Technology Efficiencies and Opportunities for Universities

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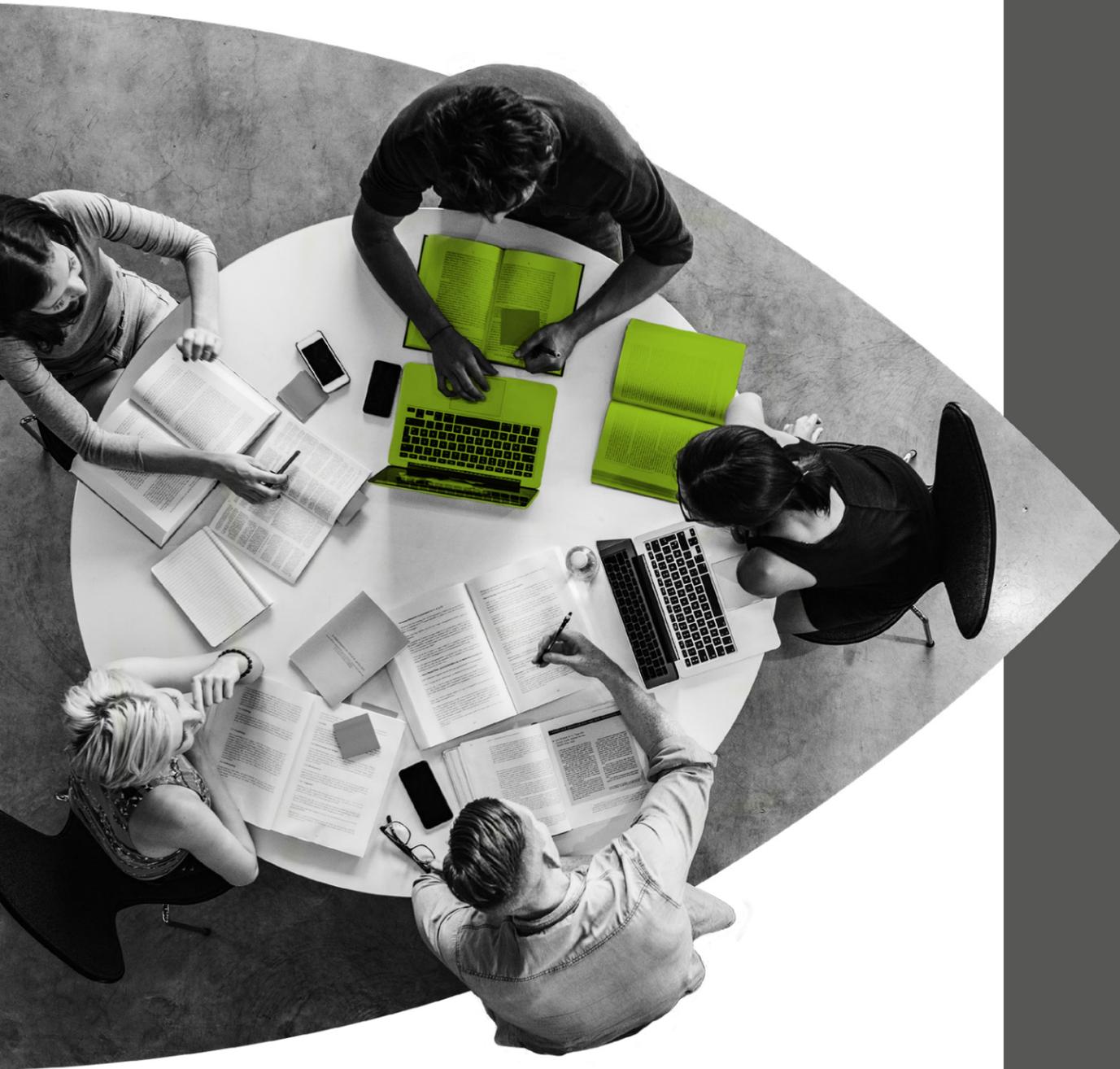
Executive summary

The higher education sector is at a crossroads. As the gateway between learning and working, universities play an important role in preparing students for what lies ahead.

But with approaches to learning changing, students and staff expect more. Traditional universities need to invest in different areas to attract and support learners and workers, today and tomorrow. As such, universities are relying more on technology and digital transformation for learning, operations, research, and collaboration. Even with global disruption and an evolving competitive landscape, technology can bring vast opportunities for the education sector and beyond. Investing in the right areas now is more important than ever, for long-term viability and success of the university sector.

This white paper covers key challenges and opportunities specific to the higher education community and navigates the roadmap to the future for universities. And, most importantly, it outlines the evolving role that the right technology plays, for students, staff, and the integrity of campus life.

Message from Pedro Faustino

Executive Sponsor of Axians Education and Research International Club

We have placed the digital transformation of society at the heart of Axians' mission. Transformation for the best.

We like digital transformation. In fact, we love it. And among all sectors of society, education is by far the one that has the greatest impact today and for the future of each community and country worldwide.

Higher education is at a turning point in digitalisation. It is accelerating and shifting due to the way we live, the way we work and what is expected by students and workers. But that doesn't mean it comes without challenges.

This white paper is more than just a list of innovative and efficient technology solutions. It focuses on the challenges facing the educational community, especially those with high impact, and helps summarise the role that it plays for students, staff, and campus infrastructure. We see this as an evolving document, as technology and society are in constant change.

At Axians we passionately address the challenges of digital transformation in education. Along this journey we have involved not only our most experienced colleagues but many external participants (customers, partners, educators and government officials, etc).

We hope it will be as useful and exciting for you as it has been for us.

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INTRODUCTION

A vision for education

The way we learn, teach and work is changing rapidly. Students and staff no longer want static, one-dimensional teaching and processes. They crave innovation, collaboration, and sustainable approaches.

There is no denying that the COVID-19 pandemic accelerated innovation and changed the way institutions now approach teaching, learning, working and research. While technology has played a growing and supporting role in student engagement and enabling teachers and administrative staff to take advantage of the very latest resources, it has now taken the lead role and provided many more opportunities for students, teachers and staff to succeed.

Innovation acceleration

For universities and other higher education institutions, the global pandemic resulted in huge disruption as campuses closed their physical doors, and institutions and students had to adapt quickly to remote working and virtual learning. Although a quicker shift than most were prepared for, it resulted in a positive step-change for the leading role that technology can play in the success of higher education evolution around the world. Technology is now crucial for lifelong learning and realising efficient ways of working.

But this swift change in approach, to support the drive for remote working and blended learning, requires a change in investment and mindset. New hardware, applications, connectivity, and networking capabilities are inevitably needed, along with stakeholder awareness and capacity of usage, to sustain new and secure learning approaches, ways of working and increase satisfaction on campus. This investment in innovation also requires a renewed focus on data and network security – to ensure the integrity of user and university data is sustained when accessing content and applications across a sprawling and increasingly complex network infrastructure.

Despite the challenges, students, teachers, and researchers expect the current momentum in technology investment and innovation to keep up with their growing desires for learning, teaching, and working.

"The blended approach to learning that universities are now adopting means they need to be able to deliver courses and content as effectively online as they used to do face-to-face, as well as preserving the campus experience that students value so much. Technology is key to this. Not only do universities need access to the systems and tools required to deliver learning in this way, but they also need high capacity, low latency, secure and scalable connectivity to cloud hosted services, online resources, partnerships and collaborations, and the internet at large. Without connectivity, teachers can't teach, learners can't learn, and researchers can't research. A university simply couldn't operate."

Neil Shewry, Deputy Director, Network Delivery, www.jisc.ac.uk

Increased competition

Strategic partnerships between universities and major platform providers will become crucial in the coming years, to safeguard the future of universities and help create opportunities to develop new learning approaches and flexible pathways. Higher education is no longer restricted to bricks and mortar environments. Students and staff are more aware of the doors that technology can open for them when it comes to online learning, in-class interaction and beyond. Universities now need to do even more to attract students and staff by offering innovative and flexible approaches to education, ways of working, and research.

Pre-pandemic figures suggested that e-learning would enjoy a compound annual growth rate of 7.5% to 10.5% between 2018 and 2024[2]. But in 2020 alone the global online education market grew by over 18%[3]. Therefore, the online learning market is likely to see absolute growth of about 110% by 2026[4]. If traditional universities were already playing catch-up, their online competitors are growing stronger and more relevant every day.

