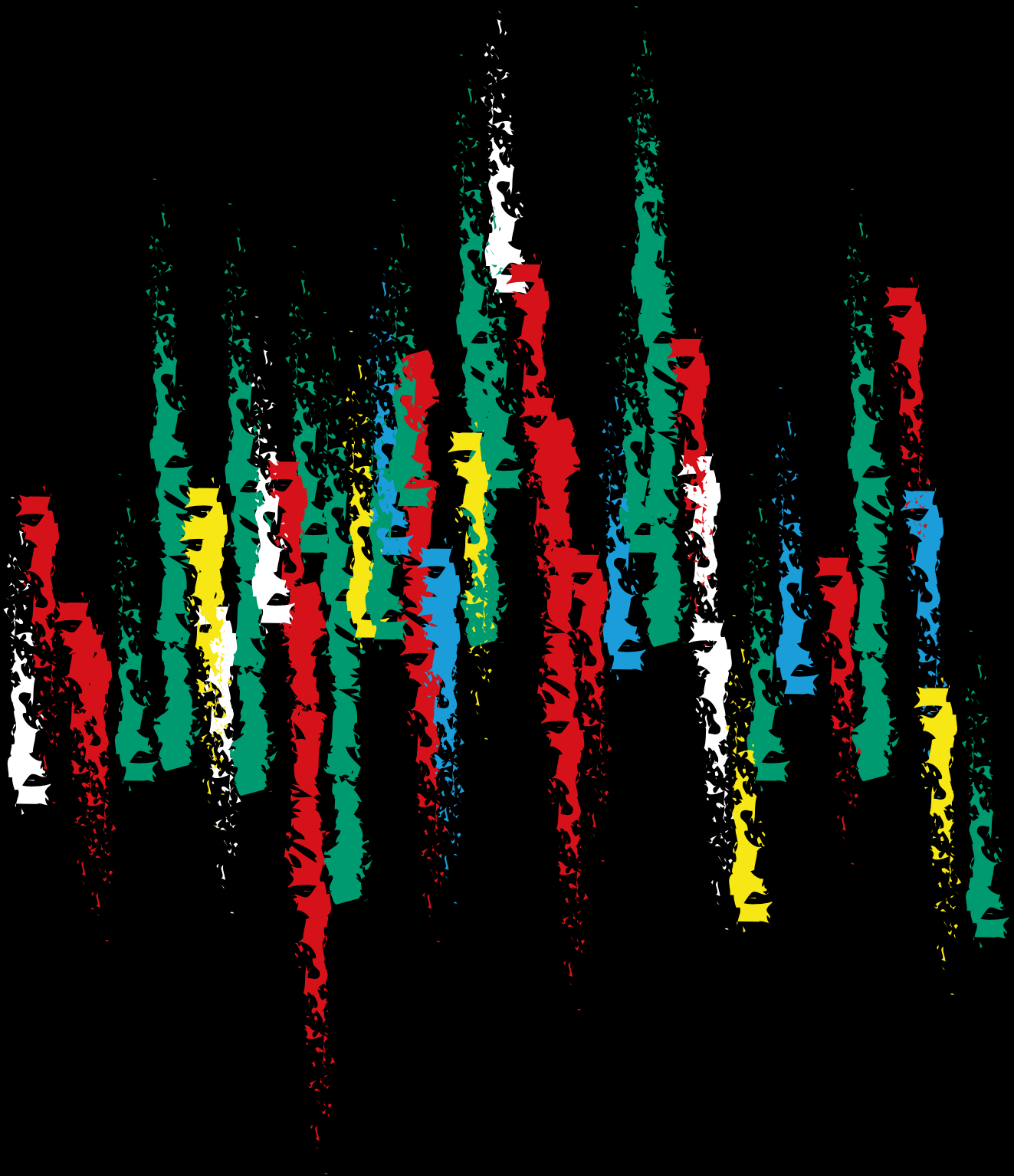
Radical Capital



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Executive Summary

Radical Capital steps beyond the property space to address the big picture themes fundamental to the long-term future of the Oxford-Cambridge Arc.

By assembling more than 60 leading thinkers from across academia, business, real estate and the knowledge economy; this report seeks to uncover how these sectors can work more cohesively to drive UK innovation, economic growth and deliver societal benefits for us all.

The report is arranged around six sections. Each investigates a different strand of 'capital', but it is our belief that to 'Supercharge' the Arc these six aspects must be considered collectively.

By bringing a think tank of senior leaders and Bidwells' partners together in a series of roundtables and one-to-one interviews, we created the space for big ideas to blossom.

Each section provides both the deep perspectives of our expert contributors as well as a collection of radical policy ideas, raised during discussions and shaped by Bidwells and Blackstock into ideas with the potential to grow, advance or supercharge the Arc.

The Arc's economy – which currently accounts for seven percent of England's economic output - could grow to £235 billion by 2030 and already supports over two million jobs. The region is home to some of the UK's most innovative life sciences and technology businesses, as well as giants such as Cambridge-based AstraZeneca, Apple and Microsoft.

The region is also the birthplace of the Oxford/AstraZeneca Covid-19 vaccine, which helped open up economies around the world after extensive lockdowns. It's partly thanks to this that UK GDP now sits just 0.5 percent below pre-pandemic levels.

Our Grow ideas, if implemented, are intended to continue growth in the Arc along the same growth trajectory. Our Advance ideas could, if picked up, advance the economy further.

To Supercharge the Arc and to maximise the untapped potential for world-changing research and innovation taking place across the region, we propose six key recommendations that would help generate unprecedented prosperity on a national and global scale.

#radcap

1. Establish a Science and Tech Growth Board to ensure central co-ordination of activities which affect the Arc ambition
2. Establish a new 'innovation' use class in planning terms, comprising of principal laboratory and space for knowledge-intensive R&D. Using that Use Class Order definition, define any development over 50,000 sq m as a Nationally Significant Infrastructure Project (NSIP) covered by the NSIP process.
3. Set up an Arc-wide Skills Task Force with further and higher education bodies working alongside business and industry leaders.
4. Establish a branch of government which acts as a clearing house facilitating introductions between S&T enterprises and education institutions
5. Agree an Arc-wide policy that allows for cross boundary delivery of biodiversity net gain outcomes
6. Create an Arc-wide promotion agency to continue telling the story

With the right support from central and local government, we believe these recommendations will not simply advance innovation and grow the size of the Oxford-Cambridge Arc economy but be revolutionary in their effects.

But as policy makers and politicians have come to acknowledge, the Arc's potential is not so easily activated simply through new infrastructure, tax incentives or planning reform.

To maximise the Arc's untapped potential for world-changing research and innovation, we need a radical rethink of how we invest in its economy, its people and the environment.

Patrick McMahon
Head of mixed use development, Bidwells

$3.1bn

The total raised by Oxford and Cambridge in venture capital investment from January to the end of June 2021

70%

The proportion of investment into the Oxford and Cambridge lab markets from overseas in 2021

11%

The contribution to UK GVA the Arc is expected to contribute by 2050 (up from 6% currently)

UNIVERSITY OF OXFORD

The World within Our Reach

Discovery, ingenuity, experimentation and investigation are essential to the human condition. Our desire to continually push the frontiers of knowledge, leaving footprints on seemingly unimaginable places, is as much a product of an inner drive to advance humankind as it is innate curiosity. We could call it a necessary obsession. Inventiveness and enterprise, and our yearning to explore and solve life's greatest questions, is a mantle which is passed through to every generation.

Some discoveries, like the Oxford-AstraZeneca SARS-CoV-2 vaccine, are born of unexpected emergencies which require original thought. Without the quick-thinking innovation behind the vaccine, we risked an insular society perpetually held prisoner to a virus we neither knew nor could control. Other discoveries are slow burners - less urgent but equally complicated - made possible through a series of incremental steps forward though their potentially world-changing implications makes them just as significant. Across all innovation undertaken in the UK, we're pushed into new and unfamiliar territory, which is one of the greatest joys of furthering science and technology. With every fragment of new knowledge, we improve our comprehension of the world around us and open new avenues to better our collective society.

That desire to advance societal outcomes is no better displayed than within the Oxford-Cambridge Arc. The common thread that binds together the knowledge economy we have created is a propensity to collaborate. This is deeply embedded in the culture of the region and replicated in long-term public and private sector investment, the creation of commercial partnerships, universities as educators and incubators of talent, and the cross-fertilisation within science campuses and innovation districts, which act as catalysts of the scientific endeavour. By sharing new ideas and testing preconceptions, we continually challenge the status quo in ways that agitate and accelerate the creative process.

Clusters in Oxford and Cambridge, and their adjacencies with the centre of the Arc, collectively form a fertile and dynamic ecosystem of innovation. Thousands of pioneering enterprises, from start-ups and academic spinouts to listed and globally recognised companies, have their roots in the Arc precisely because of its rich and irreplicable culture.

In life sciences alone, we need only look at companies like Vaccitech and Oxford Nanopore as examples of where this region's unmatched knowledge economy and its unique assortment of business, academic institutions, science parks, government research organisations and industry networks have made a profound impact on our social prosperity.

The Arc has all the distinctive characteristics to be a leading region of world-class research and development. In some respects, it already is, attracting investment from other high-performing clusters in the U.S., Europe, and Asia, though we know that further investment into its capital stock presents a remarkable opportunity to 'supercharge' its potential. This value-add isn't just measurable in economic terms alone: in the right combination, improvements to knowledge transfer, skills, sustainability and the connectivity of the Arc will spill over into societal returns which far outweigh the impact monetarily.

Through commitment of time, resource and a determination to support and empower the companies breaking new ground in the region, the Arc can consolidate and advance its position as the source of world-leading scientific and technological enterprise that once appeared impossible. The world within our reach is ultimately one which we do not yet know, but it's guaranteed to be shaped by the activity within the Oxford-Cambridge Arc.

Sir John Bell, Regius Professor of Medicine, University of Oxford

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Three Cheers for the Arc's Triple Helix

Back in 2019 when we created the Radical Regeneration Manifesto, things looked starkly different. We wrote that a tremendously bright future awaited if we supported the Arc and embraced progressive thinking around digital engagement and sustainability. We couldn't have predicted what was to follow.

The regional collaboration between Oxford and Cambridge that we so strongly advocated for underpinned the Oxford-AstraZeneca vaccine - now jabbed into billions of arms worldwide. It underlines what a coming together of private, public and academic minds spanning the length of the Arc can achieve. And it stands as a testament to the UK's very real ability to be a global leader in developing life changing solutions to the problems of our age.

Those more articulate than me refer to this type of innovation as the "triple helix". I just call it "amazing, smart people coming together for a common cause". The vaccine is but one example of regional achievements with a global reach. And if we inject vital resources into the Arc as the base of Britain's ambitions to become a scientific superpower, then countless inspiring enterprises will doubtlessly follow.

Initiatives we see emerging right now range from automation and quantum computing to nuclear fusion, environmental sciences and nuclear engineering. All these, and more, are packed into this report.

Beyond its ground-breaking potential for improving the human condition, the Arc is the engine through which we can power the next phase of economic success for Britain. At a new frontier across so many cutting-edge industries - from life sciences to automation and robotics, to the game-changing possibilities of nuclear fusion – our potential to enter a new chapter of growth as a nation is unparalleled.

Infrastructure and housing remain key challenges in securing this growth. This means jumping on opportunities to better use public land and leveraging the need to decarbonise but investing properly in energy systems that can power not just homes, but innovation.

The economic value of the Arc could easily double by 2030. But we must continue to support the region's growth. The concentration of talent and technical skill, underpinned by world-class universities and a nurturing ecosystem for new start-ups, are no-brainer for global investors seeking defensive income streams against a backdrop of economic volatility.

This report shows that the only way to leverage such investment is by affecting radical change. We have to tie together disparate strands of capital with our collective desire to encourage responsible investment. This demands a climate where all boats can rise in a sea of talent, awash with incubating start-ups and waves of investment.

We have to learn from the mistakes of the past, too, where British inventions like the jet engine instead became the money-spinners of Boeing and Airbus. This doesn't mean becoming protectionist but simply supporting our domestic researchers, innovators and entrepreneurs enabling them to commercialise their scientific output at home. Now is not the time to become lukewarm on the Arc, just as it is starting to build momentum.

We need to redouble our efforts to put the Arc further ahead of similar technology clusters around the world. And the way to do this is to think about the region as an arc running across the Atlantic and beyond the Channel. The road ahead may be bumpy, but the future remains bright.

Andrew Teacher, Founder, Blackstock Consulting

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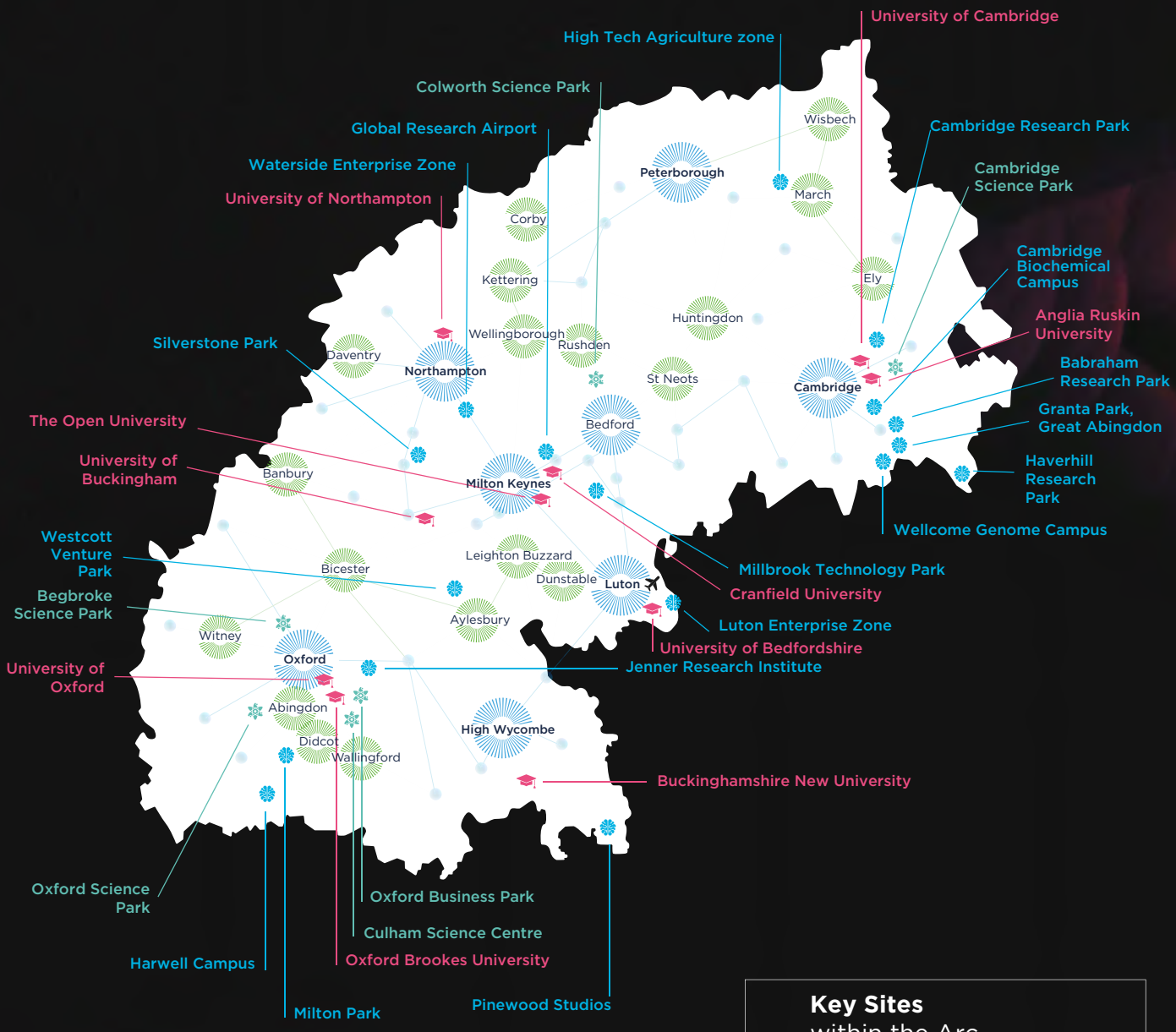

Key Sites within the Arc	
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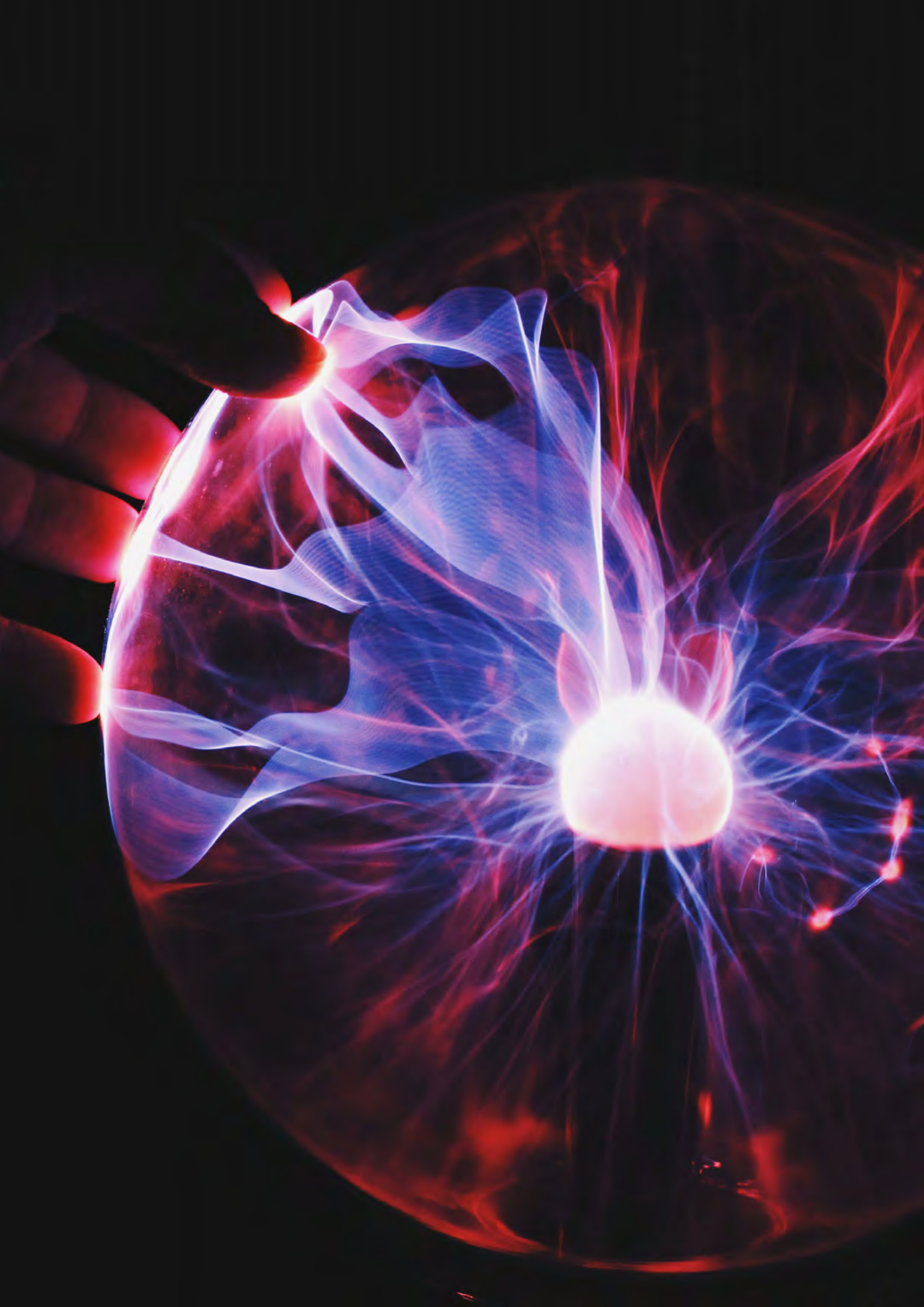
Image courtesy of Arc Leadership Group, Economic Prospectus



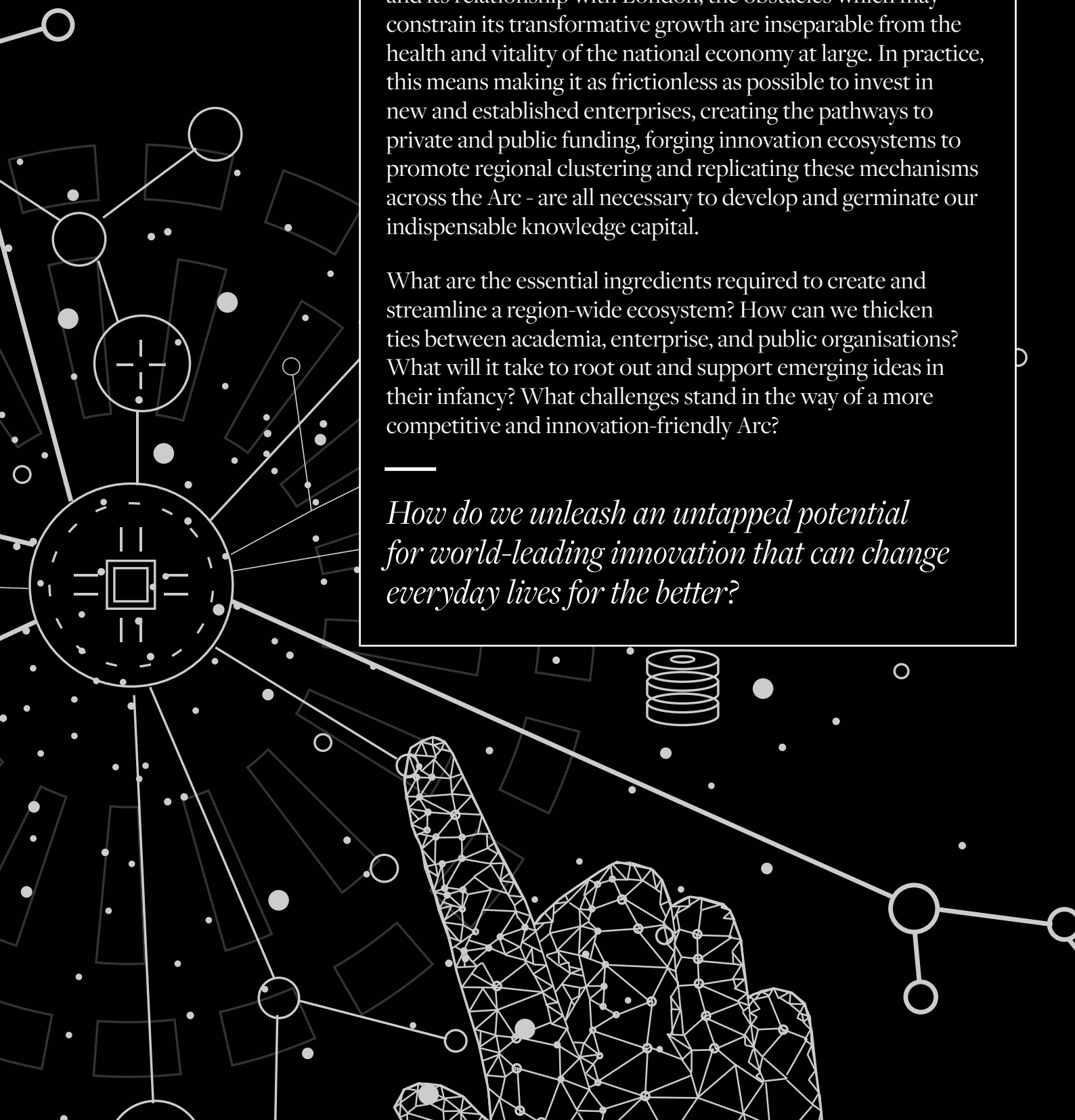
Knowledge Capital

Innovation and scientific discovery in the Oxford-Cambridge Arc has the potential to be world-changing. A stronger, more cohesive 'Triple Helix' relationship between academia, private enterprise and public sector collaboration, catalysed within science parks and innovation districts and empowered by investment, assemble to make it easier to source, invest in and commercialise new ideas.

Because of the global interest in the Oxford-Cambridge Arc, and its relationship with London, the obstacles which may constrain its transformative growth are inseparable from the health and vitality of the national economy at large. In practice, this means making it as frictionless as possible to invest in new and established enterprises, creating the pathways to private and public funding, forging innovation ecosystems to promote regional clustering and replicating these mechanisms across the Arc - are all necessary to develop and germinate our indispensable knowledge capital.

What are the essential ingredients required to create and streamline a region-wide ecosystem? How can we thicken ties between academia, enterprise, and public organisations? What will it take to root out and support emerging ideas in their infancy? What challenges stand in the way of a more competitive and innovation-friendly Arc?

How do we unleash an untapped potential for world-leading innovation that can change everyday lives for the better?



x19

The proportion of patents generated in Cambridge is 19 times higher than the national average

£9bn

The total value of spinouts from the universities of Oxford and Cambridge in 2021 - 28% of the UK's total

£54bn

The total government has committed to spend on R&D in 2027 (2.4% of GDP), rising from £32bn today

£10.30

The amount generated for the wider UK economy for every £1 invested in the University of Oxford's research and knowledge exchange activities

£33bn

Amazon and Alphabet's R&D expenditure in 2018 combined. UK expenditure on R&D, both public and private spending, was approximately £30bn in the same year

62%

The percentage of UK spinout capital raised, attributable to life sciences

8

The number of the top 10 UK spinouts in the UK by valuation, worth approximately £9.8bn, that are life sciences companies

What we Stand to Gain

Andrew Groves, Head of Capital Markets, Bidwells

Knowledge capital is, in many ways, a representation of our culture. It's the networks we build and the degree to which we actively nurture original thought and challenge ideas. Our intangible 'stock' of knowledge comprises the information we cultivate, while the speed at which this knowledge spreads is inextricably linked to the conversations we share.

While the Arc comprises just 5% of the UK's landmass, it has all the innate ingredients to become one of the most technologically advanced and knowledge-intensive regions in the world. A cultural foundation of ingenuity, experimentation and enterprise connects prestigious universities as educators and incubators of novel ideas with tens of thousands of companies commercialising research.

Public-private partnerships, such as the UK Atomic Energy Authority (UKAEA) and the Cranfield Forensic Institute (CFI), make it possible to share the advantages of large-scale, demonstrative infrastructure. Clustering within science parks, towns and city centres, at all growth stages in advanced sectors like manufacturing, life sciences and AI, provides the ideal environment to share knowledge. This recipe of culture and collaboration is precisely why the Arc's economy has doubled over the last 20 years.

If the Arc absorbs almost two-thirds of total venture capital investment across the life sciences industry, and generates over £110bn in GDP every year, we ought to ask how much more 'knowledge capital' can be cultivated organically. Total investment activity across the Arc reached almost £2.4bn in 2020, 56% ahead of 2019 levels, driven by a depth of demand in the Arc's existing activity. The Arc also commands 22% of the nation's science park floorspace, housing start-ups, industry titans and everything in between. Is there a need to 'supercharge' the Arc if the region is performing well without intervention? How would this influence the culture of knowledge transfer already established in the Arc? These are questions of confidence, but also collective ambition.

Leaving the evolution of the region to its own devices is one option, though we're fast approaching a point of saturation where the Arc's knowledge capita formation will be shackled by the weight of its own success. Whilst the Arc has a total of some 60m sq ft of commercial office and laboratory floorspace, and innovation centres are in planning, there remains a critical under?supply of both categories as demand ration continues to decline. Because the availability rate for R&D labs in Oxford and Cambridge stood at just 6% and 4% respectively, many emerging companies have been forced to adopt a 'make-do' real estate strategy which will temper the potential and proliferation of fledgling start-ups. Commercial and residential rents are also rising exponentially while employment in technology-driven sectors climbs at an unprecedented rate – 6% year-on-year – within the nuclei of the Arc.

As an idea engine, the region is only as powerful as the resources available to it. Attracting global investment, empowering a skilled workforce, creating the infrastructure to foster knowledge sharing, and providing long-term solutions which enable the interfacing of universities, investors, accelerators, and companies commercialising ground-breaking innovation, demands structural investment and policy reform.

With the right interventions, the Arc's economic output could grow to £235bn by 2030. More importantly, the Arc will serve as the origin of potentially world-changing innovation, with an outstanding social reach that improves lives around the world.

With the right interventions, the Arc's GVA could double by 2030 to £235bn

Source: ONS, Bidwells Research

The Crucible of Knowledge in Context

Harriet Fear MBE, Director, Cambridge&, previously the Prime Minister's Business Ambassador for Healthcare and Life Sciences

Investing in the 'lightbulb' moments that trigger world-changing innovation is not a selfish enterprise. I'm always deeply struck by the fact that innovative ecosystems aren't evolving ideas and commercialising creativity because it satisfies a select group of people. Or because there's a profit that stands alone from the social purpose of the scientific endeavour. Time and time again I see that the pride comes from the knowledge that the spoils of focused research have the potential to benefit present and future generations globally, in ways that perhaps we can never begin to expect.

It's not always easy to show all parts of our societies how science can have monumental societal advantages. Perceptions abound about what goes on behind laboratory doors and in the shiny buildings that are springing up throughout clusters.

NASA, the International Space Station (ISS) programme, and the UK Space Agency domestically, have all seemingly faced an uphill struggle when justifying large-scale public expenditure on space exploration which doesn't immediately impact human activity on Earth. Doing some research, it's clear that the aspiration to understand our cosmos has resulted in over 3,000 'spin-off' inventions contributing magnitudes more than their budgets to GDP and general humankind. These inventions include satellite communications, solar panels, implantable heart monitors; cancer therapies, advances in weather forecasting, air travel, search-and-rescue, water purification, computing, aerodynamics, wireless networks, fuel cell storage, drones, augmented reality and prosthetics.

I sometimes wonder if our ecosystems, and the UK as a whole, have a tendency to downplay how brilliant we are at having and developing original insights.

This could have the effect of leading to an undermining of progressive and potentially world-changing ideas that test the societal parameters we've set ourselves. We should be bolder in our 'promotion' and I know many in our ecosystems are working hard on that. I've lost count of the number of times US investors have said to me 'Goodness, I didn't know THAT' about the UK, and questioned why we aren't shouting from the rooftops about our scientific excellence.

We don't have to look too far of course to be supremely proud as a 'region' of recent advances. As a product of ingenuity and perseverance involving all aspects of the Oxford-Cambridge Arc, the AstraZeneca vaccine and its contribution to the safety of millions of people worldwide has social advantages that are both obvious and unassailable. In the face of an indiscriminate pandemic, hundreds of other innovators worked tirelessly behind the scenes in laboratories within the Arc, contributing as suppliers of 'blank' proteins and antibodies necessary for experimentation, as PPE suppliers, test creators, diagnostics providers and more.

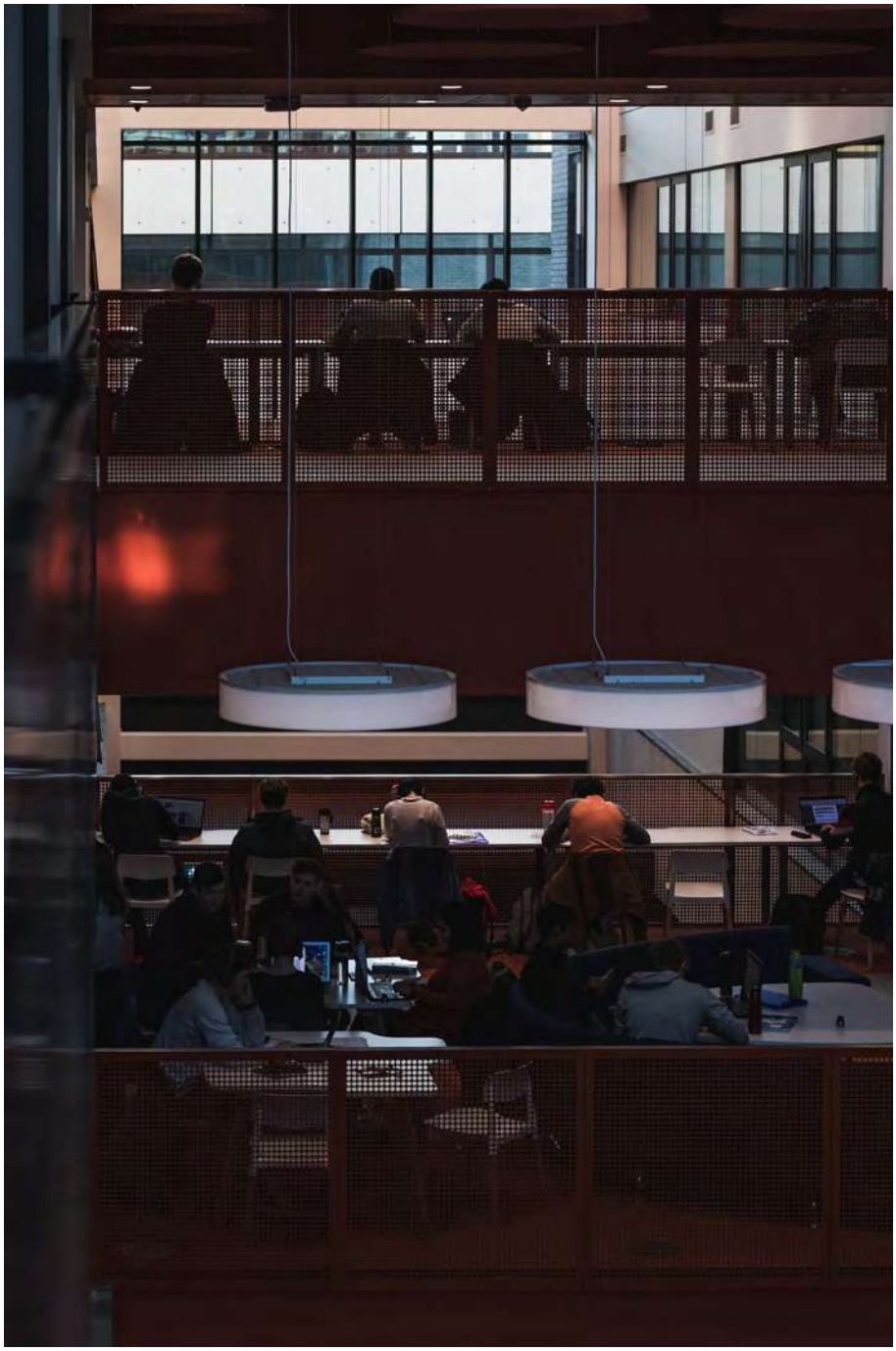
This is one world-changing innovation among many being incubated and evolving within the Arc. Its fundamental importance to life and our collective social prosperity is a wakeup call to what's possible if the region's innovation ecosystem is fully supported. In my experience, we are always pushing boundaries and will never be comfortable or satisfied with the familiarity of the path well-worn.

This is the tip of a tremendous iceberg of scientific and technological progress that could be made even more possible if we look to double down on what the Arc does well. And alleviate barriers encountered by innovators, investors, academic institutions and the providers of that space, to enable the ecosystem to flourish.

From Plinth to Pillar

Dr Phil Clare, Director of Innovation & Engagement University of Oxford and Professor Yvonne Barnett, Deputy Vice Chancellor (Research and Innovation), Anglia Ruskin University

Three or four decades ago it was universally acknowledged that the main role of universities was to educate students and conduct research. The 'D' part of R&D was firmly the domain of business and industry, and the job of taking research into society, or to the market, was largely left to others. Of course, there were always enthusiasts who worked with businesses, or even founded their own, but they were few and far between.



However, around that time, there was talk of a 'third mission': that universities should invest time and energy in taking the ideas they generated and using them to make a difference. Academics that wanted to see their ideas fully realised, increasingly recognised that they had to put in effort to take them forward and they called on universities for support. Research contracting support services, business engagement teams and technology transfer offices were created, professional staff with commercial and legal experience were hired and the transformation of the role of universities gathered pace.

Educators also began to consider more deeply, how to equip their graduates for careers beyond academia. Future employers require both knowledge and skills and increasingly, universities are responding strongly to growing demand from students to support their entrepreneurial aspirations. More students than ever before want to start their own businesses either when they graduate or shortly afterwards, and universities are acknowledging this with training, access to investment, incubators and accelerator programmes.

Strengthening The Triplex Helix Ties

Dr Phil Clare

Professor Yvonne Barnett

Universities also do an enormous amount to support those already in the world of work through CPD programmes and part-time Doctoral provision, both of which are crucial for driving forward innovations and improvements in professional practice. For example, Anglia Ruskin University is a lead partner, with NHS England and NHS Improvement, in delivering the world's largest healthcare entrepreneurship programme. This helps clinicians and healthcare professionals gain invaluable commercial skills, knowledge, and experience to bring their ideas and innovation into reality.

Putting this together, universities have transformed themselves into engines of innovation that would have been unthinkable 50 years ago. Of course, universities have always had an impact on the economy; for example, the Oxfordshire economy is populated with companies founded by members of the universities stretching back to Oxford Instruments in 1959. The difference is that rather than passively allowing these things to happen, universities are now determinedly setting about the task of making a difference across all disciplines and are providing support for innovation and entrepreneurship through all parts of the academic community.

University innovation centres, tech transfer offices and business partnerships teams are now an integrated and essential part of university operations; entrepreneurship and mentoring programmes are commonplace; and a consistent interplay between business and academia has become a normal expectation rather than an infrequent occurrence.

The pandemic has brought many challenges which have been eased by pioneering innovations coming out of universities such as rapid testing kits, ventilation equipment and even an app to help people avoid crowded places. SMEs have felt the strain and university business support programmes, such as the KEEP+ partnership led by Anglia Ruskin University, have been important in helping businesses access talent and academic expertise to sustain further growth.

As charities, universities are committed to work for public benefit, and commercialisation of research and support for entrepreneurs includes a commitment to social enterprise and social action. A recent, well-known example is the Oxford Astra Zeneca vaccine where the partners eschewed profit maximisation in favour of a low cost, globally distributed vaccine.

Universities are becoming more focused on how to support social ventures, which have rarely attracted the amount of financial backing afforded to more traditional spin-outs and start-ups. Earlier this year, Impact 12, a 10 year, multi-million pound investment fund, was launched to support and accelerate the social ventures of 12 universities that are collaborating to find solutions to support the UN's Sustainable Development Goals. The fund will support up to 15 social ventures from across the partner universities, with both seed and follow-on funding over the next 10 years.

Three years ago, when we started looking at the impact of the nine Arc universities collectively, their combined economic impact in the UK totalled £13bn. A more recent impact study of Oxford University alone has topped that. Things change quickly. This is indeed evidence of the role of universities in the engine room of the economy.

Arc universities are founding businesses at an increasing rate. Oxford alone spun out 31 companies last year and attracted £1.1bn investment. Cambridge has experienced similar growth and across the board, Arc universities are engaging with and launching businesses at an increasing rate. These businesses are often knowledge driven and grow rapidly, and are part of the reason why the UK can aspire to be a knowledge superpower.

Clearly, university research, knowledge exchange and innovation make an enormous contribution to the prosperity of the UK. This can only be strengthened by collaborative working such as the visionary programmes being implemented by the Arc Universities Group. These include zero carbon aviation, advanced therapeutics and space technologies, and will create jobs and businesses as well as contribute to a low carbon, healthy economy.

Universities are linchpins of the innovation districts within the Arc region, generating essential research, skills and innovation to support inclusive and resilient growth across the region and beyond.

Telling Our Success Stories

Q&A with Richard Turnill, Senior Bursar, Trinity College, Cambridge

Trinity College founded the first science park in Europe - Cambridge Science Park - providing land and funding for hi-tech enterprises in the region. 50 years on, over 100 world-changing companies occupy the Park, pioneering R&D in everything from disease prevention and robotics to renewable energy generation.

How important is it for universities and colleges like Trinity to be involved in incubating and supporting innovation across the Oxford-Cambridge Arc?

At the heart of all university and academic institutions is a desire to push forward original thought. For Trinity specifically, our mission is education and research for the public good. Advancing R&D and driving innovation will always be part of this; investment in scientific and technological progress helps us to maximise returns that further support Trinity's activities, while at the same time encouraging future innovation that is emerging here and elsewhere.

As you've rightly pointed out, the best example of how Trinity supports innovation is Cambridge Science Park. My predecessor, Sir John Bradfield, had enormous foresight to create the first science park in Europe; it's remarkable to think the land – then of course only fields – was donated to the College by its founder, Henry VIII, in the 16th century.

The success of Cambridge Science Park has accelerated in recent years. 40+ years ago, Trinity took a very long-term view and now the College and society at large benefit from the ground-breaking innovations that companies at the park have, and continue to develop. Owlstone Medical introduced the world's first breath biopsy test for the early detection of cancer, Excalibur Healthcare produced one of the first lateral flow and PCR health kits to detect Covid-19, and there is exciting work in fields like virtual reality.

Trinity was at the forefront of creating a fertile environment for this innovation. The College developed the park as a key hub for innovation in the region and to catalyse exchanges between innovators and entrepreneurs with similar interests. It's inspiring to see this model replicated in the region and beyond.

Of course, the park is a focus of attention because of its history and success – and because we are continually developing it - - but the College's approach to innovation is broad based. In Felixstowe, we helped establish a joint venture between the port and the University of Cambridge to incorporate 5G IoT technologies. And across our securities portfolio, we identify and invest in innovative start-ups and emerging sectors.

There is a keen interest in making a real-world difference by supporting innovation that has positive impacts, yes in Cambridge and the East of England, but also around the world.

What about innovation in the College itself? How does the environment created by Trinity support emerging start-ups and spinouts?

Across the College there are Fellows involved in successful, real-world applications of their research, notably the former Master, Sir Gregory Winter, who developed of a new category of drug that revolutionised the pharmaceutical sector and changed many people's lives worldwide. This culture of innovation and entrepreneurship helps show students and researchers that support can be provided as they look to develop their ideas and take them outside the university into the wider world.

Within Trinity, world-leading research that wins global prizes makes a big impact on current and prospective students. The College is fortunate to have 34 Nobel Laureates, mostly recently Professor Didier Queloz, for physics, not to mention leading mathematicians and scientists such as Professor Greg Hannon and Professor Rebecca Fitzgerald, who are pioneering smart techniques to identify cancer and pre-cancerous conditions early on.

