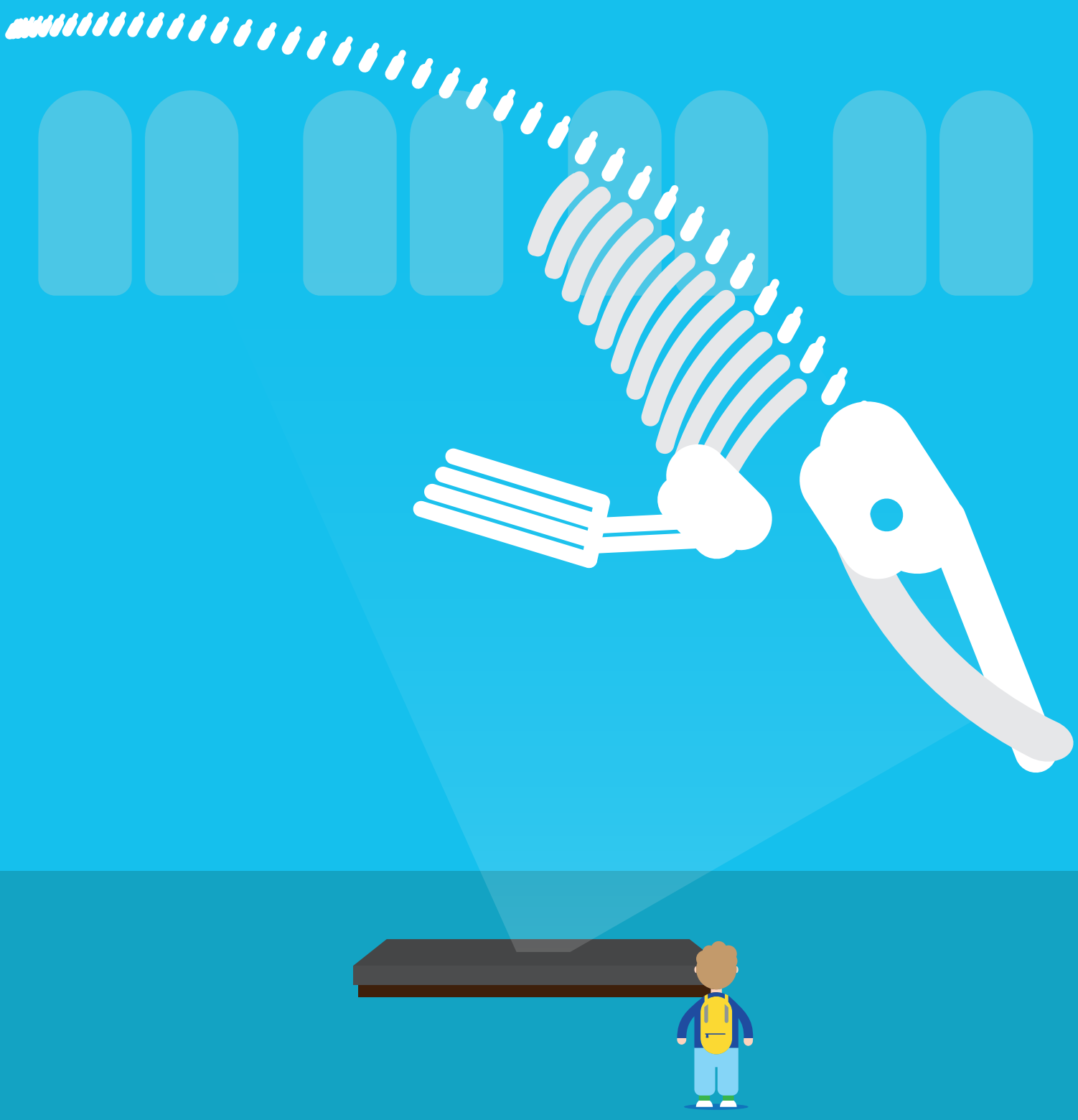
White paper

UK Museum Sector: Embracing Digitisation



With thanks to the Natural History Museum and the Science Museum Group

Contents

Acknowledgements

With thanks to:

The Natural History Museum;

The Science Museum Group;

Propellerfish;

And all the interviewees who contributed to the production of this paper.

Foreword

Today's culture is a digital one; one in which technology and the Internet shape our lives and the way we think, behave and communicate. A digital culture has emerged as the Internet and pervasive connectivity has infiltrated virtually every area of society, facilitated by easier access through mobile and broadband technology. This 'digital vortex' is rapidly accelerating people's expectations of the provision of services, and content in all aspects of life, including museums and other cultural institutions.

Museums and cultural institutions have a duty of care to educate people and preserve objects for future generations. They also need to ensure that all sections of the community are able to explore their rich cultural heritage – virtually or physically – support literacy and access to knowledge and help prevent a digital divide. And with many 'traditional' brick and mortar venues experiencing a reduction in footfall, their digital presence has become more and more relevant, across the UK and globally.

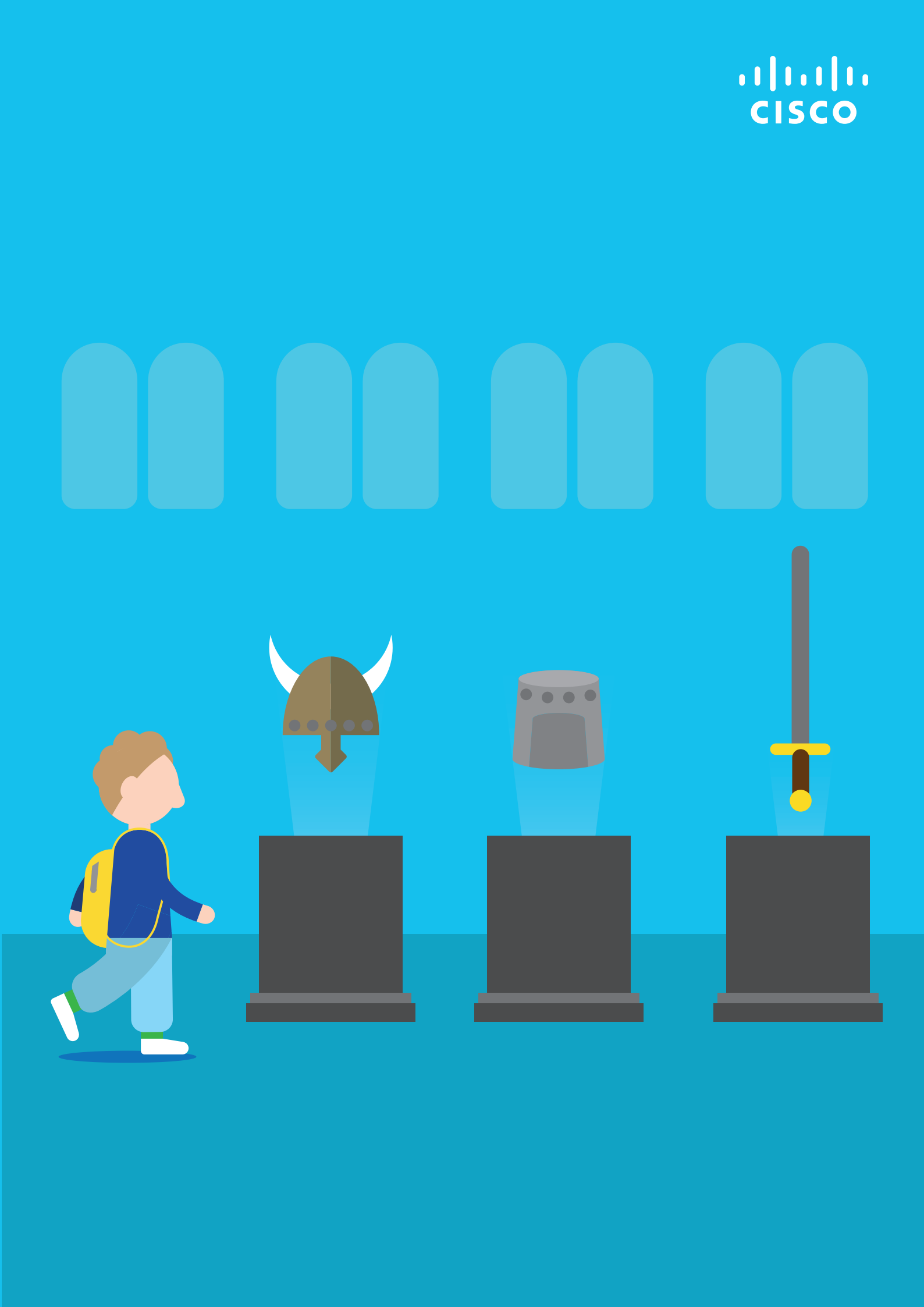
Over the last couple of decades, digital technology and platforms have started to merge the physical and virtual landscape, as industries and countries across the world move towards digital engagement and capability. The UK Government's #CultureisDigital initiative is supporting the sector's digital ambitions by encouraging communication and greater collaboration between the Government, the culture sector and technology companies.

Cisco's Country Digital Acceleration (CDA) is a long-term programme which sees Cisco partner with national leadership, industry and academia. It is part of our belief that accelerating the national digitisation agenda will grow GDP, create new jobs, increase innovation and support education across both public and private sector organisations across the globe. In the UK, CDA is supporting the laudable aims of #CultureisDigital through a series of digital-specific strategic commitments that we have made to the UK.

But how do cultural institutions, especially ones like museums, which are steeped in tradition and history, adapt to the digital age? And how do they take full advantage of the benefits technology can deliver?

Cisco strongly believes that closer alignment between business and technology, along with the continually improving capabilities offered by digital technologies, offer new opportunities for innovation and transformation of service delivery. In this paper we will explore how this can be achieved, and discuss the physical, operational, and digital opportunities that could help museums and cultural institutions meet society's changing expectations, while also giving them new ways to engage with audiences around the world.

Paul Garvey, Cisco Head of Government and National Security



Executive summary

There are approximately 2,500 museums in the UK[1], of various sizes and types, and managed and funded in many different ways. While many museums are relatively small – often equivalent in size to a small-to-medium enterprise (SME) – as guardians of national heritage, their work is of enormous historic, cultural and scientific value, and their buildings are often of significant architectural and historical importance. From advancing research and sharing knowledge capital to education and inspiring the next generation, their remit is surprisingly broad and of great value.