As a result of the pandemic, most universities confirmed that they have plans to explore new ways of teaching (92%) and enhance digital capacity (75%) beyond the crisis.
European University Association, 2020[1]

Resilience and agility will be vital if universities are to remain competitive and attract high calibre students and staff in the years to come. Customer and user experience are key to the success of every industry, and it's no different in the world of education. Figures from KPMG suggest that three-quarters (76%)[5] of higher education institutions are making 'customer centricity' a top or high priority.

This means that blended and flexible learning approaches to teaching are no longer perks or benefits, but a necessity for both students and staff. Facilitating 'lifelong learning' will be the new normal for universities.

"Universities today are not just home to full-time students, which means they need to offer flexible learning options. Students expect a pathway that suits their lifestyle. Distance and hybrid learning can support this and promote continued, lifelong learning. Once you have attracted students, you can retain them not just for the life of their course but for years to come. To achieve this requires a completely new business model and approach. As such, universities have been slow to adapt and take advantage of a huge, untapped potential."

Georgi Dimitrov, Head of Digital Education, European Commission

Lifelong learning definition

Fuelled by the dislocation of workers due to **automation** and new ways of working, demand will be high for upskilling, reskilling, and retraining. Some estimate that almost all growth in formal hours of learning within static populations will be with adult learners who are older than the typical graduate. Some universities may move towards a subscription model, whereby for a regular payment, people will have access to a range of programs, thus potentially keeping the loyalty of their students across their lifespan.

(Source: Future of higher education)

Next steps

As reinforced by the European Commission's Digital Education Action Plan (2021 – 2027)[6], the education sector needs to act now in response to the unprecedented shift to online learning and digital technologies. 95% of respondents to the open public consultation on the Action Plan considered the COVID-19 pandemic to mark a turning point for how digital technology is used in education and training.

But with only 39% of teachers in the EU[7] feeling well prepared for using digital technologies in their daily work, having the right infrastructure, connectivity and equipment in place will be key to making student, staff and researchers' needs a reality. Only then can the sector create a high-performing digital education ecosystem across Europe and reset education for the digital age.

"The role of digitalisation in education has increased dramatically over the past 24 months. As well as investment by member states, awareness of technology among students, parents and teachers has risen, creating a lot of political pressure. Digitalisation in education is knocking on the door of becoming mainstream. To support this, the sector needs to have the right infrastructure in place to ensure people not only have the access and connectivity they need, but the right equipment. Alongside infrastructure considerations, teachers and educators need to be armed with the appropriate digital skills and competencies."

Georgi Dimitrov, Head of Digital Education, European Commission

To support universities as they navigate their next steps, this white paper looks at the evolving role that technology will play for students and staff – from admin through to lecturers and researchers – and the impact of growing expectations on campus infrastructure. How can universities balance student and staff success with the challenge of systems and applications security?

As well as learning approaches, how can efficient buildings and learning environments fuel success? How can technology support blended learning and the virtual hybrid campus of the future? Finally, we look at the role played by infrastructure and availability in supporting the university ideal and what key components are needed to ease the agility and resilience needed now and in the future.

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SECTION ONE
Disrupting education

Empowering students and staff through innovative IT

The way students learn is driven by the need for teaching to continue in the new worldwide context – whether that is inside or outside of the campus. Students don't want a 'one-size-fits-all' experience; they want options and choices. According to recent research from Jisc[8], this includes providing a blend of activities, learning in more manageable chunks and more interactivity including quizzes and video support. It's up to universities to embrace this and support lifelong learning or risk missing the grade.

"For students, the university 'experience' is paramount, and they just want to be connected. Whatever they're doing, wherever they are and whatever device they can get their hands on. Much like water and electricity, connectivity is seen as a utility and its absence, or underperformance, can not only affect learning, but also the overall experience of students attending university."

Neil Shewry, Deputy Director, Network Delivery, www.jisc.ac.uk

The right technology provision and support underpins this ability to keep up. The only way universities can provide the choice and flexibility craved by students and staff is through understanding what they want and then investing in the right innovations to support this.

"High numbers of learners reported engaging in live sessions, some of which were described as engaging and helpful in promoting discussion. Fewer students said they had engaged in some of the more collaborative online activities. As more staff engage with online learning it is expected that models and practice will develop to include more participative activities."

Jisc, Learner digital experience insights survey 2020/21, UK further education (FE) survey findings, September 2021

Differing needs and opportunities
The pace of digitalisation within the university sector is only going to continue, as users realise the benefits it can bring to every aspect of their lives. For students, it provides the ability to learn in ways that suit them and can be tailored to their individual needs.

For teaching staff, technology doesn't just support but is embedded in how students learn new skills. We have seen this with the introduction of robots in dental schools[9] for training, which enable pre and post graduate students to forge successful careers with access to the very latest innovations. New York University College of Dentistry (NYU Dentistry) was an early adopter when it acquired two surgical robotic devices for dental implant surgeries. These devices provided students with the opportunity to use state-of-the-art, precision technology to enhance clinical practises and patient care.

Automation and **artificial intelligence (AI)** capabilities, for example, also mean that teachers can spend less time on administrative and preparation tasks and more time making learning engaging and tailored for their students. AI and data analytics also help staff to plan more effectively and make best use of often limited resources.

For researchers, technology provides them with the ability to be agile and scale their work, as well as compete with the very best minds across the globe. And for those tasked with keeping everything running and overseeing university operations, technology has a huge role to play in supporting campus efficiencies, providing **business intelligence (BI)** insights, and even improving physical security on campus. Specific examples follow later in the paper.

With so many possibilities it can be difficult for institutions to see where best to spend their budgets and what investments will give them and their students the optimum returns. To help universities prioritise and future-proof their IT strategy, we've identified some key areas where technology will have the most impact and help meet both current and future demand.

"Digitalisation is key to differentiation. Your competitors are now even closer, and students' eyes have been opened to the value of technology in their educational journey. The development of 'stackable provision' in higher education will see more people accepting that there are alternatives to learning beyond the classic route. Technology provision needs to be fit for not only 2022 but the next decade, to support staff and students to succeed."

"It is important for institutions to take a holistic and macro approach to digitalisation, focusing on connectivity, equipment and skills. With demand for capacity and bandwidth continuing to grow, investment in the right infrastructure, equipment and networks now will be vital. To support any change there also needs to be a focus on reskilling and upskilling, so that teachers and educators have the competencies needed to teach in new, hybrid environments."

Georgi Dimitrov, Head of Digital Education, European Commission

Personalised learning
Every individual, even if they are studying the same course, has different needs, goals, and aspirations. As such, learning approaches need to be tailored to each person, to create a unique experience.

But to take this vital step, universities need to understand more about their students. This goes beyond basic data about individuals held in management systems and applications. For the right learning journey to be created, innovative AI-powered technology is needed to understand students in detail, including their motivations and how they want to learn – as well as identifying any gaps in their learning. Only then can universities set students and themselves up for success.

Once they have this insight it can open doors to create tailor-made resources that will engage and inspire students. One such example is gamification and immersive applications. This has been happening in the business world for many years with great effect on e-learning courses, bringing content to life for attendees. It might not yet be a mainstream way of teaching within a university setting but has a lot to offer in tailoring learning according to different needs.

"We need to constantly learn throughout our lives, so the journey must be increasingly personalised and customised, according to our own individual interests."

Patricia Teixeira Lopes, Associate Dean of Porto Business School, (in Digital Labs, an initiative of Portugal Digital Awards promoted by IDC in partnership with Axians)

Reskilling and lifelong learning

As well as ensuring students and teachers have the best tools and platforms to help them succeed, businesses expect the next generation to be equipped with the right level of tech competencies to help close the skills gap and support the current reskilling revolution. Universities have a crucial role to play in supporting lifelong learning for students and ensuring they are what the workplace of the future is looking for. Technology has changed the employment landscape in many ways and has a huge impact on the skills that workers need to support business growth and success.

> A report from the European Commission[10] found that almost half the EU population lacks basic digital skills, with around 20% having no or almost no digital skills at all. Approximately 40% of employers are struggling to fill their job vacancies due to a lack of necessary skills, while 30% of graduates are working in a job where the competencies they acquired at university are not required. This skills gap could threaten the stability of the labour market as well as the ability of the industry to innovate. Providing the right tools and competencies now is vital.