For students, the College provides an extraordinary networking environment to meet and discuss fresh ideas. Trinity brings together students and academics from different disciplines to collaborate, and supports innovation through awards such as the Trinity Bradfield Prize, which is open to teams across the university. As well as no-strings

Strengthening The Triplex Helix Ties

attached funding, researcher-entrepreneurs can access the Bradfield Centre's fantastic networking and mentoring opportunities, as well as business support, all of which is crucial to developing the commercial viability of research-generated ideas.

How does Trinity benefit from being in close proximity to public and private enterprise from a research and collaboration perspective?

The key here is that we need to recognise a symbiotic relationship between the university and the innovation undertaken by public and private enterprise. Spinouts from Trinity and other colleges in Cambridge come onto the park we've developed, such as Astex Pharmaceuticals developing drugs to combat diseases of the central nervous system and Cambridge Touch Technologies, making super accurate sensors for electronic devices; their biggest talent pool is the university itself.

Those success stories then inspire a new generation of innovators with cutting-edge ideas, creating the ideal environment for further collaboration. That's why we've worked hard to foster relationships with many organisations within the park and the wider Arc region.

For Trinity, it works both ways. This is essential if we're to understand why it's so important to support scientific enterprise.

How can we continue to generate global interest in R&D activities within the region?

There are three ways to maximise global interest in R&D activities in Cambridge and the region more broadly.

First, we need to listen to students and businesses present in the region to understand what support they need to grow and scale. Trinity has done this well and we need to continue actively ensuring their needs are heard.

Second, both business and academia need to come together. The Bradfield Centre is an ideal forum for these sorts of exchanges that drive innovation and help catalyse commercial application.

Third, there needs to be organised collaboration. Collaboration isn't only manifested in places like Cambridge Science Park, but in many different ways including prizes and programmes that channel capital to new ideas and our investment in innovative start-ups and emerging sectors.

We can do more by telling the success stories better: what is research and innovation for? What are the benefits of collaboration, locally and globally? R&D isn't there just to make money and it's not purely an academic exercise. It's for the good of everybody, and what's happening here has a positive impact worldwide.

If the Oxford-Cambridge Arc is going to be a primary European hub for innovation, we need to amplify this message.

Providing Student Entrepreneurs with the Resources to Thrive

Leah Thompson, Knowledge Exchange and Impact, Enterprising Oxford

At the University of Oxford, we know from our incoming student surveys that approximately 20% of our students are interested in entrepreneurship, but many more than that participate in entrepreneurial activities such as idea exploration, hackathons, pitching competitions and skills building workshops. Oxford does not have an institutional entrepreneurship unit, but instead, support is organised and delivered by a multitude of providers across the University, including faculties, departments, Oxford University Innovation, the Careers Service, the Saïd Business School and student societies.

The huge array of events and activities tailored to emerging entrepreneurs is an encouraging step-change in the way that we support and educate outside of the lecture theatre, but in some senses, it is a significant challenge. A normal Michaelmas term (October to December) can see 40 to 60 entrepreneurship events per month available, which can be confusing to those students that are seeking consistent, focussed mentorship to get their ideas off the ground. This is in addition to all the other activities, and the normal course work as well. Finding these activities, and then finding time to attend or participate, can potentially be as much a barrier as a benefit to new entrepreneurs starting their journey.

Enterprising Oxford is a University of Oxford initiative that connects all these resources in one central place. We support entrepreneurs at every stage, from the development of skills, networks, and business ideas, to pitching, finding laboratory and creative spaces, and scaling up from initial foundations. This includes a signposting and concierge service to help users find the resources and opportunities they need to develop their entrepreneurial skills or ideas when they need them. The website collates entrepreneurship-related events and activities, and the weekly newsletter provides curated suggestions to subscribers. The calendar is regularly updated, providing a rich picture of opportunities for those interested in skill or idea development. The bonus is that many of the events and activities are also open to staff and the wider Oxfordshire community.

According to GovGrant, an average of 15.8% of spinout companies produced by UK universities have their origins in the University of Oxford - more than any other university across the country. As well as access to novel research and world-class facilities, this rate of commercialisation has been made possible through the skills and development provided by the university's entrepreneurial support. We encourage entrepreneurs to lay down their roots in the region and consider their local environment to be an extension of their resource.

For the Oxford-Cambridge Arc, and to make the 'triple helix' model a long-term advantage to its growth and prosperity, keeping entrepreneurs in the region is critical. Oxford is a very global university, reflected in our students and staff, but also in outlook, and we cannot afford to miss the opportunities right in front of us. The number of companies spinning out from the university grows each year, as does the number of companies working in collaboration with us. We have a growing and thriving ecosystem in Oxfordshire, with a wide variety of sectors well represented,

Strengthening The Triplex Helix Ties

Leah Thompson

including medtech and health, biosciences, automotive, IT & digital, and creative industries to name but a few. All these innovations rely on the talent pool that the Arc continues to draw in.

Of course, there are even larger, regional obstacles present in the ecosystem. House prices are high and space for development near the city is scarce. Travel within the county can be difficult due to infrastructure challenges and sheer volume of commuters. But one of the biggest hurdles to overcome is the perceived lack of opportunity – students often do not venture out to see the breadth of exciting companies on their doorstep, and many of these companies are not proactive enough in trying to attract these students. We are training our students to be entrepreneurial, and then waving as they head off to places they think have more opportunities, both in the UK and abroad.

The challenge across the Arc needs to be addressed in a similar way – how do we not only nurture this entrepreneurial interest and growth in our students, but also retain them as employees and founders in our entrepreneurial ecosystem? To that end, here are several suggestions:

First, we must make the ecosystem attractive to be in. Innovation districts and live-work-play models offer a variety of opportunities not only for students to develop skills and ideas, but also for larger companies to engage with a more diverse workforce. Housing, transport, and social activities are just as important as breadth of companies, and these are issues that we hear from our student entrepreneurs as they consider where their careers will take them after university.

Second, we must take diversity and inclusion seriously – if we do not create better opportunities for under-represented groups to participate more fully in entrepreneurial activities, we will not be able to reach our full potential as an ecosystem. It is not and cannot be viewed as a 'one size fits all' system – by encouraging and supporting those not currently engaged, we can increase our impact and output exponentially.

Third, we need to encourage successful entrepreneurs that call the Arc home, to engage with entrepreneurs inside the ecosystem and seek assistance at the embryonic stages of their journey, to act as role models and support ('entrepreneurs for entrepreneurs'). This should involve the provision of temporary space, events and mentorship, which will give some flavour to fledgling entrepreneurs about the commercial opportunities and challenges as they grow and develop.

Fourth, we must connect the ecosystem – provide clear pathways and options for those who may be interested in working for startups, as well as those who want to be founders and CEOs. This could include job opportunities and networking events, and ways to matchmake emerging talent with innovative companies through sponsorship and proactive networking.

Finally, we must all consciously seek 'planned serendipity' to allow for chance connections and meetings to occur within a set of spaces and activities.

By creating an environment where the smallest opportunities can make the greatest commercial headway, we can ensure a vibrant and scientifically dynamic Arc which brings out the best from the earliest stages in enterprise.

Public-Private Collaboration in Action

Q&A with Dr Barbara Ghinelli, Director, Clusters and Harwell Campus, Business Development, UKRI-STFC

As a world-leading science and innovation campus, Harwell is home to over 240 pioneering public and private sector organisations. What is Harwell's makeup, and what is its mission?

The Harwell Campus is built around the UK's Rutherford Appleton National Laboratory, a primary centre for R&D and the site of large, national facilities such as the Diamond Light Source synchrotron and others that have application across a broad range of scientific disciplines. A primary attraction of the campus is that it provides industry with access to this R&D base, stimulating innovation and accelerating its commercialisation. We do this through thematic, high-tech clusters that encourage partnerships and which promote collaboration, attract international investment and top-tier talent, advance the frontiers of world-changing science and realise the incumbent societal and economic benefits.

By 'clusters', we mean creating concentrated environments of innovative companies and organisations, from start-ups and scalable micro-businesses to recognisable names we all know, to foster cooperation and commercialise powerful ideas and research across key themes. Each of these clusters has a clear governance structure, overseen by a Steering Board and individual Cluster Development Groups. Our clusters include Space, EnergyTec, HealthTec, and Quantum, which incubate and cultivate innovation, and encourage the sharing of ideas across these sectors, driving growth and empowering companies to interface with one another.

Why is public-private sector collaboration important to R&D, when we're seeing record levels of venture capital investment into the Arc's most promising companies?

It is important to remember that so far this century, government has invested over £3bn in world-leading, national science facilities at Harwell. This impressive accumulation of knowledge-intensive funding has been vital to the formation of several world-class institutions within the Oxford-Cambridge Arc, not least the new Rosalind Franklin Institute for medical research, and has harnessed the economies of scale and long-term capital necessary for new innovation to thrive. Public investment has contributed to the generation of a huge and evolving knowledge base on the campus.

Of course, while public investment is important to fuel future innovation, collaboration is where the larger gains are unlocked. Some of the biggest opportunities initiated on campus have their origins in relatively small, public-private programmes, like the cross-cluster proof-of-concept, which accelerates the germination process from idea, to proposal, to delivery, which has in turn, attracted millions in venture capital funding. This is true innovation in action which couldn't have happened without the commitment from public organisations, and Harwell's role in promoting collaboration and encouraging public organisations to talk and work with one another and together with industry.

Harwell has created a common vision and the conditions necessary to establish effective and impactful partnerships. To many this might be basic, but it's fundamental. Harwell facilitates collective ambition, which is much more than the sum of its individual parts.

How important is plurality of size and approach to creativity, and to diversity of thought within Harwell Campus?

Innovation is not always easy to drive within large organisations that have established working models. That is why larger companies tend to seek creative ideas that originate within start-ups and small companies that have fresh ideas and can be more agile. When you pull together the two at a commercial level, that is where the opportunities exist; and Harwell, and its clusters, is where this interface can and does happen.

We have the likes of Oxford Nanopore, who have just raised an IPO and are growing very fast, and enterprises such as Vaccitech at the forefront of current life science research, especially in the aftermath of Covid-19. Within the Space cluster, we now have 105 organisations that employ more than a 1,000 people, and within that, a varying composition of capital requirements. Small or large, fast-moving or more focussed on the long term, we see every company harnessing opportunities within a cluster to link-up and collaborate.

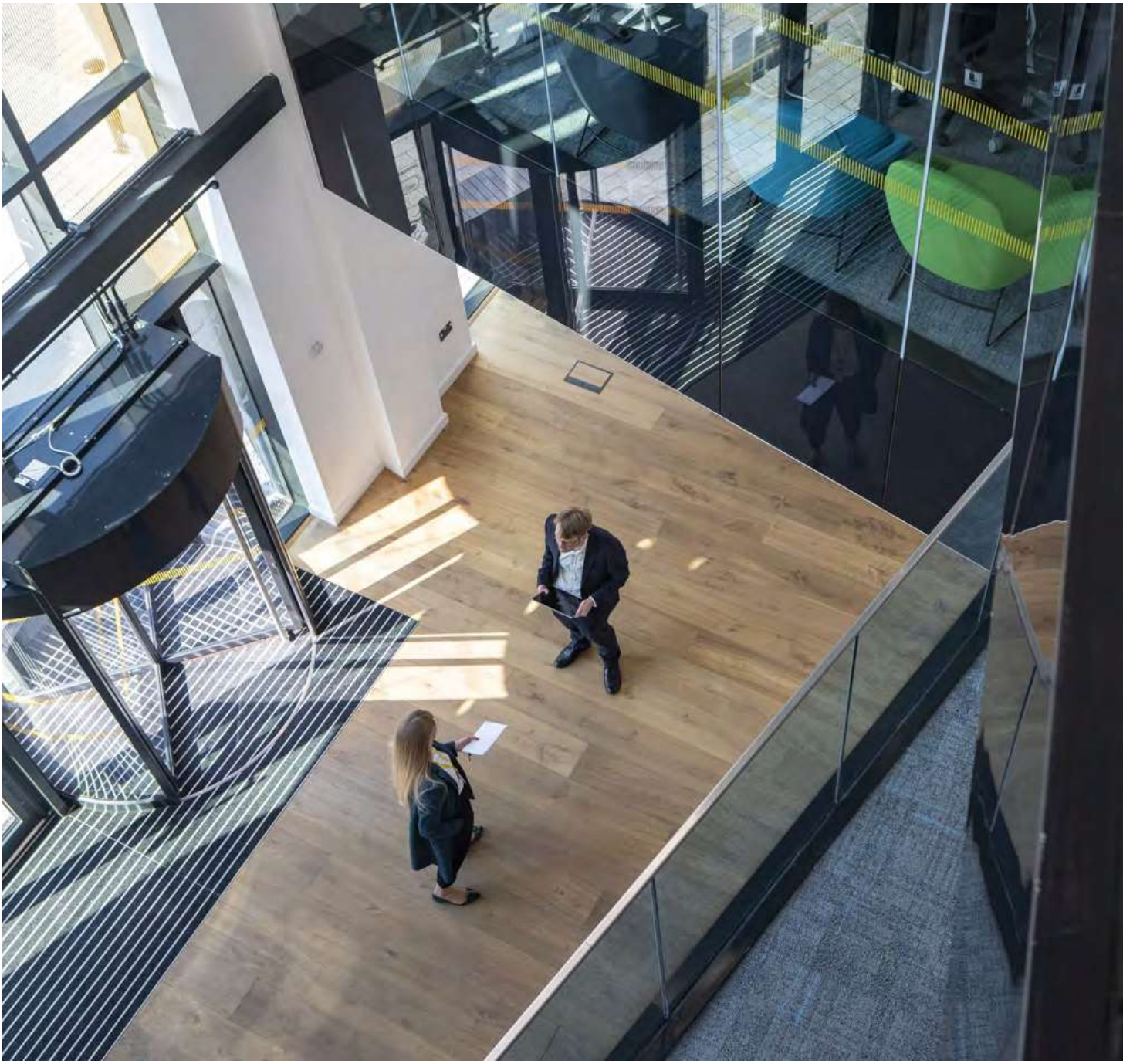
What are the benefits of being located within the Oxford-Cambridge Arc?

Harwell is in many ways a microcosm of what the Oxford-Cambridge Arc has the potential to achieve. The Arc benefits from a world-renowned knowledge base, some of the best facilities and lots of successful businesses as a real launchpad for growth. Knowledge catalysts like Harwell and Granta Park in Cambridge have a major role to play, building on the vast pool of knowledge and developing skills cultivated within the region's universities and beyond.

The Quantum Computing Centre at Harwell wouldn't have happened without the University of Oxford. Another large-scale, state-of-the-art facility within the Arc, the National Satellite Test Facility, will be ready in a few months to test large satellites, exactly the kind of mutual asset in the Arc that will benefit the enterprises that operate at Harwell, but also the wider strategic needs of the UK economy.

We're only just scratching the surface of the region's untapped potential.

Strengthening The Triplex Helix Ties

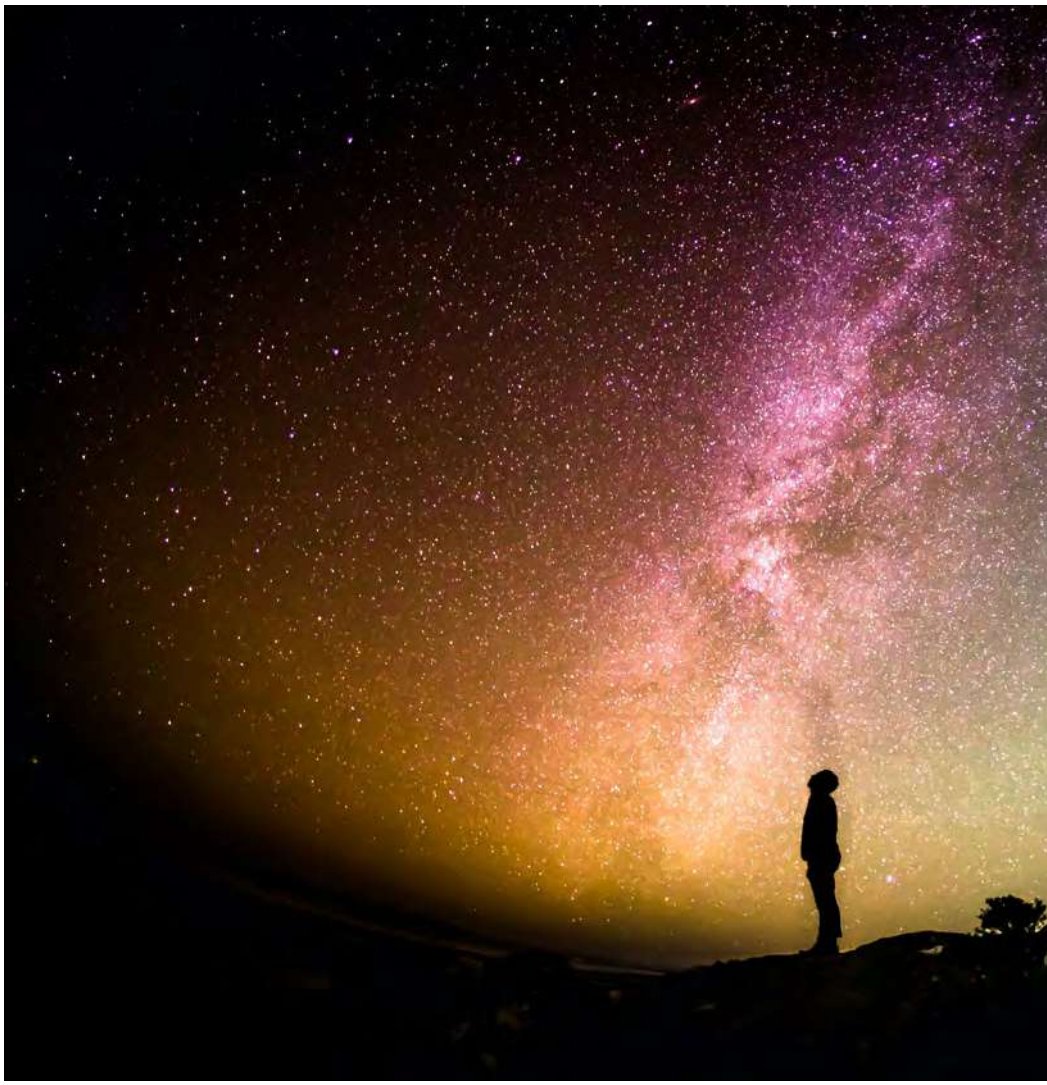


Supporting Idea Generators

Tony Jones, CEO, One Nucleus

One of the key attractions of the Oxford-Cambridge Arc is its ability to inspire and create idea generators, be they academics spinning out their research from universities or entrepreneurs eager to contribute to the Arc's economy. These individual efforts are most effective when combined with the powers and expertise of others. Not-for-profit steering organisations such as One Nucleus serve to provide connectivity for all manner of enterprises in the Arc: be that within the region, across the UK, or even opening the door to international collaboration and investment. The start-ups and spinouts that the Arc excels in producing often have great ideas and would undoubtedly succeed under their own steam, but to quickly supercharge their growth and maximise the benefits for the regional and UK economy they need the expertise and wide net of contacts that organisations like One Nucleus provide.

Biomedical and healthcare research and development has been highly impactful in driving wealth and economic growth, but most importantly in changing clinical outcomes and improving human health. This research cuts across sectors and disciplines, no more so than in the Oxford-Cambridge Arc. In Cambridgeshire the collaboration between start-ups and spinouts, large healthcare multinationals like AstraZeneca, the medical teaching of the University of Cambridge, and NHS services like Addenbrooke's demonstrate everyday the value of creating a collaborative ecosystem, not least in the delivery of the Oxford-AstraZeneca vaccine during the Covid-19 pandemic. Attracting, enabling and connecting these organisations and individuals engage with one another is the main contribution of organisations like One Nucleus, increasing points of contact between stakeholders, researcher, innovators and entrepreneurs.



Absolutely vital for this collaboration is the cooperation of the public sector with other actors. From the perspective of the Oxford-Cambridge Arc, this active public-private sector collaboration and willingness to share research in the aspiration to meet a common objective has shaped the landscape of innovation. Initial public sector support also creates an environment in which knowledge capital can 'pool', and a dialogue between public sector enablers and private enterprise which challenges traditional methods and introduces different technical approaches.

We talk a lot about how the government supports industry and innovation through

Strengthening The Triplex Helix Ties

access to capital and the levers of regulation. UK Research and Innovation (UKRI) and its internal Innovate UK funding body were mandated a budget of over £8.5bn for 2020/21, supporting over 3,800 organisations the large majority of which were small-to-medium sized enterprises.

While it's a positive step that government funding for innovation and fresh ideas to meet 21st century issues has increased 13% since April 2020, many of these companies in their nascent phases of growth would benefit from a government that is present and committed to building the facilitating infrastructure required to optimise, 'level up', and hasten the rate of new discoveries. The accumulation of knowledge capital is not 'zero-sum'; it grows within a wider constellation of innovators working collectively towards the same goal when it is shared.

Government endorsement and active encouragement of the Arc's organic clusters must not merely be the provision of finance at arm's length. Openness, transparency, and collaboration are cultural pillars of the region as the UK's innovation capital, which extends to policy actively promoting free and unfettered access to research and literature and long-term planning for government funded infrastructure. These are necessary features of a 'supercharged' Arc that can stand shoulder-to-shoulder with some of the greatest innovation districts world-wide.

As the government's organisation responsible for the development of nuclear fusion power, the UK Atomic Energy Authority (UKAEA) is one of our nation's most promising assets. The research undertaken at the Culham Centre for Fusion Energy (CCFE) and the UKAEA's Materials Research Facility attracts valuable scientific expertise, interest, and acts as a tractor beam for investment globally, most recently Jeff Bezos who has backed a link-up between the UKAEA and General Fusion to build and operate a £400m Fusion Demonstration Plant. It's a beacon for international collaboration in the pursuit of technological breakthroughs important to humankind, and a host to one-of-a-kind facilities like the Joint European Torus (JET), the most powerful fusion energy device in existence exploring nuclear fusion grid energy.

The very essence of the UKAEA's purpose is partnership. The CCFE is the site of the JET, as well as the Mega Ampere Spherical Tokamak (MAST), upgraded in 2020, which essentially replicates the processes that power the Sun. Like the UKAEA's Materials Research Facility which tests radioactive materials in both nuclear fusion and fission, and RACE, the Culham-based test facilities for robotics and autonomous systems, CCFE's large-scale infrastructure is open to users from academic and commercial organisations. Privately funded start-up companies can actively contribute to the quest for the holy grail of energy generation from nuclear fusion, without worrying about access to enabling infrastructure. BNFL, AEA Technology, and Tokamak Energy, are all examples of companies with roots in the Arc which have themselves spun out from the UKAEA's research laboratories.

Communities formed and refined by public-private sector collaboration extends to the Harwell Space Cluster, which includes over 105 space-related organisations from a range of contexts. The Cluster is supported by the Science & Technology Facilities Council managing over £2bn of infrastructure for public and private R&D in addition to government financed initiatives. The co-location of the UK Space Agency, the UKRI-sponsored Satellite Applications Catapult, and private enterprise like RAL Space, Open Cosmos, and Deimos Space UK within the Arc, generates the synapses necessary to consistently push the frontier of innovation.

Solving Global Challenges through Collaboration

Q&A with Dr Julia Wilson, Associate Director, Wellcome Sanger Institute

1. What is the strategic vision of the Wellcome Sanger Institute?

When the Wellcome Sanger Institute was founded 1993, it initially had only one task: sequencing the first human genome. At that time, the Sanger was the UK hub of the global Human Genome Project. In the end, the Institute was the single largest contributor to this 10-year ambition.

Since then, the Sanger Institute has transitioned into a fully-fledged genomics research institute with 1,100 staff working in the field of genomics - many working to sequence, read and understand the DNA genetic code. To give a sense of scale, a single human genome has three billion letters of DNA code, and the small differences in these letters equate to the differences in all of us.

The Institute transitioned from reading one human genome to understanding the difference between many genomes, and to use this information to provide new insights into the biology of humans and other organisms, to better understand the causes and progression of human disease. We have vast DNA sequencing capabilities and are one of only a handful of organisations in the world that can do genomic science at this scale. The Institute is fundamentally built on the principle of open science: DNA genome sequences made freely available for other researchers, giving them the opportunity to exploit vast datasets for collective social benefit.

Often our projects are enormous and can last decades. One example is the Human Cell Atlas: a project to read the genetic code of every cell in the human body (37 trillion) and provide a foundational dataset for every cell in health and disease.

By collaborating with partners across the UK, we're working on The Darwin Project to sequence the 70,000 different species in the UK. This is part of a larger global project to sequence all of life on earth and projects like this can help in supporting biodiversity, global ecological conservation, and no doubt will lead to the discovery of new medicines, fuels, and food to benefit society. Like all our research, it will provide those foundational datasets on which to build scientific research in the future. All our software, data and tools are made freely available to the scientific community providing the basis for many other research projects.

2. How does the Institute interact with and support the scientific community?

The Sanger Institute is core-funded by Wellcome, and we use this funding to invest in core-facilities such as our genome sequencing platform. Our scientists can then think of the biggest and boldest projects, ones that can potentially answer some of life's biggest questions. More than 90% of our scientific publications are done in collaboration with others and we believe we can only tackle some of these biggest challenges by coming together and collaborating. We have, for example, worked as part of the International Cancer Genome Consortium for many years, which, through collaboration across the global community, were able to map the genetic faults in 50 of the most important cancer types.

We enjoy deep collaboration with other large organisations. Our key strategic partners include the EMBL-European Bioinformatics Institute, the University of Cambridge and the Francis Crick Institute. We also work closely with partners based at the Wellcome Genome Campus.

For example, Open Targets, an innovative multi-year, public-private partnership with GSK, Sanofi, BMS, Sanger and EMBL-EBI that uses genetic and genomic data for systematic drug target identification and prioritisation.

All of this is supported by co-location on the Wellcome Genome Campus, where a cohort of around 2,500 people work across organisations like the Sanger Institute and EMBL-European Bioinformatics Institute as well as the Biodata Innovation Centre that houses spin-outs and start-up companies and attracts like-minded companies who are working in the fields of genomics and biodata. This co-location creates connectivity and cohesion, with events like open seminars to disseminate new ideas and best practice. We see movements between organisations, and movement and adoption of technology and management information across the sector. We also operate a conference centre and training facility, designed to bring forward the next generation of genomic scientists.

Collaboration within the Arc and the UK is one aspect but science is global and we also enjoy international collaborations, particularly with infectious disease programmes, understanding outbreaks of infectious diseases and providing a greater understanding of the patterns and spread of diseases such as malaria.

3. Why is it important that we stand behind and champion genomics research? What is at stake for society, and how does this research advance humanity?

Put simply, the health of the nation. The Sanger Institute provided the proof of principle study, demonstrating that genome sequencing was useful in helping diagnose children with developmental disorders and this paved the way for the formation of Genomics England, a British company founded and owned by the Department of Health and Social Care to run the 100,000 Genomes Project. The human aspect of this research is clear: children with undiagnosed, developmental disorders could receive a new diagnosis

through genome sequencing. Today, we have further projects in inherited genetic disease and cancer to provide greater understanding of the causes and consequences of changes in the genetic code. All this research and the evidence it generates has future utility and could direct practical impact as it feeds through into clinical practice.

The UK has always been a world leader in genomics, tracing its heritage in this field back to the work of Rosalind Franklin, and Watson and Crick with the discovery of the structure of DNA through to the successful completion of the first human genome. Support from Wellcome and belief in the importance of genomics from successive governments has maintained that position at the forefront, helping the UK to benefit as the first country to implement genomic as routine medicine within the NHS.

There are also clear economic benefits of genomics research with a number of new businesses working in this field that will contribute to the wealth of the nation, both financially and in terms of knowledge. Genomics companies spinning out from Sanger or elsewhere can scale very rapidly, also benefitting the national economy.

On another level, we can take a longer view of the sustainability rewards which could come from genomics research. Particularly as we start to understand the natural world at the genomic level, and use this knowledge across environmental conservation, protection of biodiversity, finding new tools for decarbonisation, as well as understanding ecosystems helping us all to be better custodians of the planet.

4. How does the Sanger Institute help to commercialise research? What sort of partnerships are formed, and how does this collaboration advance scientific research?

Colleagues here run a 'start-up school' where staff from all parts of the organisation can apply to attend and learn more about entrepreneurship. We hope that providing our people with a foundation in the process of ideation, regulation, and funding gives them the sort of training and confidence to go on and potentially start up and commercialise an idea.

The Sanger Institute Translation Office works with scientists to identify projects that could have commercial application. The team provide support and advice to scientists and operate a translation fund to provide funding that allows scientists time and funds to follow a lead, build more data and maybe, take an initiative to the next stage. The translation team also supports scientists to explore spinning out a company and with pitching to potential funders.

We also invite senior scientists in co-located businesses on-site to give bench-to-boardroom seminars and mentor staff, as well as informal coaching and networking to help build that culture of entrepreneurship.

5. Why is the Oxford-Cambridge Arc an important region for innovation?

We benefit from a concentration of talent and skills. Science is insanely collaborativ, and you need that critical mass of people. The beauty of the Arc, and the Golden Triangle, is that none of us can solve these world challenges alone: we need collaboration, like the fantastic nation-wide scheme Health Data Research UK, which frees up routinely collected health data for use in research and industry. You can't make new discoveries with a small sample size - you must extend a hand to others to better society.

This ecosystem isn't something you can replicate in a day, but something we can all learn from. The Oxford-Cambridge Arc represents decades of accumulated collaboration and starting from scratch anywhere else would require us to rebuild that entire ecosystem.

To succeed in science, we need diversity of approach and ideas with many people coming at the problem from different angles. We equally need that concentration of people, skills, and players in the ecosystem. Scientists are now increasingly comfortable moving from academia to NHS Trusts, or into the private sector and back again, bringing a better understanding of the language and the drivers of all these sectors.

6. How is the Wellcome Sanger Institute changing the world?

One such example of our impact was our recent work initially as part of the COG-UK Consortium to deliver Covid-19 virus genomes to the UK government to understand the spread of disease, and help spot new variants. Skilled, technical staff working at the Institute created and adapted protocols to rapidly sequence the virus genomes at scale, and then shared these protocols globally for the common good.

We have many years of experience in dealing with millions of samples, and experience of researching vast tomes of genomic data, ready to respond to any crisis, and helping to keep the UK at the forefront of scientific research.

World-class R&D is in the Arc's DNA

Q&A with Sam Hyde, CEO, The Technology Partnership

What is TTP, and who does TTP work with?

The Technology Partnership (TTP) invents, develops and manufactures new technologies for clients around the world. Our aim is to maximise technology's impact through the development of gamechanging new products and bring these to market, rather than solely scientific discovery, working across high-growth sectors such as life sciences, telecommunications, high value industrial and advanced manufacturing.

We work with clients that vary from start-ups, corporate MedTech companies to multi-nationals, doing everything from inventing and realising technologies and products to building production lines which support deployment.

We've also created 20 companies ourselves, including one of the largest GSM/3G mobile phone technologies in 2000 which was floated at a valuation of $1bn before being acquired by Motorola, and two new businesses we are nurturing today in molecular diagnostics for pharmacies and GP surgeries to provide point-of-care, super-rapid Covid-19 and flu diagnosis, and ultra-high speed cell sorting.

TTP does a lot of work in the UK, about one-third, and the Oxford-Cambridge Arc is a key source of partner for us.

How does the work undertaken by TTP support new discoveries through to the commercialisation of scientific breakthroughs?

TTP spots the intersection between commercial application, technological potential and consumer need. We're trained to understand everything from the development pathway and the risks of translating emerging technologies into a product, to user need and how these products interact with people.

Sometimes we start with a commercial idea, while in other instances we begin with a known application or science that works on a benchtop, but not with the right kind of performance or design. People underestimate the complexity of taking a product created in a lab and then taking it mainstream. We need to consider technical performance characteristics, commercial viability and how that product meets user demands.

We have a mixed model of business: we fluidly adapt the multi-disciplinary teams we build and the expertise we offer to bring the right skills at the right time, to match the specific requirements of our clients. Start-ups will have different needs to large corporates, but essentially our role is the conversion of science to reality. DNANudge is a prime example of this from the start-up side where we designed and developed their PCR test from initial concept all the way through to manufacturing high volumes of prototypes onsite. Corporates might want a different scope of work, focusing on specific aspects of the technology or proprietary expertise, or they might want also want complete concept to production support.

In every instance, the key thing is to be agile, rapidly adapting teams to meet new challenges at every stage and matching the resources needed by our partners at that stay. This tends to mean bringing in expertise ranging across the spectrum of hardware and software engineering, and sciences from physics to biology to materials. We also need to help our partners navigate the nuances of product and regulatory frameworks, and how to manufacture at volume.

Why is the Oxford-Cambridge Arc such an interesting region of scientific enterprise and innovation?

In the Arc, skills and expertise collide with commercial insight and academic research to create an ecosystem. TTP is a critical part of this 'glue', and an important part of the Arc, meeting the needs of enterprises looking to commercialise innovation and training people. The range of businesses in the Arc provides a strong base of education and experience. There is a strong flow of people between companies that fosters partnerships, broadens training and develops the whole ecosystem. We recruit from academia, start-ups and corporates, while some of our alumni go on to support start-ups and established corporates to further R&D elsewhere.

When we survey comparative innovation centres across the world, not least in the U.S., the scale of Oxford and Cambridge is really small. These two cities cannot compete on the world stage in isolation, and so the Arc is needed to bridge these leading clusters to elevate the region's international standing. This is especially true for cutting-edge technologies where the UK has a world-leading position, like in cell therapies, where we can expect a drain in businesses in this area without a regional outlook.

What do you see as being the greatest opportunities and barriers to invention and the commercialisation of new ideas in the Arc?

The opportunities are in scale, doing what is done well with more regional collaboration. The Arc benefits from huge inward investment, and an extraordinary number of new enterprises; we can do more with the ingredients we already have and there is wider momentum if we invest in skills within

the Arc, attract expertise from overseas and train those people in key areas to be better. These are all essential components of a globally important knowledge region.

The barriers have been spoken about over many years, and these are difficult to overcome. Infrastructure and housing are the first hurdle, particularly as growing enterprises like TTP and the clients we work with hire a lot of graduates who might not be able to afford to live in central locations and cannot live remotely due to the lack of transport options available. The practical reality for knowledge-intensive, inventive and lab-based companies means that we need to work in-person and interactively. We must create communities that make access to work, housing, and amenities as easy as possible.

Recently, there has been a push to create these places, which fit into the wider sciences ecosystem. TTP has partnered with Bruntwood SciTech in Cambridge to create a life sciences hub that supports early-stage innovators both in terms of office and laboratory needs as well as the type of equipment occupiers will need. Nevertheless, we need more investment into infrastructure, particularly where the integration and transport between these hubs is poor. A lack of infrastructure slows the extent to which we can share knowledge and build cross-regional teams, and fold in lots of communities in the Arc, which would be good ground for further growth and development.

Another related issue is in scale-up space we're missing: getting people to the scale required before we lose them to other geographies. One of our clients started in Scotland, creating antibodies for screening blood. We helped them develop it into a microarray diagnostic that will revolutionise screening of donated blood, and produced the manufacturing solution. They need to scale their facilities and initially looked to Cambridge as the next step. They eventually chose Switzerland due to better access to the facilities and government support.

Broader funding streams are also necessary. There's now more venture funding in the UK than there ever has been, but this performs better at the seed scale. When companies look to grow, they're encouraged to move their headquarters and critical mass closer to capital sources, and this often means relocating to the U.S. rather than staying in the Arc. To retain these businesses in the UK, not just regional outposts, but thriving corporate entities which contribute to the regional economy through job creation, skills, and economic output, we need to make access to funding more streamlined.

Finally, there is a question about availability of patient capital. Not every opportunity fits the venture capital model, and VC from overseas can potentially dilute and shift capital and returns abroad, which is value lost to the Arc. More patient capital with high returns in the long run would fit many profiles of innovation in the Arc. The British Business Bank is a start, but it's far too small in scale and doesn't touch the serious technology concepts where £10m or more is required to get to proof of principle. If we want to keep more of the major UK innovations created in the Arc in the region, we need to find ways of funding these businesses through the early stages with patient capital. This will require government to align with other longer term funding sources such as pension funds.

What's at stake societally for the UK and the wider world, and how has TTP made a difference?

TTP has been bringing ideas to reality for 35 years, from mobile phones to cell therapies, and has supported 1,000s of corporates and 100s of start-ups. We cover a massive spectrum and are heavily involved in the next generation of technologies and products that will be the businesses of the future, from neurotechnology, to satellite communications, to renewable energy generation.

Technology is the fundamental driver for change and progress. If the Arc and the UK is to benefit from this commercially, we need to focus our efforts. How much funding goes into commercialisation must align with the amount of funding into academic research to ensure we're enabling new ideas to find their feet and grow as new businesses. There's a huge gap here; sustainable long-term business growth is reliant on access to capital at every stage, and the upshot is that these technologies might not make it despite their potential to revolutionise healthcare and our daily lives, and make industry more efficient and sustainable.

To take an idea and make it reality, innovation can't just be left to the whim of where capital is floating around. This must be choreographed and channelled to where it's needed; where we want to be training people in industries of the future where people add value; learning skills and deploying them commercially, to the benefit of broader society.

What we can create in the Arc is an engine for business and people growth – an engine for development. In doing so, we create better people, and better people create better businesses, with better value, generating better and more refined skills.

This will happen. Technology is the pathway to future value and social prosperity. The question is whether this will happen in the Arc.

Commercialising Ideas within the Arc

Professor Bill David FRS, STFC Senior Fellow (Rutherford Appleton Laboratory) and Professor of Energy Materials Chemistry, University of Oxford

The United Kingdom was the first country to fan the flames of the Industrial Revolution and, to this day, we are a nation known for our inventions and innovations. But we have also earned a reputation for often failing to capitalise on our originality and commercialise our ideas.

For example, in 1935, the Air Ministry department of UK government famously refused to pay £5 to renew the turbojet-engine patent of Frank Whittle, RAF inventor and future Air Commodore. This setback was compounded because public financiers and conventional banks of the time deemed speculative proposals with no immediate value to be untouchable. It was left to the investment partnership O.T. Falk & Partners and steam turbine specialists British Thomson-Houston to fund a first prototype. But it was too late. When the Air Ministry finally expressed interest, the patent for world's first jet-powered aircraft had been filed in Germany.

This failure to back new ideas is reflected in my own experience as a young research scientist in Oxford in the early 1980s working in the group of the now Nobel Laureate, John Goodenough on the first reversible lithium-ion batteries. After the 1980 invention in Oxford, AERE Harwell led the innovation of these batteries through the 1980s but struggled to find UK partners for commercialisation. The patent was finally licensed to the SONY Corporation which drove the early dominance of Japan, and not the UK, in the digital world of personal electronics.

Painfully similar stories of uncertainty play out across many home-grown innovations, including early medical treatments, social care, maritime technologies, wind turbines and rail infrastructure, where promising creativity has been stifled by late decision-making and an apprehension to invest in early-stage concepts.

Today, the UK is again at a critical juncture in several of its most exceptional industries. In both the consistency of UK investment and the strategic allocation of funds, it is clear that the history of relatively agnostic relationships with innovations is, in aeronautical parlance, holding back the thrusters and creating unnecessary drag. According to the trade body ADS, the UK's R&D funding in 2019 amounted to just 5% of annual revenues, relative to 8% in Germany and 11% in France.

The UK has proven to be resiliently world-leading in its scientific output: in 2020 the Global Innovation Index, compiled by Cornell University, INSEAD and the UN, ranked the UK as first globally for the quality of its scientific publications and second for the scientific innovation of its universities. The same index scores Cambridge and Oxford as 'the world's most science- and technology-intensive clusters' in the international top 100. This dramatically contrasts with the UK's historical lack of success in translating this leading position to the capture and commercialisation of knowledge capital. This has resulted in numerous missed opportunities for economic growth and development at a national level and, with its concentration of invention and innovation, is particularly apparent within the Oxford-Cambridge Arc.

Dealroom.co analysis of European venture capital (VC) places the UK fourth (€1,112) for funding per capita, significantly higher than France (€470), Germany (€440) and Spain (€204). VC investors deployed a record £11.8bn in the first half of 2021, equating to the total sum raised in 2020. This is highly encouraging (and undoubtedly why the UK is the European destination for global investment in emerging technology classifications like Deeptech, Healthtech, Energytech, Fintech and education technology) but this sentiment must be backed and financially supported by government. We cannot expect to reach every emerging breakthrough and carve out a clear commercial advantage if early-stage commitment to innovation is not replicated by the public sector.

How is government supporting innovation?

Investment into new ideas is increasing. UK Research and Innovation (UKRI), founded in 2018, invests in cross-disciplinary R&D and has

awarded over 4,000 research and innovation applications and fellowships in the period 2020-21, amounting to a commitment of £3.1bn. This funding has been essential to the UK tech start-up and scale-up ecosystem which Tech Nation reports to now value $585bn, more than double the next most valuable ecosystem, Germany, at $291bn.

The UK Innovation Strategy also promises an increase in annual public investment in R&D to £22bn, skills programmes, ring-fenced finance for innovation infrastructure projects, and intellectual property education, among other incentives introduced including R&D tax relief, Research and Development Expenditure Credits, and a historically unique enhanced 'superdeduction' equal to 130% of capital expenditure on plant and machinery.

Together with the Life Sciences Strategy and the recently published AI Strategy, the Government is demonstrating a commitment to ease the obstacles to commercialisation in emerging and potentially extremely valuable sectors economically and societally. As the statistics suggest, there is an impetus to become a "Global Britain" that nurtures, celebrates and internationalises our competitive advantages. The concern on the horizon is whether that intent manifests itself in a way that is comprehensive.

What can we learn from?

The issue circles back to the UK's approach to funding, and the extent to which public expenditure complements and uplifts private investment. Within the UK Innovation Strategy, the Government seeks to commit to a £10m 'innovation seed fund' to meet early-stage patient capital requirements, which is a proportionally small sum to catalyse and commercialise emerging ideas.