With relatively few employees, and increasing financial pressures, technology solutions that support digital transformation are fundamental to the sector's future success.

And – as some establishments are already demonstrating – the digital museum of the future is emerging now, with large scale programmes and game-changing initiatives already underway.

Digitised museum collections for example, can increase audience access and interactivity. As technology makes it easier for teams to work together and share information, it also supports greater collaboration among research communities. And through the application of artificial intelligence (AI) technology, museums are increasingly able to reveal new connections and make new discoveries.

UK museums are also thinking more commercially in terms of finding ways to secure sustainable financial growth. They understand that digital can unlock new levels of customer interaction and income earning opportunities, both within and beyond the museum walls. From retail and electronic donations to digital exhibition blueprints that can be easily shared across the world, all have the potential to increase income at a time when museum attendance rates are declining. On an operational level, collaborative working platforms are connecting employees, partners, research communities and volunteers more effectively. Meanwhile the Internet of Things (IoT) is enabling more responsive, efficient and environmentally friendly estates.

But while the culture sector has started to take advantage of digital technology across all its activities, including the digitisation of its extensive collections, long-term digital success requires a comprehensive digital strategy rather than a traditional short-term project-oriented approach. It necessitates a roadmap for strategic IT investment aligned to the museum's needs and goals.

That's where Cisco can help, using our extensive knowledge in this area to help you build a roadmap for success and a digital strategy based on best practice.

1 *Museums Association*

Scope and purpose

Cisco's work with the UK's museums has enabled us to build a picture of current digital practices and the many digital opportunities available to the sector. From there, we have developed our vision for the digital museum of the future, although this model can also be applied to libraries, stately homes and other cultural institutions. This paper offers our insights into the evolving museum sector and the digital museum of the future, and explores how we can support you as you develop your digital plans and start your digital transformation, as well as helping the sector share insights and replicate each other's digital successes.

For the purposes of this Cisco paper, 'digital museum' refers to an establishment that takes advantage of the many opportunities technology presents, using them to improve public services, engage new audiences, expand its research capability and create new, exciting revenue streams.

We also discuss how the sector's business drivers will influence the creation of digital strategies and offer advice on how to get started, using an architectural approach, which we explore in more detail in section 3.

First steps
When looking to start your digital journey, there are two key principles to consider:

1) **There is no need to invent everything from scratch**

   Analysis and measurement of benefits, along with best practice sharing principles, should ensure that culture organisations are able to copy each other's successes.

2) **Secured, common infrastructure should be designed with a platform approach**

   Informed by business need, it should support the re-exploitation and re-use of capabilities for multiple use cases, and requires a new way of thinking about - and investing in – technology.

   It may necessitate a greater initial investment but will deliver better value and greater returns on investment over time. This therefore requires a programmatic approach to strategic technology investment, rather than the traditional project-oriented style.

   Again, we discuss these points in section 3.

1.0 The UK museum sector landscape

"Museums preserve, protect and promote one of the few irreplaceable public assets: the nation's collective memory, knowledge and history. Preserving our heritage through museums is a fundamental aspect of maintaining a healthy and prosperous civil society."

– National Museum Director's Council, Museum's Matter report 2015

Small organisations with big responsibilities ...

While many of the UK's 2,500 museums are relatively small in terms of employee numbers, the work they carry out is of enormous historic, cultural and scientific value. Guardians of national heritage and often of international importance, not only do they inform and educate the public, but they also inspire careers across the arts and science.

... In a challenging financial environment

Nominally, the total figures for government funding each year are broadly flat. In real terms, however, there has been a 13% decrease in funding over the period when taking inflation into account: in 2007 prices, from £829m in 2007/08 to £720m in 2016/17[2]. It means museums need to think more commercially and create new revenue-making opportunities.

These include new membership programmes, attracting more donations, taking advantage of e-commerce opportunities, and generating income from knowledge and consultancy, and selling digitally-packaged exhibitions to international audiences.

According to the Department for Culture, Media and Sport (DCMS), 2015-16 saw a decline in the number of visitors to its sponsored museums and galleries compared with previous years. While the reasons for this change are multi-faceted, it paints a challenging picture for the sector as a whole.

"There is nothing more aspirational than visiting a museum or art gallery. It is an expression of hope and self-esteem...Going out to an exhibition or taking your kids to the Natural History Museum is surely a symbol of belief in your family and the future."

Jonathan Jones – The Guardian, February 2017

However, museums remain committed to being accessible to the public and are using technology more and more in order to facilitate this. This reflects people's lifestyles, particularly very young people, most of whom would have traditionally visited with their parents, guardians, or schools.

2 *Mendoza review*

Embracing a digital future

"Digital allows you to connect people up on a global stage; enabling more important work with more people."

Science Museum Group - Interviews, July 2017

Museums interact with a diverse range of people and institutions, from the general public to schools, academic and research communities across the globe, and other cultural institutions, as well as the media, local communities, government and volunteers.

With such a broad remit but with limited resources and with increasing financial pressures, digital transformation can play a fundamental role in museums' future success, as the already emerging digital museum demonstrates.

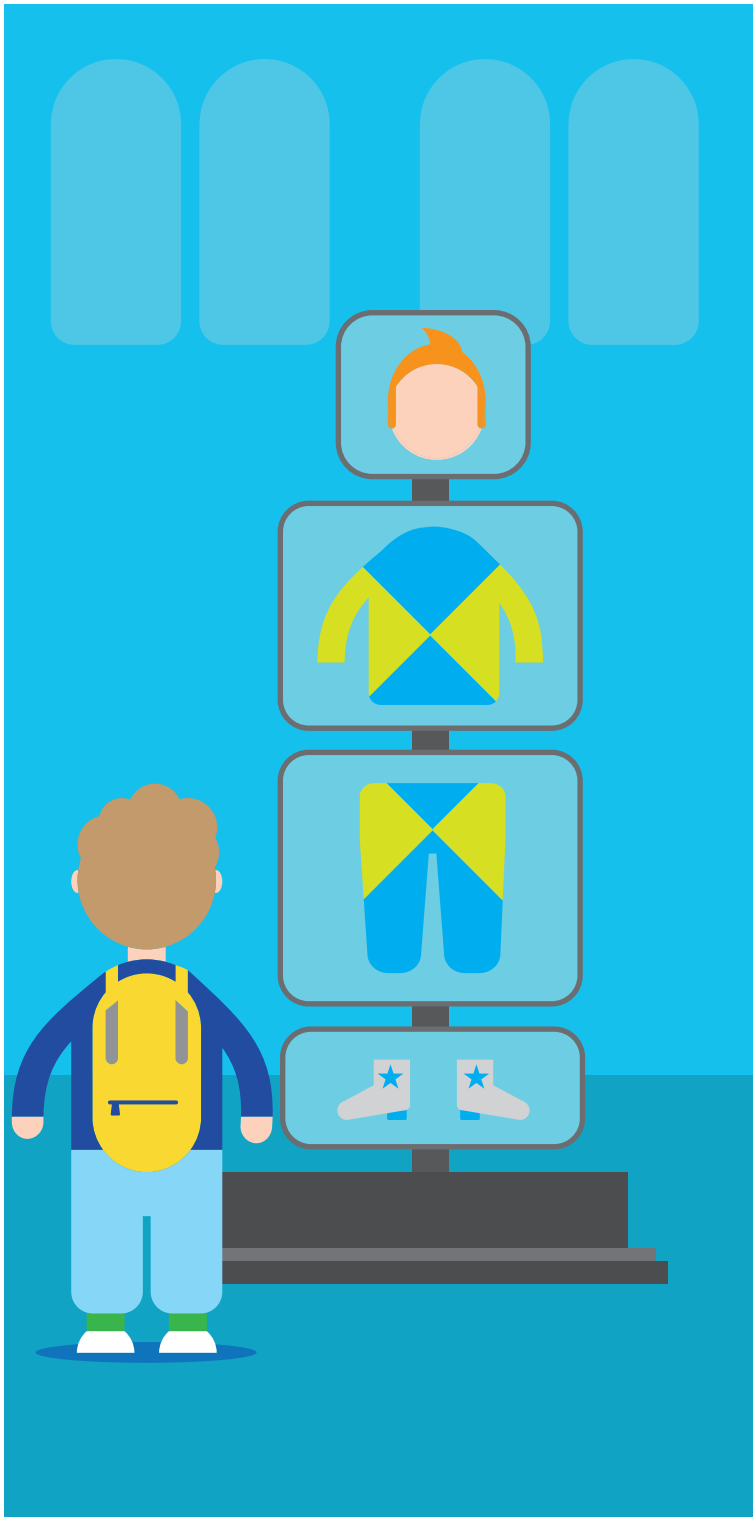
The Science Museum Group's ambitious 'One Collection' initiative for example, aims to digitise its entire collection, with the first phase due for completion in 2023.

However, large scale adoption of new and experimental technologies may be considered risky; the public nature of the UK's museums, combined with financial constraints, mean that they must adopt tried and tested technology with a 'future-proof' digital roadmap.

On top of this, evidence collected through the 2015 Digital Culture survey suggests that some museums neither think about their use of digital technology nor plan strategically.

Two-thirds of museums responding to the survey said that not having a senior leader with a specific remit for digital technology was a barrier to effective utilisation of technology. The museum sector workforce is also unusual, often consisting predominantly of a combination of experts who are specialists in their field, and volunteers, many of whom also possess specialist knowledge.

While neither group can be expected to be particularly digitally or commercially focused, digital success goes hand-in-hand with giving staff digital confidence.