According to Pedro Santa Clara, Director at 42 Lisboa, higher education is still an assembly line of classes and exams. It's not inclusive or preparing students for the future by promoting creativity, ownership, leadership, or lifelong learning.

42 Lisboa develops project-based learning with a foundation of peer-to-peer interactions, which it believes bring a much better pedagogical experience for learners such as analytical thinking, solving complex problems, being critical in terms of creativity, originality and taking initiative. Students have ownership of their learning process.

> "The world is changing. Businesses and employers expect different skills and tools from workers which traditional forms of schooling don't always provide.
>
> Companies have tools to filter applicants and recognise talent, attitudes, and knowledge of the candidates. Technology needs to serve pedagogy, not the other way around," suggests Pedro Santa Clara.

Student capture and retention

Technology innovation also has a huge role to play in understanding student needs and underpinning key decisions. Data analysis is becoming more important for universities to retain and attract new students – insights that can be gained and acted upon through BI and analytics tools. Understanding how students use technology and engage with the physical campus will enable university leaders to make informed decisions and changes when it comes to provisions and operational efficiencies.

As-a-service as an enabler

Students (and consumers) are already familiar with subscription-based purchasing when it comes to consuming and creating content. For universities, the equivalent 'as-a-service' model provides the scope to react quickly when needed, to adopt new applications or programs. (We will explore this further, later in the paper).

Costs can be managed effectively by paying for services on a day-to-day basis through an **Opex**-based approach, rather than investing one-off sums upfront via a **Capex** model.

'Software-as-a-Service' is one example of this, where a specific need is managed by a third party and paid for in increments. Digital exams are a case in point. Managed by an external provider, they can offer a flexible and automated way for educational institutions to run exams through an as-a-service model. From preparing and setting up the exam, to the assessment and complaints handling, universities can have the reassurance that exams are conducted by experts, transparently and according to the rules.

If something deviates, the institution is alerted, which prevents any risk of cheating or undermining the integrity of the process. Exams can be made available to exam candidates automatically, manageably, and securely with results and relevant data stored centrally.

> "In general, digitisation has made great strides in teaching during the pandemic - for example, with IT-supported exams, using exam servers and multiple choice tests. If these were considered a makeshift aid during the pandemic (with problems of cheating, for instance, understood as an issue), they are now considered in a different form - with things such as digital check-in rooms at the university seen as a 'quick win'. Now, these 'quick wins' need to be identified and taken into regular operation."
>
> *Michael Redinger, Head of IT, University of Innsbruck*

Blended approaches to teaching

Online learning and teaching options have opened up significantly for universities over the past few years, putting pressure on institutions to take the plunge in overhauling their current Learning Management Systems (LMS) for a more blended approach.

The likes of Zoom and Microsoft Teams have worked alongside face-to-face learning out of necessity, but the application and flexibility that it has provided is a positive by-product. As cited in a recent Gartner report[11], workplace collaboration tools have complemented rather than conflicted with the LMS, to provide enhanced learning experiences. It's now up to higher education CIOs and learning experts to guide their institutions in the appropriate use of these tools and the LMS, to build better learning practises and support student skills development.

For example, FCCN – the scientific computing unit of the Foundation for Science and Technology (FCT) – works with the higher education sector in Portugal to support the adoption of technology and help institutions reap the benefits. Services like Colibri (web conferencing), Educast (lecture recording), Videocast (live streaming), Video Studio (audiovisual content production), and Nau (**MOOC** platform) are services that might help to modernise the way that universities interact and collaborate remotely.

These platforms simplify the way people teach and learn, through synchronous and asynchronous activities. Through these types of services, FCCN provides the right tools that allow universities to embrace different education models and prepares higher education institutions with virtual and hybrid educational environments that can work seamlessly with traditional educational approaches.

Research opportunities and challenges

A significant beneficiary of technology innovation is the university research department. High Performance Computing (HPC) facilities, advances in **big data** analytics and data processing techniques to name just a few, have enabled institutions to remain competitive and agile when it comes to conducting world-class research.

But alongside the opportunities there are also risks, especially when it comes to cloud-based services and storage. Any breach of intellectual property can have a potentially damaging impact on a university, and data in the cloud can also take longer to compute. Many universities are also reluctant to move to cloud-based services due to the confidential nature of the data they are creating and processing. This is especially true for research entities.

They operate in a complex landscape[12] and need to maintain the confidentiality of data as well as integrity when sharing it. As such, protection, control, and management of data are key considerations for research communities worldwide and have a bearing on how they approach cloud and **on-premise** solutions.

"In recent years, IT systems have become an integral part of almost all research areas - from carrying out research, to storing data and publishing. We see three trends here:

1. The necessary IT skills are almost always available, especially among young researchers. But you need support with the implementation. This includes both the provision of resources and training in specific sub-areas, such as in research documentation or **automation**. Here, IT is getting closer and closer to providing content support for research.

2. In many cases, support means providing the necessary infrastructure - from large data memories and self-service virtual machines through to the provision of additional digital infrastructure, such as research data repositories and electronic lab notebooks.

3. A major topic is possibilities for digital collaboration between researchers: from enabling content-related collaboration, through to appropriate options in the software products used in electronic lab notebooks, for example, and general exchange of data to generic collaboration systems.

This leads to a massive increase in research requirements. Since research is often a very agile, innovative process, the requirements change very often and quickly. This results in completely new demands on IT for the flexible and fast provision of resources - and for a high degree of automation and scalability of the IT infrastructure."

Michael Redinger, Head of IT, University of Innsbruck
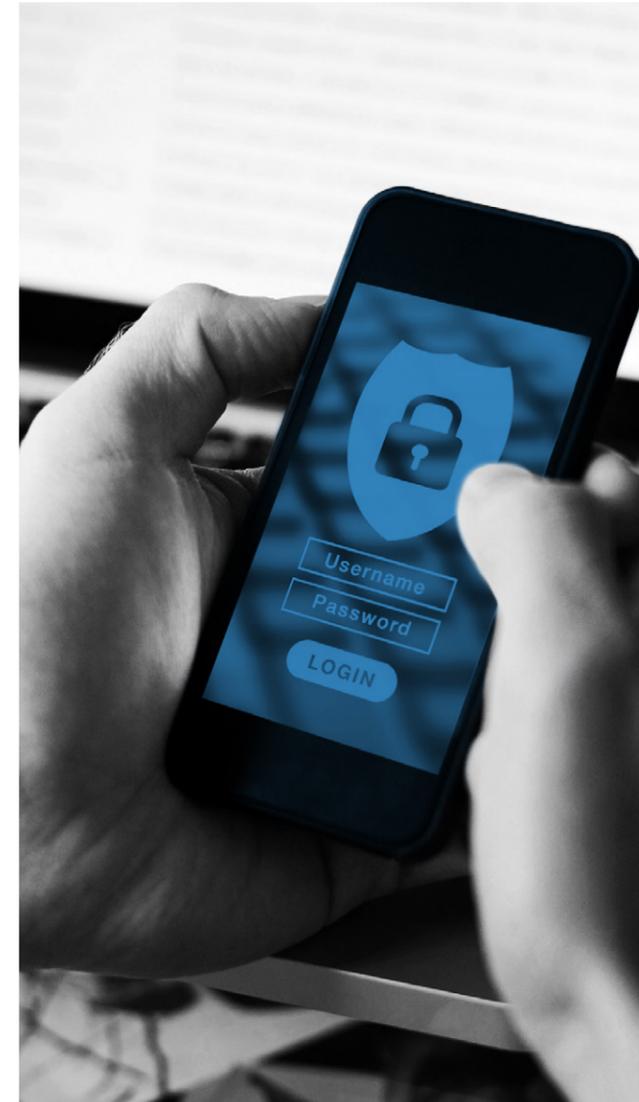
The challenges of supporting choice and maintaining security

To make these and other new learning approaches a reality, universities will need to mainly prioritise four key considerations when it comes to technology deployment:

- Security of the network, data, and people

- Bandwidth and capacity

- Affordable, sustainable and flexible investment

- Awareness levels of users and decision makers

These four areas have certainly been put to the test in recent years, with existing infrastructures and resources stretched to their limits. However, one particular issue which underpins any investment in digital transformation is that of security and how universities can meet everyone's needs safely and securely.