Navigating away from the fallacy of sunk costs is another barrier which public decision-makers must overcome, the shadow of which lingers in the form of historically poor and scattergun financing as was apparent by analogy in the aviation industry. There is much to be learned from academic institutions within the Arc in this respect, particularly Oxford and Cambridge whose total value of spinouts amounts to over £10bn, with a raised-to-value ratio of £3.1bn and £1.3bn respectively. Both ancient universities have vast and accessible investment frameworks offering funding, consultancy and business advice, formally and through campus initiatives. In Cambridge, for example, the Office for Translational Research and its Enterprise initiative offer mentorship and contacts, while at the other end of the Arc, the Oxford Seed Fund, Enterprising Oxford, IDEA and entrepreneurship networks create a loose coalition of support networks. These structures buttress the crucial foundations and growth stages of start-up companies, enabling innovators to develop their research and technical ability into a commercial enterprise.

There are many examples where this formula for incubation and growth has been proven, including NoBACZ Healthcare whose success in turn represents a significant success of the commercialisation of research in Oxford-Cambridge Arc and the proper utilisation of its existing knowledge capital. Its story also demonstrates how tied current investment and infrastructure is to the universities within the Oxford-Cambridge Arc. Without initial access to the infrastructure and funding provided by the University and its Cambridge Enterprise initiative, NoBACZ would have faced the difficult prospect of relying on a range of diffuse government schemes such as the Enterprise Management Incentive, the Future Fund, or the Medicines and Diagnostics Manufacturing Transformation Fund.

Equally, with the availability of R&D labs around Cambridge standing at just 4% at the end of 2019, access to University labs and facilities was a significant advantage for NoBACZ. But unless 20 million sq ft of new lab and office space is built within the Oxford-Cambridge Arc over the next two decades, new start-ups and spinouts will struggle to access the necessary infrastructure for both R&D and future growth outside of the university structure. The scarcity of non-academic laboratory space risks throttling start-ups and spinouts, as does the high cost of rent, which in Oxford, Cambridge and Milton Keynes have skyrocketed by 74%, 32% and 28% respectively. Currently, without the physical infrastructure to support it, non-academic research and development will struggle to access the facilities necessary in the Oxford-Cambridge Arc without significant further development.

'Breaking through' fundamentally relies on active government participation in the growth and evolution of the Arc as a regional ecosystem of world-leading innovation. This means more than money; it means a multi-dimensional commitment to nurturing existing capital within the region to ensure that we take seriously and seize each spark of commercialisable innovation for the benefit of our collective social prosperity. That leads me to my final comments where I will return to my first words on aviation and mention my own personal take on the future of flight.

The biggest challenge facing aviation today is decarbonisation of the industry. Achieving 'net-zero' flying using carbon-free fuels on a global scale is the only guaranteed way to achieve this and it is our aim and our ambition. We are a handful of science and engineering colleagues at UKRI-STFC National Facilities at the Rutherford Appleton Laboratory and Reaction Engines at Culham Science Centre. We have done the numbers, completed the initial demonstration phase, spun out a company and are taking the first steps towards commercialisation. Hopefully, with a following financial wind, this will take off.

A Brave New World, Where We Must Be Braver

Saul Western, Partner, Head of Commercial, Bidwells

What is it that makes the Oxford-Cambridge Arc unique? This is the simple question that investors, academics, businesses and entrepreneurs are faced with when considering the crucial question of where to invest their capital, where to study, of deciding where their business can innovate and grow or where their expertise can be put to the best use.

Since the first examples appeared in the 1970s, the world has seen the emergence of many science parks and regional tech clusters, from Silicon Valley in the United States to Gyeonggi in South Korea – places where industry leaders in science and technology-based R&D have benefited from the clustering model and where co-located businesses and researchers become, through intense collaboration, far greater than the sum of their parts. What is it about the Arc that puts it above these established and emerging competitors?

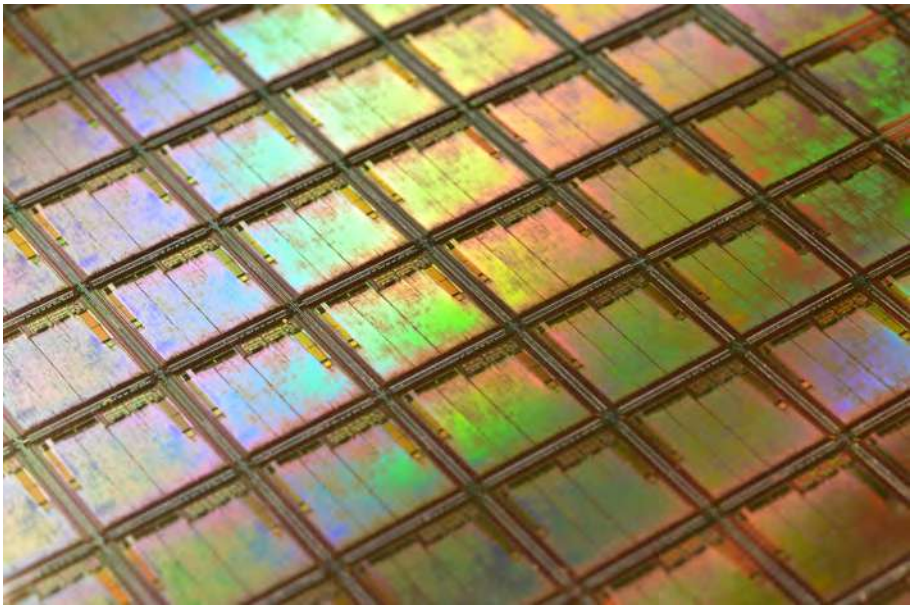
The true answer to this question lies in the Arc's greatest asset; its stock of knowledge capital. The region has an extraordinary ability to produce, attract and retain talent and knowledge, a self-sustaining ecosystem of academic and research excellence. This is fostered in no small part by its universities; Oxford, Cambridge, Anglia Ruskin, Cranfield, Bedfordshire, Oxford Brookes and MK:U, and propelled by cutting-edge businesses, research institutes, accelerators and tech clusters. The institutions and enterprises that operate within the Arc work together in a unique and mutually-supportive structure, strengthened every year by bright young students from around the world attracted to the Arc's providers of higher education, graduates drawn to innovative or start-ups or large multi-nationals, entrepreneurs looking to benefit from a world-class incubator for start-ups, and investors looking for the next British unicorn company.

In short, the Arc already has a momentum that produces, sustains and values excellence and international competitiveness in technical research and business. From developing solutions that move us closer to environmental sustainability to rapidly producing the most-used vaccine against Covid-19, the Arc continues to demonstrate its essential relevance to overcoming the most pressing problems of our age.

We must never underestimate the attraction to companies and investors of operating within the Arc. By co-locating themselves within a region with an intense and long-standing culture of academic excellence and R&D-led innovation, employers can dip into a ready made pool of exceptional talent and benefit from an ongoing academic churn from some of the most renowned universities in the world.

£2.30

On average, universities have helped their spinouts to turn £1 of capital raised into £2.30 of value



In tech clusters from Harwell in Oxfordshire to Babraham in Cambridgeshire, knowledge capital is built and compounded by the reinforcing influence of co-located resources, capital and talent that makes the steps from research project to start-up to global company shorter than ever before.

Not only does this groundswell of academia and business working hand-in-hand serve to drive the UK economy, it also benefits humanity across the globe, be it through life science breakthroughs tackling sickness and disease, to 'smart cities' software improving the environmental sustainability of our urban spaces.

Faced with this intense concentration of talent, and attracted by the international reputation of many of the institutions and companies involved, more innovators are attracted to the UK's pillars of scientific innovation.

Research from Dealroom and Adzuna from December 2021 has already shown the UK attracting £29.4bn of venture capital investment in the technology sector this year – with Cambridge hailed as the epicentre of this flow of capital, the nexus for UK tech and a beacon of excellence and familiarity to foreign and domestic investors. This is more than double the figure of venture capital funding from 2021 of £11.5bn, showing that the knowledge capital of the Arc isn't just driving economic growth and investment for UK – it's creating exponential growth and a hub for business and academia that can serve as an engine for growth in the wider UK economy.

The only constraint that exists in the Arc now is one of geography. We are far from discovering the Arc's ceiling of economic potential: the region already produces £112bn of economic output each year, and forecasts show this amount could double to over £200bn by 2030. The ecosystem of the Arc is of monumental benefit to the UK and its economy, and the public, private and academic sectors, including central government and local authorities, need to work together to ensure we do everything in our power to sustain and grow this unique and enviable national asset. We need to ensure the infrastructure is there to support this growth, be that creating new transport links, constructing more laboratory space to help start-ups grow, or ensuring we meet housing needs to support a growing population of educated and industrious workers and researchers employed across the Arc's many new enterprises.

We need to ensure that the appropriate space for scientific and technological expertise is available. In November 2021, we found there to be record high investment in the Arc office and lab sectors, yet the demand is ballooning and we must be prepared to accommodate it in an era of vigorous international competition. Over three quarters of investment into the Cambridge market by the end of Q3 2021 can be attributed to overseas investors, and this capital is globally mobile and in search of a home. We need more lab space and greater opportunities to invest in logistics, which will propel the Arc as an engine of national growth.

Against intense international competition, we need to ensure the Arc remains a beacon of excellence in the fields of life sciences, software development, aerospace and environmental technology. The Arc has built its reputation over many years: let's not miss the changes when it comes to its future, but build firm the foundations for the next century of growth.

Breakthrough, but Faster

Dr John Baker, Senior Vice President, Product Portfolio & Innovation, Abcam

We live in an era of just-in-time logistics and near-instant availability of goods and services. Physical retail shopping, hailing a taxi on the street, even cooking dinner – all of these have become optional in a world where almost everything is now on-demand in a way never seen before. Why should it be any different in the world of life sciences research? Now researchers across academia and industry can rely on the superfast delivery of the biological research tools necessary to continue their work. Abcam is one of those enablers, providing antibodies, assay kits and other essential tools to researchers, accompanied with a wealth of accurate data.

Abcam's success is in many ways a product of an innovative ecosystem that can cultivate and nurture research-related enterprises. Envisaged in 1998 by two Cambridge academics, Jonathan Milner and Tony Kouzarides, as a means of addressing a shortage of research tools of a sufficient quality to study a common and debilitating illness in the UK, breast cancer, Abcam was founded at one side of the Oxford-Cambridge Arc.

Abcam's early growth was supported by the presence of the capital and mentorship of entrepreneurs like David Cleevely, who provided vital seed-stage funding and expertise as a consultative mentor to the company, and other angel investors within a nurturing and sympathetic research cluster. Abcam is now listed on the London Stock Exchange and Nasdaq, with a market capitalisation in excess of £3bn, and has become one of the most successful life sciences companies in the world. Today, less than 10% of Abcam's business is in the UK; the remainder reflects the global distribution of life science research, with ~ 45% in the US, 20% in EMEA and 20% in China. Abcam's influence has considerably grown – over half of all life sciences research papers published globally in 2019 cited at least one Abcam product, a truly staggering statistic. In addition, Abcam was recently voted in Glassdoor's 5 'best places to work in the UK' for the second consecutive year, and recognised as one of 'Britain's most admired companies' by Management Today.

Increasing the understanding of the inner working of cells in the human body is the key to combating many major global public health issues like cancer and cardiovascular disease. Companies like Abcam are setting standards in the way discoveries are made and translated into potential benefits for society, enabling both academic and industrial laboratories to better understand diseases and improve diagnoses and treatments.

Biological reagents, such as antibodies, can be supplied with the specificity and consistency required for projects spanning from fundamental research to development, commercial manufacturing and clinical applications. Understanding the details of Abcam's offerings isn't necessary to understand its relevance and necessity for research and development in the life sciences in the Oxford-Cambridge Arc and across the world: what's important to understand is that Abcam offers a 'bench-to-bedside' approach, allowing

"Our purpose is to enable breakthroughs by serving life scientists to achieve their mission, faster. Abcam's vision is to become the most influential life sciences company for researchers worldwide, supporting research, diagnostic and therapeutic applications."- Alan Hirzel, CEO at Abcam

scientists to de-risk every stage of the process and accelerate their research programme.

A cursory look at Abcam's catalogue of biological tools also reveals disease-centric expertise beyond the engineering of antibodies, and demonstrates the depth and breadth of disciplines needed to address major societal issues, such as cancer. The tumour micro-environment, for example, describes the dynamic interactions between cancer cells and the local tissue they grow in. Studying the tumour microenvironment helps bring insights into some of the key processes behind cancerous growth including how new blood vessels are formed to feed the tumour, or how the natural, anti-cancer immunity is muted. The incremental understanding of some of these processes contributes to future breakthroughs in cancer research that have the potential to positively impact human health.

Abcam's expertise also expands into areas such as the cardiovascular system, helping to achieve advances in our ability to treat heart disease – currently the cause of over a quarter of the UK's annual deaths (an average of 460 deaths a day). This is a tangible issue that innovators like Abcam are helping to address, demonstrating the contribution to the regional and UK economy but mainly how life sciences companies can improve the way we live our lives.

As clusters develop and attract more companies and institutes, the co-location of expertise fosters better collaborations. Abcam's headquarters in Cambridge is located only a street away from Addenbrooke's Hospital and the Royal Papworth Hospital. In October 2021, Abcam announced further collaboration with the Cancer Research UK Cambridge Centre, allowing for greater research into the early detection of cancer in the health system. A short cycle away, students from prestigious institutes such as Cambridge's Laboratory of Molecular Biology, the Department of Biochemistry or the Department of Pharmacology, can use Abcam's innovative reagents for research that one day can ultimately benefit the medical and clinical public health endpoint, only 100 yards away.

Being part of an active and dynamic cluster also gives Abcam the best opportunity to hire, retain and grow the best talent in life sciences and digital, and to offer its people truly rewarding, impactful, purpose-driven careers.

We'd like to think that Abcam is a success story for the Arc, and a profoundly compelling proof of concept not only for the power of chance encounters in an academic cluster, but also for the power of large companies partnering with academia, research institutes and NHS trusts for a common cause.

We also know that there are many other companies like Abcam striving for social prosperity, who need support. Just as Abcam gives researchers the tools they need, when they need them, we need to ensure enterprises in the Arc enjoy a similar advantage – getting the talent, funding, collaboration and business development mentorship necessary to enable or make similar breakthroughs.

Matchmaking Investors with Ideas and Changemakers

Yvette Lamidey, Executive Coach and Mentor, co-founder Central Arc Angels Edward Lee, Partner and Head of Corporate and Commercial, BlaserMills Law, co-founder Central Arc Angels

Preventing potentially lifechanging ideas and the creative potential behind them from slipping through our fingers is a huge challenge. While we can't overlook the importance of fostering the right environment for entrepreneurs to thrive, and the ecosystems which can be cultivated through clustering within the Arc's many science parks, urban centres, and districts of innovation, commercialising research relies on mentorship, advice, and practical guidance. After all, there is no better or more well-equipped teacher than those who have taken a similar journey

'Matchmaking' entrepreneurs with advisers and other skilled educators within the Arc's science and innovation communities opens up meaningful avenues for collaboration. These networks share and coordinate knowledge, educate others on the dos and dont's, and connect budding entrepreneurs with user-friendly routes to finance, prospective partner, and business support. When government assistance is particularly complex to access, especially in the form of R&D tax breaks, these loose-knit forums provide the tools necessary for entrepreneurs in their infancy to navigate available incentives.

Because these communities are not formalised in the same way as guilds, worshipful companies and chartered associations are, it is easy to overlook their importance. Yet, in spite of this, these forums strengthen the entrepreneurial spirit of the region and provide a layer of connectivity that further emboldens tacit connections to academic and industry clusters. The Arc's unparalleled growth is, in part, a by-product of these informal gatherings that encourages more business and investment, attracting others to the region and creating a hinterland of excellence.

It isn't just in Oxford and Cambridge that the demand for matchmaking is prevalent. In my experience, interest extends into Milton Keynes, south Bucks, Bedford, Luton, Northampton and around the universities in the centre of the Arc, particularly where there is an outstanding variety of embryonic and well-established enterprises in the technology space. Connecting capital partners with potentially world-changing ideas is not always as proportionate as we'd like it to be. However, I've heard repeatedly from prospective investors that they'd also welcome support with how to assume positions as angel investors and catch opportunities to inject seed funding when they arise.

The Arc has all the right ingredients, including businesses ranging from small-scale spinouts and start-ups to multi-nationals, pioneering educational institutions, supportive local authorities, and numerous forward-thinking administrative bodies, to actively nurture entrepreneurship in the region. Support networks like the Silverstone Technology Cluster and centres of excellence built around specialisms like human performance technologies, cryogenics, and nano-technology, further foster a sense of community, and make as much room as they can to accommodate new businesses.

While there are many ways to improve upon and expand the potential for innovation in the Arc, through match-making and tacit communities of entrepreneurs, it is a focus on education of both new entrants and potential capital partners which requires encouragement. It will be these investors that give the wings for new ideas to take flight.

Yvette Lamidey

Edward Lee

The Accelerators of World-Changing Ideas

Q&A with Miles Kirby, CEO, DeepTech Labs

What is the purpose of accelerators within the Arc, and what is DeepTech trying to achieve?

Having worked for Qualcomm in California for 18 years, and run an accelerator and incubator in the US and venture capital groups in the Europe, I've come across a huge variety of talented academics, engineers and entrepreneurs with ground-breaking ideas. For those experiencing a 'lightbulb' moment, it's relatively easy to obtain seed funding from angel investors. The challenge lies in developing a deep tech idea; what is essentially an original thought, into a commercially viable business.

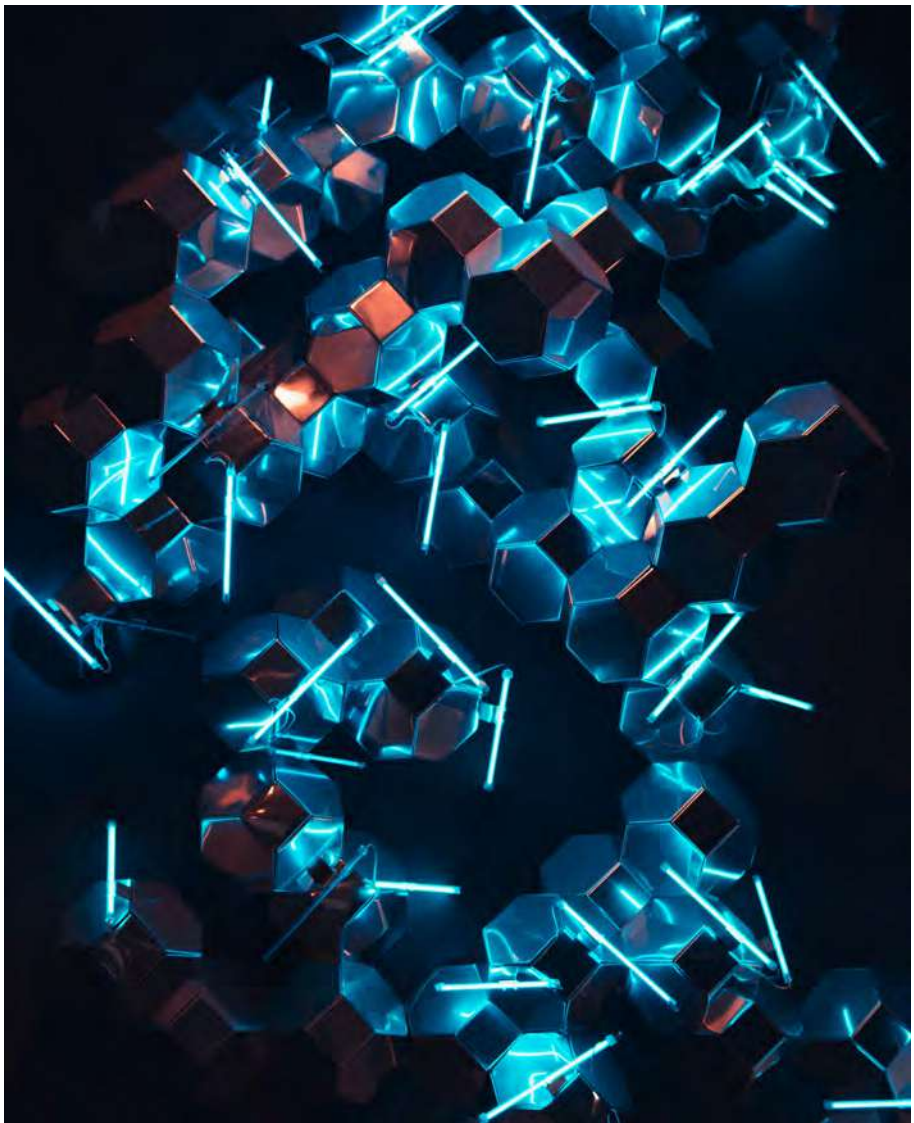
Often, first time founders, and especially those that come from an academic or engineering background, struggle to make this jump and may not know to ask key questions like "which market do I target?", "what's the commercial application?" or "where is the value added?" They don't necessarily home in on the right areas for business development. Moving from a high-level idea and prototype, to getting initial seed capital engaged, to then attracting Series A investors with a coherent and cogent business model and plan for developing the business, requires more than having a great idea.

This is where accelerators like DeepTech Labs can step in. What DeepTech Labs is doing, as you'd expect, is focussing on the deep tech sector, that being new or existing technologies combined in a unique way, which seek to solve our greatest societal, scientific or engineering challenges. Where we see potential, we invest at the outset before providing advice and guidance to ascertain the scalability of their offering and assist in commercialising their initial proposal.

We then bring like-minded entrepreneurs together as a cohort in a 13-week programme designed to plug them into the wider, deep tech community. Like the proverb that it takes a village to raise a child, so too do we believe strongly that it takes a community to build a successful start-up.

We're now on our second cohort, bringing those that have exited accelerators and incubators such as the founders Arm ,CSR, Imagination Technologies, Hotel.com, and others with real experience in this space and experience of taking great ideas to market in contact with current start-ups.

New businesses are at the bottom of the mountain and looking up at the daunting peak thinking "How do I reach the top?". We connect them with the people who have been to the summit before, to give them valuable advice and networking opportunities.



In your experience, what are the key needs and constraints for start-ups and spinouts?

Money has historically been a key constraint, though there's a lot of different sources surfacing. On reflection, a lot of what is necessary is guidance, help and advice to build the right team. If you happen to be a first-time entrepreneur, great academic or engineer, you must be able to bring commercial and operational experience into the company, something DeepTech Labs and other accelerators help to facilitate. We like to describe this ecosystem as a virtuous circle, or flywheel, where successful entrepreneurs who have exited the system can return to give their expertise to new start-ups.

DeepTech Labs can offer the financial side – generally our ticket size is £350,000 to start-ups to help prove their technology – but more importantly, we offer strategy and long-term planning, suggesting cogent metrics and milestones for future business development, and forum days where the community is brought around these new companies. We work on their roadmaps and business models, discussing how to attract venture capital and Series A funding from operations to focussing on key issues like intellectual property.

What do you think the benefits are for a new start-up or spinout in partnering with an accelerator like DeepTech?

Some start-ups have occasionally described themselves as 'too busy' to participate in accelerators, but the accelerator model helps to streamline business operations and make things quicker and more efficient. Companies can benefit from a much larger community and a diversity of thinking from across the research, commercial and operations sectors to really energise and expedite the process.

In accelerators like DeepTech Labs, start-ups build great connections that can support them throughout their development. These companies are provided with a launchpad to update their thinking and operations, but also are introduced to an holistic ecosystem of support both regionally and across the start-up community. What's been fantastic is that the community has really come together over this, with over 1,000 hours of time volunteered by previous entrepreneurial founders and those that have in-depth experience of achieving success through the start-up model.

What is the ultimate purpose of DeepTech Labs for a start-up?

What we're trying to do is take the fantastic research and ideas and build these into solid plans for business, which can then attract further investment. We've sometimes been described as a 'finishing school for start-ups', but having seen so many companies fail with great ideas, we're perhaps better seen as an accelerator that allows these ideas to succeed in a more commercial environment.

What makes the Oxford-Cambridge Arc attractive as a place for accelerators to operate?

One of the unique advantages of the Oxford-Cambridge Arc is its critical mass as a pre-existing ecosystem for knowledge capital. We have a highly skilled workforce with great human capital metrics already in place to meet the needs of growing start-ups and new businesses.

One of the key things that the Arc can boast is connecting back to academia, particularly the University of Cambridge which DeepTech Labs works extensively with. Companies can connect with individual professors in university departments and recruit from an enviable talent pool in the form of world-class, post-doctoral students already located in Oxford-Cambridge Arc.

The Arc also supports a venture capital ecosystem. Our last forum for start-ups had 66 venture capital firms sign up to attend, many of whom are located within or close to the Arc. This existing momentum works as a catalyst for the accelerator model to really deliver results.

What do you see as the future of investment and mentorship in the Arc?

I think the ecosystem is growing, the flywheel is accelerating, and the momentum building. Deep tech is ever expanding and investment can result in world-changing outcomes. DeepTech Labs focuses on brand-new technology ideas that are highly patentable, and we're picking out all kinds of fascinating ideas from the wellspring of entrepreneurs within the Arc: from a company building next generation processors, companies doing machine learning for object recognition, and one looking at fruit harvesting using drones and assessing yields in agriculture. These ideas have the potential to completely transform our everyday lives and help us to meet climate and social goals with the right mentorship in place.

Accelerators like DeepTech Labs expect further interest in the Arc as investment continues to snowball: something which develops the national economy, unlocks social prosperity, and helps to solve some of the key issues of our age.

Pioneering Healthcare Innovation relies on Regional Collaboration

Q&A with Jason Mellad, CEO and Co-Founder, Start Codon

What does an accelerator do, and how does Start Codon fit into the innovation ecosystem within the Oxford-Cambridge Arc?

Unlike traditional accelerators, Start Codon is a venture builder which provides the firm foundation that businesses need to propel them along their growth journey. We are one step on a continuum between academic research, business formation and the start-up stage, accelerators driving the next phase of growth, and finally the maturation of a business into the SME stage with close links to venture capital and angel investors. One of the principal benefits of the Arc is that it includes all the elements a start-up needs at any stage of its business development journey, and we exist to facilitate and make each stage of as smooth as possible.

Ultimately, venture builders and accelerators do what is says on the tin – it accelerates the progress and growth of companies, acting as a catalyst just like in a chemical reaction. This is not necessarily make-or-break for more resilient start-ups but is instead designed so that companies have a de-risked proposition for investment further down the line. Our expertise and mentorship, combined with seed-stage funding, helps businesses become as attractive as possible to investors and collaborators from both the public and private sectors.

What sort of resources does Start Codon have to support life sciences and healthcare startups?

We offer a variety of resources, all designed to target areas where start-ups have the most need. This includes our own capital to ensure a flow of money at the crucial cash-strapped seed stage, but fundamentally the mentoring time of the Start Codon team and our resident subject matter experts. Our people have fundraised and struck deals within the health technology and life sciences sector before, and crucially they understand the context and needs of research-led start-ups.

Real estate can be another challenge for start-ups and spinouts, and we can also help them find office and laboratory space as they require, scaling this with real estate enablers as businesses grow and have new real estate needs. We also cannot underestimate the importance of giving start-ups access to our network of amazingly successful entrepreneurs and business minds. Start Codon has created a community – we now have 19 companies in our portfolio, adding 10 companies per year – and we want start-ups to view the Arc as a community of their peers, where they can learn, connect and discover opportunities.

When working with a start-up, we work to flesh out their business plan and team – building a solid and plausible offering to venture capital and further financing. We also help them apply for Innovate UK grants and other public sector funding, using our pre-existing relationships with organisations and our deep knowledge of how this ecosystem works. Whatever a start-up needs – including emotional support for founders working through the stress of starting a new business – we can ultimately provide.

In your experience, what are the key needs and constraints for start-ups and spinouts?

In the early days, the team is disproportionately important. We have worked with many start-ups with deep tech and academic backgrounds, where they have already had years of university funding and multiple scholarly publications, but what they really need is a commercially savvy team to help things get off the ground. Even if they have less robust technology or a less brilliant product on paper, a stronger team is the most important aspect to drive sustainable and lasting success. Dynamic and capable teams really help to minimise risk in an asset for investors and for ourselves.

Another key constraint is product market fit. Start-up founders can sometimes assume an advanced and impressive technology will make a viable product – but it's an understanding of the commercial side, and where the unmet needs are for the right product solutions, which accelerators and mentorship schemes can provide.

There are perennial reasons start-ups fail: a team that doesn't work, poor market fit, and running out of cash. Start Codon and other similar programmes give start-ups sufficient finance and mentorship and identify follow-on investors to give them the capital to achieve key milestones in the journey to resilient and sustainable growth.

What do you think the benefits are for a new start-up or spin-out in partnering with an accelerator like Start Codon?

There are plenty of start-ups out there who decided to go it alone and were successful, but proportionally they are quite rare. Being part of a community increases the chance of success, as does a tried-and-tested pathway for growth. It's key to understand that not all programmes are created equal, but research from Beauhurst in 2018 found that companies that use accelerators raise 44% more money than those that don't, and are also 75% more valuable.

Many research-led start-ups emerge from the Arc's universities, and their founders

have a lack of experience of commercial practise and the knowledge of what it takes to grow a business. They may have a great idea, but they need support in forming a company, funding to achieve a proof of concept, and mentorship until they can achieve an exit with a continuing relationship with their peers and potential sources of capital. Being introduced to the right contacts by accelerators means they can get to the nitty-gritty of research and development, free from the worries and difficulties of business development.

As much as possible, Start Codon removes the necessity for start-ups to begin from scratch, duplicating effort and learning processes across start-ups, and instead provides a signposted path for them to follow.

How do your partners, like Cancer Research, benefit from this approach to nurturing and cultivating start-ups?

I think previously there was a distinction between return-on-investment or ROI investing and impact investing that has largely broken down, and investors are increasingly viewing them as one and the same. No more so than in healthcare and the life sciences where we no longer see an either-or between impact and return, as enterprises and ideas with life-changing products and amazing potential are also increasingly highly profitable.

Our strategic partners, like Cancer Research UK, benefit from our experience in translating this amazing research to a clinical setting. There is a disproportionate amount of capital spent at the beginning of a funnel, but the amount of research and lifesaving solutions driven by this early step is exponential. We help in making the transition from a technology or scientific observation into a new therapeutic or diagnostic that can transform patients' lives.

StartCodon has always said that the number of lives saved, in addition to a return on investment, is a crucial measure of the technologies we invest in. We're not just box-ticking to make a return, we have been given an opportunity in the Arc to genuinely contribute to saving lives.

What makes the Oxford-Cambridge Arc an attractive place for accelerators to operate? What is it that draws investment into the region?

The deal flow in the Arc is outstanding, and the supporting resources even more so. The close, spatial dynamics of the Arc enable researchers and entrepreneurs to interact with their peers and a high concentration of likeminded individuals. This allows for a cross-pollination of ideas between sectors and industries – battery technology feeding into aerospace or motorsport, or sensor production providing local authorities with smart city technology – which is one of the Arc's major selling points.

For businesses, the Arc is an outstanding place to be and one of the best clusters of its kind in the world. We want to ensure that access is given to those not physically present: Covid-19 has proved that a physical presence isn't always necessary to do business, and for the Arc to reach its full potential, we can't go it alone. We are focussed on supporting UK biotech as a whole, including the Arc, and for those in the rest of the country we can also act as their entry point to the region. We would love for them to set up shop locally, but we help other UK and international enterprises make connections into the Arc even for those not physically located here. To reach its full potential, global investment and interest has to flow into the Arc – Start Codon has recently begun its first collaboration with the sovereign wealth fund of Singapore, and connections like that are absolutely vital if the Arc is to continue to grow.

What does the future of life sciences and healthcare look like?

I'm particularly passionate that the innovations produced by businesses in the Arc are deployed to help British patients. Too often companies from the UK or internationally utilise NHS resources and goodwill to discover new drugs and develop diagnostic tests, but that technology isn't deployed locally for years and the UK doesn't reap the full benefits. If the residents of the Arc are going to be convinced of its potential, innovation has to spill over into local communities. We need to make sure the Arc leads the way in innovation, but also in deployment and access, to help the population of the Arc and of the UK – improving healthcare outcomes and ensuring the NHS benefits from the research it supports.

The region is often compared to the Bay Area and Boston clusters in the US, but I can see the Arc potentially surpassing both in the future. What we have is a mature and developed ecosystem and pathway from world-class universities to start-up support and accelerators like Start Codon, all the way to major sources of investment and venture capital and the support of vast multi-nationals like AstraZeneca. Helped by accelerators, the Arc is one of the best places globally to translate your research into a successful business.

Supporting Scientific Breakthroughs

Q&A with Pete Wilder, Head of Property, Oxford Science Enterprises

What is Oxford Science Enterprises' mission, and how does your team support scientific breakthroughs?

When we were founded in 2015, then operating as Oxford Science Innovation, a critical part of our foundation was our partnership with the University of Oxford. We wanted to combine the best scientists and brightest business minds together, helping to solve the world's biggest challenges at speed and to better commercialise ground-breaking research. We receive a stake in every company that spins out of the various science departments of the University, across everything from the computer sciences to engineering and in return, the University holds a stake in our business.

There is a huge pool of untapped potential within Oxford and our mission from the start has been to support Oxford's academics to commercialise their scientific breakthroughs and grow the companies we believe are capable of making real contributions to the UK economy, and the world. Oxford is renowned for its world-leading science and academics, but has traditionally struggled to get the critical mass of entrepreneurs, investors and funding operating effectively together. Our organisation has enabled us to bring all that simultaneously together and as a result, we have helped increase investment in university spinouts from an average of £125m per year in 2011 to £600m in 2021, and helped provide and attract the funding these small, research-based companies need to sustain their growth. At Oxford Science Enterprises we invest very early; from initial idea to seed stage and then continue to invest all the way through a company's journey to IPO and beyond.

Are there any enterprises that you've funded that have been world-changing in their approach to societal challenges?

Vaccitech is the obvious answer to this question. This is an enterprise that we have invested in since its inception, founding and creating the business in 2016 alongside Professors Sarah Gilbert and Adrian Hill. Vaccitech is now credited as co-inventor of the Oxford-AstraZeneca vaccine, and it is their technology, created by Adrian Hill and Dame Sarah Gilbert, that underpins the vaccine. This has been a phenomenal journey to have witnessed and been a small part of over 18 months, and it is amazing to see the impact it has had on the world during the Covid-19 pandemic.

We are still in the early stages but very recently, an electric-powered plane broke the world speed record for electric vehicles. In collaboration with Rolls-Royce, this was powered by an innovative YASA engine, produced by one of our enterprises, and has real potential both for a British company with an innovative and highly versatile product on the global market, but also as a potentially scalable solution to the climate issues surrounding aviation. These are just two examples, but there are a host of enterprises across quantum computing, artificial intelligence, diagnostics and fusion energy which are really inspiring and could have an extraordinary impact on the way we live.

Why is the Oxford-Cambridge Arc a unique region for scientific and technological collaboration?

Oxford and the Arc aren't operating in a bubble - our scientists and academics are collaborating globally all the time. Both the University of Oxford and Harwell see regular collaboration with a global group of academics from hundreds of different universities working together.

But we recognise that to actually build the ecosystem and create an Arc, we need more than academics. We need places for companies to scale, for employees to live, infrastructure for them to commute easily, and the opportunity to send their children to decent schools.

The cost of living in Oxford is unsustainable to accommodate everyone who needs and wishes to live here, and companies are also now drawing their highly-skilled workforces across the middle of the Arc and adding to the jobs, training, and connectivity advantages of the Arc. Ultimately, the Arc, and the wider Golden Triangle, are excellent brands for international investors across the real estate sector but also in all sectors of this economic and research growth, representing excellent concentrated targets for FDI.

What are the opportunities and barriers to commercialising research in the Arc?

In some ways, the opportunities and challenges are one and the same: there is so much going on within the University it can be difficult to fully understand its output, and we need to be working with academics to better understand the scientific research coming out of the departments from these amazing and talented people. We also have to continue to strip away pointless bureaucracy and ensure everyone's interests across academia, the private and public sector are aligned.

From a real estate perspective, I see space remaining a critical issue for companies – there's still not enough commercial or residential space being delivered in a format that suits the needs of our companies. It's not coming through frequently enough, or in the right specifications, and if our companies can't find the right real estate fit they will obviously consider moving their businesses elsewhere.

Investment Potential

Backing Founders from Seed Stage and Beyond

Q&A with David Mott, Founder Partner, Oxford Capital

What is Oxford Capital's mission?

Oxford Capital was established in 1999 as an alternative investment manager, passionate about investing in early stage technology companies across multiple sectors. Over the years, we've invested half a billion pounds into over 100 companies. Our investors are people who want to generate returns, but are also interested in the impact of technology, and in backing UK enterprises.

Our portfolio is evenly split between deep tech and digital technology companies. These include the sectors one would naturally associate with the deep tech clusters of Oxford and Cambridge, such as artificial intelligence, machine learning, robotics and biotech. In comparison, the other half of our portfolio invests in digital economy businesses across e-commerce, digital health and sustainability. Often these are companies we've been able to access across the UK, but they are also linked to the Arc by alumni of the universities and research institutes. Today, our portfolio consists of 21 companies invested at seed or Series A stages, which we will be looking to back across multiple rounds to Series D and E Stage and ultimately to exit.

What is the Oxford Capital Co-Investor Circle?

One service we offer to private investors is the Co-Investor Circle, a group of angel investors who give us the firepower to invest into individual companies in special situations and enable us to bring more capital into our portfolio companies.

These are typically more sophisticated investors, looking for direct investment either through a specialist interest in a certain sector or through seeking to invest in later stages. To date, the members of that group have invested over £60m into 26 companies across multiple sectors.

Which sectors is Oxford Capital investing in, and how does Oxford Capital back founder-entrepreneurs?

We invest in technology sectors in which the UK is considered a world leader. This includes sectors such as fintech, through the presence of the City of London and the huge proportion of our national economy taken up by financial services. The UK also leads in artificial intelligence and machine learning, especially in the Arc, with Oxford and Cambridge representing deep centres of excellence for computer science and machine learning research.

The impact of the NHS in the UK also creates excellence in the fields of digital health and biotech, which are also important sectors for Oxford Capital. The UK has the highest take-up of e-commerce of any country in Europe, and so looking at new developments in e-commerce, and particularly sustainability, is an important sector to track. As a UK-only investor, we naturally try to play to the strengths of the UK, with the Oxford-Cambridge Arc forming an obvious concentration of talent and excellence within the national economy.

For Oxford Capital, the importance of the founder-entrepreneur lies at the heart of our investment approach. From our long experience, we believe that if we can support the founder from the earliest stage of building their company, we can maximise value at the point of exit. We focus on backing founders right through the entrepreneurial journey, helping them grow and get the foundations of their business right. We also support their growth as individuals, mentoring and surrounding them with the right board members, independent directors, and giving them training in specialist areas. This allows them to grow and emerge as strong leaders as the business goes through its multiple stages of growth.

We also recognise that starting a business is an incredibly challenging thing to do. It can be a very lonely experience, punctuated by incredible highs and lows – in short, it's an incredibly tough job. Oxford Capital believes that working closely with founders to support their mental wellbeing is incredibly important. We don't want them to burn out, but to stay the course, and we really take the long view on that point. When we talk to potential new portfolio companies, we

explain how we've supported our founders over the years, and often they are attracted to that opportunity for development. This is absolutely at the heart of our investment approach.

What makes the Oxford-Cambridge Arc such an attractive place to invest in?

This is a very simple answer: outside of London, the Arc has created more unicorns than any other region. This is not only because of the Arc's incredibly successful universities but it's also where the value has been created for investors. Oxford and Cambridge are probably the top destinations for UK and international venture capital looking to invest outside of London. Foreign investors might land in London, and then head to Oxford and Cambridge. The Arc is incredibly important as a magnet for foreign investment.

What are the key challenges for start-ups and spinouts in the Arc when securing investment?

They're the same challenges that all start-ups face: securing capital, finding talent and potential customers. Housing and transport links may represent small challenges, but in the world of start-ups, particularly digital start-ups, the challenges are the same as everywhere else. We ultimately need more talent, capital and entrepreneurs in the Arc, but we also need more start-ups because that means more successes over the long-term. We need to make the Arc as an environment, even more favourable as a place to start a business.

What challenges remain?

There is definitely a strong theme that outside of London, investors prefer to invest in other European tech clusters (such as Paris, Berlin or Stockholm), than to invest regionally in the UK. This is a very real challenge. The answer to this is more depth within the cluster and to increase its relative attractiveness. Oxford and Cambridge are perhaps too well-known for being deep tech clusters, and not well-known enough for being digital clusters. They need to do more to position themselves as rivalling leading European tech clusters.

Attracting a mass of people into Oxford and Cambridge has been a challenge and both clusters can be perceived to be quite insular. We need to encourage companies to be presenting and opening themselves up to UK and foreign investment. The UK has more unicorns than France, Germany and Scandinavia put together, and that puts the UK in a really strong position for encouraging investors outside of Europe to head to the UK for investment opportunities first. As a UK-only investor, Oxford Capital harnesses the benefits of this concentration of unicorns within the Arc, not only to achieve returns but to fund cutting-edge research and development in science and technology.

How does Oxford Capital benefit from locating itself near the Arc universities?

Oxford is in our name and DNA! The wonderful thing about Oxford is its 1,000-year-old brand, which has great global penetration and is very powerful – it's a truly international brand.

Based in the heart of Oxford means we're close to entrepreneurs, research, technology and know-how, making it an extraordinary place to do business. What we also find is that Oxford, just the same as Cambridge, acts as an extraordinary magnet for global talent and resources. We have the world's most successful politicians and businesspeople who want to speak, visit and have an association with the universities of Oxford and Cambridge. Just look at the American billionaire Stephen Schwarzman: he donated £150m, the biggest donation to a British university since the Renaissance, to be associated with the university and to fund academic research into the ethics of artificial intelligence. All of these factors point to the sheer quality and density of knowledge capital that exists in the cluster.

We spend a lot of time focussing on connecting with our networks, and we are lucky to be near the likes of the Oxford Foundry and other accelerator programmes in Oxford. These help companies with links to the university to access talent and mentoring services, and to accelerate their business. We see these as really positive initiatives – with a number of these programmes running, they help to get entrepreneurs kick started.