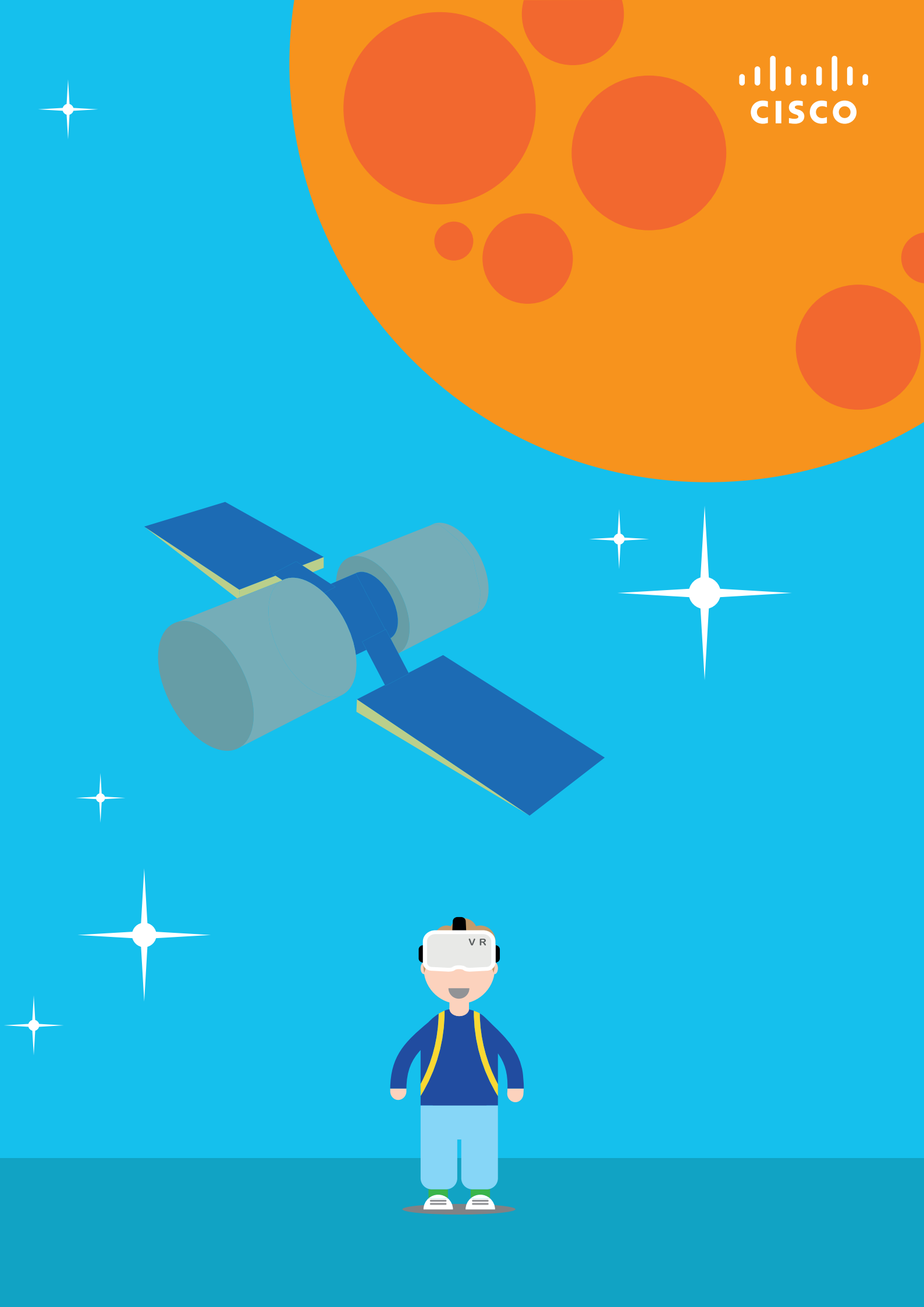
2.0 Envisioning the digital museum

Bringing to life the digital future of UK museums
In this section, we consider the UK museum sector across four key areas:

- **collections**
- **sustainable growth**
- **income generation**
- **operational excellence**

Across all of these areas, we have examined the digital innovation already taking place in our museums sector and explored how digital innovation used in other industries could be harnessed to create the digital museum of the future.

In doing so, we reveal a digitally progressive sector that attracts more visitors from both existing and new demographic groups, both inside and beyond the museum walls. The digital museum of the future also facilitates unprecedented levels of new academic research, data and collaboration, supports a more connected workforce, operates environmentally-friendly buildings, and helps create a more financially secure future for the sector.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2.1 Collections

Digital content and distribution

"New technologies allow the Enlightenment ideal to be given a quite new reality. It should be possible to make the collection accessible, explorable and enjoyable, not just for those who visit, but to everybody with a computer or a mobile device. It can become the private collection of the whole world."

Towards 2020 – The British Museum Strategy

Engaging audiences

The curation of digital content is not a new concept. Many museums have made their collections available online for research and academic purposes, and as a way of attracting greater public interaction. And this availability isn't confined to the UK; nearly half of the Science Museum Group's online visitors live outside the UK, opening up a new and previously unavailable customer base. Museums are also connecting research communities across the world in ways that were previously impossible.

As well as offering greater convenience, this online capability gives museums access to enhanced customer data for more detailed analysis of visitor profiles, helping them build better visitor experiences and create more mutually beneficial relationships.

"We hold about 425,000 objects, and by 2023 almost all of these, plus the most significant items from the photographic and archival collections will be accessible online."

Inspiring Futures, Strategic Priorities 2017-2030 – Science Museum Group

Virtual experiences

Examples of online access to and interaction with museum collections include Hold the World, an interactive virtual reality (VR) experience at the Natural History Museum, hosted by Sir David Attenborough. The first ever VR experience to combine video game technology with documentary-style storytelling, the event will enable participants to handle specimens from the Museum's collection virtually, in a one-on-one interactive experience.

Meanwhile, in August 2014, the Tate Britain's After Dark live streaming project allowed participants to experience a 'voyage in the dark,' with access to one of the world's largest art collections via robots equipped with cameras, combining state-of-the-art software with bespoke hardware design and engineering to create a world-first experience that attracted audiences from around the globe.

In 2013, the Dutch national museum, Rijksmuseum, made around 150,000 images – including artworks by Van Gogh, Vermeer and Rembrandt – available on a dedicated website, and invited visitors to download free high-resolution versions of these pieces copyright free. It meant people could then take digital copies of the artwork away for free to print in unusual formats such as posters or bed covers.

And thanks to a high-definition version of Street View, audiences around the world can now 'walk' through the statuary in the Musée d'Orsay in Paris or the portrait gallery of the Museu de Arte de São Paulo.

Objects however, only constitute one part of the digitisation journey. As John Stack, Digital Director at the Science Museum Group explains, the construction of detailed descriptions and

narratives to surround these objects is critical to providing rich and meaningful audience interaction:

"To do the double helix structure of DNA justice, we need not only to tell the story of Jim Watson, Francis Crick, Maurice Wilkins, Rosalind Franklin and so on, but also draw on wider narratives through multiple objects. Such narratives should enable both linear and non-linear journeys and be rich with multi-media, taking us to the latest generation of DNA sequencers and beyond."

John Stack, Digital Director - Science Museum Group

Research and study

The potential impact of digitisation on academic research should not be underestimated; the Natural History Museum for example, believes that it will eventually have access to data on 1-3 billion specimens, and the ability to 'slice and dice' this data and share information in real-time will be used to support and enhance research projects.

Preservation and conversation

Digitisation can also play a significant role in preservation and conservation, although digitising entire collections can present major challenges. The Natural History Museum alone is home to 80 million specimens; individually digitising each piece in the collection would take up to 400 years. Yet this work is of great importance, as many objects are old, delicate or biologically unstable, and as a result difficult to handle and store correctly. Museums are therefore in a race against time to digitise degradable objects.

As new items are regularly added to collections, conservation teams are under constant pressure to find ways to preserve them, and digital solutions such as artificial intelligence (AI) and using methods such as crowd-sourcing to accelerate the conservation process, could be part of the solution.

The British Library for example is trialling machine learning to read handwritten text, building on its knowledge and ability to decipher with every task it completes.

Meanwhile the Natural History Museum has crowd-sourced help from members of the public to transcribe close to 370,000 bird records digitally in the last three years - a major contribution to its digital collection.

But the benefits of digitising museum collections go even further than just improving access and supporting conservation.

Solving the digitisation puzzle

Over recent years the Natural History Museum has solved many of the scientific, technical and social challenges of digitisation, and has developed high-throughput cost-effective workflows capable of digitising tens of thousands of objects per day. The UK is currently the international leader in pioneering these approaches.

Furthermore, unlocking the data in these collections could help solve global challenges from neglected tropical diseases, food security and climate change.

Merging the virtual and the physical

Creating the 'digital twin' of a physical piece can help improve our understanding of the physical world. AI enables existing data to be cleaned up, classified and analysed at a meta-level to reveal new connections and discoveries. San Francisco Museum of Modern Art (SFMOMA) for example, has conducted 'sentiment analysis' to identify patterns in the ways specific artists titled their work.

AI and machine learning can also be used to recognise and classify the emotions in faces depicted in artworks, while social media content and responses can be analysed to interpret and improve understanding of public perceptions[3].

3 *MW17 paper, Exploring Artificial Intelligence in Museums*

2.2 Sustainable growth

Museum visitors are sophisticated, and they have high expectations. Museums are working harder than ever to communicate with people through their collections, both during and after physical and virtual visits. Now, web-based content and remote access to collections means visitors can experience the museum's facilities without entering the building. This helps museums collect customer data which can be used to deliver the right experience to the right person each time and generate income.

"What is gratifying about the rise of digital technologies is that we can not only understand how we engage with our audiences, we can reach new audiences. Even better, these audiences are global and they are growing all the time."

John Stack, Digital Director - Science Museum Group

2.2.1 Elevating physical visits - more than just a great day out

Websites can be very useful in helping customers plan their visit in advance and decide which items they want to view.

Following a website re-design, The Natural History Museum saw an increase in its website traffic, from people searching for opening times to looking for more varied collection information and content.

Once inside the building, technology also allows museums to offer increasingly flexible ways to interact with and view exhibits.

Very often, visitors do not take the anticipated route through a museum, which can result in some areas becoming over-crowded while others are missed completely. Providing online content that helps visitors customise their journey in advance can result in a more personalised experience and help ensure they understand the full layout of the building.

Examples of this include the American Museum of Natural History's explorer app.

This offers on-demand behind-the-scenes stories and interaction with its exhibits, which can be viewed in detail remotely. Similarly, Tasmania's Museum of Old and New Art has replaced its traditional wall labels with 'the O', a tablet that tracks visitors' on-site movements and offers useful information about nearby artefacts to help them navigate the building.