A spotlight on security

We have already discussed the conflicting views within the field of research and there have been countless examples of where university data has been breached over the years to validate these concerns. Unfortunately, universities will always be a target for cyber threats due to the valuable nature of the data they hold. This includes personally identifiable information of thousands of students and staff, confidential research data, and other valuable assets. Medical schools have also become growing targets in recent years, particularly in the race for vaccines and other competitive scenarios.

In addition to external threats, the explosion of devices connected to the network, increased remote access and different levels of security awareness and maturity among all users of the network, have seen the risks and points of vulnerability remain high for all institutions. According to figures from Microsoft, education is by far the top industry affected by **malware** attacks.

Whether it's a **phishing** or **DDoS** attack, any data breach or inability to access systems will have huge financial, reputational and trust consequences. Lack of budgets to devote to security and overcoming legacy technology constraints will always be barriers to reducing risks. But as digital transformation continues to grow, so too must security considerations. A reactive stance needs to be replaced with a proactive approach, where all users are aware of and remain vigilant to constantly evolving **social engineering** tactics. Educating and raising awareness levels of all users to the potential security risks is vital.

Getting buy-in to security early on is crucial. This can be achieved through building a business case and measurable KPIs, making senior stakeholders aware of the potential consequences of not having this particular insurance policy in place. With limited budgets, universities need to prioritise investments. Safeguarding the perimeter infrastructure is crucial to securing data, applications, and the network from growing threats. Deploying identity and network management controls is the first important step in making systems 'secure by design' and not just an afterthought.

"Like many other businesses, universities are in deep digital transformation processes exposing themselves to cyberattacks, such as recent cases we have seen in the Iberian Peninsula. This implies an urgent reinforcement on universities' cybersecurity skills and teams, to protect themselves and avoid business disruption. These teams must ensure an increased level of monitoring to respond quickly to attacks and report other vulnerabilities in their network and services."

Nelson Schäller Dias, Head of Multimedia Services, FCCN

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SECTION TWO

Smart buildings and learning environments

So, how does technology investment affect the physical campus of today and tomorrow? Achieving efficiencies and engagement through technology isn't just reserved for learning, teaching or research, but includes the built environment. As universities battle with budget allocations and operational efficiencies, technology has so much to offer in terms of enhancing learning environments, supporting sustainable efforts, and building performance, through supplying a deeper understanding of the entire student population.

Universities need to adapt - and quickly - to ensure that the virtual hybrid campus of today is an important part of campus plans moving forward. This will put a key focus on buildings and the role of the physical campus. Will teaching spaces change? How will buildings be used in the future?

Smart buildings will become more crucial than ever, to help universities remain relevant to students and manage the changing dynamics of current campus life. Students want the flexibility to learn in person or virtually, meaning that a blended or hybrid learning approach will become the reality.

However, there is no replacement for campus life and, even though many courses and interactions can be done online, we shouldn't overlook the advantage of an environment focussed on learning. Whilst distance learning is good for those needing to minimise travel, it's no replacement for an academic environment.

As a coding school, 42 Lisboa relies on technology and facilitates remote learning, but its students are still mostly present on site. They can work anywhere they want but have the choice to be physically present. According to Pedro Santa Clara, the most important thing for a campus is to be designed to maximise interaction among people:

"Make sure it's a place where people want to be and where they can meet others. Traditional, formulaic classroom environments don't encourage creativity or interaction between peers or colleagues," he says.

Supporting sustainability
With a blended approach, physical locations will need to become more sustainable and developing a 'green university' is of huge importance. Although the concept is not new, it has certainly been put in the spotlight in recent years, reinforcing how campus and university life needs to adapt to sustainable ideals and wider **Sustainable Development Goals (SDGs)** across the globe.

The Green Office Model is just one such initiative championing universities to set up a sustainable approach, providing students with guidance on those institutions who are making the change. Student expectations of universities' environmental obligations play a key part here, with the younger generations much more environmentally aware and conscious.

The case for a 'smart campus'
Evolving into a smart campus is the next logical step for universities who want to ensure that data gathered from connected devices can inform decisions and meet efficiency and sustainability goals. All whilst enhancing learning and working capabilities for everyone.

Indeed, a smart campus can be compared to a small scale smart city with the same principles of utilising internet connected devices to govern resources and optimise the user experience. Due to the specific location of a university campus, a continuity of technology can be achieved to create a smart campus model. The desirability of the smart campus for university boards is twofold, it can save money and improve the experience of the education community.

Whilst many universities have embraced the concept across the globe, it is still seen as futuristic and expensive for others. The principle is simple: to collect data on the operation and use of the building to optimise use, improve the experience of occupants, and better manage resources (including energy and space). Value can be realised by a number of stakeholders including professors and researchers, students, visitors, administration staff, and building operators.

However, data gathering and managing the movement of people can lead to objections in relation to privacy and ethics. But if data is anonymised, or you give students the chance to reduce their carbon footprint, buy-in across the board is more likely.

The right data can also help manage spaces more effectively, improve travel times, decrease operational costs (including waste management, lights, grounds maintenance), improve transport infrastructures and much more – just by knowing how many people are where at any one time. This also provides universities with the chance to interact with users to improve their experience, keep them safe and increase all-round wellbeing.

For example, the use of **IoT** and sensors with the right technology infrastructure behind them can help monitor air quality and alert to any toxic substances. More testing is also underway on environmental technology to provide safer, healthier spaces to reduce the spread of airborne viruses.

Energy and power consumption typically forms a significant part of operational spend[13], with lighting, ventilation and cooling systems consuming the most electricity. Estimates from the US suggest that a typical higher-education building of around 5,000 m^2 consumes more than 90,000 euros worth of energy each year. Optimising operational efficiency, and knowing what spaces are being used and when plays a key part in reducing costs and achieving goals through the smart campus environment.

While the opportunities are numerous, there are still challenges to achieving a truly digital campus – namely obsolescence of old technology and the robustness of the infrastructure to keep up with future scalability.

The role of automation on cost saving
Underpinning the smart campus and the most effective way to optimise efficiencies is through **automation**. For example, while traditionally, the estates manager would handle heating and lighting, an automated approach means that this can be controlled and optimised through IoT devices managed by the IT team. Having exact insights and data around usage can help significantly reduce costs.

Congestion around campus and attendance monitoring is another area that can be automated, using sensors to supply insightful data about peak usage, rather than relying on manual processes. Every area of campus life that has an impact on cost and resources can be automated – from signage and library systems to exams and lecture attendance – and all can lead to operational efficiency gains and provide scope for innovation.

But despite the opportunities, it's important to start small and review the best fit areas to reap the benefits. Where are staff spending unnecessary time and resources? Where could **automation** add value? IT and estates teams need to work together to ensure the best outcomes and that the necessary steps are put in place to automate key parts of campus life. Only then will universities have the necessary resources to focus on increasing innovation and attractiveness of their offering for students and staff, for years to come.[14]

Realising learning efficiencies

While smart buildings and automation can have a significant impact on energy and spending efficiencies, the smart campus is also vital for supporting the new blended learning environment and enhancing the student experience.

Safe and reliable network connectivity is the foundation from which universities can offer a variety of options to support learning experiences. This doesn't just mean flexible and online learning; connected lecture theatres with reliable multi-media and collaboration capabilities, intelligent booking systems, access to real-time information about resources and room availability all make for a seamless and stress-free experience whether on or off campus.

Spotlight on location intelligence

Location Intelligence (LI) solutions are set to become hugely important for universities within the blended learning environment. Typically, the domain of planners or those looking to assess the feasibility of sites for new buildings, spatial data analysis can work on many levels in a university setting. Adoption within education is still in its infancy, but the value of location intelligence could set institutions apart from their competitors by using location data to optimise student and staff recruitment and retention.

Understanding what's going on both inside and outside of campus buildings will provide a much clearer picture of foot traffic and what areas of the site are busy or quiet and at what times. This is not only important for student and staff navigation, but for operations and facilities management teams to support the maintenance of classrooms, optimise cleaning, ensure the right levels of security, general campus maintenance efficiencies, and of course to realise building efficiencies. Where do lights need to be on? What can be automated? Where is the Wi-Fi under most strain? Not only will this support current needs but provide data and insights on which to make predictions for the future of building use and efficiencies.

In addition to understanding what's happening on campus, location intelligence solutions can also support universities to understand where they are attracting students from. Through visual mapping, different data layers can provide granular details of the student population to show what towns and villages they come from, the age ranges, etc. This will help universities better understand where more efforts need to be made to attract students from different locations or backgrounds to ensure they are appealing to a wide and captive audience.