A strong venture capital ecosystem also exists, including ourselves, Oxford Science Enterprises, and Cambridge Innovation Capital on the other side of the Arc, that help provide local seed-stage capital alongside local angels to get companies off the ground. Invariably over time they will need to seek more capital, potentially from London or overseas, and that's a natural part of the ecosystem. A greater depth of capital within the Arc which could help to develop businesses beyond start-ups would be very positive.

Oxford Capital invests in a range of enterprises from AI to life sciences technology: what do you think the most inspiring enterprise you've worked with?

I always hate to choose my favourite child within the portfolio, we have a very diverse range of investments and some really fantastic companies. To pick out some examples, Latent Logic, which grew out of the Department of Computer Science at Oxford, develops AI software for the mobility market to train the algorithms for self-driving cars. This had already had trials with the world's biggest companies in the self-driving car market, and one of them very quickly acquired the company (Waymo – Google's self-driving business), providing not only a very good return for our investors but also a very good example of what international investment can do when targeted in the Arc.

Other examples include Xihelm, the company that develops robotics to pick tomatoes in greenhouses, transforming the automation of the workforce in agriculture and potentially alleviating labour shortages. Oxford Capital were also seed investors in Moneybox, a digital tech company providing wealth management to everyone, not just to the wealthy. We backed Moneybox when they had no customers, and now they have over 700,000 – providing services to help people save, invest, buy property and manage their pensions. These are all companies doing inspiring things and prove the depth of technology in the cluster and beyond, which has the power to attract international attention.

What would be your recommendations for the future of the Arc?

Things have really shifted since we set up Oxford Capital. Academics are far more interested in becoming involved in start-ups based on their research, and attitudes have really changed. It's increasingly acceptable, and desirable, for academics to be associated with spinouts and new companies associated with their research. All of this makes it much easier to talk to academics about businesses, and there's an increasing understanding around the whole concept of building shareholder value.

My key recommendation would lie in getting more collaboration and more sharing of insights between investors, managers and academics, to gain an understanding of what good really can look like. If we can collaborate on all this together, we can continue to learn and build successful companies in the long term.

Giving New Ideas the Wings to Take Flight

Q&A with Michael Anstey, Partner, Cambridge Innovation Capital

As a preferred investor for the University of Cambridge, CIC provides the runway and follow-on Series A funding for emerging spinouts and start-ups to lift their initial ideas off the ground. Why is this important from a perspective of commercialisation, and what happened before CIC existed?

If we look at the-Cambridge ecosystem as a whole, there are several key sources of innovation. The University of Cambridge is at the centre of the ecosystem and is recognised as one of the most entrepreneurial universities in the world. In addition to the University, there are multiple research institutes, accelerators and multi-national companies translating globally important science in Cambridge. The pain points and capital requirements that start-ups originating from Cambridge face are much the same as elsewhere in the UK.

At creation, nascent companies are really focused on getting proof of concept of their idea and ultimately finding a way to protect that idea through intellectual property. At this stage there are lots of sources of funding in the form of government and academic grants, as well as seed investment. The University of Cambridge has a seed fund itself, providing £500,000 to £1m to activate these companies and launch them off the ground.

From there, there are other priorities to think about: team-building; securing the appropriate advice and expertise; R&D capabilities; operations; and business strategy. This requires growth funding, and it's this that CIC provides, enabling those start-ups to spread their wings.

Before CIC there was a shortage of growth funding in Cambridge. Companies would be forced to exit earlier than they should, meaning that these pioneering innovations would get acquired by large, multi-national corporations. Cambridge was at risk of being a technology exporter, rather than achieving its full potential as a global company-builder. CIC was created to address this.

How does CIC's relationship with the University of Cambridge ensure that good ideas don't slip through our fingers?

The University was very forward-thinking in finding ways to fill the funding gap. This is where we've stepped in – setting up an independent venture capital fund through a collaboration agreement with Cambridge Enterprise.

Cambridge Enterprise's mission is to help academics to commercialise their ideas. This is a social-driven mission and CIC supports it by being profit-driven and plugging the funding gap for greatly needed growth capital while creating consistent returns for our investors. We're fortunate to have this privileged relationship with the University and its spinout enterprises, as the trusted investor in these emerging opportunities as they arise. This enables us to have a different but symbiotic vision that the University is seeking to achieve.

The way this relationship works in reality is that we feed in our network, provide strategic advice at creation to build out the appropriate foundations; develop fundraising strategies to look three or four steps ahead, and offer ongoing collaboration as these businesses evolve. This is not just about funding, but easy access to the ingredients required to accelerate growth in a seamless and organic way.

What are some of the challenges involved in the life cycle of company growth and outlook?

All companies come up against the same three challenges:

The ability to attract talent – human capital is a scarce resource, and yet this is the lifeblood that takes innovation further. CIC seeks to relieve that issue by leveraging our network and connections, and by being hands-on in team-building.

Financing risks – companies fail when they're drip-fed capital. If they're not given sufficient funding to grow and scale at pace, we can only expect to be technology exporters for the long-term. CIC provides the pathway for start-ups and spinouts after initial seed funding, to get good ideas off the ground.

Adopting a global outlook – nascent enterprises must be able to connect to partners, customers, investors, and capital markets, to achieve their full ambition. CIC introduces these companies to a network that is local and global in reach, to take advantage of these opportunities.

When you bring in these ingredients simultaneously, exciting things happen, as we have seen with many of the start-ups that we have invested in over the last few years.

What is it about the Oxford-Cambridge Arc that attracts the best of enterprise, talent and investment?

The Arc is a fantastic place in which to innovate. It can facilitate collaboration across a wider geographical scope than we see elsewhere in the UK. It eliminates the need for enterprises, investors, and domestic and overseas specialists to choose between several ecosystems such as Oxford or Cambridge, for example, when dipping into each of these to select the best resources.

Engagement with a single, coordinated supercluster is where the Arc can be extraordinary. This enables the seamless movement of people across the Arc – the

most scarce resource there is right now – and the more we can move people across the region and eliminate the choice between insular ecosystems, the greater the mixing of ideas and integration that is possible.

It also creates the platform to compete at a global level. We will lose if we don't have sufficient scale in our offering. Cambridge or Oxford alone can be seen as subscale. Together we achieve scale and can be extremely competitive with other global ecosystems, like the Boston and Bay area.

Finally, looking at Cambridge as an example, there is a lot of structure and resources for companies to grow through the first couple of years of their life. But as they scale, they require a greater footprint to expand their manufacturing and other large-scale activities. CMR Surgical, a globally-leading robotics company that has its HQ in the centre of Cambridge and is building a new manufacturing facility in Ely, is a perfect example. It has benefited enormously from a cross-regional supportive ecosystem that keeps growing companies. The Arc offers this opportunity.

Is there anything missing from the Arc's R&D and investment ecosystem? How does this make it harder for new innovation to grow and scale?

There are two things that come to mind:

The Arc needs coordination – not top-down governance, but coordination, something akin to the work that Cambridge& does across the Cambridge region. Cambridge& exists for the benefit of the Cambridge ecosystem, doing its best to bring together a complex ecosystem to have a coordinated offering to external partners. The Arc needs a similar coordinating organisation or body to bring a single offering to domestic and overseas investors, to convey what the Arc can offer.

The Arc needs government support – the aspiration to make this a global supercluster and a leading innovation geography will only work if there's appropriate infrastructure in place, from funding, to transport, to housing.

Within your portfolio, what have been some of CIC's greatest success stories, and how can we make more of these within the Arc?

I'd like to touch on three success stories from within our portfolio:

CMR Surgical – an extraordinary example of a company that has harnessed all that the Arc ecosystem has to offer when it comes to finance, talent and infrastructure, to create arguably one of the world's leading robotics companies. When the Arc works well across these dimensions, these companies give back to the ecosystem in unprecedented ways.

Sense Biodetection – a pioneering, next generation testing platform which will be highly disruptive in the way we think about molecular testing. The company has dual HQs in Cambridge and Oxford, setting up in those locations to enjoy the resources at both ends of the Arc. Sense is doing what many companies could be doing if the Arc was coordinated, constantly moving back and forth across the Arc's geography.

Gyroscope Therapeutics – now a transatlantic gene therapy business with its HQ in Cambridge, deliberately located there to benefit from its resources. Leveraging those resources is one of the reasons why it's a 'unicorn' company valued at over $1bn.

The common thread of these three companies is that CIC is the only local investor in these organisations, providing funding over multiple rounds, team-building support, and acting as a gateway to fully benefit from the Cambridge ecosystem. We'd like to think we've played an important role (but not the most important!) in their success stories. I'm certainly very proud of what CIC has been able to help them achieve.

Policy Recommendations

The American economist Julian L. Simon once wrote that "the main fuel to speed the world's progress is our stock of knowledge." In his book, The State of Humanity, Simon referred to knowledge as "the ultimate resource", infinite in abundance and nurtured within hearts and souls rather than locked away under rock and soil. Accessing it only requires imagination, and the will to see it manifest.

In the Oxford-Cambridge Arc, universities burgeoning with domestic and international talent collaborate with public-sector institutions and private enterprise to form of a 'Triple Helix', which has been fundamental to the region's success in commercialising innovation. The ideas spun out of university laboratories or picked up and funded on campus have become some of the most notable achievements that the Arc has to offer, incubated, cultivated, and financed by a growing range of investors, accelerators, knowledge catalysts, and privately-run campuses.

When this ecosystem operates effectively, ideas which start in the confines of a conversation have the potential to be world changing. The Oxford-AstraZeneca vaccine is one homegrown example, but there are others in areas ranging from life sciences and pharmaceuticals to fusion and renewable energy, motorsport, forensics, AI and robotics, advancing the pursuit of further discoveries which continually improve the collective social prosperity of the human race globally.

By contrast, when we struggle to commercialise fresh thought and make it more difficult to access the necessary resources; like talent, capital, and support for emerging entrepreneurs, that thicken the ties which bind the 'Triple Helix' together, we fall away from the frontier of innovation in science and technology.

Supercharge

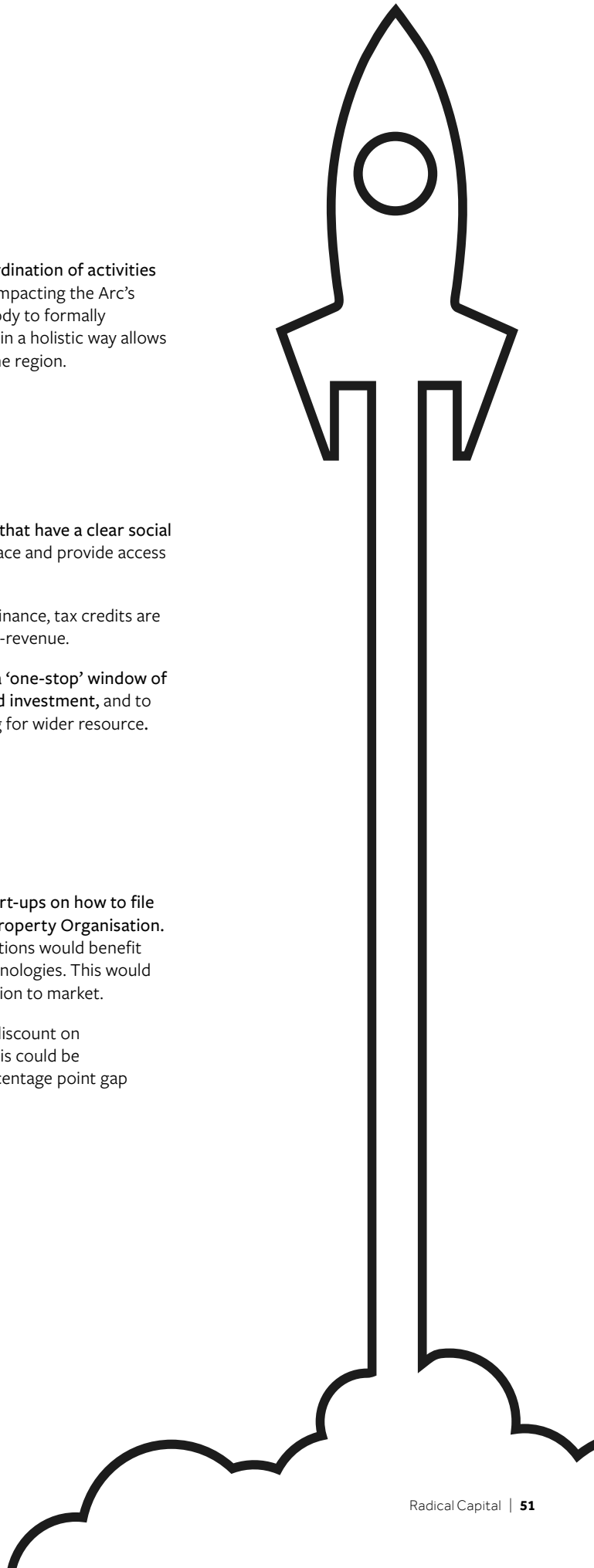
- **Establish a Science and Tech Growth Board to ensure central co-ordination of activities which affect the Arc ambition.** The current lack of co-ordination is impacting the Arc's ability to operate within a global context. Establishing an Arc-wide body to formally engagement with different sections of central and local government in a holistic way allows for less friction, while unifying local policies to maximise growth in the region.

Advance

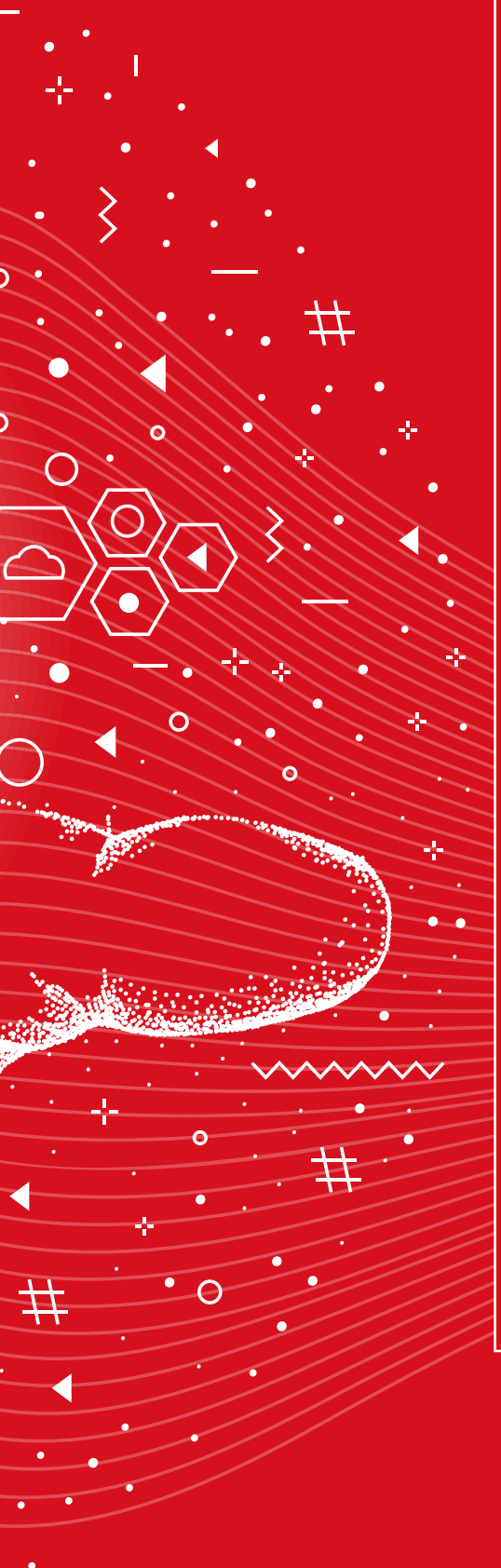
- **Grants, such as subsidised rents, to knowledge-intensive start-ups that have a clear social purpose.** This would help fledgling companies access appropriate space and provide access into further long-term support.
- **A more generous R&D tax credit system.** As a form of non-dilutive finance, tax credits are fundamental to the survival of start-ups with negative cash flows pre-revenue.
- **Creation of a UK-equivalent tech-by-sector digital marketplace as a 'one-stop' window of access to simplify the innovation landscape for international inward investment,** and to make the process of partnership easier for private enterprise looking for wider resource.

Grow

- **Establish an independent patent advisory agency that educates start-ups on how to file patent applications nationally and through the World Intellectual Property Organisation.** Start-ups and spin-outs companies linked to higher education institutions would benefit from training to file and administer patent applications on novel technologies. This would greatly accelerate the transmissibility of new technologies and adoption to market.
- **Adapting the UK 'Patent Box Regime'** which currently allows a 10% discount on Corporation Tax if eligible companies exploit patented inventions. This could be accomplished by adjusting the Patent Box rate to maintain a ten-percentage point gap between the Patent Box rate and the Corporation Tax rate.



Human Capital



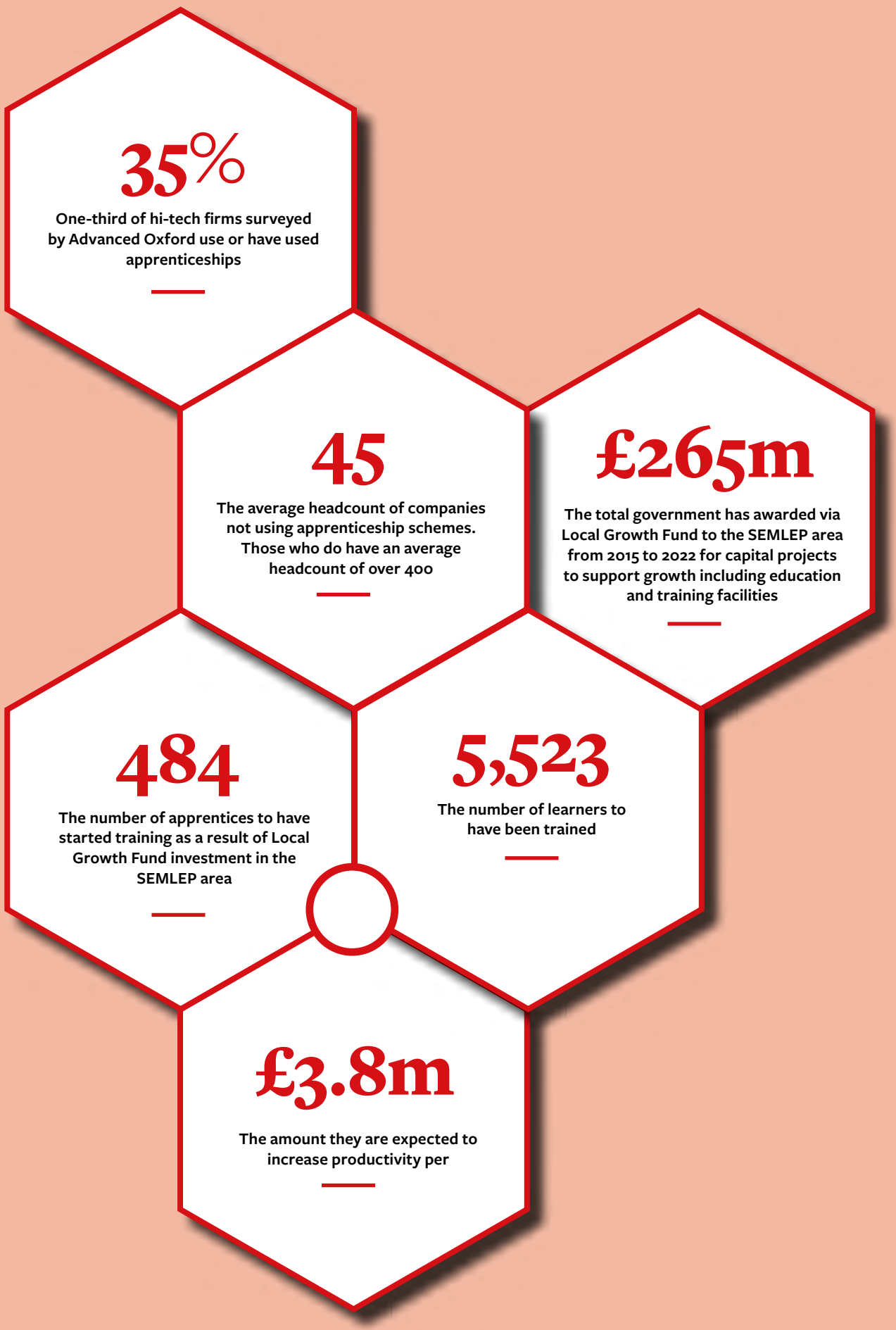
While it's easy to focus on founders and entrepreneurs of the Arc-wide knowledge economy, a highly-skilled, dynamic, and future-proofed workforce will be the lifeblood that emerging innovators need to reach their full potential.

To bridge the skills gap and ready ourselves for the Fourth Industrial Revolution, we need to 'level up' our relationship with education and training. This means fresh thinking around STEM education and the process of obtaining credentials regardless of age or socio-economic background, widening the relevance of apprenticeships and work placements, and bringing private sector requirements into a more flexible system of teaching with a direct vocational pathway to hi-tech employment.

Automation, digitisation and the computerisation of jobs is a moment of opportunity rather than alarm if the rigidity of the education system is addressed early. Through careers advice, students still in schooling must be made aware of the relevance of highly-skilled digital jobs, like computer science and coding, while those seeking a transition to future-proof their skillset must be able to do so without substantial trade-offs in their living conditions or displacement from their current work. 'Micro-credentials', foundational degrees, and retraining programmes in collaboration with higher education providers, are some of the ways in which this shift to a more knowledge-based economy is already occurring in the Oxford-Cambridge Arc.

What does the future of employment look like in the Arc? What are the new 'tools of the trade'? How can new and existing education institutions in the Arc lay the groundwork for seamless reskilling? How does this play into the 'levelling up' agenda, which seeks to elevate the UK's domestic workforce in light of structural shifts in employment and job creation?

How do we rewire our relationship with education to support the knowledge capital taking root in the Oxford-Cambridge Arc?


35%
One-third of hi-tech firms surveyed by Advanced Oxford use or have used apprenticeships
45
The average headcount of companies not using apprenticeship schemes. Those who do have an average headcount of over 400
£265m
The total government has awarded via Local Growth Fund to the SEMLEP area from 2015 to 2022 for capital projects to support growth including education and training facilities
484
The number of apprentices to have started training as a result of Local Growth Fund investment in the SEMLEP area
5,523
The number of learners to have been trained
£3.8m
The amount they are expected to increase productivity per

A skills revolution?

Alistair Lomax, Director, Arc Universities Group

In the messy conflict between those who would not change and those who cannot wait, revolutions usually reveal their full nature only after they're done; after the cordite has cleared. When we think of the future of work, we tend to default to the worst possible outcome. I, Robot, Blade Runner, Ex-Machina, and A.I., present a dystopian reality where unrestricted technology undermines and eventually usurps the role of the worker. But is it really all that bad?

We talk about 'robot-proofing' society as if an apocalyptic conflict between 'us-and-them' looms ominously on the horizon. The Oxford Martin School's assertion that almost half of all today's jobs studied will be susceptible to automation does not bode well for the next generation.

It is true that the makeup of the workforce is changing. According to techUK, the rate of digital and technology-intensive jobs is growing at more than double the pace of traditional jobs. The government's Digital Economy Council has also observed that advertisements for job roles in technology and digital fields have increased by 36% since June 2020. This also reflects how the Covid-19 pandemic has accelerated this transitional demand in favour of higher-skilled, 'digital-compatible' labour. Investment in the ingredients of the so-called 'Fourth Industrial Revolution' - like life sciences, consumer software, cybersecurity, robotics and artificial intelligence - is a lodestone of Westminster's 'levelling up' agenda. This is more of a revolution than a fleeting trend.

Should we be worried or afraid, as we gaze into the crystal ball to see a transformed workforce in the future? In most instances, new technology is driving change through unprecedented social prosperity and is digitising repetitive administrative tasks. This should free up opportunities for greater creativity. These 'jobs of tomorrow' will be requiring a high-level of qualification and specialism. They will call upon a very different training and education system.

The Arc's productivity in emerging 'high-technology' sectors is one of the greatest testaments to this effect, creating, rather than ultimately displacing, jobs for new generations.

For the last five years, the region has created an average of 44,000 new jobs each year, many of those in technology-related fields. In 2018, employment in the science and technical sector across the Arc grew by 6.1%, compared to a 1% expansion in employment for the Arc as a whole. Between 2009 and 2019, 72% of additional jobs created in the 10 most R&D-intensive industries were located within the Golden Triangle of London, Oxford and Cambridge, a relationship which has supported the Arc's human capital creation. The Arc is also home to one-third of the UK's biotech employees, developing new drugs and therapies which, through the pandemic, have delivered value to public health on a global scale. There is also an extraordinary concentration of jobs in environmental services and stewardship.

It has been estimated that, with investment, there could be as many as 1.1 million new, high-skilled jobs in the Arc by 2050. We already have one of the most highly qualified and specialist workforces in the UK and more than 60% of workers in Oxford and Cambridge are qualified to degree level or higher. Alongside the network of further education colleges, and an enlightened network of support from local authorities and enterprise partnerships, the Arc plays host to one of the most diverse and dynamic group of universities. Located between the research-intensive giants of Oxford, Cambridge and Cranfield, we have the great skills and growth engines of the teaching-led universities, such as the universities of Northampton, Bedfordshire, Anglia Ruskin, Buckinghamshire New and Oxford Brookes. A new model is also being championed by MK:U in the middle. Milton Keynes is also the home of the Open University, that utopian model which has a footprint across each of the UK nations. What is done here has the potential to reach and benefit the whole of the UK.

But what more should we be doing? The Arc promises to be one of the most attractive parts of the world in which to live. More can be done to retain our home-grown talent. Our economy performs on an international stage. What about mechanisms to attract the best international talent, expanding eligible prizes for fast-track emigration and the criteria for technical and entrepreneurial skills, and providing seamless pathways to pain-free domicile through visa sponsorship?

Already we can get a sense of the 'jobs of tomorrow' from the superclusters developing in the Arc today. Pioneering industries have so far captured the best of a burgeoning pool of human capital, but we ought to be replenishing this resource through a combination of upskilling, reskilling, and real opportunities to undertake technical training at all levels of education.

Now is the time to identify signs of promise and potential; to level-up and get ready for a future fully prepared to embrace the collective and collaborative opportunities that are promised once the revolution is done.

Quantifying Human Capital

Julie Archer Director of People & Change, Bidwells

One of the most extraordinary successes of the Arc's 'Triple Helix' lies in an unparalleled ability to retain and pull talented individuals into the region. Positive relationships with an immediate locality, whether born from friendships made in formative years or through community ties and industry networks, are critical when making the decision of where to put down roots for the future.

In a recent study from Liberty Living, 77% of graduates in Cambridge cited 'networking opportunities' as a primary driver for keeping them in the city. Research from UC Berkeley on 'vortex universities' describes this positive effect on innovation ecosystems where these influences are most frequently strongest: "students matriculate, learn, contribute to the campus ecosystem, and graduate... then many of these alumni stay in the vicinity of the campus to work and live."

Attracting and retaining talent sharpened in the Arc empowers the region and pushes the frontier of innovation further. The 'stickiness' of towns and cities like Oxford, Cambridge and Bedford is already evident in the changing composition of professional occupations. Milton Keynes ranks in the UK's top five for concentration of high tech and digital SMEs, while the town is now home to over 10,000 software and data engineers which is more than double what it was five years ago.

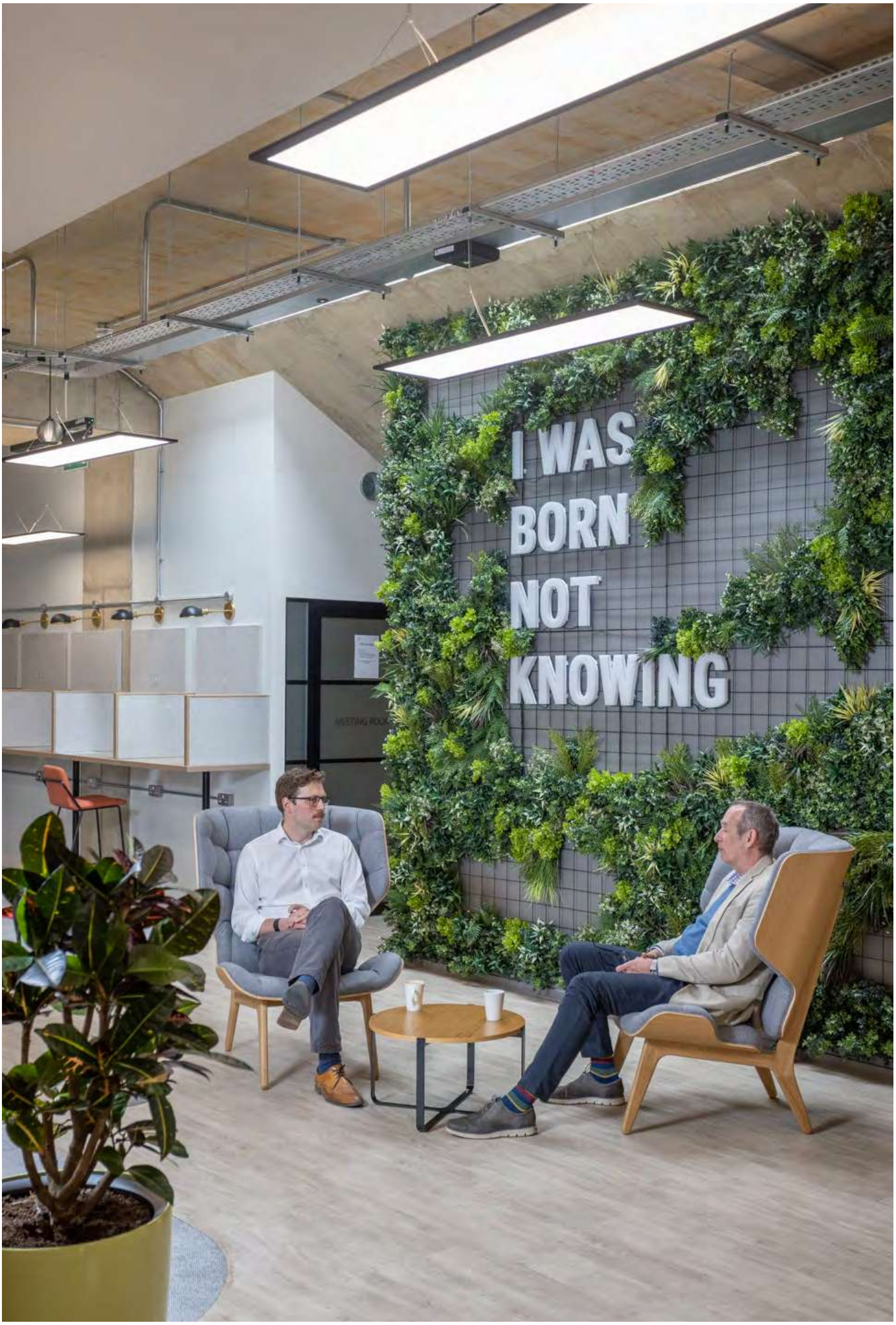
Despite the region's highly educated young population, barriers to human capital formation still pose unassailable limits to the Arc's growth in the long-term. In Oxford and Cambridge, house prices are over 10-times average earnings and housing formation rates are some of the lowest in the country, while regional transport links are poor when measured against better integrated knowledge clusters that have achieved a far greater geographical scale.

Actively cultivating talent within the Oxford-Cambridge Arc, and retaining it, is as important as attracting best-in-class talent from around the globe. In this respect, the Arc is underperforming as relative income inequalities and housing affordability across the Oxford-Cambridge Arc mean that access to education can vary profoundly. As the National Deprivation Index demonstrates, while South Oxfordshire (308) and Cambridge (300) enjoy some of the highest mobility and accessibility of education scores of the 318 UK local authorities included in the analysis, the same is not true for Luton (52), Peterborough (53) and Corby (70), which rank at the other end of the scale.

If we want to harness our pool of human capital and actively cultivate it within the Arc, we'll have to level the playing field for future generations, both domestically and internationally. The Arc, in its truest sense, must be more than an expression, but a commitment to elevating the opportunities available to form meaningful bonds with its ecosystem.

73%

The percentage of respondents to an Advanced Oxford survey that currently recruit principally among those with an academic background


I WAS
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Reskilling for the Jobs for Tomorrow

Richard Tunnicliffe, CBI East of England Director

If we were to survey the dynamic landscape of established businesses and start-ups that operate in the Arc from scratch, we'd quickly come to appreciate their tremendous influence over the way people live and work in the UK. This isn't solely confined to the more mesmerising, almost other-worldly evolution of AI, robotics, automation, augmented reality and cutting-edge 'deep tech'. Familiar and well-known industries for which we are internationally recognised, as well as those in their nascent stages of growth, are collectively open to and rapidly adopting new technologies, which will constitute a paradigm shift in our internal market for skills and employment.

As an emerging scientific superpower, the Oxford-Cambridge Arc will require more than most to comprehensively overhaul its training and apprenticeship provision to meet a skills requirement in transition. And yet, the last decade has been a nadir for learning and education for adults. At a time when work is set to be revolutionised by the Fourth Industrial Revolution, described by the International Labour Organisation as automation, digitisation, the growth of platform employment and the application of artificial intelligence, the UK is failing to meet even its current needs for reskilling and upskilling. In the next decade, the needs of business in the Arc must be synergised with the qualifications and skillsets of its workforce. Tertiary education must meet the skill gaps that exist in the market, and anticipate the likely needs of tomorrow.

While we shouldn't be panicked by shifting skills requirements set in motion by factors such as automation, technological displacement of jobs, and ever-thickening globalisation, we ought to be normalising the practice of reskilling and making these resources available. According to the CBI's own research, only a third of adults say that they have participated in learning during the previous three years, representing the lowest figure in the past two decades. Crucially the group at the highest risk of losing jobs to automation is the group least likely to have been involved in learning, those without a higher education qualification and from lower socioeconomic backgrounds. To avoid the seemingly paradoxical situation of simultaneously high unemployment due to automation with a labour shortage driven by skill gaps, significant increases will have to be made to future-proof opportunities for further education.

Creating the Launchpad

Many firms will have had to speed up their pace of technology adoption during 2020 and 2021 to ensure business continuity during the pandemic: estimates from recent survey data suggest that consumers and businesses have leapt five years ahead in digital adoption within a space of eight weeks. – CBI Learning for Life Report, 2020

With high levels of skill mismatch in the UK, and disappointing progress in widening adult education and lifelong learning programmes and incentives across the economy, the risk is that the incredible innovation potential of the region could fail to translate into lasting commercial success due to an inadequately or inappropriately trained and educated workforce. That's not an unreasonable conclusion to draw, for which the Arc may enjoy the presence of world-beating academic and research, but the ancillary requirements necessary to support and deliver a knowledge-based research and development cluster will be an exponential burden unless we act ahead of the curve.

'Nine in 10 workers will need some form of reskilling by 2030 - this is an issue that affects everyone. Virtually every job will change – some incrementally, some radically'. – CBI Learning for Life Report, 2020

The Role of MK:U in shaping the Oxford-Cambridge Arc

Prof Lynette Ryals OBE, CEO, MK:U

What is the founding philosophy of MK:U, and what is it doing differently from a digital skills perspective?

The founding philosophy of MK:U is that we are a university designed with business, for business. Working with and consulting with employers at every step of the way, MK:U will develop and maintain a curriculum and an educational approach that is uniquely relevant to the world of work – in effect, blurring the boundaries between work and learning, always thinking about how knowledge can be applied to tackling real-world business and societal issues.

MK:U is focused on providing knowledge and skills that are uniquely relevant to the digital economy and new technologies. To understand what digital skills our learners need, we consulted with tech companies of all sizes. Without exception, these employers told us that they valued a range of commercial and interpersonal skills in their employees. We responded by creating a suite of professional skills that are hard-wired into each of our courses, bearing credits that contribute towards the achievement of their degree.

Is it urgent that we rethink our approach towards the traditional curriculum?

The UK is suffering a chronic and growing skills gap, especially in digital skills. With companies struggling to recruit or train enough talent to meet their needs, our economic performance is being adversely impacted. This isn't just about producing lots of people with relevant skills on paper; it is about producing people who can apply their learning so that they hit the ground running when they are at work.

In terms of rethinking the traditional curriculum, current skills crisis requires innovative solutions. This translates into a problem-based learning (PBL) approach by which students work in groups to research and develop solutions to problems and challenges set by business. In a PBL traditional curriculum, content is tempered by a focus on 'how to', with skills and applied knowledge balancing theory. MK:U uses problem-based learning across all of its curriculum.

How do we ensure that future generations have the necessary skills to be adaptable and agile in a changing economy?

At MK:U we believe that future generations will need flexible and transferable skills to enable them to adapt to new technologies and innovations throughout their working lives. We already see the rate of technological change driving an increased requirement for people to retrain during their working lifetimes, a development that is likely to gain pace in years to come.

The best way that we can help future generations to adapt is to teach them to 'learn how to learn' and to develop the whole person, not just the technical specialist. By utilising problem-based learning, we include requirements for professional and personal development that are fully integrated into every course we offer. We use novel means of assessment to ensure that our learners have truly developed agility and adaptability. Finally, we work with our business supporters group and our industry advisory boards to discuss how the curriculum is developing over time and the new subjects that are emerging so that we can constantly adjust our courses to the needs of working life.

Why is the Arc the most appropriate region to be carving the path for transformative education?

Our values (Innovative, Exciting, Relevant and Professional) reflect the distinctive qualities of the Oxford-Cambridge Innovation Arc, which is home to breakthrough scientific innovations in exciting fields including space propulsion, life sciences, and aerospace.

The Arc is also very much a place where new ideas are applied and relevant in practice, where technology demonstrates new possibilities for sustainable growth. These green technologies include Auto-Shuttle autonomous buses in Cambridge, hydrogen and electric-powered aircraft at Cranfield, shopping delivery robots in Milton Keynes and gene technology at Oxford.

Finally, the Arc – and especially the central Arc area in and around Milton Keynes – is a national hot spot for entrepreneurial activity. At MK:U we recognise that entrepreneurs and innovators need support to help their businesses survive and scale. Our Innovation Hub, which opens in March 2022, will provide that support, creating a network of smart city entrepreneurs to work on technology challenges with our support and with help and advice from our partners.

What do you see as being the greatest opportunities and challenges as we upskill to meet the future demands of high-technology industries?

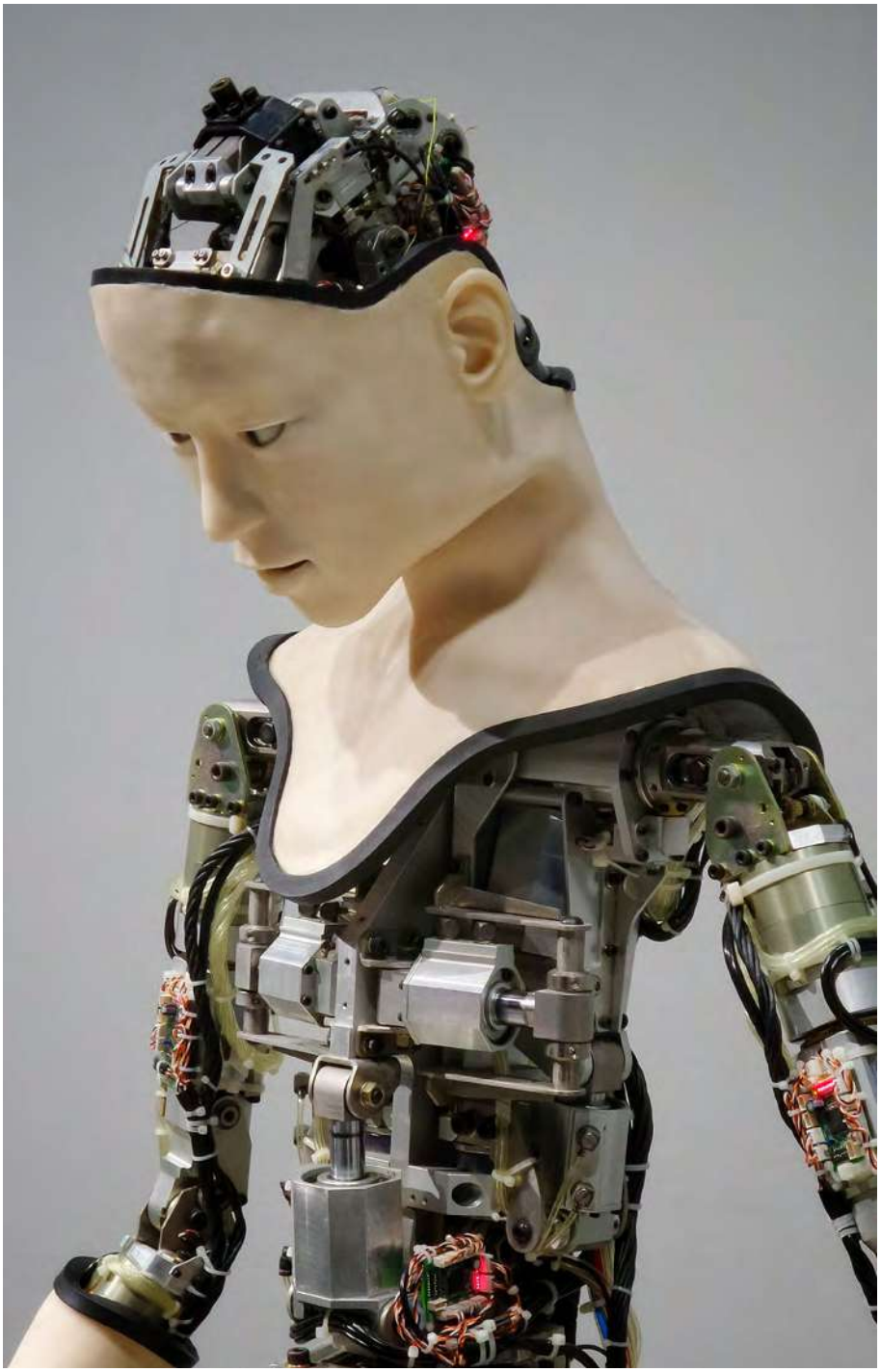
The opportunities are huge, both for individuals and for society. Technology changes offer the creation of new, skilled jobs and whole new industries. A World

Creating the Launchpad

Economic Forum report in June 2021 found that robotics and automation increases both productivity and jobs; PwC estimates that artificial intelligence could add $15tn to the global economy by 2030 – more than the current output of India and China combined – resulting in an increase of 14% in global GDP. New technologies such as automation and robotics offer solutions that could aid inclusivity by helping those with health or learning differences to participate more fully in their communities.