Following the success of the its David Bowie exhibition, which used sophisticated 3D audio, the V&A in London has been inspired to expand its use of digital innovation, as its Head of Digital Media Kati Price explains: "We're now looking at how we might use iBeacons to deliver multi-media content in our exhibitions, or provide tours for visually impaired visitors or exploration trails and games for kids, for example. We're also exploring how wearables, like Google Cardboard and Oculus Rift might introduce new layers of content and even more immersive experiences in our buildings or remotely."

"Integrating mobile experiences with CRM is massive game changer for us. Optimising a visitor's digital content for their interests changes everything and that's for the long-term rather than just one-off visits."

Dave Thomas, Chief Information and Technology Officer - Natural History Museum.

The digital museum of the future is offering digital experiences inside the building.

The Natural History Museum has used Cisco technology for an optimal visitor experience. Museums are also starting to operate 'post-digitally,' bringing together virtual and physical worlds, creating context-aware visitor experiences using real time location-based services. And by helping visitors quickly locate specific topics and areas of interest, they are able to create unique, personalised experiences.

2.2.2 Engaging the public beyond the building

Museums want to do more than merely making their collections accessible across their physical and virtual communities, however. Arts Council England Chair Nicholas Serota for example, once described the Tate's role as: "Encouraging people to engage with their visual heritage and to strengthen their understanding of the values and insights of their predecessors and peers, leading to a greater understanding of their own capacities and identity."

This combination of aspiration and improved digital capability means museums are no longer confined to or defined by their physical space and are therefore able to actively encourage people to participate in cultural activities, regardless of their geographical location.

"The experience of our galleries will always be a touchstone, but we must also find ways of giving equivalent encounters to those who want to engage with Tate, its ideas and values, through digital and other forms of publication. Increasingly, people will seek stimulus and guidance from Tate in building their own experience and understanding of the visual. In the next few years we shall need to devote as much attention to the digital as we have given recently to the physical expansion and improvement of our buildings."

Nicholas Serota, Tate's Vision - Championing Art and its value to society

Examples of large-scale digital initiatives already in progress include the Natural History Museum's Citizen Science programme, which encourages public participation in specific science projects, recording wildlife or climate observations and collecting samples, resulting in vital large-scale scientific data. The Metropolitan Museum of Art (the Met) in New York City meanwhile, has recently adopted a full and open access digital model via Creative Commons Zero (CC0).

CC0's premise is 'no rights reserved' - enabling scientists, educators, artists and other copyright owners to waive their interests, making their works fully available to download, use, remix and share, in a move that the Met describes as a "major milestone in the museum's digital evolution".

Digital museums are also engaging people in content creation. In 2014, The Smithsonian Asian Pacific American Centre invited the public to participate in a Day in the Life of Asian Pacific America exhibition, where both professional and amateur photographers submitted over 2,000 photos, and a cross-section were showcased.

In addition, digital museums are developing next-generation interactive educational and learning tools, moving away from static downloadable teacher resources. In 2013, Culture24, supported by the Arts Council England and Trinity College, began an interactive collections service that supported museums and schools in delivering cross-curricular, creative and cultural learning experiences at Key Stages 2 and 3.

It is available for young people at *www.show.me.uk* and *www.culturestreet.org.uk*

"We have published a curated set of digital collection objects from a range of museums in child-friendly, fun and flexible online environments. We've brought it to life with video content co-created by children and young people, topical editorial, related venue and listings info, plus existing interactive and interpretative content from museums and galleries."

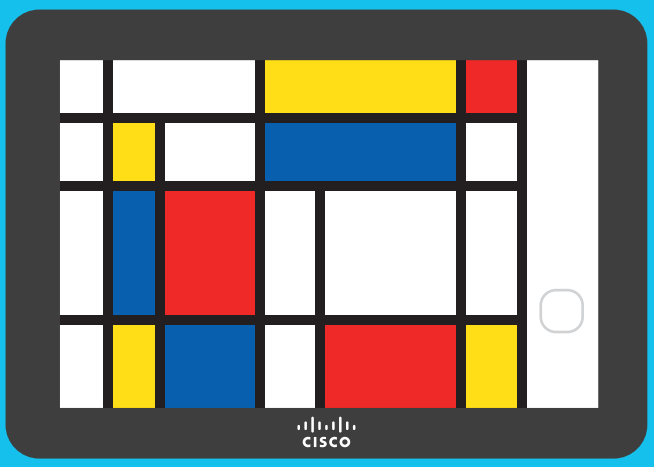
Anra Kennedy, Culture24

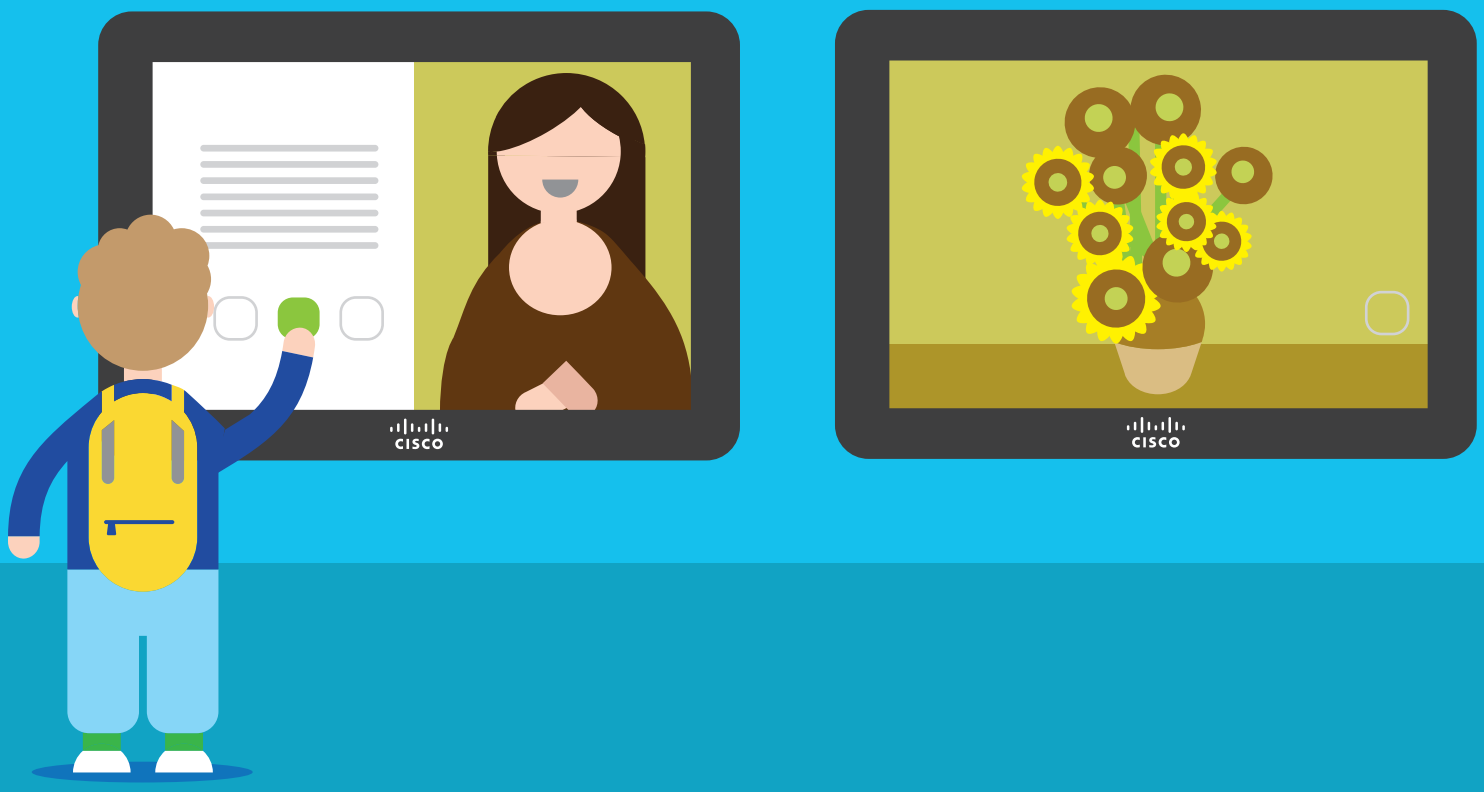
The digital museum of the future is therefore generating more data collection opportunities and using the information and insights it gathers for greater interaction and more collaborative relationships with its audiences.

"Knowing what drew your attention during the exhibit would mean the app could deliver a perfect summary for further reading."

American Museum of Natural History

It is also benefiting from access to more data through better data gathering, management, analysis and protection.

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2.3 Income generation

"We need viable commercial models that don't betray the public trust."

Science Museum - Interviews, June 2017

For the UK's museums, income is an enabler rather than an end game, but museums increasingly need to be more commercially focused without betraying public trust. Relying solely on government funding is not an option, and according to the Mendoza Review funding has reduced by 13% overall in real terms over the last 10 years. Combined with the many challenges arising from a tough competitor landscape and estates that are costly to maintain, they must find new ways to drive income growth.

2.3.1 Retail and e-commerce

Physical and online museum shops both attract high visitor numbers, but taking advantage of the technology routinely used by other retailers, such as simple app-based tools for till-free retail transactions could help increase existing sales and revenue. Pop-up exhibitions and shops present further income-making opportunities by helping museums reach new buyers in different locations. During the 2014 Summer Streets Festival for example, the V&A set up a fashion pop-up shop in Regent Street, a one-off shopping experience consisting of a special selection of goods inspired by the Museum's fashion and textiles collections.

Online sales are another area that is ripe with opportunity. According to the Government's Strategic review of DCMS-sponsored museums in November 2017, online sales could improve customer service, reduce costs and increase revenue. Tate Art on Demand offers an online selection of customisable artwork reproductions, and has an online licensed image use service.

More generally, museums are looking to improve their checkout experience, through single online basket for buying tickets, membership and online shop products, which also potentially provide them with useful customer relationship management (CRM) and automated marketing tools.

