user device support, and layered security). This will create a strategic business asset for the institution

4. **Implement unified access** for BYOD and secure mobility support. This requires a robust identity management infrastructure to provide secure, policy-based access for students and academics, and allow students to use their chosen devices

5. **Introduce collaboration tools** to provide a rich mix of unified communications, real-time and Show and Share video, and collaboration technology. This will transform the student experience, support new ways of teaching and learning, support partnerships and research in more effective ways, and enable smart and mobile working for staff and students

6. **Investigate how to provide ICT more cost-effectively** through the use of cloud and managed service models, and shared services partnerships

These recommendations may be implemented sequentially, or in any combination that meets local conditions.
How Cisco can Help

Cisco has a long-standing track record of supplying ICT solutions for teaching, learning and research.

Cisco is ideally placed to support your future deployments and to help you maximise business benefit. There are a number of reasons for this:

**Leadership position:** Cisco is an acknowledged, long-term leader in the provision of networking, data centre, unified communications, video and collaboration technologies. Our end-to-end capability is reinforced by our security product portfolio for safeguarding ICT infrastructure and information.

Gartner places Cisco in the top right of many of its product and technology ‘magic quadrants.’ We interpret this as Gartner’s acknowledgement of Cisco’s vision and ability to execute across a range of key technologies.

**Architectural approach:** Cisco’s technology has been developed around three logical architectures. Each architecture comprises a structured blueprint and roadmaps that allow ICT function and performance to be increased at a pace that suits local conditions.

**Delivery partners:** Cisco does not contract directly in the education market, but works alongside established partners to support our customers. Cisco has long been credited as an outstanding example of how to operate a successful partner-centric business model. It offers our customers the benefit of Cisco’s reliable and innovative technology allied to the delivery and operational support strengths of our partners.

**Device and operating system agnostic:** Cisco recognises that we live in the post-PC era where academics, staff and students demand a BYOD approach. On most education networks, Apple now accounts for more devices than Windows, while Android is the dominant operating system for smartphones. The Cisco approach is to support secure mobility and BYOD, and provide full-function unified communications and video clients for most device types. The Cisco Jabber, Cisco WebEx and Cisco WebEx Social client applications are all available free of charge in the AppStore and Google Play.

**Cisco research and development:** Cisco invests $5.1bn per year in research and development. Of this, approximately $1bn is invested in collaboration and 25% of all investment is devoted to driving interoperability.

**Support from Cisco services:** Cisco has a long-standing tradition of working with institutions to deploy business- and education-led ICT solutions. Cisco’s consulting and services teams can help you create your business plan, develop your ICT strategy and deploy the technologies. Our Advisory Services Team provides business consulting; our Advanced Services Team provides design, build and operate services; and our Technical Services Team provides assistance and support services. We believe this combination offers a unique Cisco services proposition that can be positioned alongside our partners to specify, design, deliver and maintain even the most complex technology solutions.
Appendix – Further Information

This appendix provides links to further information on the Cisco technology solutions described earlier in this paper. It is structured around Cisco’s three logical architectures discussed earlier.

**Borderless Network Architecture**
http://www.cisco.com/go/bn

**Cisco EnergyWise Energy Management**
http://www.cisco.com/go/energywise

**Unified access: secure mobility and Bring Your Own Device (BYOD) support**

**One Unified Network – Cisco Catalyst 3850 Series Switches**

**One Policy – Cisco Identity Services Engine**

**One Management – Cisco Prime Infrastructure with Cisco Assurance Manager**

**Information and infrastructure security**

**Virtual desktop technology (VDI and VXi)**

**Data Centre Virtualisation Architecture**

**Cisco Unified Data Centre**
http://www.cisco.com/go/dc

**Unified Fabric – Cisco Nexus Family of Switches**
http://www.cisco.com/go/nexus

http://www.cisco.com/go/ucs

**Collaboration Architecture**
http://www.cisco.com/go/collaboration

**Unified Communications**
http://www.cisco.com/go/uc

**TelePresence**
http://www.cisco.com/go/telepresence

**The Capture–Transform–Share Video Solution**

**Capture: Cisco TelePresence Content Server**

**Transform: Cisco Media Experience Engine**

**Share: Cisco Show and Share**

**Smart and Connected Buildings**

**The NIST Cloud Model**