One challenge is to ensure that everyone does indeed benefit from new technologies, such as ensuring that AI rules are fair; at MK:U we have added ethics as a core part of our compulsory professional skills portfolio studied by all our students. We have also designed our courses, facilities and delivery mechanism to be inclusive of differently-advantaged groups including neurodiverse learners. Another challenge is sustainability and tackling climate change, topics that are built into our core curriculum.

A third challenge is the sheer speed and scale of technological change. New entrants into the workforce, as well as people that are mid-career, will need to prepare themselves to upskill and retrain frequently during their careers. At MK:U we tackle this by bringing together the worlds of work and learning. We have a firm conviction that learning is a core part of every week, for everyone, and a determination to connect people for learning in virtual and in physical domains.



Investing for Prosperity in the Centre of the Arc

Nathan Bostock, CEO, Santander UK

When thinking about the Oxford-Cambridge Arc's scientific and technological potential, a lot of people understandably tend to focus on the two cities which bookend the region. I believe that is a mistake. To truly tap into the full potential of the Arc, it is vital that we drive investment across the whole region and work collaboratively to fuse together all of its key towns and cities. Towns like Milton Keynes, Bedford, Cranfield and Northampton are now some of the fastest growing centres for R&D in the UK, and home to ground-breaking innovation in areas ranging from cyber security and data analytics to driverless cars and autonomous drone delivery.

At Santander UK we believe passionately in the potential of the Arc, and that's why we pledged a substantial financial commitment in 2019 to MK:U, Milton Keynes' forward-thinking institute for higher education backed by Cranfield University, committing to the revolution in digital skills that will be indispensable to our future, high-tech society. Alongside this, we have also invested £150m into a purpose-built headquarters in Milton Keynes, recognising the city's position as Europe's leading Smart City, its growing population of well-educated young people and its great potential as a place for our colleagues to live and work. The centre of the Arc links great universities and public enterprise with local businesses and a global pool of talent and from this vantage point, it is ideally placed to bring together the various types of innovation that thrive across the region. Innovation in the centre of the Arc gives a competitive advantage to the UK as a whole, and factors strongly into the Government's ambition to level up regional economies.

It's also a region where we should be cultivating homegrown skills. Despite the wealth of human capital in the Arc, we continue to face a real lack of technical skills across the economy in areas such as data science, analytics and cyber security. These skills are increasingly needed by all businesses in the UK, regardless of the sector they operate in. To address this, we will need real public, private and academic collaboration.

The Arc is a perfect place in which to develop these skills, as it is home to a vast number of innovative businesses, both large and small, as well as playing host to a number of globally renowned universities. It's crucially important that businesses invest in the higher education system, supporting these institutions in developing courses that deliver the skills which employers will need in the future. With the right investment and skills, the centre of the Arc can match the wealth and prosperity of Oxford and Cambridge.

To do this, Santander has collaborated with MK:U to launch a business focused degree apprenticeship scheme, enabling colleagues to pursue a Cranfield BSc degree at MK:U whilst working. My intention is that this will give young people a chance to gain experience in the workplace, while providing an education focused on solving real problems that can be applied to an increasingly digital business like Santander. It is also a crucial way for Santander to be able to invest in colleagues, enabling them to retrain on the job while supporting the retention of good people in a competitive job market. It makes sense to develop a university like MK:U in the centre of the Arc, as the technical skills it provides to students will be of use to businesses across the entire region and the wider UK.

More fundamentally, universities need to collaborate with employers to ensure we are getting the right skills to tackle tomorrow's problems. The development of an outcomes-focused university like MK:U allows business and academia to work together to invest in our talent locally as part of the triple helix approach that underpins the Arc concept. This is an important issue that goes beyond Santander and MK:U – the lesson we need to learn from this collaboration is that the UK will thrive if different parts of the country succeed. It is far healthier for the regional economies of the UK if we can invest in human capital and retain it within regions, and to do this we must not just create opportunity, but also a thriving environment and community around clusters like Milton Keynes.

I look forward to seeing the fruits from continued investment and growth in Milton Keynes and the surrounding area of the central Arc. By fully realising the potential of this area, we will be securing a bright future for the Arc, its people, and the businesses that are now setting up in the region.

Investing in the Arc's Propensity to Innovate

Pete Gladwell, Group Social Impact and Investment Director, Legal & General

L&G is one of the pioneers of 'inclusive capital' and has championed social impact investing as a way to address key societal challenges. What has L&G's involvement in the growth and prosperity of the Oxford-Cambridge Arc looked like in past and present, and how will investment factor into this development in the future?

It goes without saying that L&G has invested a lot in both Oxford and Cambridge over the years. In 2019, we signed a £4bn, 50:50 partnership with Oxford University to build homes, workspaces and research facilities for 1,000s of new staff and students. We've also invested heavily in Cambridge Science Park, providing the essential funding to science and innovation districts which power national prosperity.

'Inclusive capital' is about putting money to work in a way which helps to build better societies. Across the Oxford-Cambridge Arc, we see opportunities to invest in emerging technologies and regional development that supports and accelerates R&D in the region and which is fundamental to solving some of the biggest global challenges we face today, like the climate emergency, the skills and infrastructure gap and social inequalities.

How have these initiatives engaged the social growth of the Arc?

When L&G make investments, we're keen to locate both the areas of greatest need. We also target opportunities where wider societal returns will be strongest, screening for positive social impact which lasts.

Across the Arc there is a clear need for social housing. Funding can also help nurture and support nascent start-ups and university spinouts which strive to generate world-leading social impact, like Oxford Photovoltaics – a company pioneering new silicon solar solutions to make solar energy more affordable in the transition to an all-electric world – which we invested into alongside Oxford University Innovation, Innovate UK, the European Investment Bank and the Engineering and Physical Sciences Research Council, among others.

By taking an inclusive capital approach, investment has generated more jobs in the Arc in the areas of growth, which serve to catalyse societal advancement.

What sort of public infrastructure does L&G invest in? Is investment in hospitals and healthcare, schools and education, as well as public utilities, overlooked in terms of what's required to supercharge the Oxford-Cambridge Arc's growth?

L&G invests in hospitals, healthcare and education collaboratively with the public sector. We see our greatest social impact when we are a partner, and we're in discussions with HM Treasury and Homes England to explore new funding models for joint public-private investment to drive greatest national outcomes at the same time as realising strong and consistent returns.

The Arc is a great example of where social impact investing has already borne fruit, realising 15-20% returns annually in the region. We've been able to invest across physical, financial, legal and digital infrastructures, to help develop and reinforce the innovation occurring in the Arc.

In 2019, we signed a £4bn, 50:50 partnership with Oxford University to build homes, workspaces, and research facilities for 1,000s of new staff and students.

An Arc Forged from Our Diversity of Thought

Prof Karen Holford CBE, CEO and Vice-Chancellor, Cranfield University

I have spent my whole career pushing for greater diversity, first in industry and later in academia. There have been great strides in growing the participation of previously under-represented groups in higher education. This has opened places of learning to a vibrancy of thought and access to a wider pool of people that has tangibly improved in academia, education and training in the UK. Furthermore, as a BCG study of a few years ago has shown, increasing the diversity of organisations leads to more and better innovation and improved financial performance – producing up to 19% higher revenue. We can continue to make great headway by improving diversity, including the diversity of thought, of culture, and experience in the region.

The Oxford-Cambridge Arc, as a region of exceptional potential, is home to a range of progressive, educational institutions. Oxford and Cambridge are the best known. Alongside them, Anglia Ruskin, Oxford Brookes, Cranfield and MK:U, the Open University, the University of Northampton, Buckinghamshire New University and the University of Bedfordshire have all carved out superb legacies in STEM fields, among others. Just as recognising the importance of diversity of background can help organisations to grow and succeed, recognising the many providers of pioneering education in the Arc underlines the depth of this unique knowledge ecosystem.

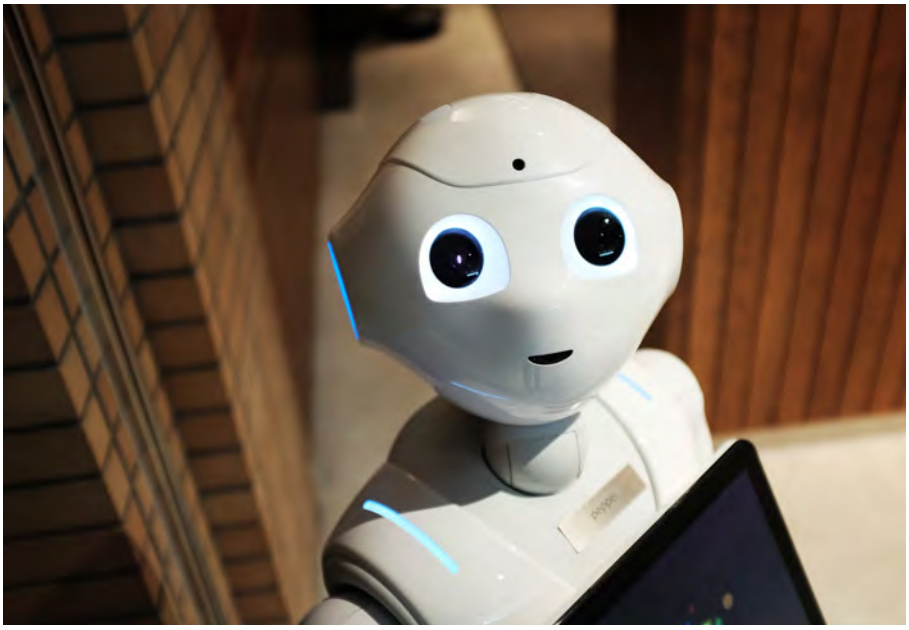
Isaac Newton, who made profound contributions to the stock of human knowledge, supported himself through Cambridge by looking after other students. He was allowed to take his degree at the same time, later providing the field of physics with his own unique perspectives and intellect. This may seem like an archaic scheme to modern eyes, but it was initiatives like this that allowed people from non-traditional backgrounds to contribute to scientific progress. Now we have more egalitarian approaches to attracting and empowering candidates with a diversity of background and thought, such as bursaries, mentorship and apprenticeship schemes, but the principles are the same. When universities like Cranfield attract from the incredibly diverse human capital available across the region and beyond, they ensure they can continue to be at the forefront of

Creating the Launchpad

producing world-leading innovation, attract home-grown and international talent, and build those vital skills for research and development that is the unique benefit and gift of the Arc.

It is in light of the Arc's special history, and its relevance today, that we should strive to champion diversity of thought, culture, and experience. Without a sufficient diversity of opinion, and the ability to challenge and scrutinise original thinking, we risk closing ourselves to the skills and knowledge accumulated by those who come from all walks of life. Awareness and development of the Arc is a golden opportunity to ensure that efforts to improve the diversity of the institutions of higher education in the region and across UK can translate into the creation of an atmosphere where diversity of thought is given the value it deserves. Just as most initiatives in the Arc, be they in academia, research start-ups or infrastructure projects, are at their most successful when assisted mutually by the public and private sectors, underlining our need to recognise that diversity itself comes in many forms.

A real commitment has to be made to make the Arc a nurturing environment for a diverse range of thought, opinion and background; from the two ancient and world leading universities that bookend the region to the transformative research done at Cranfield, and to the valuable of training institutions in the Arc like the Bedford College Group or the Buckinghamshire College Group in mentoring and producing apprentices from a diverse range of backgrounds and in the vital technical skills that will allow us to prevent skill gaps in the future. Equally impressive and valuable is when traditional



universities can commit to schemes to empower those who, for a variety of socioeconomic reasons, would struggle to attend by their own efforts alone: Cambridge's STEM SMART programme provides the world-class teaching of the university to those who want to go on to study science and engineering but have experienced educational disadvantages, or belong to a range of demographics that statistically struggle to reach higher education.

In June 2021, Cranfield was proud to extend its mentorship programme to all students at the university, ensuring they have a link with alumni who work in industry. By linking current students to those with professional experience, and fostering an atmosphere of mutual learning and support, both mentee and mentor can benefit from the diversity of thought that passes through our doors. We can take this further by making our commitment to diversity clear in the student and academic body, and representation across learning environments, not least within STEM studies.

Through MK:U, the new technology institution in Milton Keynes, we are supporting the development of a suite of Level 6 degree apprenticeships in management and digital and data subjects that are delivering new opportunities for school leavers and employees in the region.

Greater diversity isn't a 'nice to have'. It's absolutely necessary to the Arc's prosperity, as the origin of some of the most globally important innovation solving some of the great questions of our age around the environment, automation and the future of work. When we work to maintain, grow and develop the Arc's status as a science and technology research, development and innovation hub, we must do so in a way that champions every institution working to educate and innovate within it.

The Tools of a New Trade

Holly Dawson, Head of Milton Keynes, Bidwells

Investing in human capital in a way that matches current skill gaps will be vital. Yet with the technological advances of the Fourth Industrial Revolution, set to revolutionise the way we work, and with the Arc itself boasting a dense concentration of highly innovative, deep tech enterprises, we are faced with a challenge: how to ensure we invest in human capital in a way that meets the needs not just of today, but of tomorrow, and of the next century.

A report published in 2019 by Dell Technologies and the Institute for The Future made the claim that 85% of jobs available in 2030 to those currently in education do not yet exist. This is a high figure, and undoubtedly an ambitious one, but the truth of the matter is that the skills we need for the future are increasingly disconnected from our current education and training system. A welcome announcement in the 2021 Budget was the provision of £1.6bn to roll out new T-Levels for 16 to 19-year-olds, designed to offer a blend of classroom and on-the-job vocational training in partnership with local employers. No one doubts the necessity of traditional academic and humanities subjects at A-Level, but continued commitment to these new vocational training qualifications demonstrated not only an equitable way of investing in human capital – with learners of all types and abilities catered for in an environment which prioritises employment and practical skills – but a means to plug the skills gaps of the future.

Emerging tech today is not only creating new possibilities for how people and jobs find each other more seamlessly, they are also enabling new ways of working together. These advancements in technologies will require new skills and capabilities for workers to excel in the 2030 work environment.

Dell/IFTF Future of Work Report 2019

A key hurdle which the new government policy on skills will have to clear is that of awareness and value. According to Ofqual's Perceptions of Vocational and Technical Qualifications in England report from June 2021, only 25% of learners in the UK have a good or very good understanding of T-Levels, with over 35% of learners having no understanding at all. Crucially, only 12% of employers were aware of T-Levels, when employers are meant to play a vital role in their delivery. The trust of levels of employers expressing trust in vocational qualifications remains low. The conclusion to be drawn from these figures is that greater awareness of skills-based education such as T-Levels needs to be fostered and the value of training and vocational qualifications, for many years considered the also-ran of the education system, has to be brought home.

We have already seen skill gaps emerge in the UK, but this disparity between the jobs that are necessary to keep society functioning and the people properly trained to do them – those that have learnt the tools of the new trades emerging across every sector due to the march of the Fourth Industrial Revolution – is only likely to grow unless greater action and awareness is fostered around the UK's skills qualifications. A 2020 report from the World Economic Forum predicted that by 2025, 85 million jobs may be lost to automation, while 97 million new roles will emerge that require different skills. Some of these will reflect the changes that deep tech will bring to industry and the workforce, and new careers will undoubtedly be necessary to better reflect the relationship between people and machines. In the face of this change, the bold strategic planning that underpins the Arc concept has to include a commitment to invest in the human capital needs of the next generation.

It's clear that the world of work is going to change – including the way human capital is identified and hired into roles. Young people don't need to be taught archaic interview and job application skills – many industries are a long way from the physical interviews and paper CVs still preached by school careers guidance – but instead need to be taught the skills necessary to land a job in the world of behavioural testing and the gamification of processes. With major employers including PwC and the Civil Service turning to gamification and algorithmic testing for the bulk of their interview process, the way human capital is assessed and sifted has already changed.

Addressing Adult Learning

We need to ensure that education and training in the Arc is preparing people to go not just into the roles of today, but the roles of tomorrow as well. Those in education in the Arc today need to be aware of, and be trained to achieve, key roles in the future workforce including:

- data analysts and scientists
- big data specialists
- digital marketing and strategy specialists
- process automation specialists
- AI and machine learning specialists
- information security analysts
- software/applications developers
- digital transformation specialists
- internet of things specialists

One of the key skillsets of the next decades will be at the interface between people and artificial intelligence, with a raft of skills necessary at the junction between robotics, analytics and philosophy and ethics to properly manage it. The MIT Sloan Management Review for 2017 identified 'trainers, explainers and sustainers' as the three categories of new skills necessary for the new model of work alongside AI. The 2019 report by Dell Technologies and the Institute For The Future explained this as: 'AI trainers will be needed to develop AI personalities and train them to convey empathy; AI explainers will be enlisted to elucidate algorithmic decision-making; and AI sustainers will seek to prevent AI from doing harm'. The new skills strategy such as the T-Level will have to accommodate the rise of automation and AI applied in practice in workplace, and not just in theory or in the laboratory.

3 million

The number of jobs in the UK digital tech economy

Forging a Flexible Workforce

Viren Patel, Director of Development, Open University

The Open University is part of the Arc Universities Group (AUG), a consortium of nine universities working together towards inclusive and sustainable economic growth in the Oxford to Cambridge Arc. As the largest academic institution in the UK and a world leader in flexible distance learning, since it began in 1969, the OU has taught more than two million students worldwide and currently has over 205,000 students, including more than 8,000 overseas.

The Open University works collaboratively with employers and other partners across the Arc to reskill and upskill their workforces. For many years, employers across the public and private sectors have been demanding flexible, work-based learning, which cuts down on disruption to both the business, and the employee's work and personal commitments. Employers often comment on the immediate benefit felt by the organisation as OU learners learn while they earn.

The Open University works with over 2,480 organisations and three out of four FTSE 100 companies have sponsored staff to take OU courses. Apprenticeships are a nature extension of the OU's philosophy to support people to earn while they earn. We have long invested in the delivery of higher and degree apprenticeships and have offered programmes since 2016. The OU offers apprenticeships in healthcare, social work, policing, digital, systems thinking, leadership and management. Within the Arc, this has given organisations large and small the opportunity to immediately benefit from apprentices' new skills and knowledge. This drives retention by offering clear development and progression routes to new and existing employees – a vital differentiator for employers in counteracting challenges such as "the Great Resignation".

But it doesn't stop there...

Developing digital skills in Oxfordshire

Olamalu is an Oxfordshire-based digital solutions company helping organisations through better use of technology. It was set up in 2009 and co-founder Kate Berman recognised that opportunities for younger people were scarce in the aftermath of the financial crisis. Therefore, the company decided to get involved in apprenticeship programmes and dedicate resources to upskilling employees from the local area.

Olamalu currently has three highly skilled degree apprentices studying with The Open University and is about to hire a fourth one. The Digital and Technology Solutions Professional Degree Apprenticeship programme is funded by a levy transfer and allows Olamalu to continue business growth through challenging times.

Berman said: "The apprentices are ready to get stuck in and it's been rewarding to see them grow. Following their study days, the apprentices come back and share with us what they have learned – it's a fantastic experience."

Supporting the NHS through upskilling

Digital skills are also in high demand within the NHS, especially since the new challenges of Covid-19. Robson Grant is also on The Open University Digital and Technology Solutions Degree Apprenticeship programme and his skills have come to the fore at Milton Keynes University Hospital. The hospital's 'Apprentice of the Year 2018' created a tool that allowed people to book a slot for visiting their loved ones safely to manage visitor numbers and track who is visiting.

Grant explained: "This has been a great success with almost 7,000 visits in just a couple of months. I feel really proud that I am making a massive difference across the whole hospital – every single ward uses it, including the Intensive Care Unit.

"To see the things I have created improve lives is one of my greatest achievements and I cannot wait to create more applications to help more people. All of this is possible because of the opportunities and support that I have received from the OU and the NHS. The NHS has helped my family in so many ways, so to give back and provide others with help like me is extremely rewarding. This is more than just a regular job - it is a pleasure."

Progression pathways through collaboration

The Open University also works collaboratively with other educational providers within the Arc to offer clear pathways for learners moving through different levels of education. The OU works with Milton Keynes College and the South Central Institute of Technology (SCIoT) to allow learners to take two years at the College qualifying for an HND (Higher National Diploma), followed by a third top-up year with the OU to achieve a Bachelor of Engineering (Honours) Degree awarded by the University. They will follow the same pattern of study at the SCIoT, to obtain a BSc (Honours) Computing & IT Practice.

In addition, the OU is working with the college on a Department of Education Strategic Development Fund pilot to provide training opportunities for skills required by local employers.

Addressing Adult Learning

A bright and innovative future

These are just some of the success stories as The Open University continues to play a significant role in delivery priority skills needs both within the Arc and the local region. Keen to be visible and proactive in the local business community, the OU has been a headline sponsor of the Milton Keynes Business Achievement Awards (MKBAA) since its inception in 2014. This year's theme of 'MK – Leading the UK's Green Recovery – Survive, Revive & Thrive' fits strategically with the OU's own sustainability commitments and the need to evolve employee skills to face today's challenges.

The Arc Universities Group is working towards making a step change in the region's contribution to the national economy. Collaboration and working in partnership will be key to the Arc's success as the skills landscape evolves, and we recognise the unique contribution the OU can make to this partnership. The Open University has evolved over the past five decades and will continue to do so – supporting local people and businesses in the region, through innovative learning which addresses the challenges faced both within the Arc and the wider UK.

Policy Recommendations

Human capital comprises the skills, knowledge base and qualifications that empower the workforce driving the growth and prosperity of the Oxford-Cambridge Arc.

Although the Arc as a whole benefits from one of the UK's most highly-advanced 'hardcore' of technical expertise and specialised skills, the requirements of the knowledge economy will create new expectations. Computerisation and the automation of repetitive tasks, digital enablement and our ever-growing exposure to the internet, lay the pathway to the jobs of tomorrow.

Preparing future generations for a skills revolution is essential if we're to sustain industries such as advanced manufacturing, data control, AI and robotics. In anticipation, we need to consider how to equip new and existing workforces within the Arc while paving the way for further opportunities to reskill. Employment in these sectors will be ubiquitous long before we realise it.

A region which invests in its human capital helps its population to become better valued as workers and more employable, enabling them to do more advanced and fulfilling work, and enjoying higher salaries and competition from employers. The Arc has to harness the power of its centres of tertiary education and encourage their participation in supporting local schools and colleges, to create a continuum of excellence in skills training and educational potential from early education to entering the workforce skilled in the requirements of future jobs.

Supercharge

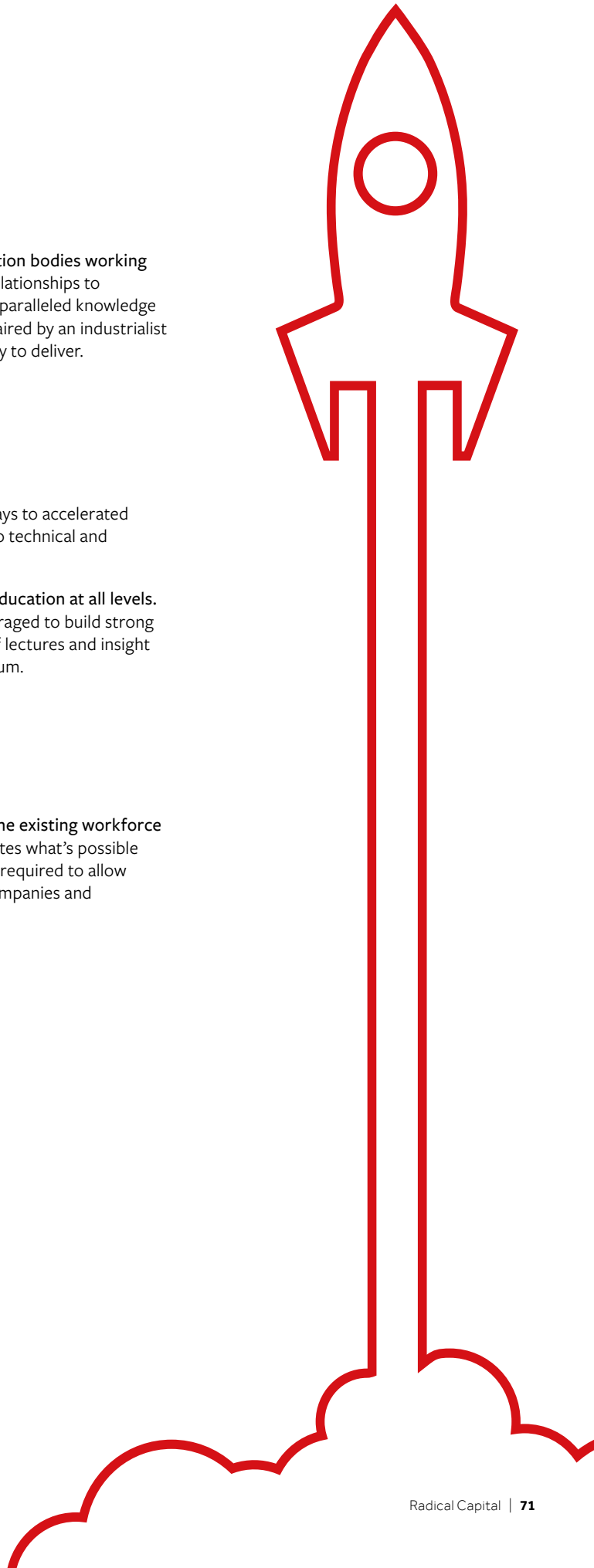
- **Set up an Arc-wide Skills Task Force with further and higher education bodies working alongside business and industry leaders.** Universities with strong relationships to innovators and advanced manufacturing can bring to the table an unparalleled knowledge of the future needs facing the workforce. But the body should be chaired by an industrialist of national standing to set direction and conceive a coherent strategy to deliver.

Advance

- **Recommit and provide better national publicity to T-Levels.** Pathways to accelerated qualifications and micro credentials provide unprecedented access to technical and vocational skills with a direct application to the future of work.
- **Establish enterprise coordinators to support the development of education at all levels.** Primary, secondary and higher education providers should be encouraged to build strong links with local and regional companies, which could take the form of lectures and insight workshops with entrepreneurs, forming part of the regional curriculum.

Grow

- **Develop apprenticeship and work shadowing avenues to broaden the existing workforce skills base.** The Open University's collaboration with the NHS illustrates what's possible when employees have access to consistent training. A culture shift is required to allow retained talent to grow and evolve through interfacing with other companies and challenging existing processes.



Connective Capital

When we think about the connectivity between focal points of innovation across the Oxford-Cambridge Arc, it's assumed that we'd be talking about the 'hard' infrastructure with which we are most familiar.

However, the road, rail and utilities systems, which geographically thread together the Arc, constitute one piece of a complex ecosystem of knowledge transfer and integration which includes real estate, space for science and technology, regeneration, social and digital ('soft') infrastructure, in addition to freight and logistics, which are all equally vital to the region's productivity. The Arc is also home to nationally important infrastructure including renewable energy facilities and irreplaceable R&D technologies.

For too long we've failed to appreciate that connectivity is something far broader in scope than bridges, beams, roads and canals. In turn, we've neglected the other 'golden threads' which make for a stronger and more competitive Arc of innovation. As a holistic community, the Arc must reconcile the requirements of transport and essential infrastructure needed for the order of communities with the social and digital infrastructure which accelerates the region's creative potential.

What infrastructure is necessary to maximise knowledge transfer and promote better integration across the region?

3.2m sq ft

Take-up in Oxford and Cambridge office markets over the last three years

60%

Nearly 60% of all jobs created in the Arc over the last decade were created in Oxford, Cambridge and Milton Keynes

0.5%

The availability rate of laboratory space in Cambridge in 2021

2.2%

The availability rate of laboratory space in Oxford in 2021

20m sq ft

The amount of office and lab floorspace that is estimated to be required in the Arc by 2040

£1.3bn

The amount invested in office and lab space in the Arc in 2021

84%

Cambridge has seen science and tech employment growth of 84% over the last 10 years, which amounts to 6.3% per annum

Counting the Cost of Failure

Max Bryan, Head of Science & Technology, Bidwells

As head of Bidwells' business space agency team in Cambridge you have a unimpeded view of one of the most attractive UK commercial markets of 2020-21. But where is it headed next?

We now have a dysfunctional supply & demand imbalance in Cambridge, which means that growing businesses just do not have the space to fully realise their growth potential. We've got lab demand approaching 1.4 million sq ft in Cambridge, with no space available, the situation with offices is not as acute but with similar levels of lab demand and only one building of plus 50,000 sq ft being delivered speculatively this year and only one building of more than 50,000 sq ft coming this year.

But that is only one part of the story. Office stock levels in the city have nearly doubled over the last twenty years but housing has not kept up with that growth, so you have economy growing quicker than its infrastructure which, in the end, is going to be an even greater curb on growth and enabling Cambridge scientific research to compete at its best.

Planning is the crucial blocker in all this. Without making a stronger case to local politicians, local people and the wider community around the wider benefits that developing commercial spaces, housing and transport infrastructure we are going to see increasing shortages and inequalities.

There is demand for more employment space but it's also the housing and wider infrastructure investment which needs to be delivered. We cannot focus purely on one or the other – they are both huge problems and opportunities for the city.

Global investors have flooded into the Arc's clusters during the pandemic. How do they see their long-term investment into the Arc now they are getting under the skin of the area?

The Arc can be the leading life science cluster in Europe. It already is in many ways. It is already delivering world-beating science but it still lags behind the east and west coast of America in terms of scale. In Boston they are delivering more than 6m sq ft this year, but we won't deliver that in five years across the Arc.

The world wants to invest because they see that the Arc has the potential to be as important as the US centres of innovation but we're just not enabling them to build quickly enough and at some point that global money will get frustrated and give flight and go elsewhere. This type of capital is patient but for how long? The quality of the buildings global investors are seeking to deliver are going to be 'best in class' with impeccable environmental credentials. Positively the rents in Cambridge stack up to deliver buildings with highest sustainability standards. It will be a lost opportunity for Cambridge if we don't get these schemes on site and have Cambridge and the UK providing leadership on sustainability in the built environment.

How do you think infrastructure delivery should be prioritised across the Arc?

We need real estate provision for business, R&D, and logistics, and the soft infrastructure in between. Prioritising one over the other actually creates a bias which slows growth, like we're seeing in Silicon Valley where office and R&D space has reached a point of saturation.

Decision-makers must weigh considerations around new and existing infrastructure collectively, to strike the right balance in the allocation of limited resources.

At the same time, a lack of commitment to one choice over another can result in stalled growth. At the time of writing, the government's commitment to physical infrastructure in the Arc rests on shaky foundations. Overpromising on new projects elsewhere in the UK could potentially push upgraded infrastructure in the Arc, like East-West Rail, further down the chain of priority, while the capacity for innovation in the region remains constrained by diminishing office and S&T real estate.

While there is no 'silver bullet' to these varied infrastructure pressures, inward investment from the private sector can help ease the reliance on government finance if backed by government intervention. As the contributions herein show, this is not a problem so easily solved through funding alone.

There are no easy solutions here but where do you think action needs to be taken to alleviate these issues?

At some point, we've got to get real. We know that the Arc is a national asset in terms of producing revenues for the exchequer and local politicians are currently blocking that growth and preventing companies from investing and developing their world changing ideas and delivering equitable growth for places like Cambridge. I think local politicians should be held accountable for the cost to the economy, not just in terms of pounds and pence but in terms of the lack of progression in schools, hospitals and other infrastructure. This also has a knock-on effect for households too. This lost revenue to the Arc could have a hugely detrimental impact over the long term to all of us.

Integrating Labour Markets and Post-Pandemic Mobility

Hilary Chipping, Chief Executive, SEMLEP

The Oxford-Cambridge Arc concept was borne out of a recognition that greater connectivity across the area could lead to significant economic gains. The Cambridge Econometrics/SQW study, conducted for the National Infrastructure Commission in 2016, found that there were a number of successful north-south economic corridors feeding into London, but very little in the way of east-west economic linkages. According to 2011 Census data, only 1.7% of the resident workforce in the central area of the Arc worked in Oxford or Cambridge, versus 5.1% in London. There is a consensus that if these corridors and their respective knowledge-intensive labour markets could be better integrated, the national economic benefit from knowledge spill-overs could be huge.

However, exactly how this connectivity should be improved is the subject of more debate, particularly given the need to protect the local environment and transition to zero carbon. Hence, the proposed, and then withdrawn, Expressway plans, which would have improved connectivity but at significant environmental cost. Thus, the challenge is to find ways to increase connectivity while also improving the natural environment and supporting the transition away from fossil fuels. Decisions around infrastructure provision should take account of the Environment Principles, as agreed by the Arc Environmental Group. These make clear that the concept of net environment gain should be factored into any transport infrastructure decisions together with a commitment to 'doubling nature'.

The recent acceleration – brought about by the pandemic – toward working from home and more flexible working provides part of the answer, in that greater connectivity is not just about physical journeys, but also encompasses digital solutions. A recent Department for Transport/Ipsos Mori survey found

that two fifths (41%) of companies expect to make fewer business trips than before the pandemic. Plus, around a fifth of businesses (weighted by employment) expect to use increased homeworking going forward in the UK, a figure which rises to nearly half for the IT and communications sector. This shift can be consolidated through continued improvements to digital connectivity, particularly in more rural areas.

But physical journeys will still play an important role in the overall connectivity picture and where possible, modes of transport beyond private car use should be encouraged. The Local Industrial Strategy for the South East Midlands set out an aim to pilot the use of demand-responsive transport and mobility as a service more broadly, and to link these to plans for wider residential and commercial growth at the outset. Active transport options are also important, as are first-mile-last-mile links connecting to plans for East West Rail. Also, non-car modes of transport need to be made more reliable and attractive for users if they are to compete with car use; integrated ticketing across transport modes is an important component of this, as are schemes such as Smart Move Northamptonshire, which provides a single access point for live travel and transport information from a variety of sources, and for all modes.

Yet it is important to recognise that a significant portion of the Arc lies within rural areas and that some private car use will still be required. The challenge here is to put in place the appropriate charging infrastructure as well as to produce a sufficient quantity of renewable energy to power them, and to employ battery storage solutions to smooth out supply. The central area of the Arc is at the forefront of EV and hydrogen developments, with Milton Keynes having a higher EV charge point concentration than Inner London, Milton Keynes and Luton both being home to electric bus hubs, and with Cranfield University in Central Bedfordshire and Chelveston Energy Park in North Northamptonshire leading on hydrogen research and green hydrogen generation (and use in HGVs) respectively.

There is a key role for central and local government to strategically plan for – and in some cases, financially underpin – the renewable energy production, charging infrastructure, public and active transport links, integrating ticketing and digital infrastructure that is needed to realise this vision for the future. This will involve some retrofitting and/or upgrading of existing infrastructure, as well as new provision, and will also involve thinking creatively and ahead of demand about new regulatory frameworks that might be required e.g. for hydrogen use.

Connective Capital Spillovers

Rob Hopwood, Partner, Planning, Bidwells

Creating a seamless knowledge economy

Transport infrastructure acts as the sinew of movement and communication within a regional economy. Any strategic, long-term view of the Arc's transport infrastructure has to recognise the importance of investment in this connective capital, and its potential to supercharge growth. Within the spatial dynamic of the Oxford-Cambridge Arc, strategic and concentrated infrastructure spending and development has the potential not only to supercharge the economic growth of already prosperous areas, but also to ensure that regional growth is managed equitably to include the fast-growing economies central to the Arc.

Compelling international evidence and analysis from Spain to China to India demonstrates that infrastructure projects produce a measurable growth in productivity and economic outcomes for manufacturing and research, on both a macro and micro-economic level. Investment in connective capital and improving transport links not only allows for greater logistical efficiencies for the private sector, but also improves wellbeing as negative factors for individual productivity, such as long, inefficient and expensive commuting, can be considerably reduced. Direct government grants to businesses such as those provided by Innovate UK can help to provide crucial, early stage capital for start-ups and spinouts, but a lack of decent infrastructure can act as a bottleneck to developments in a regional economy, with small businesses forced to choose between being constrained in their growth potential or relocation.

Improved transport infrastructure can act not only as an engine to drive the Government's Levelling Up agenda, not least in towns and cities like Milton Keynes, Bedford and Luton, but also represent an example of how the public sector can play its part as a pillar of the 'triple helix' of private, public and academic collaboration, which forms the basis of the Arc's success. Major infrastructure projects are the monopoly of the private sector and with the Autumn Budget announcing £6.9bn worth of investment towards train, tram, bus and cycle projects across the UK, we should look to see how this investment can create positive spillovers in areas like the Arc, where investment in connective capital adds more to the stock of connective capital than simply a new relief road or train station.

'New empirical research conclusively supports the view that hiring for government supported infrastructure projects creates a significant number of private sector jobs in the rest of the economy... our analysis shows an emerging consensus that for every $1 spent on transportation infrastructure, the increase in economic growth is between $1.5 and $2'.

Progressive Policy Institute Infrastructure Investment and Economic Growth Report 2014

Levelling Up the Arc

Improved transport links would ensure that rural areas across the Arc can better access services, and through the provision of commutable transport links, would open up new avenues to employment in urban centres. They would alleviate the high cost of living in the Arc's cities by allowing residential development further afield, offering job opportunities and a chance for greater economic prosperity in deprived parts of the Arc. In Wisbech, East Cambridgeshire and Fenland, for too long considered the periphery of other more prosperous urban centres in the Arc, faster and more reliable transport links with Cambridge, Peterborough and other Arc towns and cities would not just allow for minor efficiencies for the private sector but rather make a drastic and tangible impact on local communities, achieving the Levelling Up agenda and ensuring no area of the Arc is left behind.

'It is important to ensure that everyone in the Arc, whether in towns, cities or rural areas, has the skills and opportunities to engage in our potential economic prosperity'.

Arc Leadership Group Oxford-Cambridge Arc Economic Prospectus 2020

Enhancing Integration and Knowledge Transfer

The abiding lesson of infrastructure projects on the scale of Crossrail and HS2 is that investment in connective capital often creates spillover communities, as people flock to transport hubs that allow them to quickly access their places of work and study. Investment in connective capital has already allowed the growth of the Eddington community in West Cambridge, planned from its inception as the terminus for the connected university bus route, which incorporates university faculty buildings with Cambridge train station and Cambridge Biomedical Campus. Operated by private sector business Whippet, and with the potential for British engineering firm Aurrigo to now operate autonomous shuttles in Cambridge, the scheme nevertheless runs in conjunction with the University of Cambridge with the cooperation of local authorities. It serves the needs of businesses at the Biomedical Campus, of students and academics and of local people who need to access services like Addenbrooke's Hospital. A passenger on a U-bus might be an undergraduate on their way to lectures, a cutting-edge researcher at AstraZeneca, a resident of Eddington who commutes to London via Cambridge train station, support staff for the university or local hospitals, or those with limited mobility that cannot take advantage of the city's cycling routes. We need infrastructure projects that consider the needs of all users and we can create a tide to raise all boats – through mutually-beneficial projects that consider the needs of local residents both strategically and holistically.

Making sustainable connectivity a regional priority

Historically the Arc has been the testing ground and the petri dish for 1,000s of inventions that have changed the way we live our lives. One of the trends of the last five years has been the growth of innovative micro-mobility solutions to the infrastructure challenges of dense urban centres. This is particularly true in an area with the architectural patrimony of the Arc, and those towns and cities designed largely around the medieval pedestrian such as Oxford and Cambridge rather than the needs of today. The success of micro-mobility trials including e-scooters and dockless bikes in Cambridge give us an indication of how we can move forward with a more efficient, and crucially, more environmentally sustainable future for urban centres in the Arc. Not only will it be provide 50 jobs, the collaboration between private sector provider Voi Scooters and the Cambridgeshire and Peterborough Combined Authority serves as an example of this innovation in personal transport. Likewise, the Redways in Milton Keynes, shared-use routes for walking, cycling and scootering, have become the backbone of the city's transport system – not only helping the local authority to meet sustainability goals by reducing single-person car use but also taking advantage of the popular rediscovery of micro-mobility solutions during the coronavirus pandemic to improve individual wellbeing – from commuters to students to retirees.

The 2020, the Global Infrastructure Trends Report from PwC underlined the need for the public and private sectors to reconsider the potential, positive spillovers of infrastructure: 'rather than focusing on the lowest-cost option, companies need to apply a framework that considers the total economic, social, environmental and financial impacts over the whole life of the asset'. Where connective capital spillovers occur, its after a holistic and strategic consideration of infrastructure wants and needs from across sectors. Development of the Oxford-Cambridge Arc gives central government and local authorities, working closely with private sector providers and operators, the opportunity to achieve so much in levelling up communities, supporting local business and unleashing the potential of the Arc. Connective capital is so much more than a train line or a bus route – it's about providing communities and individuals with the means to fulfil their potential. In considering the infrastructure needs of the Arc, let's make sure we go forward with that as our ultimate goal.

'Infrastructure can be a powerful force in helping to unlock the economic potential of regions, supporting jobs and helping to rebalance the economy.'

UK Government National Infrastructure Delivery Plan 2016-2021

The Digital and the Physical

Belinda Fawcett, Director of Property and Estates, Cornerstone

One of the abiding lessons of the coronavirus pandemic has been the need for a blend of digital and physical infrastructure, allowing us to access work and leisure in a fluid, flexible, and multidimensional way. Both physical and digital infrastructure needs to be sufficient to match moments of peak demand, with people in the Arc having the assurance that, just as the train, busway or autonomous shuttle will be running reliably enough to get them to work on time, superfast broadband and 5G will also be able to connect them seamlessly from wherever they may choose to work remotely. Removing the element of doubt from the commute, or the telecommute, will be a key part of how we harness the positive changes in the nature of work which have followed from the pandemic. Here the public sector can use its infrastructure and strategic planning ability to support the other points of the triple helix, with a government report estimating that £75 billion of additional GDP has been generated through the democratisation of 4G network between 2010 and 2020. We have seen a sea-change in opinion and attitudes towards innovative and efficient modes of work, which can also contribute to improved wellbeing and satisfaction. The TUC estimates that the average commuter now spends nine days a year commuting using inefficient transport infrastructure – and just as workplaces have increasingly adapted to flexible modes of working, we have to ensure investment in connective capital has equal flexibility in combining physical with digital infrastructure. We cannot continue to view digital and physical infrastructure as separate issues or even two sides of the same coin, but rather fundamentally and inseparably linked.