Museums are also changing their approach to membership, from a rigid, transactional process to a more flexible and commercially viable proposition with customisable benefits. Traditional models have too often led to cannibalisation of ticket sales for otherwise paid exhibitions, and tend to only target existing 'heavy users'. New models of membership are moving from admission purchase to a 'fan-base' and are proving more successful by offering more customisable and 'money can't buy' benefits, including digital access. For instance, The Whitney Museum of American Art offers a 'Curate Your Own Membership' programme made up of five membership options, from 'Insider' which provides opportunities to interact with curators, and 'Learning' which offers lectures, talks and other activities.

2.3.2. Smarter donations and new services

The museum sector already relies on donations to secure funding, but while examples of innovation in this area do exist, including the Science Museum's successful crowd-funding campaign that raised £50,000 to re-build the 1950s Premium Bond robot Eric, these revenue streams could be exploited further.

Within the museum, donation requests have traditionally been placed unobtrusively at entrances and exits. The digital museum however, will create exciting interactive processes that encourage people to donate at their convenience. Digital storytelling for example, using location-based services, can encourage donations from visitors immediately after an exhibition, while contactless payment technology will make donating easier than ever.

Beyond the public, educational programmes can also generate income, and paid-for-learning is already a reality. The Design Museum for example, offers paid workshops on topics such as Design Thinking and 3D printing, while the Royal Opera House, V&A and Kings College have developed 'Inside Opera', an online course that is free of charge to participants who take it over 14 consecutive days, or available at a small charge should they prefer to work at their own pace.

The digital museum of the future is well placed to benefit from the explosion in digital accessibility, and by digitising and curating learning content and taking advantage of their existing brands and reputations, they can reach international audiences willing to pay for accreditations from respected institutions.

2.3.3 New digital spaces

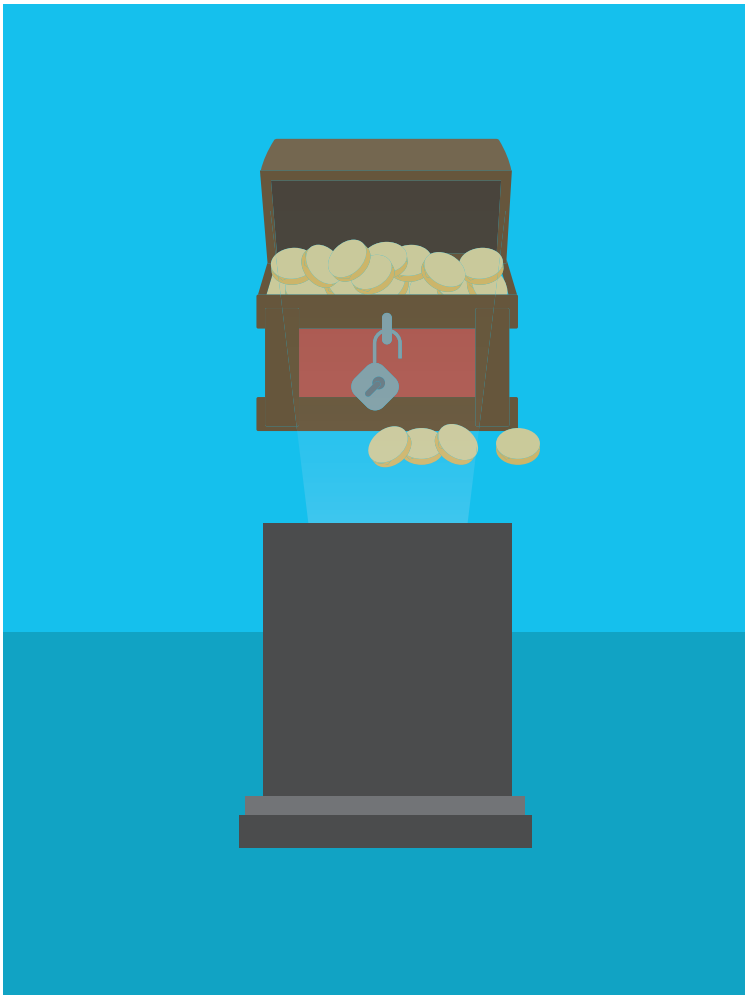
In another exciting innovation, museums are starting to generate income by creating and selling digital exhibitions internationally, while creating new digital spaces and digitising existing activities offers additional income-generating opportunities.

"For the first time in history it is now possible thanks to changes in transport and technology, to be a museum for the whole world."

Towards 2020 - The British Museum

The 'Blueprint' model is an IP and content-based model that allows the Science Museum to stage an exhibition anywhere simply selling a memory stick with some data and instructions. This means that an exhibition can tour without a single asset having to be shipped. Examples of the adoption of computer generated imagery and hologram technology in practice include rap artist Tupac Shakur, who died in 1996, 'appearing' at the 2012 Coachella music festival, and Michael Jackson apparently moonwalking at the 2014 Billboard Music Awards, five years after his death in 2009. CGI presents exciting opportunities to transform the touring exhibition and 'Blueprint' model via the ability to create a complete virtual exhibition in a 'blank canvas' space.

Museums have long used their spaces to generate additional revenue. The Tate, V&A, Natural History Musueum, and Science Museum have all broadened their appeal to new customer groups through live evening and late-night events, transforming their sites into entertainment hot spots, increasing brand awareness and creating new revenue opportunities, while the live streaming of cultural events is a growing phenomenon which attracts international audiences.



2.4 Operational excellence

2.4.1 Collaboration and connection

"Training and skill-sharing programmes developed over recent years are building a global community of curators, conservators, scientists and museum professionals. This global community of museums provides the ideal context for the shared study and display of the British Museum's collections, allowing joint research programmes, the circulation of exhibitions, and the exchange of people and skills."

Towards 2020 - The British Museum Strategy

Collaboration between museums is both a way of life and a necessity. The Natural History Museum is home to over 350 scientists, all working on cutting-edge projects and collaborating with experts from around the globe to produce around 700 scientific papers a year. Delivering world-class exhibitions, asset management and experiences require extensive skills across many disciplines, and multi-site teams of experts collaborating and knowledge sharing.

Digital collaboration in particular is widely reported to improve employee morale, transparency and quality of communication, as well as offering a practical, cost-effective way of enabling multi-site teams to work together.

The digital museum uses collaboration platforms to enhance its workforce and partners across multiple disciplines and areas of expertise. A cloud-based digital workplace allows employees to work together in real-time regardless of location, while brainstorming and sharing ideas and information securely and easily. Instant messaging (IM) and video technologies enable instant communication with experts, peers and customers, together with one-to-one or one-to-many meetings – anytime, anywhere.

The ability to capture, store and preserve knowledge in one central repository enables access to information from any location or device. This content can be searched, tagged, rated, and shared with peers, work groups and communities, and even after an employee has left the organisation, their documentation and insights will still be available through this digital library.

The New York Hall of Science (NYSCI) is a hands-on museum focusing on children, families and teachers. Struggling to cope with the demand for its programming, which had outgrown its technology infrastructure, Cisco's network and collaboration technology helped the museum create a better learning experience that now reaches over 500,000 students a year and offers professional development for over 4000 teachers. Cisco TelePresence connects NYSCI to schools, libraries, community centres and hospitals around the USA. Across the museum itself, connected devices enable real-time data collection and sharing via apps in order to conduct research and experiments, while new wired and wireless LANs help visitors connect the science, technology, engineering and mathematics (STEM) learning centre to research institutions.

2.4.2 Digital empowerment

Creating a digital organisation is only half the story, however. Understandably, many organisations struggle with adoption of new technology among their employees, but supporting staff as they use these new tools and ensuring that any new implementation improves their working processes will help them make this important transition.

The Association of Art Museum Curators in New York, has conducted a series of webinars to help

curators develop digital skills. Curators Thinking Digitally offers live discussions on essential skills, topical issues, and best practice to improve their understanding of how digital relates to curation and support the profession of digital art curator, improving their digital confidence and benefiting the museum.

2.4.3 Maximising the power of volunteers

"Volunteers outnumber our employees."

Science Museum Group - Interviews, June 2017

Volunteers play a vital role in any museum's success, often outnumbering staff. From customer service to operational support, specialist knowledge and corporate services, they fulfil many important roles. Volunteers can be of any age, with working hours ranging from ad-hoc to full time.

The Science Museum Group currently benefits from around 650 volunteers who contribute over 80,000 hours of support each year.

The importance of volunteers to UK cultural institutions is demonstrated by the existence of Heritage Volunteering Group, which consists of several organisations including English Heritage, The Science Museum Group and The National Trust, working together and sharing best practice. The digital museum of the future will use technology to grow its volunteer bank and enhance their skills. UK museums are using online recruitment initiatives, while looking to develop open digital and social communities for existing volunteers that also enable members to enlist new volunteers. They can also enjoy real-time information sharing and problem solving across the volunteer network.

Flexible, online instructor-led and self-directed training platforms in areas including health and safety, site tours and specific areas of expertise will equip volunteers with the skills they need to get started in their roles conveniently, flexibly and more quickly[4].

Increasingly, volunteers prefer to work remotely. The digital museum makes this possible through instant secure access to files and networks, giving them more variety and scope in terms of the work they carry out and the projects they participate in.

At the same time, the digital museum of the future is increasingly automating its processes. Take the Science Museum Group, which aims to automate its recording of working hours, and to use paperless records for its volunteers by the end of 2019. In addition, knowledge mapping and analysis tools will help to ensure that the most appropriate person is allocated to a project, and also help identify training needs and requirements.

2.4.4 Smarter buildings

"In all of digital you have to pay close attention to the plumbing: the data, skills, and technology. This is even more important with smart technologies."

Dave Thomas, Chief Information and Technology Officer - Natural History Museum.

The digital museum embeds technology into its fabric across every area, from energy efficiency, security systems and facilities management, through to customer experience.

It also needs to be flexible as museum buildings serve many different functions – from storage, exhibitions and theatre conservation to preservation work and leisure space. Many UK museum sites are of historical interest, and are often listed buildings, requiring costly, specialised facilities management systems. At the same time, they also want to reduce the environmental impact of preserving collections in controlled climate conditions. In many ways, the digital museum of the future shares the same

aspirations as the smart city of the future: to be a connected, energy and environmentally efficient, physically and digitally integrated, live data using, free-flowing entity. And like the digital museum of the future, the smart city of the future is also starting to emerge. In some cases, the two are emerging together.