Overcoming challenges to the smart campus reality

Smart buildings and the potential to streamline efficiencies across the board do however bring some challenges. With most universities bound by strict budgets, building a business case for longer term investment – however compelling the future efficiencies might be – is not easy. Universities typically focus on short-term investment so any heavy investment in technology and innovation might not be seen as economically feasible. This is where a subscription-based approach to technology provision could help to get buy-in, as there are no large up front costs.

Universities across the globe are also steeped in history and often home to impressive buildings and landmarks making the switch to a smart campus a difficult one. Old buildings and campus layouts can be against IT teams as they endeavour to ensure connectivity is reliable and secure, no matter where you are on site. Solutions exist to ensure a robust network can be developed on any site, but this will likely have an impact on cost and resources to make it happen.

There is also a potential impact on the aesthetic of the environment to consider, with universities cautious about making wholescale changes that might affect the look and feel of a campus. Getting the balance right between innovation and respecting heritage is crucial.

Central to the challenges facing universities in embracing the smart campus is security considerations and concerns. The more **IoT** devices connected to the network, the more points of vulnerability for cybercriminals to take advantage of user error. This can have a huge impact on the security of the entire network. To alleviate this, security must underpin every network connection, application, and policy, to ensure that any risks are minimised.

Embracing the smart campus ideals is a sensible move for universities, to future-proof their investment and remain agile and flexible to changing needs. Increased insights gained through data and deeper analysis will also ensure that institutions can remain competitive and relevant for learners at all stages of their journey.

"During the pandemic, universities showed their strength and will to change fast and readapt to new models of remote work, teaching and learning. We still have a big path in our way, but technology played a crucial part in keeping us teaching and learning remotely across the country during these difficult times.

But we cannot forget a structural problem: access inequalities. They still exist. Institutions are going through a massive transition to digital solutions when not all students have technological resources yet. Above all, education is a universal right. More than technology, we need to be focused on people, and educate and prepare students, teachers and staff on how they use the technology. We need to be prepared for these new educational models based on distance learning, virtual learning environments, hybrid classrooms, cross-communication inside and outside of campus.

To be prepared for this new reality we must create better multidisciplinary teams. Also, dedicated distance learning departments with know-how and different skills in design, video and multimedia, and instructional design. It is critical to build support teams to work closely with teachers and students and help them adopt the best tools and services for their needs during the early stage of technology adoption.

This raises a lot of opportunities but also challenges with increased global competition between universities and quality content."

Nelson Schäller Dias, Head of Multimedia Services, FCCN

SECTION THREE

The technology behind operational and process efficiencies

We have highlighted the numerous benefits that technology can offer students and all stakeholders within the higher education sector. But the success of blended learning and teaching, streaming of lectures, remote access, and collaboration – and beyond – rests on infrastructures and processes being robust and reliable.

"Universities need to build for the future, it's as simple as that. If you think you need a certain capacity in your network now, build something capable of delivering 10 times that. If you think you need a certain level of security for your infrastructure and systems, build something that's twice as secure. The cost of change can be so great that it's often better value to invest up front, rather than piecemeal over a period of time. But even then, you still have to keep investing to keep up with technology evolution and demand."

Neil Shewry, Deputy Director, Network Delivery, www.jisc.ac.uk

Universities need to ensure that content and library systems are always available and accessible; that lecture capture and streaming is effective; that all staff and professional services departments can carry out their jobs without hindrance. For those universities carrying out research, they need uninterrupted access to systems, high performance computing power and collaboration platforms.

For many institutions, facilitating this type of environment means replacing or augmenting remote access systems which can bring challenges for security. Network vulnerability increases, with more people connecting their own devices, and a growing focus on remote teaching widens the window for cyberattacks, among other things. Indeed, figures suggest that **ransomware** attacks targeting universities have doubled over the past year[15]. However, on the flip side remote working opens up the geographical footprint of the university, which could in turn support it financially by making it more competitive and enhancing brand reputation.

Mobilising staff, who may have traditionally used desktop machines, can also be a pain point for universities when looking to drive efficiencies. To make any digital transformation project a success requires effective change management, to ensure all users understand the benefits and their role in the process. If not prepared for change, this disruption and any future requirements will put a huge strain on IT systems. Quite simply, if the underlying infrastructure and support are not there, any technology investments and subsequent efficiencies will fail.

"The leadership of the university plays a big part in the level of adoption and speed of digitalisation. We often see regulatory and geographical burdens become a barrier to technology take-up, as well as budgetary constraints. Although there is systematic underfunding in specific areas and institutions across Europe, it is often a lack of prioritisation rather than an issue of funding that can stall investment. There is a lot that the university sector can learn from different industries when it comes to digital transformation and understanding the best approach and how to get buy-in from the board."

"Certain disciplines have traditionally been better at capitalising on technology to enhance learning and engage students and teachers, such as engineering and computer linguistics. But other areas including humanities and the arts are starting to see the value of technology and how the user can benefit."

Georgi Dimitrov, Head of Digital Education, European Commission

For a university to be efficient and remain competitive, it needs a reliable and secure modern network.

Key components of a modern network

1. **Availability and agility**
   Users at all levels expect systems and technology to just work. Availability underpins everything. The network must be able to cope and have the capacity to keep up. Downtime will not be tolerated and could have a significant impact on the progress of teaching and research. University systems also need to be agile and flexible to deal with unpredictable and evolving user requirements.

2. **Scalability and cost efficiency**
   Agility and responsiveness go hand-in-hand with scalability. Technology provision and user demands for new services and ways of working will only continue to grow[16]. As such, any changes to the underlying IT network need to be made with future-proofing in mind. If the pandemic has taught us anything it is to be prepared and remain resilient in the face of uncertainty. Having systems in place that are scalable will mean universities can flex and change services as required without unnecessary upheaval or costs.

3. **Security by design**
   We touched upon the relevance of security earlier in the paper, and how it underpins all efficiencies within the modern network. We live in an 'on-demand' world, and everyone wants to be able to access what they want, when they want, from wherever they are and on a device that suits them. Ten years ago, IT networks were under capacity and had limited Wi-Fi coverage. Today coverage needs to be everywhere. Capacity is less of an issue but, with sprawling connections and hybrid infrastructures, ensuring the security of users, applications and the network is the biggest challenge.

   As a result, security needs to be an integral part of any IT system and 'by design', not an add-on. The network is key to smooth and successful operations, so its security is paramount. Recent acceleration of innovation resulted in many universities losing control over their technology landscape with students and staff turning to 'shadow IT' (installing their applications that are not approved or controlled by the institution's IT department) to access content.

   Securing data and personal information needs to be high on the priority list for every institution, as the number of connected devices increases and ensuring accessibility for all becomes a key focus. As more services are accessed remotely, a robust and common policy for connecting users to applications, whether **cloud**-based or in the data centre, is also vital to safeguard individuals and the integrity of university systems.

The 'as-a-service' approach

As highlighted earlier in the paper, subscription-based models make flexible technology and security provision much more viable. For universities with limited resources and budgets, taking an 'as-a-service' approach (XaaS) can not only make upgrading systems financially achievable through an **Opex**-based model but also provide much needed third-party skills and expertise through managed services offerings, to further future-proof systems and ensure efficiencies are realised with every investment.

XaaS definition

Everything-as-a-Service (XaaS) is a collective term that refers to the delivery of 'anything as-a-service'. It recognises the vast number of products, tools, functionalities, and platforms that vendors, service providers and integrators now deliver to (IT) users as-a-service over a network – typically the internet – in a pay-per-use format.

The as-a-service model will be an important consideration for universities, as they look to provide the breadth of technology required now and in the future. While there are a number of such models on the market (including SaaS as covered earlier), we have defined two key offers that can provide significant value to universities:

1. **Infrastructure-as-a-Service (IaaS)**

2. **Network-as-a-Service (Naas)**

IaaS definition

A standardised, highly automated offering in which computing resources owned by a service provider, complemented by storage and networking capabilities, are offered to customers on demand. Resources are scalable and elastic in near real-time and metered by use. Self-service interfaces, including an API and a graphical user interface (GUI), are exposed directly to customers. Resources may be single-tenant or multi-tenant and are hosted by the service provider or **on-premise** in a customer's data centre.