Meeting the digital needs of individuals and businesses in the future will require substantial growth in digital infrastructure, especially in light of the fact that mobile data traffic has grown 4,000-fold over the past 10 years. To date, 94% of homes and businesses across the Arc have access to superfast broadband via fibre-to-the-cabinet (FTTC), but data demand is still surging. A UK-specific forecast published by the UK Spectrum Policy Forum suggested that overall demand for data usage will rise 22-fold between 2015 and 2030. Far from a bold plan for the future, combined digital and physical infrastructure will be necessary just to meet current projected demand, let alone account for the kind of growth planned as part of the government's Build Back Better strategy. If we are to adequately support the growth of regions like the Arc as part of the government's levelling up agenda, serious efforts will have to be made to ensure that the momentum created by the wave of digitalisation after the pandemic is backed up with the necessary underlying digital and physical infrastructure to support it. After decades of slow acceleration, we have seen a rapid and successful take-off for homeworking, virtual meetings and other digitally-enabled efficiencies. Further investment and integration of digital and physical infrastructure needs to take place so that this can continue to gain speed, supercharging growth and ensuring the Arc stays at the forefront of international economic and innovation competitiveness. Through recent advances in technology, including many innovations produced within the Arc, we stand on the cusp of radical change in the field of digital connective capital. 5G is itself expected to deliver speeds up to 100 times faster than typical 4G technology – and as well as making communication faster, 5G allows us to achieve the most out of the potential for smart cities, functional public technology and even, through innovative technology developed in the Arc, help facilitate the burgeoning field of telemedicine. Through investment in digital connective capital, we can observe spillovers into improved social capital, such as through thorough GP examinations that can take place virtually anywhere and facilitated by ultrafast communications. The Future Communications Challenge Group (FCCG), advising the Government on the subject of 5G connectivity, has suggested that not acting to ensure UK leadership in 5G would result in losing an opportunity to create £173bn of incremental GDP over the decade from 2020 to 2030. Investment in infrastructure is clearly vital if the UK is to remain competitive, and just as HS2 or Crossrail might shave hours off a commute and free up time for businesses and individuals, universal connectivity will make everyday interactions across sectors quicker, more efficient, and more equitable for those who will be able to access a wider range of services. We can alleviate pressure on the physical transport system by increasing its speed and capacity, but we can also do so by reducing the necessity of physical presence. By ensuring that a business meeting can happen virtually, that a consultation with a pharmacist can be done via an ultrafast online service, that a university seminar can be a hybrid of virtual and physical, we reduce the load on physical infrastructure through improvements in the reliability and speed of the digital space. 5G and other innovative solutions will be at the forefront of this mixed infrastructure policy, reflected our new flexibility of life and work with an equally flexible approach to connective capital investment.

In March 2021, the government's Project Speed taskforce identified the Oxford-

Enhancing Integration and Knowledge Transfer

'High quality infrastructure is crucial for economic growth, boosting productivity and competitiveness... Digital connectivity is unlocking new and previously unimaginable ways of working, and is now essential to facilitate public services, including healthcare and education'. – HM Treasury Build Back Better Report 2021

Cambridge Arc as one of a number of high-profile 'pathfinder projects', underlining its importance as a region with a regionally-focussed approach to supercharging growth in the UK economy. The Arc is the source of much of the UK's innovation in the digital space, and stands not only to contribute in an incredibly concentrated way to further development in technological solutions to future problems, but to benefit from increased consideration of digital infrastructure as just as vitally important as the physical. When conceptualising the Arc, there has been an evident sea change from National Infrastructure Commission's emphasis purely on an expressway and physical infrastructure, to an increased awareness of digital connectivity in a post-pandemic climate.

Beyond connective capital alone, considering digital and physical infrastructure as fundamentally interlinked can help the investment in all aspects of the 'capital' concept which underpins this Manifesto's vision for the future of the Arc. Sensor technology and digital replicas of buildings like those used by Boeing and Tesla can collect data on real-time energy usage and automatically adjust to optimise performance, allowing us to preserve and conserve natural capital. By digitally mapping the Arc's natural capital infrastructure, we could better illustrate visually how new development patterns would affect natural capital assets and the associated costs and benefits. Just as digital and physical infrastructure works seamlessly together through the smart city concept, natural capital can be grown by the combination of physical and digital infrastructure working to relay the environmental sustainability data of the built environment across the Arc.

Universities across the Arc have likewise used the pandemic as a catalyst for developing hybrid models of working and research, in which students across subjects might watch pre-recorded lectures online, attend blended in-person and digital seminars and supervisions, and solely in-person practical and laboratory sessions, opening up the knowledge capital of the Arc to more efficient working practices, preparing students to enter a hybridised working environment, and making research and development more accessible for those with limited mobility. All of this relies on the momentum created by the disruption of the pandemic to change long-seated patterns of work to more efficient and effective models, and rests entirely on the necessary digital and physical infrastructure being in place. The teaching provided by universities, colleges and schools builds the human and knowledge capital of the region, and is supported by every pupil that can continue to learn during a pandemic, by every student that can access a broader range of academic material, by every apprentice that can learn skills virtually from their mobile phone.

Efforts have already been made across the Arc to ensure that digital connective capital is considered hand-in-hand with the built environment: in Milton Keynes, full fibre connections are now a policy requirement for all new developments, just as Smart Cambridge's Intelligent City Platform (ICP) harnesses sensors to predict travel times and suggest the most sustainable routes, a perfect example of the blend of digital and physical. This proactive stance towards connectivity should be mirrored in the policies taken forward in other local planning authorities. At the same moment as a radical shake-up in the way we consider our relationship with the physical and the digital world after the pandemic, developments like 5G are on track to redefine how we connect with one another. We need to seize this moment to break down barriers between the concepts of physical and digital infrastructure, recognising this blended approach is at the heart of the flexible way we now live our lives.

'COVID-19 has forced businesses to rethink their operations, how they engage with staff and their use of technology. BeTheBusiness estimate that three years' worth of digital transformation took place in three months when the required public health measures began in March 2020'.

HM Treasury Build Back Better Report 2021

Smart City Connectivity within the Arc

Mark Nicholson, CEO and Co-Founder, Vivacity Labs

What transforms a city into a smart one? At the heart of a smart city is the ability to improve citizens' lives and drive sustainability through the use of technology. Cities must respond to their citizens' needs, and a citizen-centric, privacy-first mindset and design is the fundamental component; this creates an ecosystem that gives the benefits of mass data without the costs to privacy.

Key to this is an adaptable and responsive urban infrastructure, sustainable development and environmental initiatives, advanced telecommunications and cloud networks and, crucially in our case, a highly interconnected, effective and functioning transport and travel network. It's a variety of complementary components that can help make cities more efficient and socially and economically inclusive.

For this to function, a huge range of technology needs to work in tandem to communicate problems and solutions and gather wide-ranging data to both facilitate and improve efficiency and sustainability. As is the case with Vivacity Labs, developing a strong relationship and collaboration between public and private sectors is crucial for smart cities to fully thrive.

Bringing smart cities to life within the Oxford-Cambridge Arc

If the Oxford-Cambridge Arc is going to be a regional superpower of innovation and a standard-bearer of social advancement, adhering to these principles will be fundamental to its success. The Arc represents the opportunity for a variety of educational institutions, public authorities and tech companies to collaborate and implement smart city technologies through testbeds, trials and subsequently, real-world applications.

There are current plans to build comprehensive developments, from houses to rail transport links, in order to establish this hub of innovation and drive economic development. However, to ensure both sustainability and a citizen-first approach, it's important to re-evaluate how we harness and adopt the right smart city technologies in a way that minimises disruption. In many cases, existing infrastructure can be turned smart without the need to construct – sometimes quite controversial – new infrastructure.

The evolution of the smart city, with regards to travel specifically, revolves around three key areas: better road data, real-time control systems for existing infrastructure and the future intersection of vehicle and fleet technologies with infrastructure. And this is what Vivacity Labs is working with cities to achieve, creating a future urban infrastructure today.

Vivacity's sensors use artificial intelligence and machine learning to capture accurate, detailed and anonymous traffic counts of different travel modes across a selected 'count line', in real-time and 24/7. These counts can show the interactions between pedestrians, cyclists and cars, for example, and provide insights on factors such as number, pathways, speed and median journey times. The data is completely anonymised and presents no privacy or personal data risk. Connected by the IoT and the cloud, this data can be downloaded by authorities on dashboards and used to help manage and adapt existing schemes, plan and implement new ones - it even removes ones that aren't working. It opens up a data-driven strategic planning of cities.

But data isn't enough to fulfil sustainable objectives and unlock ways of reusing existing infrastructure. With congestion only set to increase, and more travel modes to be using our roads, technology that can improve traffic flow is pivotal. Working with partners such as TfGM and Weaver Labs, Vivacity has installed AI-powered Smart Junctions that are able to respond in real-time to road conditions and adapt signals accordingly. They can be set up flexibly with other tech to prioritise sustainable travel, air quality in off-peak periods or reduce congestion at peak hours, for example, depending on what that specific area needs. Reducing journey times is a massive smart city prerogative, and real-world applications of our Smart Junctions have shown that they can reduce them by up to 23%. This not only improves congestion and promotes sustainable travel but as a result, reduces emissions.

Vivacity Labs has also been working with Ford to explore the evolution of connected vehicles, and is combining vehicle and sensor data to create tools such as accident heat maps to pre-empt incidents. Current trials of Connected Autonomous Vehicles (CAVs), and how they can work with street furniture and connected technologies, will become increasingly important to realising the smart city concept in the years to come. Data flow between the two can lead to coordination between vehicles and traffic lights and optimisation based on routes, not just presence.

Enhancing Integration and Knowledge Transfer

The opportunities and barriers in making our cities smarter

Policy and funding are of course both opportunities and barriers to further smart infrastructure. The two need to be aligned and funnelled into the smart city fundamentals and initiatives to progress change and make our cities smarter.

Public consultation is a highly important process in making sure schemes are designed and implemented for the benefit of those it will be used by. Even if a project is designed well and benefits the community, skipping such processes can stoke fire against such schemes and lead to their removal. That's why obtaining data is so important to settling any debates that may arise and providing an objective truth.

Another important issue is counteracting misunderstandings people may have around AI and misconceptions about data privacy. Decision makers can actively promote privacy-by-design principles and explore ways in showcasing its benefits.

In Innovation Real Estate, Experimentation is Essential

Q&A with Dr Kath Mackay, Director of Life Sciences, and Sam Darby, Head of Development, Bruntwood SciTech

How do companies like Bruntwood SciTech act as real estate enablers for innovative industries in the Oxford-Cambridge Arc?

Dr Kath Mackay: Bruntwood SciTech serves as the leading provider of specialist property and innovation services for the science and technology sector. A 50:50 joint venture between Bruntwood and Legal & General, Bruntwood SciTech's network now includes campuses in Cambridge, and more recently in Oxford.

We've got 10 campuses in six locations across the country: Birmingham, Leeds, Liverpool, Cheshire, Manchester, Cambridge and Oxford. This geographic spread means we can take a pan-UK view on how regions react to different opportunities.

We see ourselves very much as a property enabler, working to ensure world-class facilities. We offer laboratories, offices of various types, supporting science services and access to shared laboratories with pay as you go access to equipment. We also offer a wealth of innovation and business support, which we see as fundamental and complementary to our real estate offering. We look at supporting our customers holistically, with targeted programmes of business support which support SMEs in sourcing investment, commercialising products and services, and scaling more advanced businesses.

Start-ups in high-technology industries often have irregular growth patterns and variable demand for commercial real estate. How has Bruntwood SciTech facilitated this need for flexibility?

Dr Kath Mackay: Bruntwood SciTech's campuses are now home to over 500 companies, and we have exciting plans to grow the business through further acquisitions and the development of new partnerships as well as growing our existing campuses. We aim to provide 40,000 high-value jobs over the next 10 years. How are we going to achieve this? – through our deep understanding of the sectors in which we work. We look for those with science and tech backgrounds, and experience in government and corporate roles, and employ people who understand the idiosyncrasies of life science and tech companies and what makes them tick. This is especially important from a facilities and real estate point of view: not all real estate developers have this capability, but we believe it's vital to have a deep understanding of our customer base and what its unique needs are.

Sam Darby: To add to that, in-house expertise helps to inform the client brief. We need to make sure that what we are delivering is what the market requires. If we have people who come from a science or tech background, they have better knowledge of what the market needs and can help put together a specification that is fit for purpose. It's not easy to transition to a science supportive mindset without this. There is no typical lab that caters for all needs, all of them are bespoke in their own way and require certain kit and temperature controls depending on what the scientists and researchers are doing.

We work on creating a good product mix, appreciating the need for flexibility and slightly different specifications. For example, we have recently experienced new demand for high-density chemistry space, which is normally very costly in construction but using Bruntwood SciTech's expertise and flexible approach means we can deliver something fit for purpose in an economic way.

How has the 'triple helix' concept worked in practice for Bruntwood SciTech and for wider high-tech industries?

Dr Kath Mackay: Locating ourselves in the Arc allows us to align and work more closely with even more universities and key partners, and work in conjunction with additional civic, academic and corporate partners. Many joint ventures utilise their expertise to collaborate across these spaces. We've seen the benefits of this elsewhere, such as in Manchester, where we work closely in partnership with the city council, the city's universities and the Manchester University NHS Foundation Trust. At Manchester Science Park and Citylabs for example, we've used our skills in redevelopment, our vision and ambition alongside other key stakeholders including the universities and NHS trusts to transform the campus into something really special. They're one of the most established science and tech clusters in the UK, with a mixture of life science and tech companies, including those working in medtech, digital health, diagnostics and precision medicine who, through our partnership with the NHS, are able

Sam Darby

Dr Kath Mackay

to gain direct access for trialling and adopting their products or services at an accelerated rate, supporting faster growth of these businesses.

Sam Darby: Within the Arc, the spatial dynamics are also very important. Fundamental to our acquisition of the Melbourne Science Park was TTP building a facility adjacent to the Park, providing a spillover of ideas and knowledge capital. What TTP found attractive was our wider UK network, our experience with joint ventures and the 500 businesses we already have located across our campuses. With the problem-fixers of the tech world in TTP moving to a site next door, we see the importance of having a key stakeholder and like-minded business co-located with us, contributing to building up local SMEs and working with us to scale them up.

Are there any specific trends in occupier demand that you're noticing?

Sam Darby: We appreciate that many businesses are on different paths in their journey, and we know the difficulties of scaling up and work with them to overcome issues related to real estate. Flexible leasing for offices has been available for over 20-30 years at Bruntwood, and we're now bringing that into the life sciences and innovation sectors to provide flexibility so that companies aren't being restricted in growth by their lease.

Dr Kath Mackay: In the same spirit we also offer open-access labs, which provide access to specialist equipment and infrastructure in a flexible and cost effective manner, enabling companies to grow without having to spend all their seed capital or investment on laboratory space. We either put the kit in ourselves, or partner with a supplier. This helps us to support those seed-stage organisations with incredible ideas while they're finding their feet as a commercial enterprise.

Larger customers, having reached a certain size, two-to-three floors and outgrowing their current space, tend to bring a design team with them to explore more customisable options.

How is Bruntwood SciTech approaching the opportunities in the Oxford-Cambridge Arc? What are the challenges?

Sam Darby: Our acquisition and development strategy is informed by our deep knowledge of creating facilities for science and technology companies within ecosystems, such as in Birmingham and Manchester. For example, we had to really transform Alderley Park from a single occupier campus to one housing over 200 businesses, advancing many different products and technologies across life sciences, with many different needs. We're doing the same with Begbroke Science Park in Oxford and Melbourn Science Park in Cambridge. Bruntwood SciTech is really at the forefront of this process from a technical laboratory view, understanding that not all laboratories are equal when considering business needs.

Dr Kath Mackay: In the near future we will be very closely working with entrepreneurs to support the formation and growth of their companies, offering small labs and individual benches and business support which we've seen great success with in other cities and Bruntwood SciTech locations. This will include access to much-needed talent, finance and funding opportunities, accelerated access to new markets, and connections into our large national partner network. Each city, location and sub sector of life sciences and tech business has different needs and through the success of our existing business support programmes, we will take the learnings and put them into place in the Oxford-Cambridge Arc.

We'll also work closely with corporates in the region to develop integrated innovation programmes that address their current challenges and can accelerate the adoption of innovation. We've seen great success with such programmes in Birmingham, for example, where we've worked with the likes of the NHS, Gymshark, HS2 and Balfour Beatty, matching up innovative, pioneering startups who have business ideas that can provide solutions to corporate innovation challenges.

Sam Darby: With Melbourn Science Park being located miles outside of Cambridge, we really need investment in frequent transport links to make commuting easier and promote good public transport. We are currently looking at the likes of private dedicated shuttle buses to support travel to and from the Park and from a green travel perspective, we also need to keep ensuring we provide cycle facilities to and from our campuses. Investment in connective capital for science parks and campuses will be vital for initiatives like the Melbourn Science Park to take off and succeed.

How Should Life Sciences Real Estate Evolve as the Ambitions of Occupiers Change?

Doug Cuff, Vice President of UK Real Estate, IQHQ

Just as any researcher or entrepreneur translates an idea from the academic environment to its institutional framework and then to a sustainable, income producing entity – real estate plays a critical role throughout an organisation's entire life cycle. This is especially true for the basic life cycle of a life science company.

There are some basic real estate fundamentals that are for the entire life cycle of a life sciences company. For instance, most laboratory e.g. biology or chemistry space will need robust systems to provide a safe, clean environment for the research staff. Additionally, a strong amenity offering is critical to recruit and retain today's workforce, which includes, but is not limited to, solid food and health & lifestyle offerings and close proximity to transportation connections.

Most organisations have varying pressures put on them throughout the life cycle of their businesses. These pressures typically manifest across four stages of growth and will dictate how these respective organisations approach their real estate needs.

Eureka: This is the moment when an academic researcher comes up with an idea that could be translated into a commercial endeavor. This is typically in an academic or research environment such as MIT, Harvard, Oxford, Cambridge, etc. The individual then works on the tech transfer or enterprise office to begin the journey. MIT has been very successful at translating research into successful organisations and the university was one of the first to encourage its academics to pursue creative opportunities. In exchange, it would get some equity in the budding organisation. As far as space needs, MIT created the academic culture to allow the research community to examine and explore entrepreneurial opportunities.

Incubation: Academic tech-transfer and enterprise groups help grow ideas and move them into various sorts of incubators. The entrepreneur will have some angel funding and need a lot of help and support to advance the technology. On the real estate front, the entrepreneur will be looking for as much flexibility as possible on rental terms, but the rent is elastic. There are lot of incubators that have various pricing structures, but they are flexible on short lease length – some are even month-to-month. A lot of U.S. incubators also force companies to graduate after a certain timeframe, typically five years. Additionally, the incubator will give the entrepreneur access to basic life sciences infrastructure. This could include basic business advice e.g., legal, accounting, etc. or basic laboratory materials such as expensive lab equipment like NMR. This access will allow the entrepreneur to conserve capital and invest in continuing the research, which in turn will lead to additional rounds of capital investment.

Scale Up: At this stage, the company has grown and expanded through a couple of rounds of fundraising and has a core group of employees. The company will be a lot more focused on lease terms: rent is important, but term flexibility is still key. The executive team should be thinking what the eventual exit will be. This exit could be an IPO or a potential buyout/ takeover. It needs to present itself in the best financial position possible, and long lease terms don't allow that. Management will be keen to keep capital down – thus having the same access that they had

Doug Cuff

during 'incubation' is interesting to them, but not overly critical. Additionally, a strong recruitment effort to expand and attract more talented employees becomes a driver for the business. As a landowner, this is the critical stage to get the amenity offering correct. If a scale up firm cannot leverage top amenities along with premier office and lab space to recruit the correct talent, it will not be interested in the project.

SME: At this point, the organisation has either gone public, been acquired or merged, and the executive team is committed to investing in the business. Thus, there is more of a willingness to sign longer leases for a lower rent. Since these organisations are willing to commit long-term to a location, direct investment into its real estate is seen as a key tool for recruitment. Additionally, investment in expensive pieces of cutting-edge laboratory equipment is another recruitment tool. In the earlier stages, the organisation does not typically have the capital to make this level of investment. Therefore, similar to prior stages, the amenity offering is key as it is a critical tool for recruitment.

Maturity: By this stage, control is key. Maturity could be defined by big pharma or biotech. Traditionally, big pharma would mean that a landlord would sign a lease and get out of the way. The end user would want to control everything: design and construction to estate management and amenity offering. There was a period of time where these organisations did not let employees fraternize with other organisations. Over the last five years, there has been a shift from total control, especially with estate management and amenity offering. Even though these sizeable organisations are willing to give up control on the softer services – they still want to be heard and expect landowners to act in their best interest.

When assessing the real estate needs of a life sciences company, it is clear that there is no cookie-cutter approach. The stage of the life cycle will dictate the stresses on the business and the ultimate real estate needs of the organisation. Additionally, understanding what is going on within each individual market is a critical component to bring a successful project forward. To ensure that a real estate development project is successful, it is essential that the negotiator truly understands the pressure on the business based on where it is in the life cycle. The life sciences market is a dynamic and growing one, so there are tremendous opportunities for developers that can fully anticipate the needs of life sciences companies across the many different stages of growth.

Developing the Arc's High-Tech Clusters

Q&A with David Williams,
Commercial Director, Harwell Campus

What does your role at Harwell entail?

My role as Commercial Director within Harwell's real estate team involves engaging and brokering with organisations interested in locating to Harwell. Also, being part of our real estate team means we need to keep pace with the demand for space, having the right buildings ready at the right time.

Harwell is home to over 200 organisations from the public, academic and corporate sectors and open access national research facilities underpinning our four clusters of health, space, energy and quantum technology. As such, we have organisations from around the globe using Harwell, creating a vast community of organisations at the forefront of science.

Being on campus opens up opportunities for many of these organisations and our task is to unlock these opportunities by bringing together the science and real estate narrative; ultimately this means delivering flexible buildings and infrastructure to suit their requirements .

What kind of effect can a lack of infrastructure have on start-ups and small enterprises in the research and development space?

The simple answer is that without infrastructure, enterprises of all shapes and sizes won't flourish. They need the full range of support, in every sense.

Infrastructure supporting start-up and early-stage enterprises comes in many forms. First and foremost, being part of a community of like-minded people facing similar challenges and opportunities provides the important social infrastructure. Furthermore, university spin outs benefit from the incubation and nurturing those academic institutions provide. Other essential infrastructure includes having a network to access sources of funding, legal and other professional services, and of course scientific research facilities. Physical infrastructure will of course cover housing, good transport and places in urban or campus environments to bring people together and foster relationships.

What are the benefits for start-ups and SMEs in locating themselves in a campus environment as opposed to bespoke laboratories and offices elsewhere?

Harwell exists to enable scientific endeavour. We are a science community spanning life and physical sciences. At 700 acres, Harwell has the scale to provide the scientific, business and physical infrastructure to support small, fast-growing enterprises, as well as giving access to national facilities, academic and corporate bodies in one place.

Innovative companies are most successful when they are part of a thriving community that features a critical mass of research institutions and talent, agile investment and different sized businesses from start-ups to multi-nationals and collaboration.

At Harwell we have a diverse network of 200+ organisations, grouped into four main clusters where research, innovation and commercial know-how are fuelled by some £3bn of public investment that's unmatched globally.

How do you cater to quite diverse requirements in the real estate environment?

The real estate supports the growth of our four clusters. By 2027 we will add a further 1.5m sq ft of new laboratories, R&D, offices and advanced manufacturing, in both speculative and bespoke development.

Organisations within each of these clusters demand very specialist requirements from our buildings and we achieve this by designing sufficient flexibility within each typology. For example, our speculative, multi-unit R&D/light manufacturing buildings have occupiers from across our clusters doing anything from CL2 labs to building satellites next door to each other.

It is also important that we offer the full size range, from 1-2 person rooms to 500,000 sq ft bespoke builds.

What are some of the challenges you have faced in providing space and infrastructure for R&D enterprises to use and grow?

I think the main challenge is building to keep pace with demand, having the right buildings available at the right time. You have to keep up to date with your markets and interact with your potential customers; you have to stay up to date with what's happening in these industries generally – and of course Harwell has a global lens, and the conversations we're having and the organisations we're dealing with are international, calling for a few late nights.

How can government support the real estate needs of innovation in the UK?

The government has invested heavily into Harwell, with over £3bn of funding into the open access national research facilities. Investment into world-class research facilities across UK is the cornerstone of our innovation economy. At Harwell we have over 10,000 visiting researchers each year from across the UK and worldwide. It is exciting to see the collaboration happening between locations across the UK. The space sector is a very good example of this.

What do you think the key challenges for science and technology real estate will be in the next few decades?

This is all about vision and ambition. The market opportunity is huge. The UK already has mature, world-leading innovation eco-systems, and the government has set out a clear ambition for the UK's science and technology economy to tackle our planet's greatest challenges. The opportunity for the real estate industry is to create world-class places for innovation, which must happen in partnership with public and academic investment to provide the physical and research infrastructure. This is a team effort.

I feel hugely positive about this, but there remains work to done and for the Arc's perspective, it needs to communicate globally with what the Arc is and does, to achieve its own identity.

Creating Connective Anchors

Q&A with Artem Korolev, Managing Director, Mission Street

What is the current state of R&D real estate in the Arc, and how does Mission Street fit in to this picture?

It's clear that the R&D sector in Oxford, Cambridge and across the Arc will continue to be critical for the advancement of future medical, scientific and technological breakthroughs on a global level and will continue to be a fundamental pillar of the local and national economy.

Whilst homeworking and hybrid working is impacting many business sectors, and will continue to do so, R&D will continue to require suitable accommodation, by virtue of needing highly technical space for activities that cannot be undertaken from home, and environments which foster collaboration. This was demonstrated by the sustained and rapidly growing demand for laboratory space by science companies in Oxford and Cambridge throughout the pandemic.

On the other hand, access to readily available lab/office space is already recognised as a key constraint to growth for many R&D companies. Despite current development plans, there is still a long way to go if the development pipeline of new facilities is to meet the scale of the ecosystem's need, which will have a major impact on its ability to increase investment in R&D activity overall.

Supported by the above fundamentals, the Arc is attracting an unprecedented level of interest from the property sector. Whilst this is welcome, it is important that this development is integrated into the existing and flourishing R&D ecosystem. It is also key that the schemes moving forward result in a diversity of space typologies and rental levels, supporting a variety of tenant types and growth stages, which is critical to a healthy ecosystem.

Mission Street is a specialist investor and developer of R&D space, aiming to be partner of choice for the UK's research and innovation sector, supporting the entire life cycle from discovery, to R&D, to manufacturing. We are currently bringing forward over 300,000 sq ft of space in the Arc, including a new urban innovation district on the Botley Road, Oxford where we will be taking forward the first phase, Inventa, to complete in Q1 2023. At the other end of the Arc, we're working on a new science park within the South Cambridge Cluster – The Printing Press, Foxton.

What are the opportunities and barriers to supplying more commercial R&D real estate?

To be successful, R&D companies need to attract talent. Thus, the challenge for R&D developers is to deliver space that is not only technically fit for purpose but also well-designed, creating places where people want to work. Buildings need to be designed with significant flexibility for changing occupier needs, whilst maintaining viability. The commercial R&D real estate sector is rapidly maturing and innovating and new developments coming forward offer very exciting changes to the somewhat stale science park format of yesterday.

We would also like to highlight the international trend of science clustering in mixed-use, urban innovation districts located centrally or near city centres, where employment is connected to multiple transport nodes, and set in a mixed-use context with leisure and residential amenities. This opportunity aligns with what workers in the innovation sector desire from their workspace and supports companies' ability to recruit staff who want to live and work in an exciting, city centre environment.

On the other hand, the scale of the opportunity and weight of capital is essentially occurring in relatively small cities with an historic character, tight land supply and complex planning system.

It is thus critical that developers work collaboratively with planners, local residents and the key stakeholders to deliver schemes that integrate sustainably into their cities.

Incubating Innovators

How can government support the further provision of science and innovation real estate?

At a local level, local plans need to support continued growth within this sector and facilitate it in a sustainable way, close to existing populations and accessible to multiple modes of transport. It will be critical for spatial strategies to consider making best use of the land available within or close to the city to minimise travel demands, facilitate sustainable travel modes and safeguard sufficient land for R&D. In this regard, it is important to ensure that suitable sites are allocated, but that a suitable pipeline of space is deliverable in a period that can meet demand i.e. unconstrained by issues of ownership, lease expiries, remediation etc.

From a government standpoint, the biggest ask is to continue the support of innovation in the UK, providing grants, funding and facilitating partnerships between public sector institutions and the private sector. A key focus for the Government should be to provide support for R&D businesses from their early stages. Examples can be:

- Supporting and developing initiatives such as the Catapults, which have been delivering significant results. As an example, The Cell and Gene Therapy Catapult has evolved into a key anchor of the Stevenage ecosystem and is one of the stakeholders supporting the viability of further, entirely commercial development in Stevenage
- Tax breaks and incentives for earlier stage companies
- Funding for incubators/innovation centres within wider R&D developments where viability is constrained

Finally, investment in infrastructure is key. Lack of sustainable public transport access is a shortcoming many R&D sector employees highlight and improving such connections both within specific locations and indeed across the Arc is critical, particularly as we evolve from a car dependent economy. Indeed, such infrastructure investment may unlock the growth of knowledge intensive industries across a broader footprint as places become interconnected.

What does Mission Street understand as 'knowledge capital' and what are the benefits of being located within a knowledge cluster like the Oxford-Cambridge Arc?

The Arc is a world leading cluster with key ecosystem anchors (world leading universities and research institutions, medical facilities, existing critical mass of companies and infrastructure), and hosts a diverse mix of companies ranging from spinouts/start-ups, major R&D corporates and synergistic companies supporting the research and development activities.

This results in a high concentration of talent that can provide the human capital for founding and growing R&D firms and a critical mass of such companies with relationships that are needed to fund/collaborate/share ideas/spinout. The melting pot of diverse R&D activities in the Arc can facilitate further generation of new ideas across sectors.

For R&D focused developers, it is fundamental to understand the key stakeholders of this cluster and how best to unlock the potential to create, build and enhance a collaborative ecosystem. It also means that space needs to be designed in a way that encourages collaboration.

It is important to note that knowledge capital is not permanent. It needs investment, support and growth to maintain its position. To maintain the critical mass in the Arc, retain and attract companies and talent, the real estate sector must deliver the right space in the right locations.

Knowledge Catalysts

Nick Pettit, Senior Partner, Bidwells

Catalysts are used in chemistry to increase the rate of a reaction, and sometimes just a very small influence of a catalyst introduced at the right time can cause a colossal change in speed. The same ethos is true of the knowledge catalysts that exist within the Arc; those being the institutions which foster a culture of collaboration and innovation through the concentration of high-growth enterprises. Science parks, such as Cambridge Science Park or Harwell, and business collectives like MEPC Silverstone Park, work like a chemical catalyst in supercharging the growth of start-ups, spinouts and other science and technology enterprises.

The idea of academic and research co-location is nothing new: this is the model that built Oxford and Cambridge, through the Epicurean monastic tradition that saw academia as something enriched and propelled by the presence of a sympathetic and like-minded community. The halls of the medieval universities were the original knowledge catalysts for Scholasticism, Humanism, the Renaissance, and the Enlightenment, and the model of new knowledge catalysts in key areas of growth for the UK and regional economy in the form of science parks builds on this simple idea of spatial co-location and mutual collaborative support as a recipe for growth and success in business and in research and development. By taking businesses at the cutting-edge of research and development and giving them the necessary space to form relationships, test ideas, and make chance encounters with potential partners, we maximise their opportunity to grow and apply their talent.

The Arc is already home to some of the best examples of this clustering model in the world. The Harwell Campus was producing world-leading scientific research like the creation of CADET, the world's first transistorised computer, as far back as the 1950s. And just as post-war generations were allocating space and building such spaces as Harwell and Cambridge Science Park, which emerged in the 1970s, the birthplaces of research and scientific advance which has revolutionised the lives of everyone in society and contributing to the Fourth Industrial Revolution we are now living through, we need to match their ambition in creating new space and allowing for future growth.

Now, newer initiatives like the MEPC Silverstone Park, offering innovative solutions for small business and new start-ups with irregular growth patterns such as virtual tenancies and small, serviced offices within the Innovation Centre, to workshops and R&D facilities ranging from 1,000 sq ft to headquarter-style, standalone buildings. By drawing together enterprise in a way that echoes the spatial dynamic of the wider Arc, this concentrated approach to clustering research and development and creating communities and ecosystems can produce real results.

The knowledge capital that exists in the Arc has to be nurtured in institutions like the science parks if the region's substantial human capital is to be properly utilised. On-site facilities at Harwell include a hairdresser, dentist, two nurseries providing childcare and even a post office. In addition to these amenities is a gym and space and time for workers at Harwell to engage with sports teams and competitive leagues. Interactions in such an environment between those that work at the apex of scientific research help to build the atmosphere and ecosystem of mutual support and collaboration between enterprises of all kinds. Start-ups and spinouts feel like they have the support of larger organisations, just as established enterprise is energised and invigorated by new talent and ideas that, through the clustering science park model, is co-located. Through initiatives like its Nxt Gen programme, Harwell brings those in the early stages of their careers in STEM research and development and provides them with social and professional gatherings and networking opportunities, building links and dialogue and fundamentally strengthening research and development in the UK. Science parks such as Silverstone, Harwell and Cambridge Science Park go beyond simple space and real estate for businesses to succeed – although this is a vital component – but are instead committed to the holistic creation of research communities - ones which through their proximity become far more than the sum of their parts.

The archetypal science park, located in rural or peri-urban environment, should not constrain the planning or visualising of new clusters in city centre areas that require development, especially in parts of the Arc less constrained spatially as Oxford and Cambridge. The city centre Old Cavendish Laboratory was once the site of the discovery of the neutron, the electron and the structure of DNA: and the continued success of the New Museums Site as a mixture of Victorian and contemporary buildings in the centre of Cambridge demonstrates the ability and utility of developing science parks not just in a classic semi-rural model. In areas such as Bedford, Luton, Nottingham and Milton Keynes, city centre land for development could easily help to provide a solution to the drastic lack of laboratory space for new science and technology research and development enterprises.

Science parks work as microcosms of the wider Arc model by offering a nurturing environment for business to work together to succeed. Just as an incubator in a laboratory can create the ideal environment for a chemical reaction to occur, science parks need to act as incubators for the talent and expertise that the Arc is home to.

Connecting Knowledge Catalysts with the Regional Community

The Connective Tissue Underlying the Knowledge Economy

Q&A with Andy Martin, Andy Martin Consulting

While CEO of BNP Paribas Real Estate UK, you were witness to an unprecedented maturation of the domestic property market. When did science and innovation-based real estate 'take-off', and why?

To understand this question we really have to go back to the origins of the science park concept. We can look at the likes of Frederick Terman, Dean of Engineering at Stanford University in the 1950s, who put science-related real estate on the map by creating the Stanford Industrial Park. This was an early engine for commercialisation, of the university's research and eventually led to what we know now as Silicon Valley. Bringing it closer to home, we can look at the first iterations of this in the UK such as Cambridge Science Park, a similar venture started by Trinity College Cambridge, which allowed scientific researchers and academics to be part of commercial enterprises. Another example would be Surrey Research Park, a very successful model managed by the University of Surrey's Enterprise Unit which feeds off the research the university does. Later examples such as harnessing the Atomic Energy's Authority at Harwell near Oxford, Daresbury in Manchester and Herriot Watt amongst others, represented later maturations of the concept.

In the United States, the biggest early growth was in tech-based sciences rather than life sciences. Titans such as IBM, Oracle, Hewlett Packard and Microsoft became the bigger occupiers of this kind of estate. Life sciences is perhaps more interesting: it permeated the market in the UK in the same way as the sector did in the US. In the UK, our life sciences industry is very much more closely related to universities, teaching and research-based hospitals and big pharmaceutical company research facilities. The wonderful institution, the Wellcome Trust, had the means to create its own research institutions and became a major donor to universities including Cambridge, Oxford, UCL and Imperial, to promote life sciences. This collaboration provided the catalyst for the UK to become the major life sciences bastion it is today.

Many UK institutions can be credited in this process but the Wellcome Trust in particular has allowed the UK to stand toe-to-toe with many comparable institutions in the US. During my time at Strutt & Parker, we launched a research unit to understand how science campuses could be developed and improved upon. This later became part of what the business was famous for internationally.

As the market for this kind of real estate matures in the UK, this will provide another platform for real estate advisory experience to manifest itself. This could be different from campus-based growth, as demand moves to more urban locations, with proximity to colleges and universities, and major magnet resources. This is effectively why ecosystems based on something more than just the science itself become important: if you create the place, the longevity becomes the critical location criteria. People will want to be part of that ecosystem. Simply put, the collisions that spark and generate ideas can only happen effectively in that kind of environment.

Start-ups and university spinouts, as well as more established international companies with a presence in the Oxford-Cambridge Arc, clearly desire to collaborate. What does it take to create an innovation ecosystem, and why is it important to consider community building from a real estate context?

The best ecosystems are ones that are effectively growing on the foundations of a community that already exists. They're almost impossible to create from scratch without having that core element, which takes time to develop (sometimes centuries!). In areas where these ecosystems are strongest they create a 'vortex', which effectively sucks everything

valuable in, attracts vital talent, enterprises and businesses that support and feed off them, and doesn't let anything escape from the magnetic pull of the academic clusters. When you become involved in this cutting-edge, scientific research, it becomes so compelling that it has its own gravity.

Clusters succeed when they have a hierarchy of focus points: these can range from universities, research-led hospitals (such as the University Hospital of North Durham and Duke University Hospital North Carolina, Mass General in Boston, Addenbrooke's in Cambridge, all within the orbit of the research of large pharmaceuticals). The connections present in collaborating institutions like these mean that other things are drawn into their orbit.

Building an ecosystem is about creating an environment in which to thrive and that starts principally with a strong academic cluster but includes the whole social structure of work and play. These are founded around urban centres, not urban outliers. Especially in London, Oxford or Cambridge the question for this real estate will often be 'is it a cycle ride away'? The green attributes of people involved in these industries is very strong. All this proves that proximity cannot be underestimated when it comes to building this kind of real estate.

How is this informed by your research into other clusters internationally, particularly in the US? What did you learn about wants and needs, challenges and opportunities, involved in innovation ecosystem creation from the companies you interviewed?

Research into placemaking is a central part of real estate consulting life. What drives and motivates people to move, and form and strengthen communities? This has always been a question of seeing how people work.

When looking to develop the Wellcome Genome Centre south of Cambridge, we had to ask, 'what does it need?'. This is clearly not only a question of building more research real estate, but also building homes near to where researchers work. In the US, there has been a drive to build these 'Bourneville' style communities and create that agglomeration of talent; in Boston, New York, San Francisco and Los Angeles we have real estate enablers like Biomed, Alexandria, Longfellow, Bain Life Sciences and Divco focusing on the drivers in these clusters and communities.

Obviously, there is a question of scale between the US and UK markets. When we look at facilities in Boston, MA alone, that already surpass 35m sq ft, we need to be realistic that this isn't going to be matched on this scale. Commercial real estate enablers need to look less at the likes of Atlanta, where 200m sq ft of innovation real estate is planned and start looking at the reality of what's possible in a British context.

We also have to look at innovative ways to lease commercial research and development real estate. Part of the solution is flexibility as these companies can grow exponentially once in product markets. Again, we can look to the U.S. with businesses like Biolabs, as a future model of innovation real estate where co-working lab space and 'rent by the bench', or by the room, is normal. That allows new businesses, and those on contract research, to find a place close to academic facilities that they are working from. We have that in limited amounts here, but it feels like the next evolution.

How important are chance encounters between innovators? How can we design buildings to maximise the opportunity to make these connections?

This really goes back by to research done by the American sociologist Mark Granovetter at Stanford, and his concept of 'weak ties' between people and organisations. These are not necessarily strong familial ties or friendships based on mutual acquaintances, but are interactions that inform and help you become the person you are. These can be chance conversations and might come from people you see occasionally, even someone who only see over coffee. Through these weak ties you see new ideas play out in practice; those chance conversations and the 'what are you working on at the moment?' question builds to create a more informed picture of a sector; you find relationships and a spark that is essential in a sector like life sciences, where much of the research is conducted behind closed doors.

Where you can find space for presentations, functions and social events is where you can create environments to forge these 'weak ties'. If you're working in a silo, and the only collision you're going to have is in the campus canteen, that collision radii is much smaller. But if you're in a genuine community, that collision radii increase exponentially. As a real estate enabler, you have to ensure that within your ecosystem you're providing situations where people meet, facilitating those connections and ensuring people have the means to talk with each other. You can do this by creating village communities, where this collaboration and research is part of their culture. This is essentially what Oxford and Cambridge are all about - examples of places that have already created this vortex. It is exactly what we have see in Kendall Square Boston adjacent to MIT. We cannot just let it happen naturally - we must contrive to make it happen.

What is your advice for the growth of the innovation clusters within the Oxford-Cambridge Arc, and what could decision-makers do to maximise the region's innovation potential?

The idea of collaboration is essential. Science is a competitive world but we have to ensure stakeholders understand this is not a 'zero sum game', and we can all benefit from better understanding. We also cannot ignore the major potential cluster of development and its connection with other sources of innovation and enterprise in London. We need to position the Oxford-Cambridge Arc as a natural place to expand and grow from London and further afield to the growing clusters in the north west and north east. This all comes back to finding the right sort of cooperative environment; building the necessary housing to develop it, building new facilities, and investing in connective capital through greater infrastructure and connectivity.