One example of this fusion is CityVerve in Manchester. The CityVerve demonstrator project has been established to create a smarter, more connected city, where wide-spread implementation of IoT technology is being used to support its communities by making improvements in four key areas - health and social care; energy and environment; transport; culture, public realm and community.

In this latter strand, Manchester School of Architecture (MSA) is working with Cisco and other partners to create cultural installations that will merge design, virtual technology, contemporary art and heritage. This includes the Manchester Plinth, which will be situated in All Saints Park and aims are to build galleries without walls, using augmented and virtual reality.

In the digital museum of the future, technology is making its buildings more responsive too, with real-time diagnosis for every facet of its operations, from temperature control to lift breakdowns, helping estate teams manage facilities more efficiently and more cost-effectively.

"Buildings are massive systems of systems, and these systems need to talk to each other for a building to become smarter."

Metin Pelit, Department Manager of Computerised Maintenance Management - The Louvre

From schools to hotels to museums, organisations are transforming their buildings with optimised lighting, building automation and IoT technology. By converging standalone building systems onto one network platform, they are achieving operational simplicity, seamless security and sustainable savings.

New control environment systems are managing humidity levels, and sensor technology together with connected fans, mean that the network monitors and manages the fan speed to maintain precise environmental humidity.

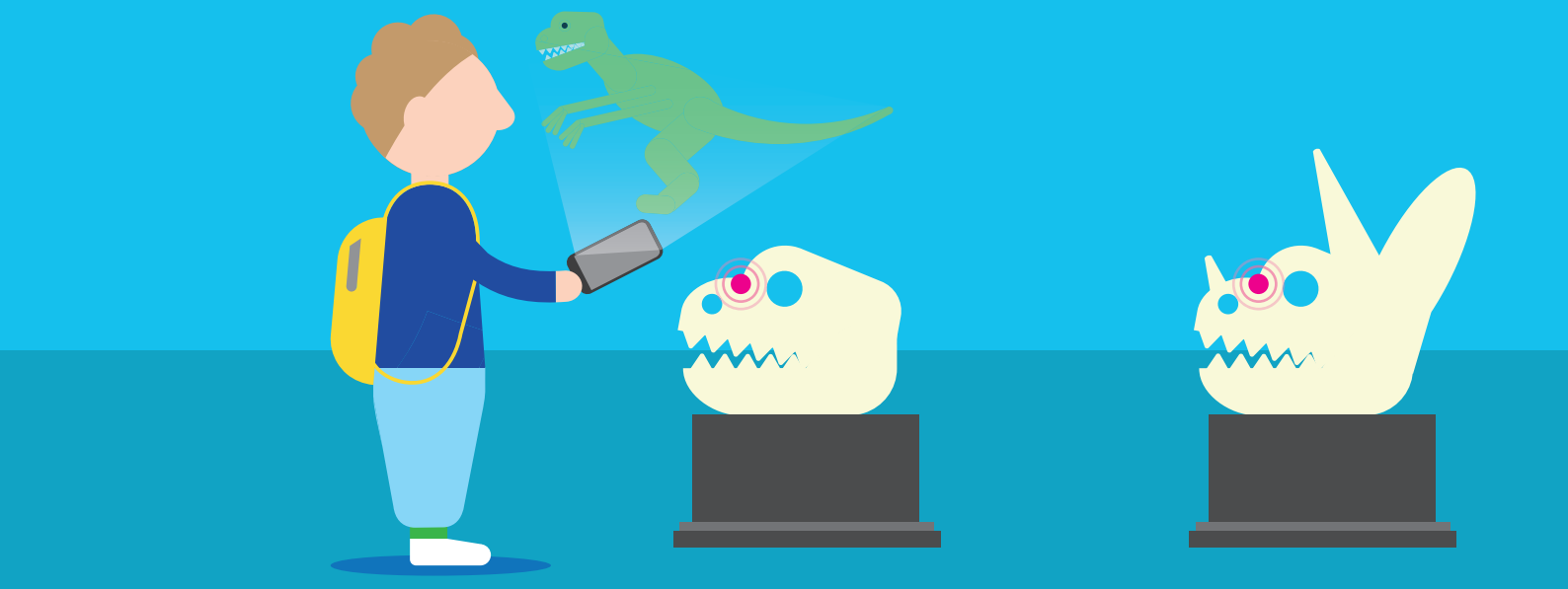
The new Science Museum site at Wroughton near Swindon, is cutting energy consumption by adopting the principles of food retail warehousing for preserving its objects, many of which need to be preserved at constant temperatures as opposed to requiring full climate control, which is both costly and less environmentally friendly.

Space management and making assets easy to access are key.

Visitors tend to congregate in the busiest areas of museums, with some sections - especially those furthest from main access area – sometimes remaining unnoticed. This can create bottle-necks and result in staff spending significant amounts of time directing visitors around the site.

The digital museum can anticipate people movement using thermal mapping, location services, live data analytics and provide virtual signage to help visitors find what they are looking for and avoid congested areas.

In addition, from the workforce perspective, the digital museum creates unique opportunities to improve the work environment and employee productivity, thus increasing employee retention.



3.0 Enabling a digital future

3.1 Putting digital technology at the heart of our museums

In our everyday lives, we are used to having ready access to information, whenever and wherever we want it, on our device of choice. Yet some areas of the business world have been slower to adopt technology solutions, citing obstacles such as performance, reliability, security and privacy.

However, as this paper has discussed, the museum sector is starting to make progress, as more and more museums are digitising their assets and using technology to enhance visitor experience. At the same time, connectivity, collaboration and mobility are now being used to support operational efficiency and enhance the shared partnership models that museums are becoming increasingly reliant on.

Far from simply providing the tools for the creation of electronic collections, archives and membership programmes, as we have seen, digital has the potential to support every area of a museum's operations, and a successful digital transition begins with the development of a single, cohesive network that spans and supports the entire organisation, from collections archiving to buildings maintenance.

Sitting unobtrusively in the background, the network nevertheless forms the foundation of the digital environment, providing a reliable platform on which everything else sits. It will also offer enhanced technical capability to dependent systems and applications. Regardless of whether the infrastructure platform is customer-owned or sourced from the cloud, it must be robust, and feature-rich to support the innovation museums and other cultural institutions require. This platform forms the basis for what Cisco refers to as an 'architectural approach', where every element of an organisation's technology fits together to create a coherent whole.

The platform will also support the implementation of other digital advancements. The collaboration tools that we are all familiar with as consumers for example, are becoming widespread in industry. However, business use demands greater quality assurance, while integration between elements such as video, IM and conferencing will be essential.

Security is also of vital importance; digital technologies such as mobility, cloud computing and other technologies are stretching the security perimeters that any organisation must defend. The breadth and depth of recent ransomware attacks alone demonstrate how adept adversaries are at exploiting security gaps and vulnerabilities across devices and networks for maximum impact. A security strategy embedded in the network is paramount for threat mitigation before, during and after events.

We will also see the emergence of even more new digital technologies – such as greater use of IoT, big data and analytics and virtual reality – all sitting on the same platform, enabling new ways of using information. The potential of these technologies demonstrates why digital is so important and can enhance both operational efficiency and service delivery across the museum environment.

The starting point for any museum embarking on this digital journey, is the development of a digital strategy that considers the whole organisation and its business needs, and explores how digital advancement will support both current and future requirements.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3.2 Creating and delivering your digital strategy

Fundamentally, any digital strategy must take into consideration the current business priorities of each individual organisation and should include an embedded transformational plan.

Many museums will share many of the same business priorities – including those discussed in this document. However, some will have specific issues to address, depending on the services they offer.

Cisco's definition of a digital strategy refers to the exploitation of new digital technologies to enable major business improvements as described in Figure 1.

Figure 1: 'What do we mean by 'Digital Strategy'?
So, when creating a digital strategy, where does the museum of the future begin? Cisco believes that the answer is the adoption of an architectural approach.

3.2.1 Adopting an architectural approach
In simple terms, an architectural approach refers to technology planning that starts with the business. This means that the involvement of business leadership is vital throughout the technology planning process and can be achieved through continual consultation to ensure business leaders clearly understand the benefits any technology investment will derive.

And there must always be a clear correlation between investment and financial and operational benefits.

Figure 2: 'What do we mean by 'an architectural approach'?
ICT teams must therefore clearly and consistently explain and promote those benefits, using transparent models and business cases to strengthen their alignment to the business. As shown in Figure 2, this joint strategy can help to close the gap that can exist between the business and ICT function.

The result should be an organisation that sees technology as an integral component of the business, rather than just another business cost.

Figure 1: What do we mean by digital strategy?

Digital strategy refers to:
-the explotation of new digital technologies
(communcations, social media, open data, data analytics,
connected devices, embedded devices)

- to enable major business improvements (such as enhancing customer experience, streamlining operations or creating new business models)

Figure 2: What do we mean by 'An Architectural Approach'?

Business led

Raise awareness of the potential of ICT at Board Level

ICT investments driven by business and clinical requirements

An architectural approach that demonstrates the dependencies of business on ICT

Guidance for ICT

A structured approach to ICT deployment using industry proven architectural models

Conceptual, logical and technical architectures

Reference diagrams that may be used by ICT departments as templates

Closing the 'Air Gap'

Moving away from 'operational IT'

Supporting ICT in raising its profile within the organisation

Models to support internal business cases

3.2.2 'Plan down, build up'

Successful adoption of technology can truly impact visitor experience and/or operational excellence. There can be no doubt that the best innovations we have seen at Cisco have benefitted from the input of a business sponsor, and strategies for broader technology investment are always more successful when informed by, and aligned with, the business and technical needs of the organisation. Cisco calls this business-led architectural approach 'Plan Down, Build Up' (see Figure 3).

Working out what your business needs are is a time consuming and often complex process. It involves an understanding of market drivers, regulation, national and international initiatives as well as a broad range of expert opinions. However, to deliver a programmatic style of IT investment, where each step builds upon and exploits the previous one, this piece of work is critical.