NaaS definition

Through a scalable, pay-per-use subscription model, Network-as-a-Service (NaaS) delivers the latest enterprise networking technology, end-to-end components, 365/24/7 technical support and lifecycle management to create a fast, smooth, online user experience.

The ability to scale technology resources on-demand and leave the responsibility of day-to-day operations and service improvements with the provider means that university IT teams can focus on what's important – realising innovation and efficiency. As-a-service offerings make it cheaper to expand the IT network because there are no investments in assets or additional maintenance or management costs.

The role of cloud

Underpinning efficiency achievements and the 'as-a-service' approach requires embracing the **cloud**. With the speed of change a challenge for universities, adopting cloud-based services is often the only way to rapidly enable applications and communications, and also ensure the security and success of new learning approaches. Indeed, taking a 'cloud now' approach has been highlighted by Gartner, as one of the top technology trends impacting the higher education sector in 2021, due to the urgency and pace of technology change.

What can cloud computing and services offer institutions?

- **Infinite computing** — Cloud presents the ability to scale service and pay-as-you-go or the end of finite computing that relies on sized machines in the data centre

- **Next generation technologies** — Cloud provides the foundation to build and deliver the next layer of technology that meets business needs including SaaS applications; **AI**; **Business Intelligence (BI)**; CRM; **IoT** solutions; state-of-the-art security

- **Enterprise acceleration** — Technology and software are critical to enterprise and organisational success. The speed of the technology used dictates the pace at which change can be achieved. Thus, technology and architecture are critical to spawning successful transformation

Source: Gartner, Top Technology Trends Impacting Higher Education in 2021 www.gartner.com
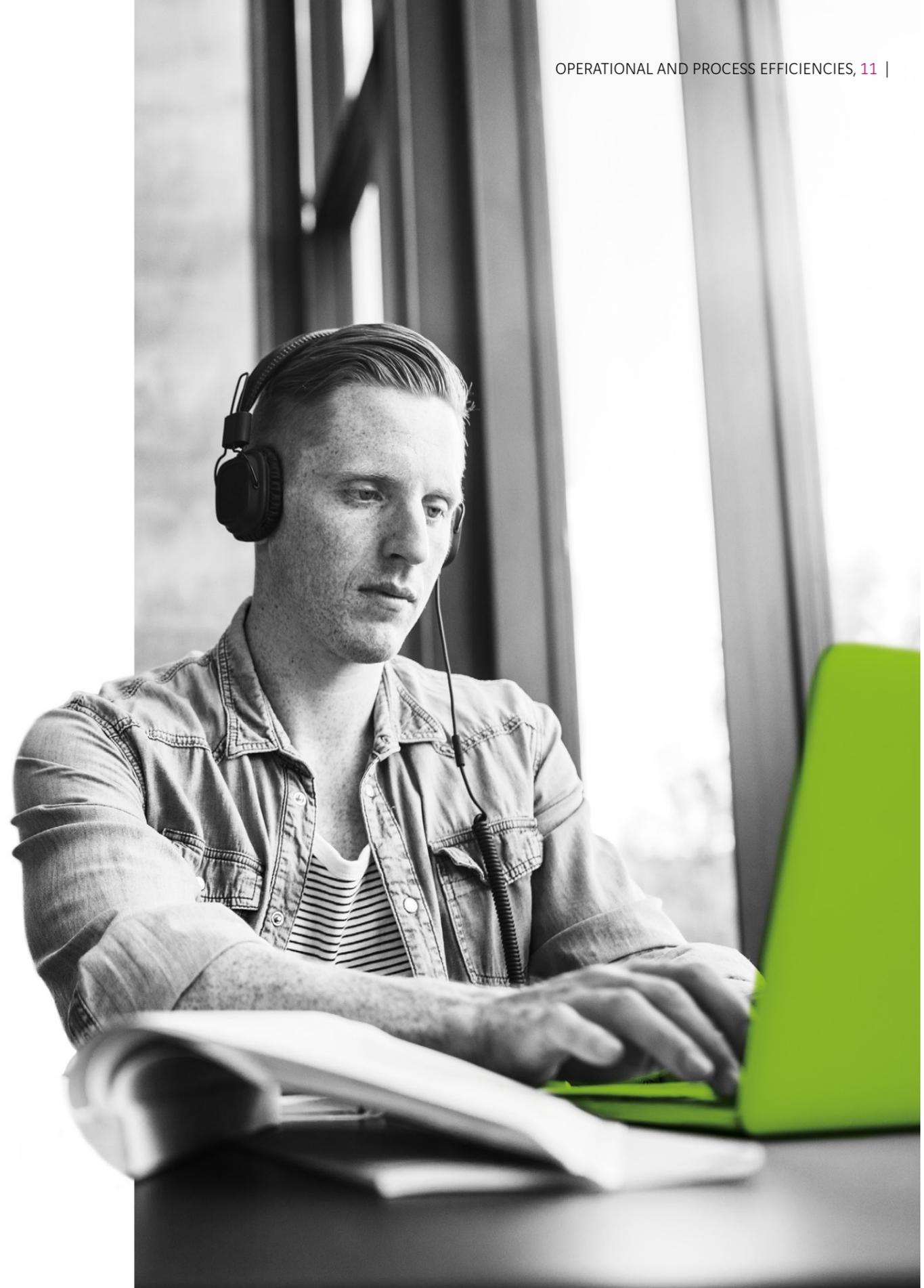
However, for many universities questions around control and confidentiality of personal and institutional data still hamper take-up of **cloud** solutions. This is especially true for research facilities that remain cautious when it comes to putting everything into the cloud and potentially risk reputational damage if data is breached, as previously discussed.

This is also true, when we deep dive into the complexity of cloud pricing, as well as lack of governance and policies to keep costs under control or insufficient visibility into cloud resources and activities. With universities under strict and controlled budgets – especially public ones – allocating funds efficiently is key.

In this scenario, a hybrid cloud approach might be the best option to get the balance right between efficiency and control. Using a mix of public and private cloud means that data can be kept **on-premise** for greater control, with the option to scale and use additional resources in the public cloud when internal capacity limits are reached.

Another point to consider about the role of cloud computing in education is its dependence on Internet Service Providers (ISPs). Reliance on internet access is fundamental for successful online learning, and service outages or poor bandwidth can detract from it. Also, typically it isn't easy to switch between service providers so choosing the right vendor for university needs in the long term is essential to create a trustful relationship. Nevertheless, whatever the chosen route, putting in place a 'cloud trust' strategy will definitely accelerate the approach and give educational institutions a better response for their current environments.

"The greatest challenge that overlaps all business areas is a shortage of IT workers. This is particularly noticeable in the public sector and means that projects cannot be implemented as planned. This labour shortage also means that increasingly cloud services are being used and that dependencies on large commercial providers arise."

Michael Redinger, Head of IT, University of Innsbruck

Tools to enable efficiencies

Automating systems and finding new ways to manage IT infrastructures will be key to achieving efficiencies and taking the strain off overstretched IT teams.

For example, as more users connect their own devices and applications to the campus or remote university network, there is more need for a reliable, secure, and personalised experience. AI connected devices need to perform optimally without increasing access management for the IT operations team or affecting the reliability of the network. In this scenario, automated workflows, informed by **AI**-driven insight and Machine Learning (ML), mean that operational efficiencies can be truly streamlined.

One of the areas where AI has made significant inroads over the past year is in the form of chatbots. In 2020, Gartner[17] predicted that AI would accelerate the adoption of analytics within higher education and enhance its impact. In Gartner's 2020 CIO survey, 16% of respondents reported that they had invested in AI chatbots. A year later that figure had almost doubled to 30%[18]. According to Gartner's Top Technology Trends Impacting Higher Education in 2021 report, "Chatbots have reached an adoption inflection point in higher education where it soon will be one of many expected 'multi experience' interaction channels for students, faculty and staff. Already, chatbots are becoming a 'cost of entry' for baseline student experience."

This is just one example of how AI can help universities improve operational efficiencies, through intelligent machine learning and **automation** of processes. A modern campus network that enables AI-driven Wi-Fi, for example as the University of Reading has done, is a way to standardise and simplify IT that in turn provides value to the students. With the right cloud architecture combined with machine learning and AI, you can transform the student experience. For example, access control for students and staff with automated recognition, apps that greet a student when they arrive at a specific location, or other location services that help them navigate their way around campus. The possibilities to tailor to the needs of the individual university and student are almost endless.