Decision-makers must recognise that they're sitting on an opportunity to grow their existing reputation as world-leaders in the sector. They need to accept that this is going to provoke conflict against a desire to develop, but we cannot risk researchers and academics who move to these clusters not feeling welcome and furnished with the resources to succeed. Investors helping to push innovation in the UK through new laboratories and spaces for research can take their proposals elsewhere if they find that it's difficult to achieve planning or develop out their ideas, and we'd lose a huge amount of potential and momentum if this were to happen.

Cultivating World-class Innovation Ecosystems

Q&A with Jamie Clyde, Regional Director and Innovation Services Director at Bruntwood SciTech

What are the necessary ingredients required to cultivate and maintain innovation ecosystems?

The first element in creating a successful ecosystem is anchor individuals – charismatic, purposeful entrepreneurs who are good connectors. They often aren't talked about but successful ecosystems have a small number of individuals with a very large impact on the success of a cluster.

The second element is an IP reservoir – that can be academic but can equally be corporate. Our obvious academic contenders in the Arc are the universities, but we also have the likes of GSK and AstraZeneca that are adept at translating key intellectual property into broader applications.

Thirdly, ecosystems need innovators – they could be out of universities as postgrads, they can be clinicians with ideas and energy coming out of medical environments or they could be corporate individuals coming out of the private sector looking to commercialise new ideas as was the case with Nokia's restructuring in Finland. This knowledge stock is a critical resource to innovation ecosystems, providing bright ideas and in many cases, bringing with them unique experiences.

The fourth ingredient is the diversity of capital sources – having joined-up capital sources between government grants, private venture capital and angel investors. Sustainable, successful ecosystems are able to integrate those effectively. In Israel they have worked very hard to marry these two funding streams seamlessly. This is something we've emulated at Bruntwood SciTech and cultivated in our Oncology Development Programme, where pharmaceutical companies work alongside public sector groups like Innovate UK to provide support to businesses in the sector.

The fifth is access to markets – the ability for early-stage businesses to access either public or private markets. In some cases, that's having channels into the NHS for clinical trials whilst in others its relationships with sales and distribution networks. Interfacing between the entrepreneurial world and the corporate world creates the portals for small and emerging businesses to access those markets, which can often be very challenging.

Sixth, professional services – the provision of specialist advice to support business development and the allocation of risk through flexible charging structures.

Finally, innovation ecosystems must engage with the local community – in many ways, the fourth arm of a 'quadruple' helix – to provide vibrancy, a social scene and quality of life. In practice, that means ecosystems must be designed to be open and interface with communities, departing from the old model of closed campuses.

How does Bruntwood SciTech foster collaboration and dialogue between innovators within its ecosystems?

We have a number of services that are trying to glue all these components together, to drive either planned or unplanned collaboration. The key point here is that some of this is actively trying to get people to connect, but it is also often as simple as creating an environment where moments of unplanned collaboration can take place rather than scripting encounters by design. That is often just as valuable, or more valuable, than the planned collaboration.

Of course, Bruntwood SciTech can still signpost business support activity and listen to what innovators are doing to facilitate the right introductions. We also run incubator programmes where the cohorts are actively encouraged to collaborate. Where we have multiple programmes running, we try and connect these. By connecting proptech with createch, we can provide opportunities where these different cohorts can compare notes, share expertise and challenges and have interesting conversations. We can also help to forge dynamic collaborations between seemingly unrelated industries. And not just between entrepreneurs themselves, but also linking them up with available support services.

An entrepreneur in an early-stage business can't do everything, they have to work closely with partners and draw on all sorts of expertise. What we do at Bruntwood SciTech is pull together all those bits of resources, to improve the acceleration of a business through these connections.

Why is close spatial clustering such an important dynamic in the innovation life cycle of start-ups and spinouts?

If people are physically present, they have to really connect. Opportunities for us to collaborate beyond virtual means is where we build deeper and less transactional relationships, with opportunities for unplanned things to happen. The world has particularly learned that during the pandemic. We've been running one of our corporate innovation programmes – we ran the first cohort just before Covid, and the second one during Covid, where we went virtual. We had a 50% lower performance on the second cohort, which we put down to having less unplanned interaction between the cohort in person. That was a great illustration to us of just that value, one difficult to measure, but which becomes very clear.

Connecting Knowledge Catalysts with the Regional Community

Getting people together to do social activities is vital. We have 'Wholesome', a social and wellness programme with six dimensions of activity: from physical activity like yoga, to mental wellness, to nutrition. These opportunities to get people together not only to promote wellbeing, but at the same time open opportunities for people to create and collaborate. Slightly more structured is in getting peer-to-peer individuals together, under Chatham House rules with no agenda, where enterprise founders can create safe spaces, collaborate, share their challenges and come up with solutions.

Bruntwood SciTech can also help by providing shared services that early-stage businesses can't afford. In open-source labs and shared equipment, we create great opportunities for businesses to work together. Finally, we have our online platform, where we have various online tools like on social media to give people the opportunity to connect electronically. These are just a few examples of where we can engender links across communities.

How do campuses and clusters forge links outside of the workplace? Do you see holistic research communities as important?

We often hear of a 'triple helix' within the Oxford-Cambridge Arc of public, private and academic collaboration. What's behind a successful cluster is really a quadruple helix, where the local community forms the fourth pillar. In the old world of science parks, they were surrounded by big walls and one needed ID to get through the gate. The key difference between an old science park and modern innovation districts is that this wall had disappeared. Now, academic, public and private activity is meshed with the local community, and the local community plays a vital part in that.

If we take Alderley Park as a good example, in the 1980s it was a sealed-off secret environment where the public were not encouraged to be involved in any way. In the last few months, we hosted the Tour of Britain cycle race with a stage that actually began in Alderley Park. One of the key messages is that we're trying to bring the community into the campus, rather than seeing it as a controlled environment where innovators go and the wider community doesn't. This is something we're seeking to introduce to science parks within the Oxford-Cambridge Arc.

There's an importance from a skills development point of view in engaging the local community to achieve the government's levelling up agenda. The potential for innovation is great across the spectrum: our Digital Ideator programme engages with local young people aged 16-18, where we give them similar challenges to those given to early-stage entrepreneurs. This is with a view to giving them an opportunity to taste entrepreneurial experience, but also for those organisations to access a group of people they may not have access to through traditional recruitment processes. This succeeds in bringing in young people and engaging them and exciting them, and providing a bridge into employment.

What are some of the benefits of so many institutions in the Arc working as joint ventures?

Where institutions work together through equity and JV relationships, we have the opportunity to align strategy and objectives that benefit the ecosystem where small and growing businesses can thrive. We don't have a scenario where different institutions are randomly investing in capital assets that are duplicated or strategically misaligned, but instead there's a cohesive plan. From a knowledge capital point of view, there's collaboration and the development of innovators and incubators acting together.

If it's public-private joint ventures, we have the opportunity by forging that partnership to have accelerator programmes that span those organisations, creating far greater opportunities than if just one of those institutions was to try and do it on their own. If you have an NHS Trust, they can become involved with local authorities and universities which allows us to have a dialogue on a very different level – a neighbourly relationship with those institutions. We can use this to set up an incubator environment, and it also gives us, as a private sector company, greater access to graduates and academic support in, for example, AI, developing a much richer system of support for more innovative businesses.

What could the government, private sector and academia do next to continue to supercharge science and technology research and development in the Arc? How could they make your job easier?

The first point is that there needs to be a clearer intelligence picture in the Arc, what support is available and who is out there to collaborate with. That would help signpost the process for innovative business and help sources of support rise to the surface. Having that visibility of who's who in the Arc would be a valuable resource.

The second point is that from an infrastructure point of view we need to keep the pressure on improving transport and rail links, increasing the connective capital of the Arc.

The final point is the need to focus on the centre of the Arc, making sure areas like Bedford, Milton Keynes and Luton become developing centres of excellence to bring in investment that complements the centres in Oxford and Cambridge. Building on existing innovation communities will help us fill in the middle of the Arc with new talent. There's plenty of space in the Arc to create and develop new centres of excellence, all working together.

Bringing Innovation into the Centrefold

David Parker, Partner, Mixed Use Development

The urban centres of the Arc represent fascinating case studies of the manner in which all settlements across the UK have grown and developed. Some, like Oxford and Cambridge themselves, shadowed the lines of ancient medieval settlements for 100s of years; others like Luton and Bedford grew from villages into large towns with the industries of the 19th century; and most dramatically, Milton Keynes went from an abstract concept to a modern city in the space of a few years. Any project aimed at regenerating the urban centres of the Arc would have to take into account this rich historical diversity when considering how space could be developed within these urban centres, but one common thread is clear: that all of the major settlements in the region can benefit from rethinking their use of urban land, helping us to meet some of the vital real estate needs of the wider Arc project while creating and regenerating its urban communities.

As this wider report has shown, the need for more laboratory and ancillary commercial real estate for research and development start-ups and SMEs is acute, and could act as a considerable headwind to future growth. Rural science parks and campuses have provided space and the vital clustering dynamic in past, whilst offering an enjoyable work environment and high standard of living. But the answer for meeting the real estate needs of the future of the Arc cannot exclusively lie in campuses on the periurban periphery of the major urban settlements of the Arc: the science park model undoubtedly works, and works well, but we need to move beyond having only a narrow, Bletchley Park conception of innovation, where research and development infrastructure has to be hidden away and contained. The opportunities for development of the necessary real estate connective capital for life sciences, artificial intelligence and other innovative industries as part of the strategic long-term regeneration of the urban centres of the Arc are exciting, offering an opportunity not only to solve a wider, long-term issue of a lack of available commercial real estate but also to contribute to the revitalisation of parts of the Arc that could be more competitive. Redevelopment of urban brownfield land can be the fundamental mechanism by which the rising tide of regional economic growth can truly raise all boats, ensuring none of towns and cities of the Arc are left behind.

With the status of high streets and urban centres in a state of flux, with the long-term decline of physical retail meeting the sudden shock of changes to the world of work and leisure brought about by the coronavirus pandemic, now is the perfect opportunity to update our thinking towards planning, urban regeneration and the way in which we ensure our city centres arrest decline. The Luton Town Centre Masterplan, approved in July 2021, set out its view of the positive effects of re-establishing a central, commercial district, citing opportunities to introduce 'greater daytime population and spend opportunities'. Luton's bold and innovative plans for the future, not only in making their town centre a more attractive place to spend time but also in attempting to establish new commercial and innovation real estate in existing heritage real estate and brownfield sites, is an encouraging positive step in reimagining the urban centres of the Arc.

Regeneration of not just commercial but also residential real estate can have a tangible impact on urban areas – adding not only to the connective capital but also the human capital of the region, as the people who live and work in the Arc are provided with the high-quality housing that allows them to maximise their potential. The Lakes Estate redevelopment in Milton Keynes aims to replace decrepit and dangerous mid-century social housing with a bold new development that uses space more efficiently, provides more vital city centre homes and amenities, is more environmentally sustainable, and crucially offers safer and more attractive central housing. The mindset that created Milton Keynes was both bold and visionary – but where original urban planning solutions have, over the course of half a century, resulted in suboptimal solutions to the housing needs of today, local government and the private sector have to work together to come up with solutions that provide crucial urban regeneration whilst remaining a participatory and positive experience for existing local communities.

Connectivity Empowers the Arc

Professor Greg Clark CBE, Chairman, Connected Places Catapult

Connectivity is imperative in driving growth across the Oxford-Cambridge Arc. Typically, we'd express this as the physical and digital connections and infrastructure between people and place, to enable the transfer of knowledge across the regional network. Connectivity can also encompass the strength of relationships between sectors, bringing together entrepreneurs and innovators with decision-makers across local authorities and the UK Government. Broadening our understanding and appreciation of the power of connections to enhance our infrastructure ambitions is paramount if we are to unlock the collective benefits that a supercharged Arc can bring us all, as an engine for UK plc, a magnet for investment, job creation, job growth, and global representation on the world stage.

The valuable lessons learnt from previous successful development in the Oxford-Cambridge Arc and across the UK is that collaboration through high-quality connections between stakeholders is the best way to efficiently grow an ecosystem. Accelerators and incubators can act as the crucial bridge between small innovative entrepreneurs and researchers in the connective capital sector, and organisations like the Department for Transport that have the funding and strategic ability to translate ideas into practice.

Connected Places Catapult is one such point of connection between innovators, academia, industry and the Government. As the UK's innovation accelerator for cities, transport and places, the Catapult builds on its links to UKRI and Innovate UK to provide impartial advice to businesses and place leaders, including local authorities and UK Government. The Catapult also works at a global scale, supporting the entry of UK business into emerging innovation markets around the world.

Connected Places Catapult is a superlative example of the triple helix concept at work, offering advice and providing connection across sectors, championing connectivity between sectors and regional clusters within the Arc in all senses of the word.

Connected Places Catapult provides impartial 'innovation as a service' for public bodies, businesses, and infrastructure providers to catalyse step-change improvements in the way people live, work and travel, by:

- Improving physical connectivity – increasing the stock of physical infrastructure, connecting places through the innovative use of new materials and engineering through new roads, bridges and improvements in the rail network and utilities infrastructure.
- Improving social connectivity – utilising innovation in urban design and placemaking to build genuine communities and improve social cohesion across new and existing developments.
- Improving digital connectivity – using advances in telecommunications technology, internet-connected sensors, and ubiquitous big data to build smarter cities, infrastructure and governance systems.

Connected Places Catapult works across academia and the public and private sectors, including the Department for Transport, to prepare the UK's airports and airfields for zero-emission flight infrastructure, creating dialogue and solutions for the future use of hydrogen and battery powered aircraft. The Transport Research and Innovation Grant: Zero Emission Flight competition funded 15 projects with £50,000 of initial seed funding in 2021. Winners were sourced from across academia, including three from Cranfield University, and private sector start-ups. The funding and business support received by these projects is part of the focus of organisations like the Catapult in commercialising academic and private research across the UK, providing sustainability solutions to help the UK reach net zero while building economic and jobs growth.

Connected Places Catapult works to match government agencies with innovative SMEs across the UK in physical infrastructure initiatives such as the decarbonisation of rail freight infrastructure and the creation of zero emissions air infrastructure. An innovative project working alongside private sector enterprises and Cranfield University aims to meet the aims of UKRI's Airspace of the Future project, looking to seamlessly integrate drones into the existing airspace system of the UK.

Working with partners within the Arc and nationally, Connected Places Catapult can be the catalyst that increases the speed of reaction between the incredible entrepreneurial ability of UK innovators and the planning and strategic ability of the public sector.

Policy Recommendations

‘Infrastructure’ has come to mean far more than the great road and rail projects of previous years. A modern cluster of excellence such as the Oxford-Cambridge Arc requires a modern approach to infrastructure development; investment in the connective capital of the region that goes beyond steel and concrete and encompasses everything from digital connectivity to physical real estate.

We have come a long way from the National Infrastructure Commission’s 2018 promise of ‘transformational growth’, aiming to accelerate the delivery of homes across the Arc and provide new infrastructure in the form of road and rail links. Our experience of the Covid-19 pandemic has highlighted the necessity of improving the digital ‘twin’ of the Arc, enabling the seamless transition from in-person to virtual working and collaboration. We want an innovation ecosystem which ties into the regional identity, in addition to infrastructure assets which accelerate the rate of knowledge transfer.

Our approach to infrastructure has meant considering the full breadth of connective assets in the Arc. Regeneration should be considered in light of new demands from office and co-working spaces. New real estate enables scientific and technological R&D that demands specialised laboratories. Last-mile logistics and transport infrastructure is accounted for as a core function of the Arc, as is social infrastructure which acts as the bridge between infrastructure for communities and commerce.

There’s a lot to look forward to: the first autonomous transport links have been introduced in Cambridge through a university, local authority and private provider collaboration, demonstrating the ability of the Arc as a centre of innovation in producing and trialling ground-breaking infrastructure solutions. And the impact of Covid-19 on varying demand on our infrastructure is being managed by the introduction of innovative smart cities technology, feeding data back to local authorities to better manage peak usage capacity and user experience of road, rail and digital connective tools. But despite this impressive innovation, the connective capital of the Arc, more so than any other sector, requires the strong planning and infrastructure delivery hand of local and central government involvement and support to truly succeed.

Supercharge

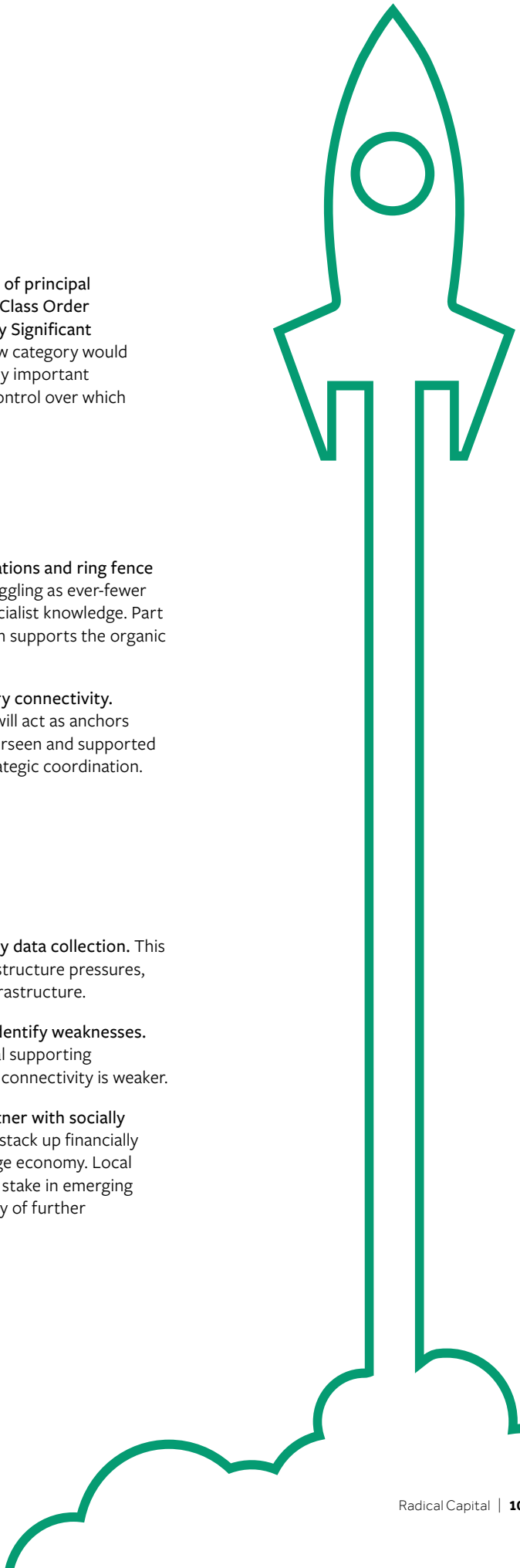
- **Establish a new 'innovation' use class in planning terms, comprising of principal laboratory and space for knowledge-intensive R&D. Using that Use Class Order definition, define any development over 50,000 sq m as a Nationally Significant Infrastructure Project (NSIP) covered by the NSIP process.** This new category would provide an accelerated route through the planning process for socially important innovation and enterprise, while allowing local authorities to retain control over which applications would fall into this category definitionally.

Advance

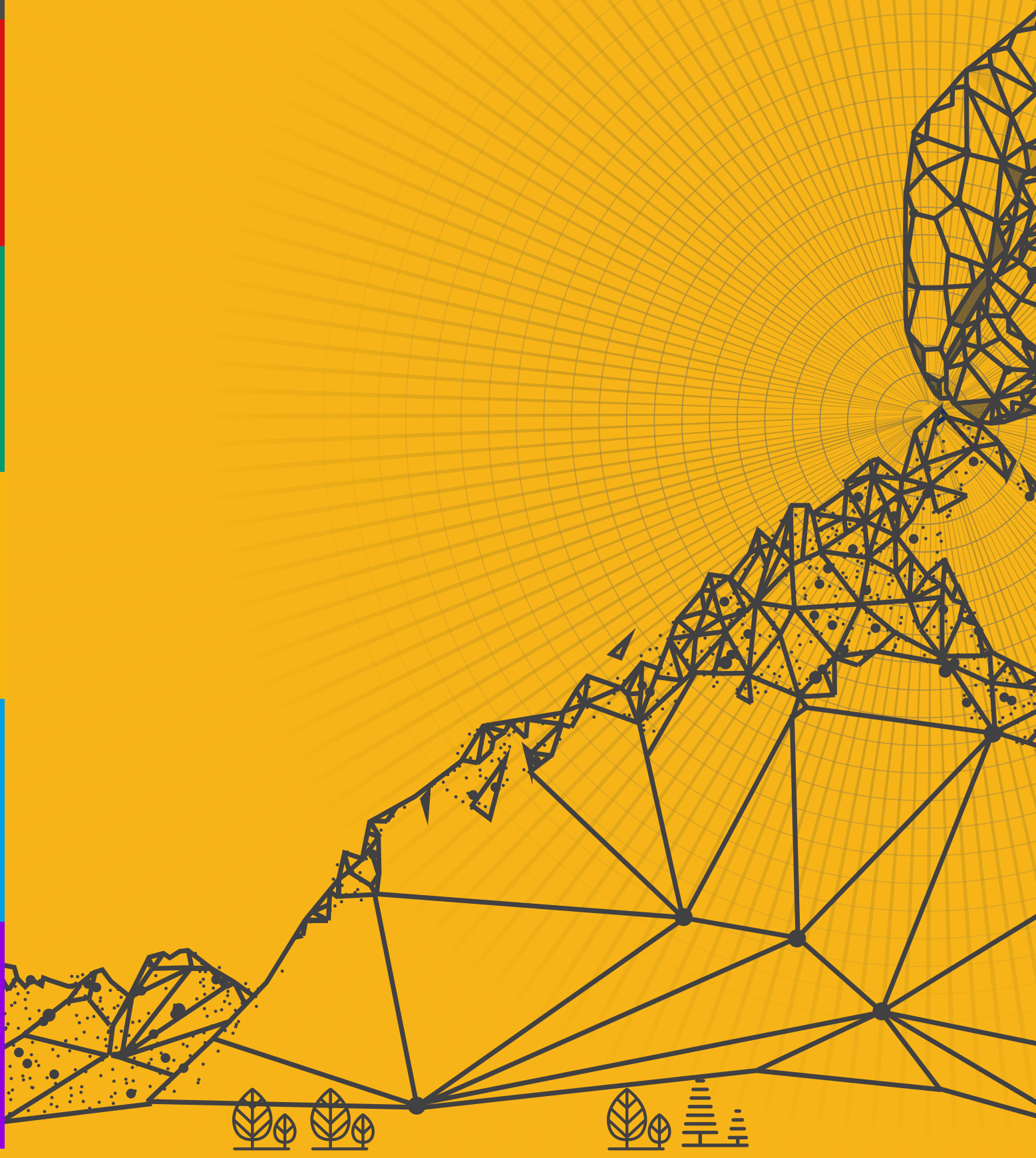
- **Allow planning authorities to set their own fees for planning applications and ring fence that income for the planning service.** Planning departments are struggling as ever-fewer resources are devoted to local authority planning which requires specialist knowledge. Part of the development process should feed back into the resource which supports the organic growth of communities.
- **Establish a regional infrastructure plan focussing on cross-boundary connectivity.** Projects which seek to bind together key towns and cities in the Arc will act as anchors which support knowledge transfer. A regional infrastructure plan overseen and supported by national government would open up further opportunities for strategic coordination.

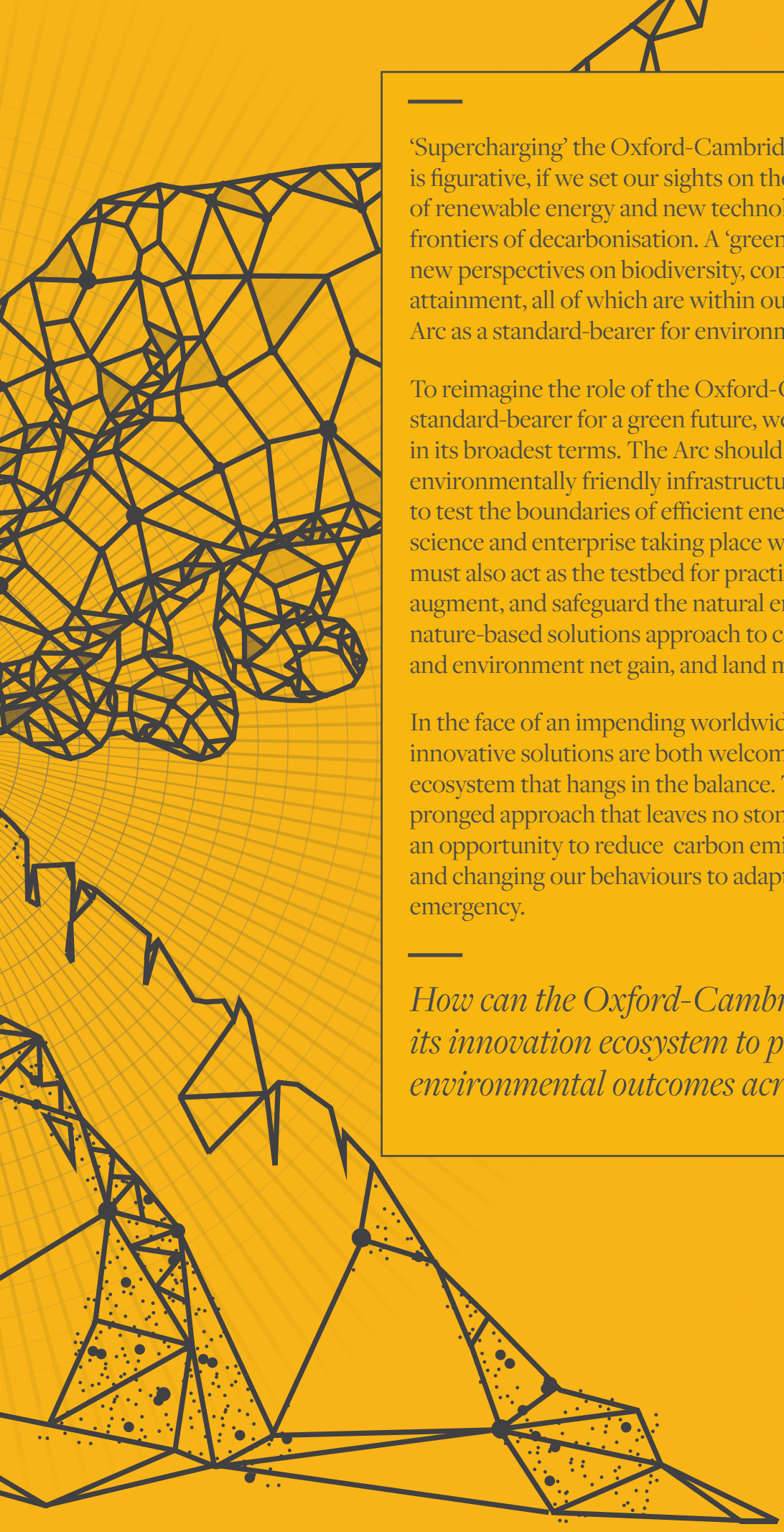
Grow

- **Arc data repositories should be centralised to foster cross-authority data collection.** This would make it easier to see which authorities are under greater infrastructure pressures, and to regionally coordinate the density and spread of large-scale infrastructure.
- **Create an interactive map of connectivity layers within the Arc to identify weaknesses.** A clearer intelligence picture of innovators, relationships, and physical supporting infrastructure will enable strategic planning to prioritise areas where connectivity is weaker.
- **Subsidise incubators and create forums for local authorities to partner with socially valuable enterprises to keep companies in the UK.** Incubators don't stack up financially and require support as an essential component of the Arc's knowledge economy. Local authorities should be encouraged to liaise with incubators and take a stake in emerging innovation to drive investment returns which can support the delivery of further community infrastructure.



Natural Capital





'Supercharging' the Oxford-Cambridge Arc is as literal as it is figurative, if we set our sights on the untapped potential of renewable energy and new technologies pushing the frontiers of decarbonisation. A 'green' Arc equally relies on new perspectives on biodiversity, conservation and net zero attainment, all of which are within our grasp if we position the Arc as a standard-bearer for environmental enhancement.

To reimagine the role of the Oxford-Cambridge Arc as a standard-bearer for a green future, we must consider 'green' in its broadest terms. The Arc should be home to clean, environmentally friendly infrastructure, but it should also seek to test the boundaries of efficient energy use by leveraging the science and enterprise taking place within the region. The Arc must also act as the testbed for practices which actively add to, augment, and safeguard the natural environment, adopting a nature-based solutions approach to conservation, biodiversity and environment net gain, and land management.

In the face of an impending worldwide climate crisis, innovative solutions are both welcome and vital to the fragile ecosystem that hangs in the balance. This means taking a multi-pronged approach that leaves no stone unturned, appraising an opportunity to reduce carbon emissions wherever possible, and changing our behaviours to adapt to an ever-pressing emergency.

How can the Oxford-Cambridge Arc mobilise its innovation ecosystem to positively drive better environmental outcomes across the region?

£135m

The amount Cambridge Cleantech has helped low carbon sector start-ups and entrepreneurs to raise since 2011

40%

The government for future energy production from wind, solar and hydroelectric sources by 2030

11k

The number of hoes powered by advanced conversion technologies, like waste recovery, which utilises heat energy recovery, in Milton Keynes

250

The number of acres of conventional farmland needed to produce the same amount of food as a single acre of land that a vertical farm occupies

40m

The number of birds that have vanished from the UK's skies in the last 50 years

668k

The number of tonnes of CO_2 per year saved by converting c.300k tonnes a year of commercial and industrial waste into pellets

Growing the 'Green' Arc

Professor Simon Pollard OBE, Cranfield University and Chair of the Arc Universities Group Environmental Partnership Board

I've been a great believer in the economy and the environment working in tandem, as it does in many parts of the world, most notably in Scandinavia. My experience has been in the restoration of post-industrial land, in managing risks to and from the environment and in accommodating environmental priorities into infrastructure build.

In 30 years, I've witnessed not only the greening of infrastructures but of the aspirations of the engineering professionals that design, build and operate our critical assets. As a result, the green economy is now providing genuine career opportunities for the next generation, and the valuing of natural capital, in its fullest sense, in many developments. It is a time to be ambitious, and the Oxford-Cambridge Arc presents us with a lifetime opportunity to be radical; to ensure that natural capital is centre stage as we plan out the Arc's place in the world for those that live, work and study within it.

I should admit, when you've been in the game a long while, you can get a bit jaded about the environment if you're not careful. In many fora, it remains misunderstood, viewed as a side issue, a 'bolt-on', a transient means of appealing to the electorate, a 'nice-to-have', or an activist's chant. We know in our bones natural resources are the basis of the global economy and our very livelihoods, but we struggle to give the environment the attention it deserves - or we become over-enthused and alienate our fellow travellers. The all-encompassing nature of the environment allows us to relegate it to a 'cross-cutting theme', secondary to the economic pillars that drive progress. We should rightly expect a high-quality environment and wide access to it. We can cope with temporary disruption whilst development proceeds, providing there is restoration and enhancement in the long-term and that precious, non-renewable resources are not wasted or desecrated along the way.

The opportunity that a 'green Arc' now offers is as a global showcase for a low carbon, liveable and affordable set of thriving communities. That's easy to 'rattle off' but challenging to deliver in practice. But why not raise the game significantly this time? With all our know-how and pole position in the providing of environmental goods and services, why not make a break from short-term planning gain and deliver a world class exemplar of what 21st century strategic development can be, and lock-in real value and benefits for multiple generations? Can we do it? Can we place the environment, and the services it provides society at the very heart of our long-term plans? Or will it become another integrating strand of activity to which we should refer in passing, but fail to prioritise in practice?

The Government's consultation of the spatial framework for the Arc is an important step forward. Having the opportunity to press for a credible, intergenerational set of environmental outcomes is central to the legitimacy of plans in the region. There are hopeful signs in the priority given to natural assets, the developing thinking around a 'green Arc' and the approach to sustainability appraisal in the consultation, but there is further to go if we are mobilising citizen support. Sherry Arnstein, the respected US policy analyst, and vice-president of the National Health Council, wrote her influential paper for the American Institute of Planners in 1969, setting out a ladder of citizen engagement. At the top of the ladder is citizen control, delegated power, and partnership. Science, evidence and power have to be shared if we are to underpin our ambitions for places with support from our citizens.

Making Every Acre Matter

Roland Bull, Head of Rural Investment, Bidwells

If we are to truly and radially transform the Oxford-Cambridge Arc, we must move to a policy making approach that allocates land according to its potential rather than its current use.

Strategic planning in the UK has become heavily skewed towards development control and an adversarial decision-making process, fixated with current land use and and over reliance on a 'you can't build that there' mentality.

We must turn away from this piecemeal approach to development at scale and stop relying on our land's current use to drive policy. Spatial planning should not simply be about the development process. It should be about the most efficient use of land.

We should identify the land in the Arc considered as having greater potential to deliver the outcomes we seek and incentivise those in control of these parcels to deliver these outcomes by directing public and private money towards them.

There are both carrots and sticks required to achieve this more strategic and efficient land use in the Arc. Of course, development control still plays a vital role. Designations and restrictions prevent land from being used for inappropriate things and the constraints imposed by local authorities and central government on the specific use of parcels of land. But rather than simply preventing large-scale development, lets promote large-scale nature enhancement by being imaginative with the carrots we dangle to ensure the best outcomes can be delivered.

More can be done to effectively direct resource from public subsidy and private markets such as ensuring the optimal use of land with significant environmental or public amenity potential.

We must give ourselves the ability to look strategically at parcels of land like these, those with the greatest potential to deliver specific outcomes, whether that's for housing, agricultural, environmental or community use.

By adopting a strategic planning approach to the delivery of these environmental outcomes, we can be more cost effective and provide greater opportunities to deliver these environmental benefits, improving ecosystem services that will benefit both wildlife and society. Only then we can do it at the scale required to deliver the Government's ambition to make the Arc a 'standard bearer for green growth in the UK that it imagines.

Of course, this process requires wide, public engagement and strong governance to deliver but there is also an opportunity here that technology affords us and which hasn't been available in the past - to undertake a more strategic analysis and planning of optimal land uses across the Arc.

For instance, striving to achieve a 20% net gain for biodiversity across the Arc will require both on and off-site habitat creation and enhancement. A proposed Arc Spatial Framework provides an opportunity to promote the protection and enhancement of nature networks, strengthen wildlife corridors and encourage wildlife movement, creating more resilience to climate change.

This type of ambitious spatial planning is not about the development process but it is about land use policy. There are millions of acres of land that exist across the Arc and we need an approach that sets out to put each one of them to the best possible use.

The Sustainable Masterplan is more than a Five-Year Mission

Q&A with Richard Hepworth, Director of Project Management, Urban & Civic

Urban & Civic has a rich history of delivering new infrastructure and revitalising communities in the Oxford-Cambridge Arc. Could you explain more about Urban & Civic's mission since being acquired by the Wellcome Trust?

Urban & Civic's project work is generally no more than 100 miles from London, and this portfolio currently consists of developments with outline planning consent for approximately 44,000 homes that will be delivered over the next 30 years. We're also promoting 9m sq ft of commercial and employment space, in addition to the necessary community facilities that these master plans include.

The majority of our development proposals are situated along the Oxford-Cambridge corridor. Our projects range from Waterbeach in Cambridge, Alconbury in Huntingdon; Wintringham, St Neots, Tempsford in Bedfordshire to Calvert in Buckinghamshire, right at the intersection between East-West Rail and the new HS2 line.

Because of this interest in the growth and prosperity of the Oxford-Cambridge Arc, what we do is in many ways mutually dependent with what happens in the region. It also means that our core values are different to other developers and master planners, carrying important expectations of new and existing communities to create something that is sustainable, organic, in keeping with local character and which doesn't sit apart from the community fabric, but rather improves and realises local aspirations.

We're well-known for our focus on brownfield land, especially land that has been out of action for some time because of the physical complexities needing to be resolved to unlock it.

Environmental net gain has therefore always been a key value with which our developments have been brought forward.

Since becoming part of the Wellcome family, the U&C vision and values for developing truly sustainable communities have only been strengthened and reinforced by their own core values.

You mentioned 'core values' and how these are unique to your approach to considered growth across the Arc. What's special from a sustainability perspective?

It's interesting that this report categorises the latent potential awaiting activation in the Oxford-Cambridge Arc as different 'capital' themes, because that is also how we've been thinking about Urban & Civic's role as a master developer, in the variety of sustainability-led contributions we need to make to present and future communities.

To put this in a different way, because we build at scale and therefore over much longer periods of time, we set our horizons far greater into the distance. In relation to sustainability and enhancement of the natural environment of the Arc, this means baking in environmental and climate considerations at the outset of our design approach, ensuring flexibility in what we propose and consistency across every site we deliver. Take environmental net gain as one example: from a position of civil engineering and infrastructure, Urban&Civic is rightly identified with the regeneration of previously developed land that has been seen as potentially high-risk for development. Should these sites contain contamination, the scale of the site area allows us to treat all of this on-site, be it natural invasive species or contamination from a previous industrial use that has made the area hazardous. We've breathed new life into previous Ministry of Defence bases, which were once seen as untouchable due to the air fuel leakages from pipework and bunkering positions or the volume of underground asbestos pipes, as well as the ammunition that would have been expected. We've been able to identify and segregate these issues and resolve them safely on-site, without resorting to landfill, with massive environmental benefits.

Elsewhere, we have developed on previous quarried areas, returning those large swathes of land to provide suitable development platforms, often involving millions of cubic metres of material being salvaged and re-used. Indeed, we engineer the design to ensure the site is self-fulfilling in respect of earth work needs, creating the correct drainage response at the same time. Our sites often contain large volumes of hardstandings which we process to roadstone to create a 'hard' environmental benefit without the need for carbon intensive movement of waste product clogging up the roads.

We take the same, long-term approach to other environmental improvements on-site, specifically those around improving noise and air quality. We've supplemented these with early adoption of noise and visual impact bunding and planting out to enhance air quality attenuation at a very early stage; sometimes five to 10 years earlier than others in this space. That gives us the ability to be ahead on environmental and climate issues, without having to resort to offsite provision or short-term fixes.

The wider landscape and public open space created on our sites demands a high-quality estate management regime to reap the intended benefits on biodiversity. Short-term curation or devolution of the work off-site is not the answer. What we create, protect and nurture on-site has a genuine impact on present and

Richard Hepworth

future communities, and in this way, these considerations are for life. We have the ability to establish new biodiverse areas that grow themselves and become exponentially more diverse over time, often also locking in additional carbon capture.

This long-term outlook is why we're already averaging 8.8% biodiversity net gain across our sites as developed at present, with one already above 16%.

The Arc has the potential to be a nation's standard-bearer in the pursuit of carbon neutrality and more efficient environmental practices. How are you advancing this now, ahead of future legislation?

Urban&Civic has identified three core challenges – climate change and the need for carbon reduction; biodiversity net gain and the need to protect and enhance our environment; health and wellbeing and the need to create communities and work places which better meet whole life expectations. All three link, and this circular review is implicit in everything we do – it's a flexible yet resilient agenda, which pieces together everything I mentioned earlier, to be comprehensive in our environmental and climate outlook. That's not to say that these practices weren't already around in one form or another, but rather that we are actively implementing the science and technology rather than simply talking about it.

Specifically in relation to carbon reduction, this means breaking down our approach to sustainable practices into four critical areas. These actions are common to all sites including the work we're already undertaking in the Oxford-Cambridge Arc, and it's the interaction between these steps that we see being the formula for a more comprehensive pathway to net zero and greater environmental net gain for the benefit of future generations:

Carbon literacy is our way to say that we must first understand the science and issues facing us in empirical terms, and then provide some definitive policy and illustration as to how to implement the changes needed. This is about not only learning and development initiatives, but also about establishing a syllabus and policy whereby all employees understand the key goals to be aiming for as they guide developments forward. We need to know what the milestones are for the next five to 10 years before being able to meet, and in some cases exceed, these objectives.

Design coding is the DNA that allows us to focus on the whole life carbon of each building and piece of infrastructure we create. This isn't just tinkering at the edges, but is instead a full-scale aspirational appraisal of how we can reorganise our residential and commercial stock to be more environmentally friendly, for example by rationalising the infrastructure we create to serve a greater proportion of homes without so much carbon expenditure – building less. The added benefit of course for the the environment is that this similarly increases the amount of land we can turn into soft landscaping. This work will entail establishing a carbon design guide to explain externally to stakeholders how we intend to deliver on our promises in physical terms

Landscaping is our next environmental net gain feature, and is underpinned by the biodiversity net gain toolkit that we issue to consultants. This doesn't mean putting grass everywhere, but lays the foundations for a landscaping plan which makes best use of the land available. Standard green spaces, meadows and rewilding might not be as 'green' as you'd think at first glance, especially when compared to alternatives like sustainably managed agro-forestry, which could be far more beneficial for local communities and the environment in the long-term. Here we then intend to build on our biodiversity toolkit and ensure that suitable species and planting guides can effectively direct our future placemaking

Utilities and energy infrastructure have to remain flexible. When you consider how models and energy supply technologies have developed in the last 15 years, you appreciate how we need to not only consider how buildings must adapt to changing utilities and energy technologies, but also the sort of energy transition we expect to see in the next 20 to 30 years. Establishing demand models for our developments that remain flexible and adaptable to changing technology and customer requirements are key.

An Environmentally Conscious Approach to the Arc

Q&A with Peter Bachmann, Managing Director, Sustainable Infrastructure, Gresham House

What does sustainable land management mean to you and your team at Gresham House?

The principles of land management in the UK are changing rapidly and at Gresham House, we are aiming to be at the forefront of implementing sustainable land management practices with our focus on the deployment of real assets (forestry, housing, renewable energy and sustainable infrastructure) and our ambition to provide permanent solutions for societal or environmental issues, whilst protecting and enhancing the multiple services and functions provided by land.

Within our sustainable infrastructure strategy, my team is aiming to achieve this through a range of sustainability-focused investment theses including use of land to decarbonise our energy system with traditional renewables, battery storage or GH Bio Power, a business that takes used cooking oil and turns it into renewable energy.