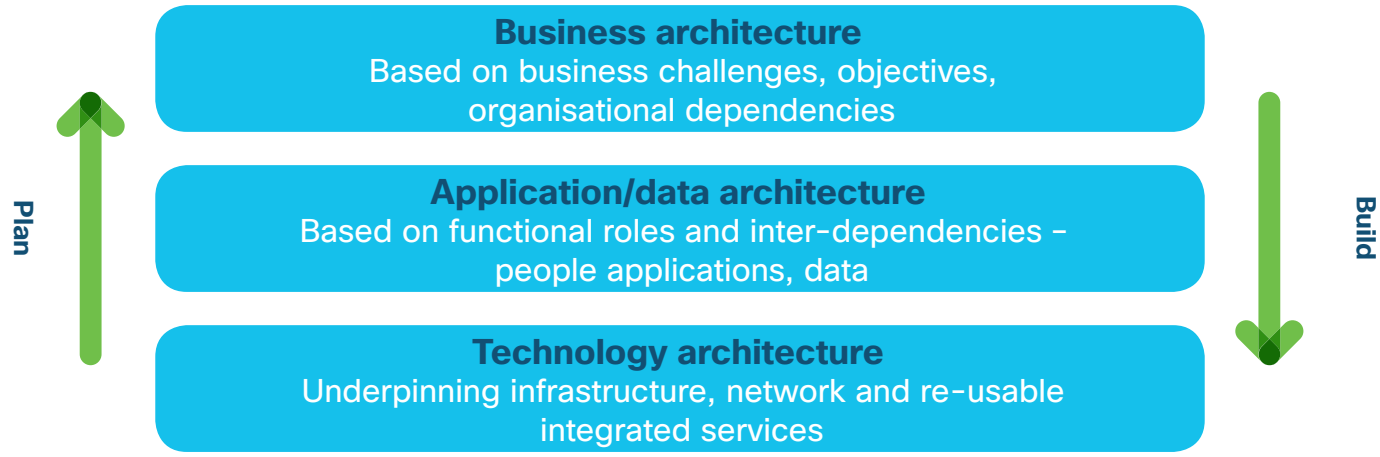
Figure 3: 'Plan down, build up'

This seemingly obvious point can often be forgotten when a museum is under pressure to make its collections more accessible and attract more customers, while simultaneously cutting costs.

3.2.3 Identifying your requirements

Most organisations will have a living business

Figure 3: 'Plan down, build up'



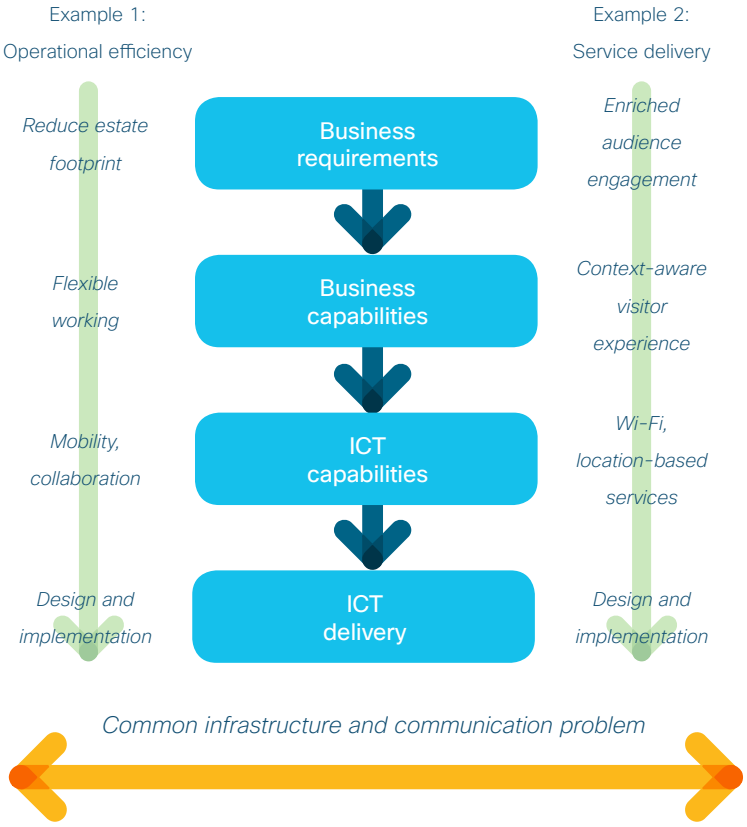
strategy and this is a good place to start in terms of foreseeable business need. In addition, the business requirements definition (BRD) can be strengthened by consulting stakeholders across the organisation as well as partners, employees and visitors.

Stakeholder views will always vary; for example, a curator will have different technology requirements to an estates manager or exhibition manager. It is important to correlate all of these perspectives to establish a clear, overall view of the future business state, which will in turn inform the technology domain.

So, where and how can you start to gather stakeholder requirements?

Firstly, consider internal stakeholders from various disciplines, for example business, operations, estates, ICT, partner organisations and visitor groups, and when gathering your information,

Figure 4: Business-led ICT investment



we recommend considering priorities in two very broad categories:

Operational excellence: typically inward facing, the focus should be on the workforce and workplace. It should include considerations of workflow, working practices and communications as well as the built environment, remote and mobile working.

Service delivery: typically outward facing. Here the emphasis is on understanding current service delivery and the future state, i.e. what is best for the service user, and the viability of new models of service.

In both cases the overarching need for effective partnering should feature prominently.

3.2.4 Capability and solution mapping

Once the 'requirements gathering' phase is completed and you have established your business needs – both current and foreseeable – you can then make an informed judgement of what capabilities are required to meet those needs – and how technology can deliver those capabilities.

Figure 4 simply illustrates this process, from the understanding of business requirements to identification of capabilities needed, and ultimately how ICT can provide those capabilities. It is supported by two examples from the inward and outward facing perspectives.

Figure 4: 'Business-led ICT Investment'
The key to this approach is acknowledging that the underlying platform for infrastructure and communications should be common across all identified projects. However, as we have already said, this requires a change of approach towards your organisation's strategic investment in technology.

Large corporate organisations will typically have something known as an Enterprise Architecture (EA). Using an EA methodology, the organisation is mapped in respect of structure, finance, operations, partnerships, service delivery and

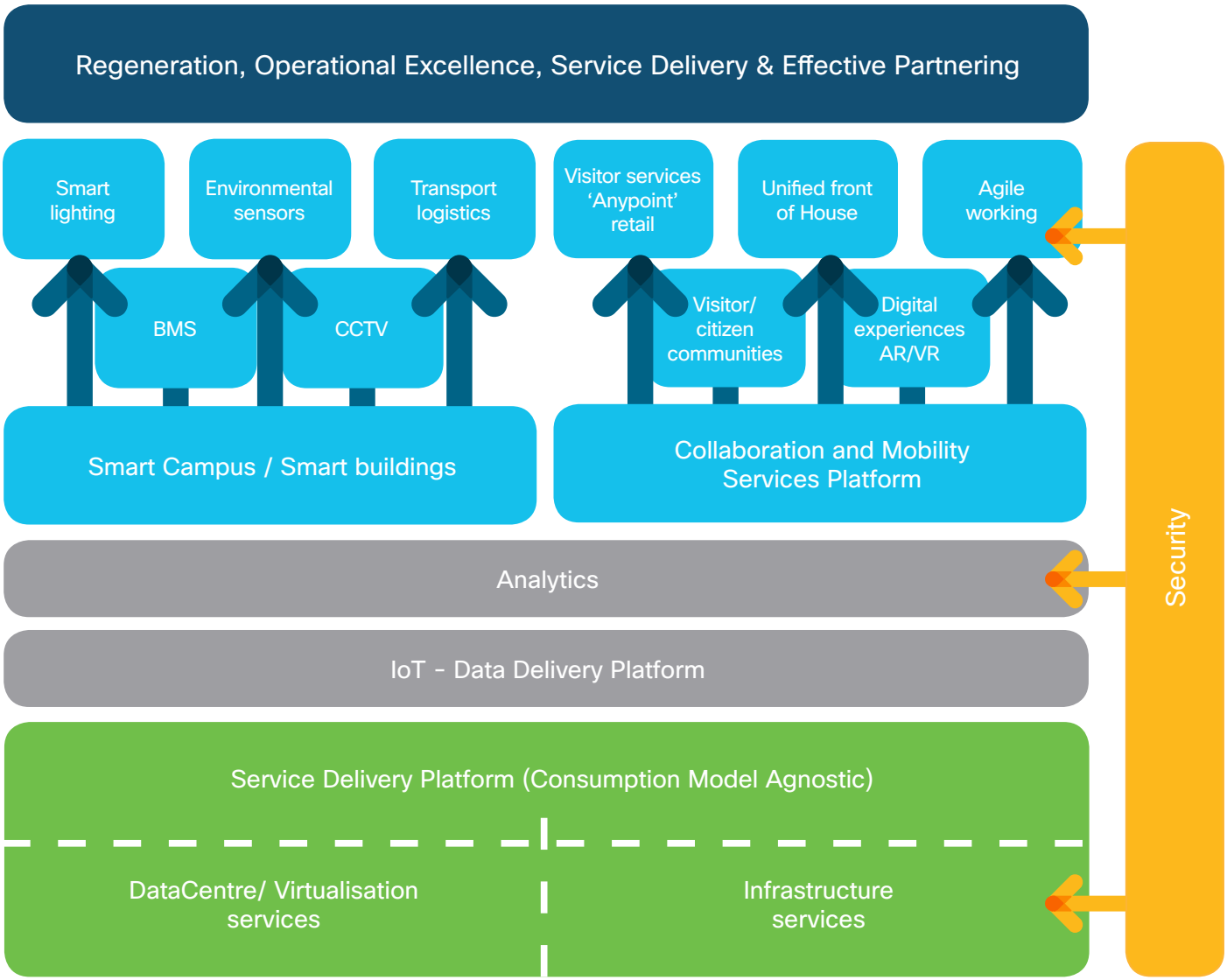
more. All of this information is used to determine the short, medium and long term re-usable capabilities that can be delivered in the technology domain. The approach supports efficiencies, cost savings and cost avoidance due to the fact that opportunities for re-use are easily identified.