Challenges to achieving success

Demands and needs from technology are hugely varied across the campus – from students and lecturers to operational staff and researchers. Keeping up with the requirements and risks, and future-proofing systems is a full-time job. When it comes to having the right resources to meet the challenge, most universities are understaffed and, in many cases, under-skilled[19].

Most IT architectures were built before mobile devices existed – let alone cloud environments – so many universities are still playing catch-up to address current limitations before they can even begin to look forward. With a considerable proportion of university IT budgets allocated to 'keeping the lights on,' the only way they can start to look to the future and evolve services is if they operate more efficiently. Skills around automation and AI are still scarce but the impact these technologies can have on universities wil be substantial.

"Future-proofing isn't easy, because user demand and technology evolve at such pace that no organisation could ever say they're truly ahead of the game in these areas. The key is to be agile when reacting to change, to invest in technology every year, and just keep going. It can be hard enough keeping pace when you're trying to move forward, but almost impossible when standing still. Be flexible, agile, adaptive, and work at pace."

Neil Shewry, Deputy Director, Network Delivery, www.jisc.ac.uk

"Digital transformation is a long-term proposition. It's our aim to support institutions and member states with education and skills to build their ecosystems with the right infrastructure, connectivity, processes, and capabilities. It's also important to understand the interoperability of data and everything needed to make digital transformation a success."

Georgi Dimitrov, Head of Digital Education, European Commission

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KEY TERMS

Third party contributors

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42 Lisboa
42 has more than 10,000 students in over 20 countries and is recognised as one of the best coding schools worldwide. Learning at 42 is entirely free of charge and doesn't require any academic degree or coding experience.

European Commission
Oversees EU strategy, its role in setting priorities, and its implementation through EU policy.
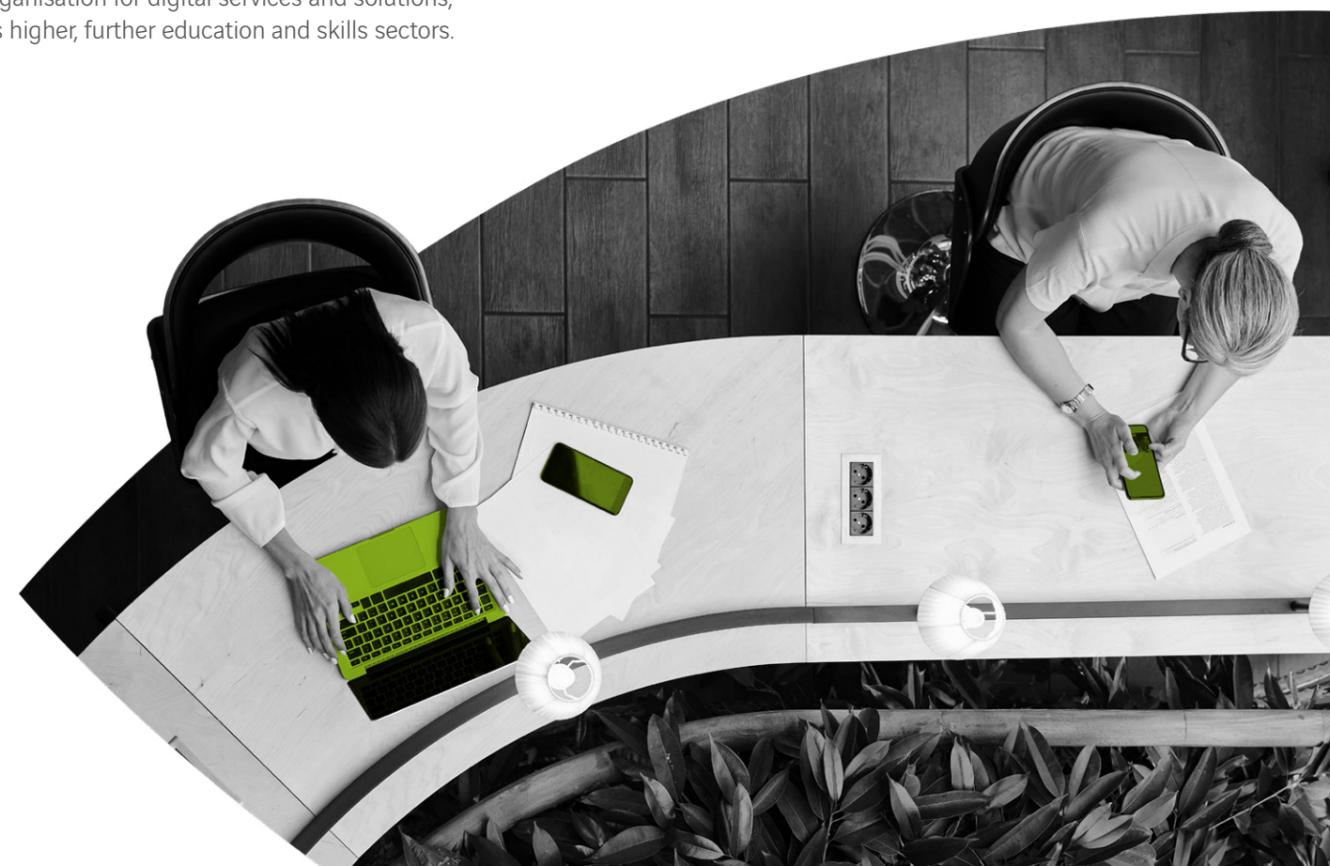
FCCN
The scientific computing unit of the FCT - Foundation for Science and Technology (FCT) in Portugal. Its daily purpose is to contribute to the development of science, technology and knowledge in Portugal.
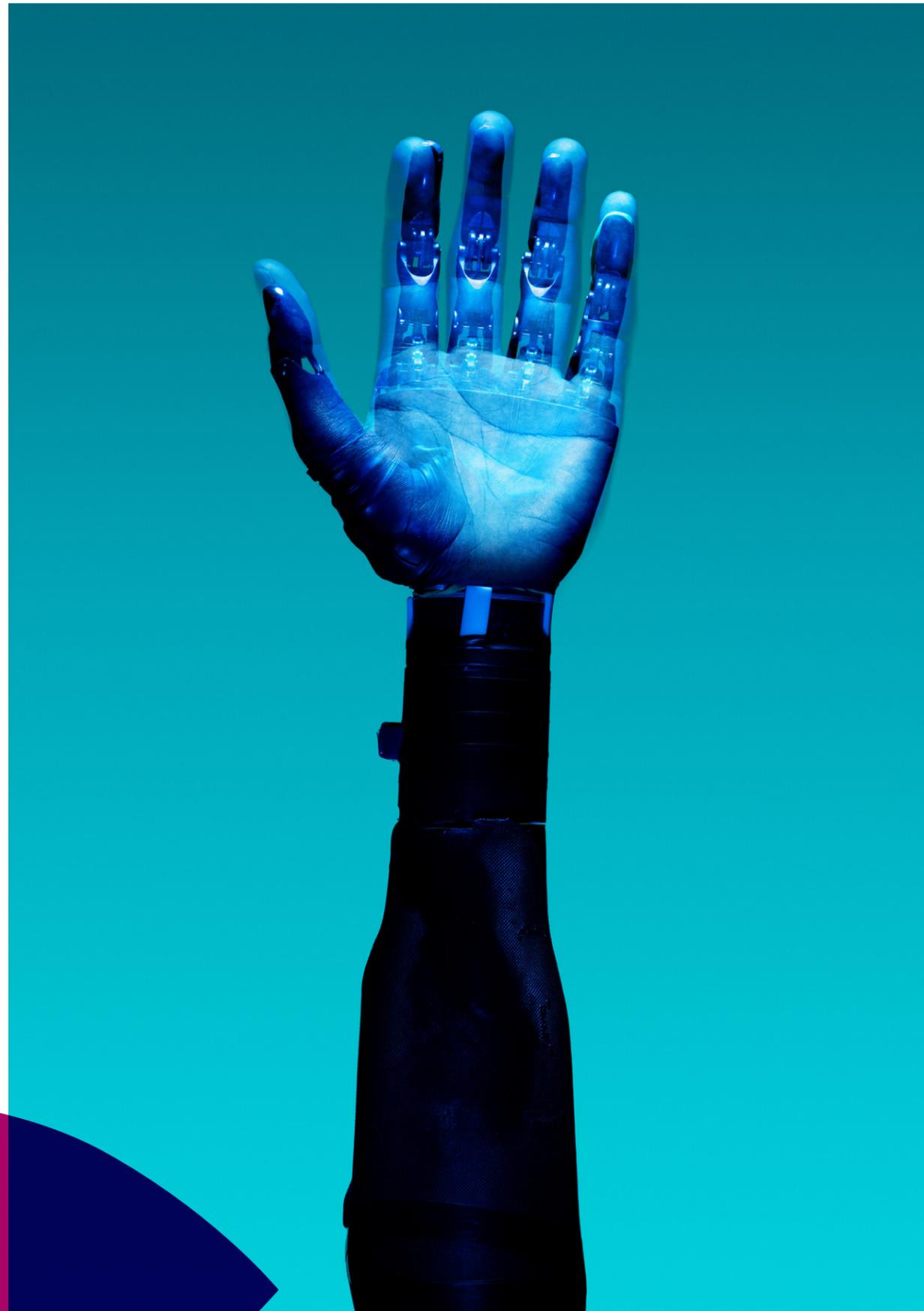
IDC
International Data Corporation (IDC) is a global reference provider of market intelligence, advisory services, and events for the information technology, telecommunications, and consumer technology markets.

Jisc
Not-for-profit organisation for digital services and solutions, serving the UK's higher, further education and skills sectors.

NEXT STEPS

Conclusion

Technology provision and developing the right skills are key to the future success of the higher education sector. Whilst change has accelerated quickly largely due to the pandemic, universities need to prioritise what is right for them and their institution in the long term. What factors of the blended learning approach do they want to keep and grow? How can innovative solutions better support staff to improve efficiencies on and off-campus and attract the very best people?

Technology can enhance all aspects of university life for students, teachers, staff, and partners but it won't happen overnight. The sector is behind many others when it comes to innovation and there is a lot to learn from other industries and the business sector in how to get it right and what steps to take next.

"Education is one of the pillars needed to create a more stable and harmonious world. Education can help create citizens who are better able to communicate and create solutions together. In the digital world, education has the role of bringing us together."

Daniel Traça, Dean of Nova School of Business and Economics, (in Digital Labs, an initiative of Portugal Digital Awards promoted by IDC in partnership with Axians)

If you would like to know more about Axians education globally or contribute to future papers you can contact;

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KEY TERMS

Glossary

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Artificial intelligence (AI) - an area of computer science that uses computers and machines to mimic the problem-solving and decision-making capabilities of the human mind.

Automation - technologies that reduce human intervention in processes. Frequently used to refer to the use or introduction of automatic equipment in a manufacturing or other repetitive processes.

Big data - extremely large data sets that may be analysed by AI platforms to reveal patterns, trends, and associations, especially relating to business information, human behaviour and interactions.

Business Intelligence (BI) - the processes and tools used to analyse business data, turn it into actionable insights, and help everyone in an organisation make better-informed decisions.

Capex - Capital expenditure; funds used by a company to acquire or upgrade physical assets such as property, buildings, or equipment.

Cloud - A global network of shared servers and network storage. The cloud enables anyone with an internet connection to access IT resources on-demand, such as those consumed by cloud-based applications.

DDoS - short for distributed denial of service, a malicious attempt to disrupt the normal traffic of a targeted server, service or network by overwhelming the target or its surrounding infrastructure with a flood of Internet traffic.

Internet of Things (IoT) - The network of everything connected to the internet, including smart devices such as speakers and fridges, as well as sensors, smartphones and wearable devices.

Malware - software that is specifically designed to disrupt, damage, or gain unauthorised access to a computer system.

Massive Open Online Course (MOOC) - a course of study made available over the internet without charge to a very large number of people.

On-premise - software that is installed and runs on computers on the premises of the person or organisation using the software, rather than at a remote facility such as a server farm or cloud.

Opex - Operational expenditure; the day-to-day expenses a company incurs to keep its business operational.

Phishing - the fraudulent practice of sending emails purporting to be from reputable companies in order to induce individuals to reveal personal information, such as passwords and credit card numbers.

Ransomware - a type of malicious software designed to block access to a computer system until a sum of money is paid.

Social engineering - a manipulation technique that exploits human error to gain private information, access, or valuables.

Sustainable Development Goals (SDGs) - Also known as 'Global Goals', were adopted by the United Nations in 2015 as a universal call to action to end poverty, protect the planet, and ensure that by 2030 all people enjoy peace and prosperity.
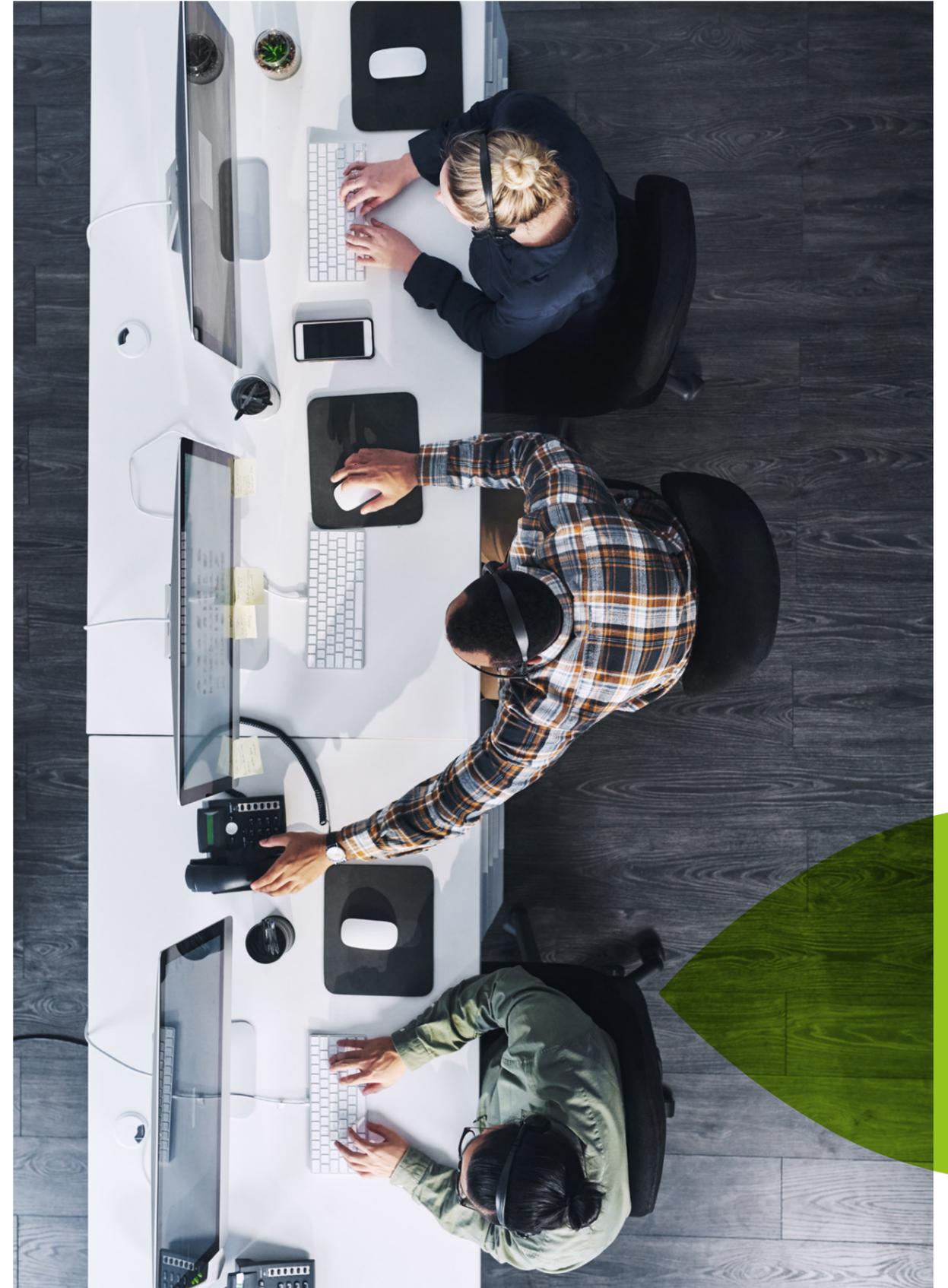
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