When thinking about infrastructure and communications, an EA based approach would allow museums and other culture organisations to invest in a platform that could be re-exploited for many different use cases, as opposed to individual project investment. Figure 5 demonstrates these underlying dependencies, but also the opportunity for re-exploitation using a sample number of use cases.

Figure 5: 'A Layered Platform'
Altogether, the adoption of an architectural approach is a logical and informative method for developing a digital strategy.

The organisation will now have a clear view of what is needed from a business perspective, and how technology can provide the capability to achieve this.

Figure 5: A Layered Platform: Underpinning Visitor Services



4.0 Conclusion

In this paper, we have demonstrated our understanding of the museum and culture sector landscape and considered the imperatives of creating new models of service delivery and visitor engagement. We have also explained the importance of creating a comprehensive digital strategy and provided guidance on how to achieve it.

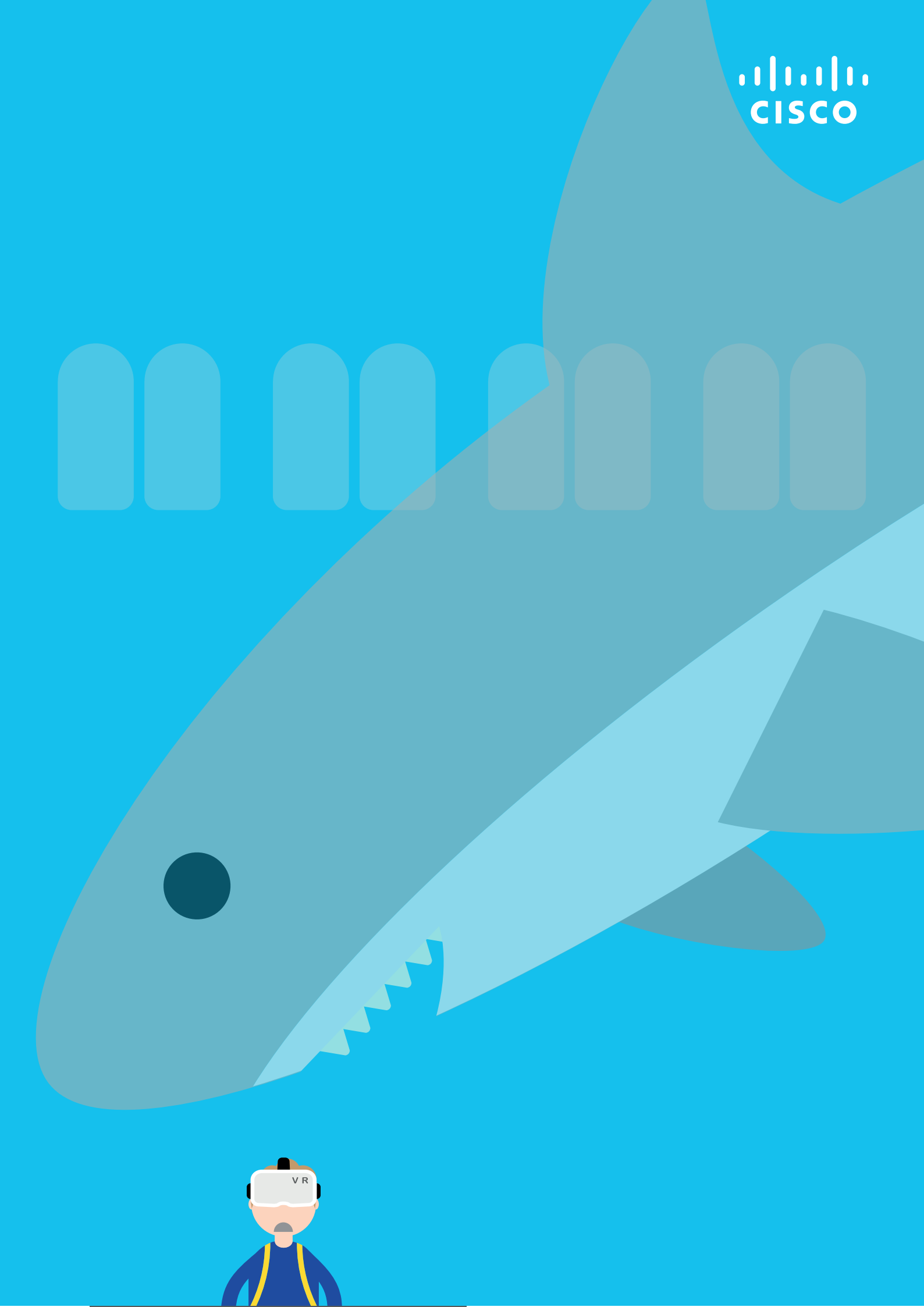
In order to achieve this, we have recommended an architectural approach, beginning with a full understanding of stakeholder views to match with the organisational business plan.

Capability mapping then helps to establish how solutions can respond to business need and ultimately lead to a roadmap for strategic IT investment.

In addition, there is an opportunity to look at a pan-sector approach to enable immersive collaborative solutions. This would facilitate faster setup of live exhibitions, immersive experiences with live remote consultation of subject matter experts and curators and virtual consultative learning environments for schools.

The approach should be based on open standards to allow for collaboration and engagement irrespective of end user device, whether it is a smartphone, tablet or compute devices. This would enable a richer experience for students, citizens and researchers both in the UK and globally, with deeper collaboration and knowledge sharing across the sector .

This approach would also facilitate increased productivity and efficiencies where museums and galleries are struggling with common challenges.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5.0 How Cisco can help

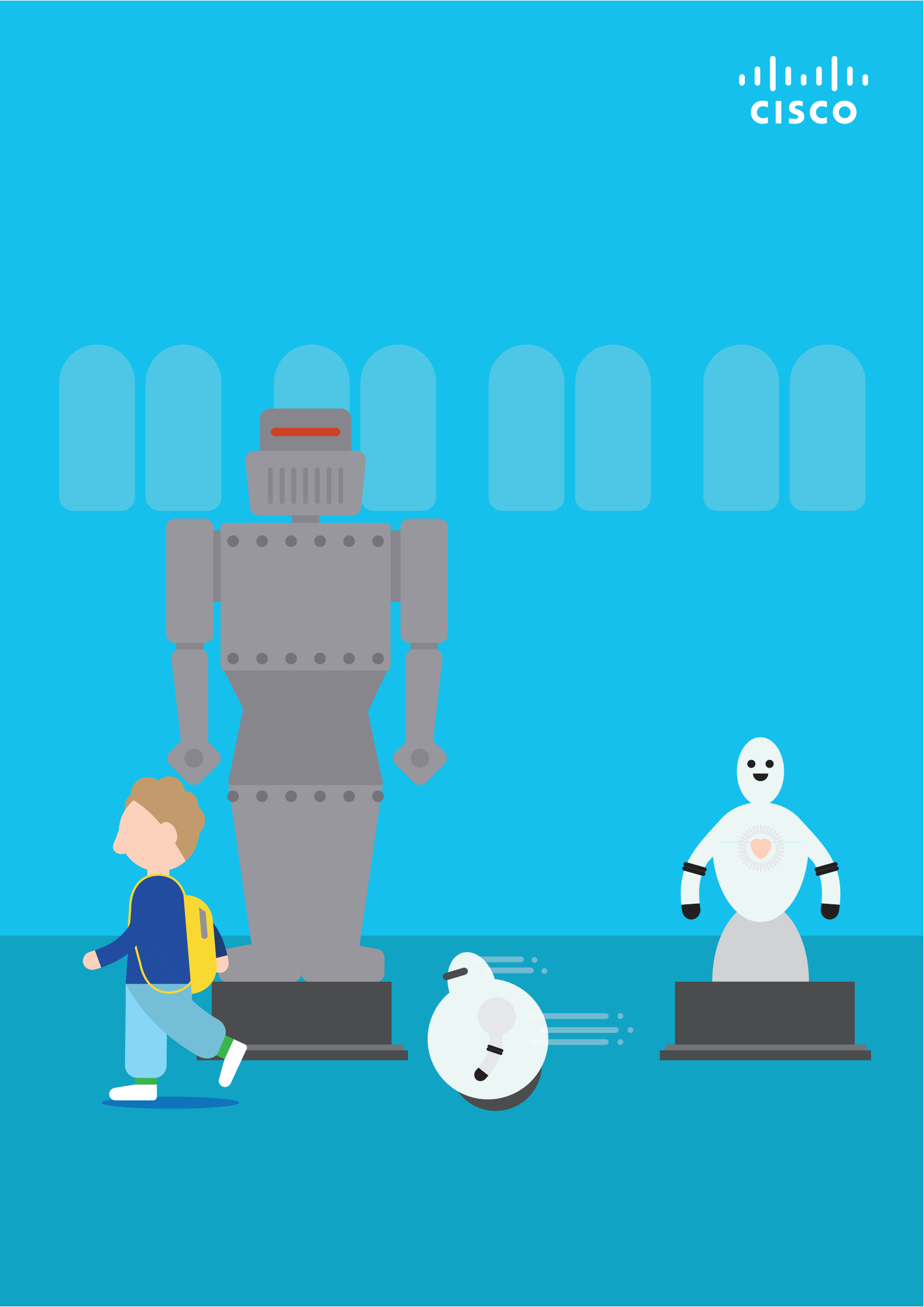
Cisco is one of the largest global suppliers of information technology products and services, and we are recognised for our commitment to annual investment in research and development. We have been at the forefront of technology innovation for many years; our technology powers the Internet and, we believe technology can and does "change the way we work, live, play and learn".

Across many industries and business-types, we have developed and delivered a vast and extensive digital services that prove our pedigree in this area, from services to switching to software to security and beyond.

At the heart of our success has been the business exploitation of interoperable Internet Protocol (IP) technology by organisations of all shapes and sizes. We invest heavily each year in the development of standards, and in interoperability testing, to ensure that technology can continue to be built with the function, features and performance demanded by new generations of users.

Cisco's dedicated team of experts supports our UK culture sector customers by combining its comprehensive knowledge of the sector with technology expertise. In doing so, our specialists can help you select the right Cisco solution to meet your business's needs.

For further information or to discuss the digital blueprint for your organisation's future, contact **culture_ciscouki@cisco.com**



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This paper has been prepared by Cisco with support from independent consultants, Propellerfish


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