We have also created, from scratch, a new solution that provides direct biodiversity and nature impact for anyone who needs it. We have partnered with the Environment Bank to launch a new infrastructure product, 'Habitat Banks', where we restore degraded habitats on a large-scale, into areas rich in biodiversity.

This will in turn create Biodiversity net gain credits and sale of these credits is underpinned by a market for biodiversity net gain which is now part of planning law.

Are we missing a trick in respect of innovative approaches to accelerating decarbonisation and maximising environmental productivity?

Innovation is driven by the need for change. At Gresham House, accelerating the decarbonisation of business and society begins with understanding the problem, be it social or environmental. The trick is to find the innovative solutions that answer the problems we are trying to solve.

A great example of this, in the context of agricultural innovation and decarbonisation of food and environmental productivity, is our investment into Fischer Farms, a business currently building the world's largest

vertical farm in Norfolk. There are many positive environmental impacts from growing food in vertical farms including a drastic reduction in the use of land and water, a reduction in food miles (growing lettuce in the UK in winter instead of importing it from Europe by air), an increase in shelf life, the reduction in the use of fertiliser and pesticides as well as the avoidance of monocultures, which contribute to the degradation of soils and loss of biodiversity.

We are also hyper-focused on the role that nature-based solutions will have on accelerating decarbonisation and maximising environmental productivity.

It was our search for answers to the sustainability problems we face that led us to find the Environment Bank and work with them to deliver their vision into an investable and scalable business model. By building large, new habitat banks, we will enhance the British countryside and provide the model through which corporate investment can meet its statutory, compliance or investor-driven requirements to become nature positive.

Another trick to spur innovation is regulation or the prospect of it. Maybe we should be discussing a carbon tax at a regional level to influence behaviour and fund innovation – even the conversation could spark change?

What does the future of agriculture look like within the Oxford-Cambridge Arc?

Clearly land use will change in the Oxford-Cambridge Arc as a result of proposed new development, including infrastructure, and from transitioning away from agricultural basic payment scheme funding.

East Anglia is the driest region of the UK and it will be critically important to conserve and expand water services and availability as a result of climate change – the recent report from Water Resources East makes that very clear. Nonetheless, agriculture will remain a major land use, though its impact on the environment will undoubtedly reduce. This will be catalysed by wider societal changes driven by climate concerns, like a shift to more plant-based foods, innovation in farming practices and an emphasis on land providing ecosystem services. The good news is this will bring diversification opportunities for custodians of land.

The business model for habitat banks, that we constructed with Environment Bank, is designed to do exactly that. It will allow farmers to keep farming and include nature, whether producing biodiversity net gain or other ecosystem services such as flood mitigation or mineral storage, in their portfolio of products and to secure a long-term, guaranteed income stream for doing so.

How do these innovations collectively enhance and improve upon the natural environment?

We need a rapid move away from intensified farming and development that disregards the environmental impacts which have caused so much damage to the extent and distribution of habitat and wildlife species in the UK.

The innovative solutions we have highlighted are just a snapshot of some of the things we are doing. As a team, we implement a strict ESG decisioning framework that assesses the positive and negative environmental impacts of our investments. We have detailed reporting at a portfolio level to track the tangible benefits for the natural environment we create. Below are a few real-world examples of our investee businesses and their impacts:

- **Fischer Farms** - For every acre of land that a vertical farm occupies, you would need over 250 acres of conventional farmland to produce the same amount of food – a staggering increase in land productivity.
- **Environment Bank** - 40m birds have vanished from the UK's skies in the last 50 years. Aggregating biodiversity creation in large habitat banks creates a much bigger conservation impact due to biodiversity multiplier benefits compared to small pockets. Lack of biodiversity is a World Economic Risk Report top five risk in terms of likelihood and impact.
- **Waste Knot** - Saves 668k tonnes of CO_2 per year by converting c.300k tonnes a year of commercial and industrial waste into pellets to replace coal in heat intensive industries such as cement and steel production. To get the equivalent benefit, one would need to install over 3GW of solar which would require over 12k acres of land.

We think these benefits are pretty powerful.

The Arc Must Wear More than a 'Green Badge'

Q&A with Rich Stockdale, Managing Director, Oxygen Conservation

How did Oxygen Conservation come about, and what is your mission?

Oxygen Conservation's purpose is to take forward conservation projects that are commercially viable, generating a positive financial and environmental return on investment. Philanthropy can only take us so far, and as the world is burning there is no time for procrastination. There is no time for fighting: we need to get on with delivering what's best for the planet.

We want to x100 the conservation we're currently undertaking and do what Google did with technology and scale and apply it to climate and environment initiatives. Larry Fink, CEO of Blackrock, recently wrote that the next 1,000 unicorn companies will be in climate technology, and the opportunity this presents is extraordinary.

We're fully funded for the acquisition of 20 sites nationally, covering tens of thousands of acres, each with a different landscape character, geology, habitat and environmental legacy. We're protecting what's special by removing threats and dangers to their ecological and environmental balance, be that invasive species or the wrong type of land management; overexploitation, underutilisation, and creating the right environment to make a positive return on that investment.

These sites will still be accessible to the community, many even more so than before. Instead, we're stimulating the local economy by providing employment in conservation activities while enabling the land to be sustainably and regeneratively farmed by those who are custodians of the environment.

Our model for revenue generation is to build and grow our natural capital stock, putting financial value to the socio-economic benefits that the natural environment gives to local communities. By looking after the land in the right way, with the right selection of enterprise in the space, we can make it commercially viable to both protect and enhance the environment.

This doesn't mean planting trees everywhere and anywhere. We must treat land individually, in the same way we would any person we meet, and respect its unique characteristics. This might mean a mixture of agriculture, productivity, eco-tourism, production of natural capital products/services, carbon sequestration and compensation. Focussing solely on maximising carbon capture risks creating monoculture at the expense of wider habitat improvement.

Doing the right thing is the foundation upon which we have built our business.

No one ecosystem of local habitat within the UK is the same. How do you work with local stakeholders to identify the most pressing conservation requirements and foster meaningful collaboration?

We do a lot of listening. 'Partnership' within this sector is a buzzword, and in the practice, this can be top-down where landowners will only want their version of events to play out. 'Partnership' should mean active engagement, inviting local stakeholders as well as custodians of the environment like natural parks, trusts and ecological management in to talk about the challenge.

Experts are drawn into these networks that we create. With good intentions come good people with an intimate knowledge about hyper-local geographies. In turn, this creates positive feedback loops where we'll share opportunities with other conservation groups across the country.

Be prepared to ask a lot of questions and appreciate that you may be wrong about how to manage any one natural site. The Oxygen Conservation model allows each geography across a mosaic of habitats to do what it does best, while communicating with local groups to maximise the natural capital mix we administer.

The Oxford-Cambridge Arc is our opportunity to create a standard-bearer for decarbonisation, carbon sequestration, biodiversity and genuine conservation. How can your experience and approach be applied to the 'green' Arc?

The reason why our partners want to work with Oxygen Conservation is that we are authentic, true and complete in our approach. When we say we care, we need to be absolutely consistent in what we say is appropriate for any local environment, especially as people are so acutely aware of greenwashing.

In the Arc, there is a certain cynicism when talking to its 'green' credentials. It can be an afterthought at times, which dilutes public trust. Some of the terminology used, like biodiversity, doesn't mean much on the ground. It needs to be communicated clearly what to be 'green' means in practice, what this entails, and then it needs to be lived and breathed, and demonstrable from more than just offsetting.

Tree planting cannot be arbitrary. Land management strategies must be informed by local geography. Environment impact means putting in green infrastructure

first to ensure that any subsequent development is shaped by these parameters. The Arc cannot be an infrastructure project clothed in a green t-shirt – we need to bring the excitement back in through an articulated vision, which goes beyond merely 'more of what we already do'.

What are the greatest challenges from a conservation perspective, and how can the products Oxygen Conservation is creating be easily adopted across the Arc?

People find the concept of 'environment' challenging, daunting, and they want simplicity. There's a lot of contradictory information and a lot of snake oil salesman, while others pedalling 'decarbonisation' do so to profit financially. Misinformation is readily apparent in the case of carbon credits associated with hydropower systems, which are sold as a positive thing despite destroying river habitats. Even the most well-intentioned people can find it hard to do the right thing.

Because 'green' will come at a premium, everything will start off more expensive. There will be challenges with budgets, reporting and procurement issues, and inflationary pressures, which will test our collective commitment. Policymakers will need to compromise to ensure alignment, and this won't be easy, not least in the Arc.

The intention of our product offering is to drive the right market behaviours. Many companies talk about social value and environmental impact, but monitoring is limited, and local collaboration is not encouraged. Companies may also only focus on one element; they may. not see the wood for the trees, and risk perpetuating existing problems. We want environment infrastructure to come first, and look to work with people who share the same ethos – in the same way that the Arc must set genuine standards around restoration and conservation.

Unlocking Healthier Homes through Digitally-enabled Construction

Chris Mortensen, Co-founder and Chief Product Officer at Modulous

The last decades of housing growth in the UK have demonstrated that our expectations of our communities have changed. Homebuilders must understand their role as custodians for the future, ensuring the next generation has the chance to move into healthy, affordable homes and be part of communities that fulfil its wider needs.

The provision of homes, built with the right materials and genuine care and attention, is part of how we ensure that each generation enjoys the same opportunities and standard of living that their parents did. It's not an exaggeration to say that the homebuilding industry is as much a service as a business: a good home may be a product, but it's also an essential for life, and thoughtful design and a commitment to sound principles of quality and longevity is a commitment to the future of our society.

The Oxford-Cambridge Arc has long been a space for innovation, and just as it serves as a testbed for a host of new technologies, we can use it to trial our vision for the communities of tomorrow. With new housing necessary to facilitate the future growth of the Arc, a region that contributes over £75bn to the UK economy each year, homebuilders need to leverage technology to deliver sustainable, affordable homes that can meet the needs of people for many generations to come.

One of our first demands for the next generation of housing has to be an expectation of higher quality. The sympathetic retention of heritage architecture is one of the UK's strengths, but the advanced age of much of our housing stock can threaten people's health and wellbeing. Many homes are difficult to heat and plagued by issues of damp and mould or involve harmful legacy building materials such as lead paint or asbestos insulation, requiring substantial investment to resolve. A landmark 2021 report from BRE estimated the cost to the NHS of poor-quality and unmodernised housing at £1.4bn per year, and the wider societal costs at over £18.5bn per year.

These issues are not unique to older homes, as traditional methods of homebuilding all too often involve the use of materials with toxicity levels known to pose serious risks to human health. Combining the latest in technology with offsite manufacturing is a means of addressing this, as digital tools can design out health risks from the outset if programmed to generate solutions based on accredited products and materials, which are sourced from approved and responsible suppliers.

Ensuring the consistent delivery of high-quality housing is simply a matter of combining design software that generates compliant and technically accurate solutions in real time, with the productisation principles adopted by the more innovative automotive and aerospace industries. Bringing together digital tools and a Kit of Parts approach streamlines the process of selecting compatible materials that are high quality, environmentally sustainable, and without the health consequences of traditional construction methods.

Homebuilding is part of a wider problem with the environmental cost of construction. The UK Green Building Council estimates that the built environment contributes approximately 40% of the UK's total carbon footprint when resources, construction, operational energy usage and transport emissions are all taken into account. At the same time, around 400m tonnes of materials are used by the UK construction industry each year, representing one of the most resource-heavy and unsustainable parts of the British economy.

The challenge for the homebuilding sector is clear: we must design the principles of environmental sustainability into the fabric of our homes and build them using the most sustainable materials possible. Through the possibilities of MMC construction, and an overarching thread of quality control, we can ensure houses are thermally and acoustically comfortable with optimised natural light. We can cut down waste in the supply chain by utilising the efficiency of the production line model and specify healthy materials right down to the ingredients in the paint we apply.

We need to prove we can reconcile our environmental objectives with affordability, and the efficiencies inherent to standardisation and offsite construction will be a crucial pillar in achieving this. Coupling these with digital tools that optimise material choice and building form, and that monitor environmental performance across the full lifecycle, will ensure a virtuous construction cycle. Ultimately, this holistic approach to building healthy homes will enable our society to invest in the safety and security of the next generation and of the environment itself.

Clean Energy

Martin Garratt, Chief Executive, Cambridge Cleantech

How does Cambridge Cleantech work to promote environmental sustainability within the Arc?

Cambridge Cleantech is the UK's longest standing membership network supporting the growth of the low carbon sector. We work with partners across the arc to strengthen the growth of businesses focusing on sustainability. We count more than 250 innovator members and 60-plus corporates among our members.

For over 10 years, Cambridge Cleantech has been demonstrating the importance of cleantech solutions in the future of sustainable development and brokering opportunities between innovators, corporates, investors and the public sector. By connecting local government bodies, investors and corporates to innovative companies with cost-effective solutions for waste management, domestic heating, clean energy and clean transport, we are ensuring a triple win of creating clean growth jobs and export opportunities in the local economy; delivering better living standards for residents; and addressing the climate crisis.

In 2019, Cambridge Cleantech helped establish Oxfordshire Greentech, its sister network with similar ambitions for the sector. Through these two organisations, we encourage low carbon innovation across the Arc and create a fertile environment for universities, corporates and founders to support and learn from each other.

Leading universities across the arc including Cambridge, Cranfield, Oxford Brookes and Oxford itself are part of both business networks and we have been able to build successful collaborations between members.

How does co-location with the University of Cambridge help Cambridge Cleantech to achieve its aims?

Several members of Cambridge Cleantech have spun out of academic research and incubation at Cambridge University including Camnexus, Aurelius Technologies, DZP Technologies, Reforestum and BlueTap.

We work with Maxwell Centre and Cambridge Zero to encourage industry – academia partnerships and have co-run networking events with both organisations. We support students from the Judge Business School Energy Special Interest Group SIG to meet and engage with cleantech entrepreneurs through introductions and mentoring.

In 2019, we helped Judge Business School students win second place at the Wharton MIINT challenge by introducing them to a shortlist of suitable cleantech companies. Oxwash, the company they selected to represent, won second place and 25k in investment in the global competition.

What benefits are there in an organisation that combines private, public and academic stakeholders?

Cambridge Cleantech has played a pivotal role in supporting collaboration across industry, academia and local government over the last 10 years, creating a pool of expertise, knowledge and peer-to-peer collaboration in the low carbon sector.

The Shadow Environment Minister, Daniel Zeichner, spoke at the Cleantech Futures conference in October 2021 and has been a long-time supporter of our work.

We helped four mid-sized cities in Europe develop pilots with smart city innovators to solve challenges in mobility, housing and air quality, as part of the Interreg 2 Seas Smart City Innovation Programme. As part of the EU-funded STEPS Energy Storage Programme, we are working to set up energy storage pilots at Allia Future Business Centre in Cambridge and Harwell Innovation Campus.

What are some recent success stories for Cambridge Cleantech?

Cambridge Cleantech works with a range of partners across the public and corporate sectors, academia and entrepreneurs, and with the support of our cluster partners across north west of Europe, we have introduced over a 100 corporates to innovative SMEs including ARM, Anglian Water, Saint-Gobain and Johnson Matthey.

Since its founding in 2011, Cambridge Cleantech has helped ground-breaking start-ups and entrepreneurs raise more than £135m in backing, seen £26m invested in climate friendly technology through collaborations with corporates, and saved 216k tonnes of CO_2 being released into the atmosphere a year.

What do you see as the future of clean tech and sustainability in the Arc?

With the impetus on funding cleantech innovations and the UK government's push for clean growth, we expect that in the coming years there will be substantial investment into the cleantech and sustainability sectors. Cleantech businesses have the solutions we need to solve some of the most pressing global challenges and reduce the impact of climate change.

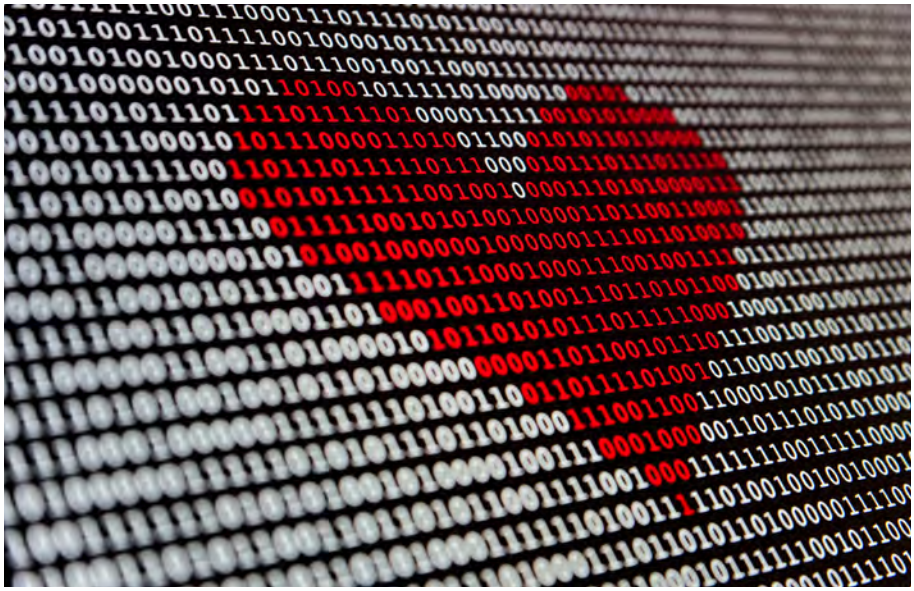
What changes would you like to see to make the Arc a more sustainable and innovative place?

Companies across the Arc should lead by example in implementing a sustainability policy. Any new transport and building infrastructure should be developed in compliance with the highest environmental standards. If local authorities and stakeholders can send a strong message that the Arc is a sustainable and innovation-friendly region, this will attract other companies and investment into the region.

Cambridge and Oxford are home to two world-leading universities with some of the most exciting cleantech innovations of the last few decades emerging from the region. We are proud to work with these companies and help them scale and create a bigger impact.

The Data Behind the Arc's Renewable Revolution

Stuart Cole, Researcher, Living Oxford



'Supercharging' the Arc is as literal as it is figurative in the context of the region's renewable energy infrastructure. Demand for clean, sustainable sources of power is at an all-time high, and 'green' generative capacity is now a necessary fuel that feeds our national economic output. The government is committed to a transition that'll see 40% of our future energy production originating from wind, solar and hydroelectric sources by 2030, in recognition that existing energy supply chains are responsible for 65% of greenhouse gas emissions globally. The Oxford-Cambridge Arc must play its part in the pursuit of carbon neutrality.

As a long-term spatial framework for growth, the Arc's responsiveness to new energy requirements will prove crucial to its collective prosperity. At a local authority level, some are seeing this relationship faster than others, not least the middle of the Arc where Bedfordshire is making strides in developing its capacity in wind, battery and solar voltaic energy production. Milton Keynes has also led the way in the operation of state-of-the-art advanced conversion technologies, such as waste recovery, which utilises heat energy recovery to convert black sack waste previously condemned to landfill into energy which now powers the equivalent of 11k homes annually.

Renewable energy generation is also important from the perspective of industry operating within the Arc. Oxford's cluster of atomic engineering has long relied on harvesting localised power in the form of JET flywheels to generate the seismic power required to undertake fusion-based experiments. 'Energy to pioneer new energy solutions' appears somewhat ironic, but ultimately the Arc is the site of some of the latest innovations in renewable energy production. Harwell Campus in Oxford includes an EnergyTec Cluster which includes Siemens and EDF Energy, in addition to consultants such as Ricardo Energy & Environment, and the Faraday Institution, the latter of which has received over £75m in UK government funding to create more efficient batteries.

Looking at our own data, we can show the positive direction of travel for renewable energy within the Arc at a grassroots level. Accounting for schemes in planning, 1663.3 MWelecs of installed capacity for solar power on 161 different sites as diverse as golf clubs, farms, schools and manufacturing plants are proposed. Oxford County Council, and the other authorities within the Arc, can use and promote renewables for a variety of applications including, for example, the biomass boiler at Northampton General Hospital, which won silver in the 2020 Health Care Climate Challenge Champion Awards, saving money for an NHS Trust and the taxpayer whilst helping the local area and the UK meet climate obligations. Local authorities must capitalise on the array of renewable energy infrastructure options that are available, if the Arc is to be a genuine standard-bearer.

The diversity of renewable sources of energy in use across the Arc, from onshore wind to solar, biomass, landfill gas and anaerobic digestion, shows the impressive array of renewables now available in the UK but also the commitment of private business, the public sector, academia and local government to contributing to the sustainability of the development of the Arc in a tangible and meaningful way. The Arc is a world-leader in producing renewable technology but when this technology is reinvested and used within the region itself, it can continue to reduce its impact on the climate in an increasingly efficient way, becoming a cleaner place to live, work and study.

Supercharge the Arc

Fast-tracking Knowledge and Human Capital for Net Zero Energy Systems

Dr Andy Gilchrist, The Energy Systems Accelerator, Oxford

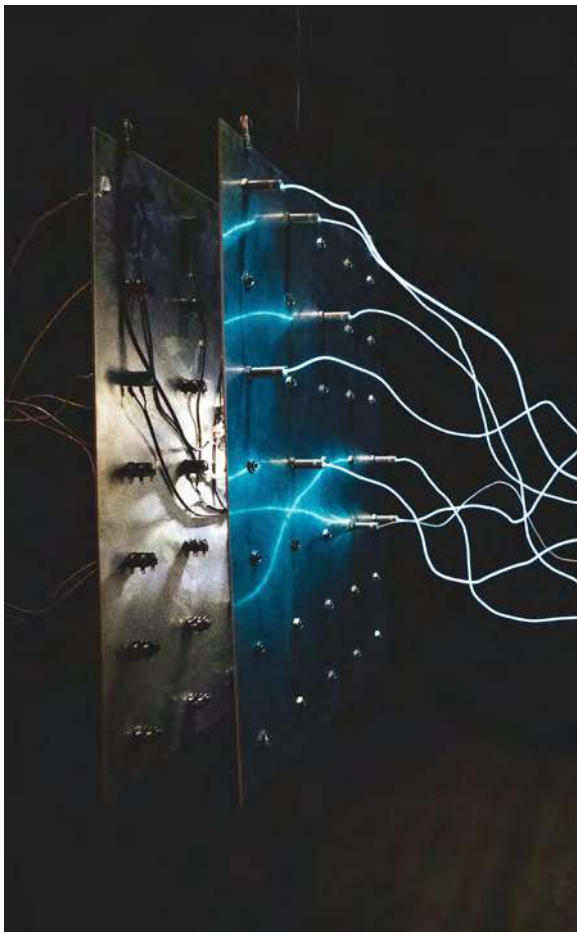
When world leaders come together to discuss a common goal, as they did during the climate summit COP26, this collaboration can deliver some notable achievements. The Breakthrough Agenda is one ambitious outcome from the talks in Glasgow, a pledge from more than 40 countries to 'turbo-charge' the uptake of clean technologies with an aim of making it easier to channel global, private investment into low-carbon infrastructure.

Although government-led targets can drive forward global progress, the urgency of the climate crisis cries for further action. Even in light of a now-scientifically proven existential threat, humanity has trouble overcoming the massive barriers of national interest, company self-interest, system inertia and gross inequality. It feels like we are still a long way off keeping the 1.5 degree ambition alive, and the UK government's Climate Change Committee has re-enforced this again: 'the UK must not walk away after COP26... at home, we need to walk the talk and urgently deliver actions in the Net Zero Strategy'. Can we be optimistic that fast solutions can actually be found?

Sitting at the western end of the Oxford-Cambridge Arc, I am encouraged by how quickly the region has galvanised an infrastructure that can attract and produce, develop, finance, and commercialise new low carbon technologies at speed and scale. Young companies such as Mixergy, who create efficient, intelligent hot water tanks, Yasa and Saietta who both develop electric motors, Oxford PV producing silicon-perovskite tandem solar cells, Arrival developing electric vans and buses manufactured at micro-scale plants, and Brill Power's battery management systems will provide some 'building bricks' of a new low carbon energy system: some are already showing the potential to be unicorns. Oxfordshire has four different approaches to fusion, three of which are private sector financed and focussed on commercial returns. It's great to see this innovation underway across the Arc and the wider UK, including innovation stimulated by the Government's 10 Point Plan for a Green Industrial Revolution.

However, developing just the 'building bricks' of a new system is not enough: we have not yet designed what the overall design of the new energy system 'house' is going to look like, and how these building bricks will create it. Put simply, we need to move away from the current three separate command and control energy systems (oil, gas and power), which are unidirectional in energy flow and have fairly predictable demand profiles. These will be replaced by a single, integrated, and decentralised energy system that is powered by intermittent renewable energy, and where consumers both provide and take energy.

Delivering this transition will require new technologies and services (the 'bricks'), but they will need to operate in a yet unknown market (our future 'house'). Innovation in technologies and services must evolve in alignment with innovation in regulation, finance and policies to minimise business risks. Doing this at speed is a massive challenge that will involve all stakeholders working together. There are many complicating factors that make this challenge even harder, one of which is that we need to transform our existing energy system without any interruption of supply (we cannot simply switch the current system off!). The second is that we must build consumers' real-world behaviour into the decentralised system operation from the start.



The Government's Prospering from the Energy Revolution (PFER) Challenge is starting to tackle these big system challenges. The core of this programme is three large-scale demonstrators, two of which are in Oxfordshire: Energy Superhub Oxford (ESO) and Project LEO

Dr Andy Gilchrist

(Local Energy Oxfordshire), which when combined represent an investment of almost £100m. Why are these located in Oxford? I am convinced one key reason is that over the last 10 years and a huge number of projects, we have focussed on breaking down traditional innovation silos: silos between disciplines, within organisations and between organisations. We are learning how to bring together academia, industry, public sector organisations, community interest companies and consumers to fast-track development of both knowledge and human capital.

We are adding further momentum to this ecosystem with two new developments at the end of 2021. Firstly, at COP26, the University of Oxford launched an International Community for Local Smart Grids (ICLSG), which will see community energy groups and electricity networks actively share key learnings from innovation projects around the globe. Secondly, we are opening a pilot of The Energy Systems Accelerator (mini-TESA), where 100 people from three organisations will be co-located (and others hot-desking) to jointly innovate in net zero energy systems. Activity will range from leveraging university research to real world deployment. OxLEP and the Get Building Fund supported the refurbishment of this mini-TESA, and occupants will trial new co-innovation and post-Covid working methods.

Mini-TESA is a start but it is not nearly enough in light of the enormous scale of the challenges and their timescales. The ambition is to co-locate 800 people, encompassing all stakeholder organisations and disciplines to innovate in low carbon energy systems at speed. Activity will co-create innovation with users and the investment community, and also undertake research, development and trials of technology, services and business models. Two key features of the activity will be a series of 'Sprints' focusing on difficult challenges, smoothing a pathway to net zero energy systems operation, and a series of UK and global knowledge exchange programmes to increase innovation efficiency globally, drawing knowledge from and influencing research and demonstrators across the Arc and the UK.

Given its size and unique purpose, TESA will require a new building and real estate. With government support to ensure fast delivery of TESA and learning from mini-TESA's activities underpinning building design, our analysis indicates that by 2050, TESA's activities can deliver an additional 9,000 jobs annually and in the order of £100m GVA annually. It will contribute to levelling up within Oxfordshire, across the Oxford-Cambridge Arc and nationally. But perhaps most importantly, TESA will underpin delivery of the UK's net zero targets and bring together UK and global stakeholders to help bring forward delivery of the COP26 commitments.

The co-location of stakeholders in TESA will underpin delivery of UK targets and smooth the pathways for innovation across the UK, so increasing the efficiency of innovation. It will challenge the 'optimism bias' and 'group think' that has contributed to failures in past major infrastructure projects in the UK. Fundamentally, it will further underpin the UK's global leadership in net zero systems, leading to increased trade opportunities and inward investment. To deliver this global leadership, TESA's knowledge exchange activity will need to harness activity across the Oxford-Cambridge Arc and the UK, so ensuring the UK has scale to compete with the likes of Silicon Valley.

Policy Recommendations

Although our lives have been most recently dominated by the Coronavirus pandemic, the rising tide of climate change is relentless. As the COP26 conference in Glasgow made strikingly clear, our attitude towards the natural environment must radically change if we're to avoid a climate catastrophe and the way we live our lives. We must utilise our resources and organise our societies, becoming more sustainable to avoid the impact of a worsening climate emergency.

As the centre of sustainable innovation in the UK, the Oxford-Cambridge Arc must be green, clean and a standard-bearer for environmentally conscious growth. On one hand, this means actively investing in and cultivating the natural capital of the region and improving and restoring the natural environment through a holistic approach to native wildlife enhancement, biodiversity, conservation and land management. On the other, mitigation asks us to address the systemic sustainability issues through R&D and innovation, like new battery technology, modern methods of construction which decarbonise the built environment, and potentially world-changing breakthroughs in the ultimate renewable energy source, nuclear fusion.

Supercharge

- **Agree an Arc-wide policy that allows for cross-boundary delivery of off-site biodiversity net gain outcomes,** to allow the most cost-effective and strategically important conservation initiatives in the region to benefit from the resource made available through the development process.

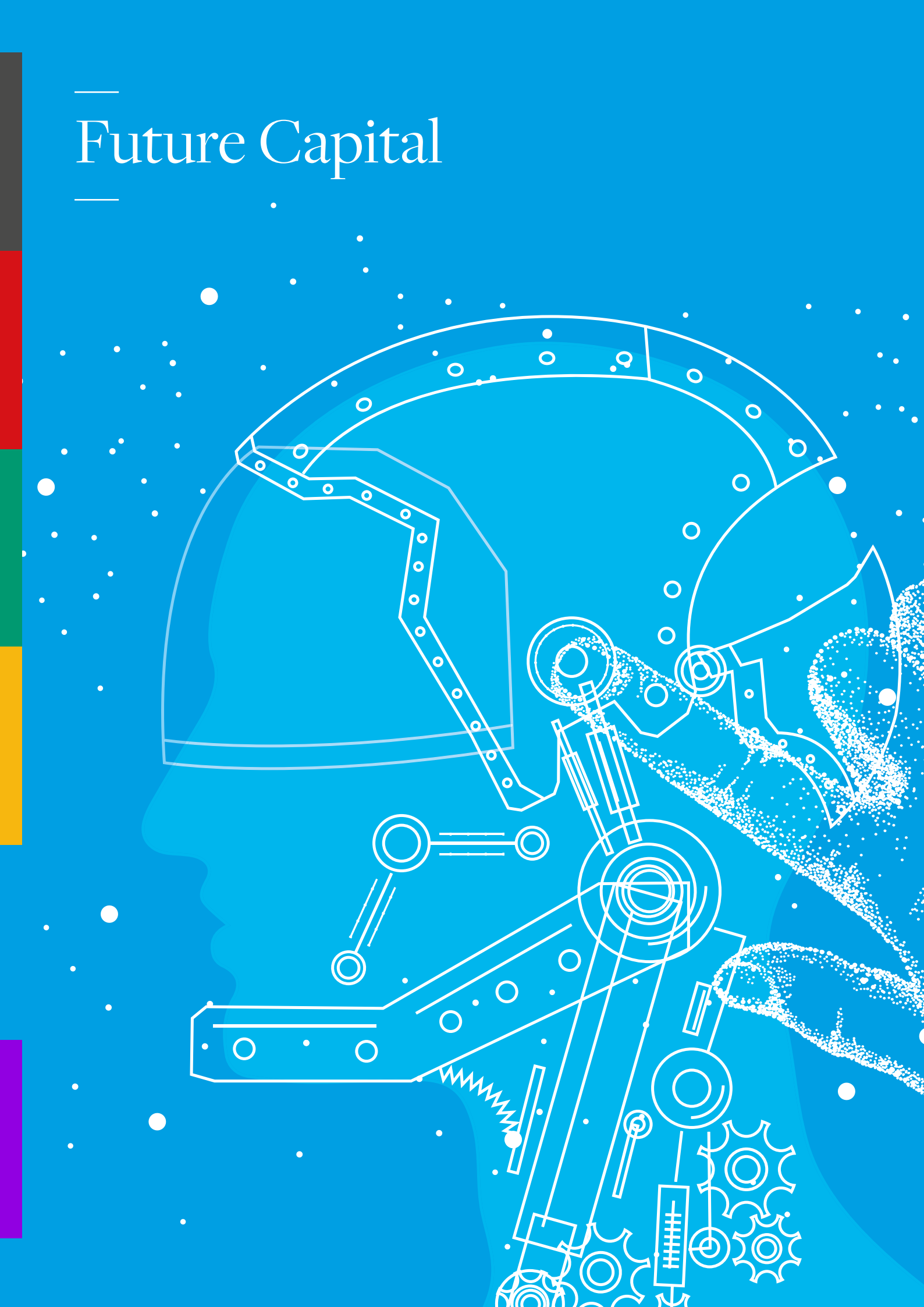
Advance

- **Create a crowd-source GIS platform shared by local authorities to consult on green initiatives across the Arc.** This would allow local and regional stakeholder groups to submit and consult on ideas for delivering large-scale nature improvements across the region, such as the creation of pollinator habitats, enhancement of agricultural productivity and green corridors to connect urban and rural environments.
- **Digitally map the Oxford-Cambridge Arc's natural capital asset, to develop a health check of the Arc's natural capital 'stock'.** Natural capital accounting would visually illustrate how new development patterns affect and/or enhance natural resources in the region. As the region grows, this would also place a renewed emphasis on biodiversity net gain and promote confidence and accountability.
- **Local authorities in the Arc should devise natural capital management plans,** labelling the principal uses of greenfield land and proposing optimal uses of underutilised built and natural assets. This would unlock the potential to convert inefficient land into wetlands and forests, which intensify carbon sequestration and rationalise the reuse of vacant space.

Grow

- **A separate climate-relevant section should be incorporated into the National Planning Policy Framework** to bring national planning policy in-line with the requirements of the climate crisis.
- **'Very Special Circumstances' conditions for development should be widened to include net zero proposals.** This criteria should apply where applicants can evidence that their proposals meet net zero targets both locally and nationally.

Future Capital



The Oxford-Cambridge Arc is a long-term aspiration that will position the UK as a world-class destination for talent and creative commercialisation of original research.

But for the Arc to truly reflect the needs of its population, it must be an intergenerational endeavour, which brings into its orbit the full constellation of communities which call it home.

By fostering an approach to the Arc which is inclusive, open and accessible, supercharging the aspects which set it apart on the world stage will provide long-term growth which generates dividends for local communities.

What will the Arc's communities of the future look like, and how do we bring every stakeholder in the region's society on this journey?

11%

The amount by which trust in government fell in the UK (in the year to Autumn 2019)

32%

Of respondents to the Hansard Society's survey in 2019 said that they did not want to be involved in local decision making at all

22%

Of respondents to the same Hansard Society survey said that they would take part in a public consultation

89%

The proportion of 16 to 18 year old respondents to a Grosvenor survey who have never before been asked about the future of their neighbourhood

98%

The percentage of 16-24 year olds who own a smartphone

5%

The fall in membership of professional, leisure and political organisations (in five years ending 2018)

15%

The increase in social networking between 2013 and 2019

Looking Beyond Financial Returns

Bev Hindle, Executive Director, Oxford-Cambridge Arc Leadership Group

If we were to capture and bottle the concept of 'capital', its essence would be anything that has the capacity to generate a flow of benefits that can be valued in real terms.

So, what will produce the flow of greatest benefits in the future? Delivering against our global carbon commitments? Eliminating the health and social inequalities within and between our communities? Or is it being the first generation to leave the environment in a better condition than we found it?

Future capital must look beyond the financial return as we seek to meet the greatest challenges we have as a species. With life sciences, energy, space, mobility, aviation, AI, quantum computing, agri-tech and many more critical clusters the Arc is the future frontier in the UK where not only will it drive economic prosperity but also social and environmental gain as well.

Radical capital seeks to amplify the case for the Arc across many areas of capital: knowledge, human skills, nature, connectivity. In a region of world-leading innovation such as the Arc, it may well be that the flow of value-added benefit does not need radical new approaches; it may be that radical just stresses the need for collective urgency.

The Arc is home to the UK's greatest concentration of innovation assets – current capital if you like. Add to those current assets the brilliance of 10 universities, including Oxford and Cambridge, and a legacy of innovative entrepreneurialism, and we have the drawing power to attract even greater investment to deliver against our greatest challenges and deliver significant value in, and for the future.

But there is a complacency with areas of success like the Arc. Not all parts of the Arc are successful and not all communities share in the prosperity. Given the state of infrastructure, the lack of effective connectivity and inequalities across many of its communities, the potential for greatest gains by levelling up the Arc's own places has somehow been lost in translation through a national levelling up agenda. This unequal prosperity did in part lead the National Infrastructure Commission (NIC) in 2017 to call on government to invest in this significant economic region to ensure it meets its ambitious growth targets for the benefit of the whole country.

In hindsight, perhaps what the Commission should have focussed on is the potential value to the future that will be lost if we do not invest across this whole region to address its own inequalities. In this way, we can create the greatest uplift in productivity and in doing so, help to drive and support a national economic recovery.

The basic assumption of growth built into the NIC work was a doubling of gross value added from the Arc to over £200bn per annum by 2050. However, the future capital potential of the Arc must be measured in ways other than GVA. When the world needed an effective and viable solution to a global pandemic, academic, public and private organisations came together to develop, test, manufacture, distribute and export the Oxford-AstraZeneca Covid-19 vaccine. Wellcome Genome leads the world in mapping the code of life itself which fundamentally provides the basis for tackling our biggest health crises and where else on earth has the power of a star been artificially produced as the model for viable long-term domestic energy supply? Well of course it is within the Arc – at Culham Science Centre. We can go on - Bletchley, Silverstone, Westcott, Harwell, Millbrook, Babraham - these are all international assets of science and technological significance, leading the way to the future.

The future is indeed bright for the Arc and its role in delivering positive benefits for the UK economy is critical; but we need to work to deliver better outcomes now for our existing communities and by doing so we will secure even greater benefits for future generations. Future capital arises from commitment and investment in the Arc now: investment in infrastructure, skills, the environment and our communities. As they say, the second-best time to plant a tree is now.

Future capital must be about adding sustained value, not accepting short-term gain. Building more homes, workplaces and infrastructure which do not meet our carbon commitments is only adding more to our significant challenge for retrofitting. Constantly borrowing against the future does not build future capital. The vast majority of the houses we are already planning for every year up to 2035 are not meeting our future needs around zero carbon, affordability or environmental gain.

Sustainability is at the core of what we want for the Arc, a green Arc2: delivering positive gain by integrated thinking across all three pillars of sustainability – environment, social and economy. The future value added through sustainable development can be invested in our health, wellbeing and overall quality of life. This is the future capital the Arc can bring.

Therefore, the key to future capital is to commit to a common vision for positive change that targets better outcomes in the future. This sort of ambition will not be unique to the Arc: what is unique is the Arc's ability to deliver against this ambition. If we change nothing, the Arc will no doubt continue to deliver future capital but the question is whether we can seize the full future value of collaboration and create greater economic prosperity, gains for our environment, human health and wellbeing – delivering sustainable development for the Arc and beyond.

Planning for a New Age

Mike Derbyshire, Head of Planning, Bidwells

It's often said that the life sciences and high-tech businesses of Cambridge and Oxford have no difficulty in attracting the world's best researchers. The lure of close collaboration with world-class universities and weekends spent walking amongst the dreaming spires and picture postcard college 'backs' views is all that is required to secure a signature on a contract for a move from Boston, Seattle, Singapore or Berlin.

What's less well known is just how difficult it is getting people to make that initial leap of faith to come to these university cities and develop their careers. Attracting graduates and mid-level employees from across the UK is also a challenge with the risk of a move to close-by London, or the cash rich big tech US corporations reduced by the knowledge that a host of other close-by opportunities await them when its time to move on.

Talented workers move to a place for a career not simply to buy a house. Our planning system and wider society still fails to recognise this simple fact of human behaviour and remains fixated on housing numbers, divorced by the complex economic drivers behind the choice of where to settle, buy a house and bring up a family The narrative around local plans continues to be a monologue around housing need. The recent spate of failed/withdrawn local plans in the south is simply a reaction to the perceived injustice of how housing numbers are calculated and distributed. The implications of not having an up to date local plan (based on real world market data) to the economic wellbeing of an area is simply not discussed

We must swap this narrow obsession on housing and instead focus on opportunity if we are to plan for this new and far more uncertain age. There are encouraging signs of a shift with the importance of wellbeing, nature and social value moving towards the top of the planning agenda. Developers and investors are also more accepting their own responsibility for being imaginative and bolder.

But to deliver the type of world-class places and inclusive economies we know are possible in our region, the planning system must better support the ambitions of the globally significant sectors that will ultimately lead the delivery of the prosperous and modern society we crave.

It's not simply about housing numbers and growth for growth sake - it's much more than that. What we've learned from the last 18 months is the immeasurable value that education, research and science brings to society. Without vaccines, the implications of the Covid-19 virus would have been similar to the great depression era. The Arc is at the forefront of all that creativity. We are at a fragile time politically and economically, but we need to be brave and grab the opportunity. Or do we say it's too difficult and let it wither on the vine?

This opportunity is about creating an environment where the major challenges of the world - health, climate and energy - can all be tackled. The danger is that the messaging is being lost in housing numbers and hysterical concerns over that growth.

In 2019 we called for a radical shake-up of planning in the Oxford-Cambridge Arc. Our Radical Regeneration Manifesto was intended as a blueprint for how the the Arc could lead the way in delivering a new type of economic growth across the whole of the UK.

But to work and live up the global UK image so beloved of No.10, we must do this at scale. The Boston biopharma cluster in the US has 37.9m sq ft of lab and R&D space, seven times that available in Cambridge. Boston has 6m sq ft of labs under construction in 2021 with Oxford and Cambridge's average at 300,000 sq ft.

We still believe we must be more imaginative in the way we develop, responding to the needs of all parts of society, while supporting our region's businesses and communities to grow and evolve in a world that is shooting ahead in so many ways.

But, when we talk about 'supercharging' the Arc we don't mean overheating its cities and towns' housing markets or building large numbers of homes in the countryside. When Chancellor Philip Hammond stood up in Parliament to deliver his Budget speech of 2017 it was a bold attempt to reset the national ambition of a country recently divided by the Brexit referendum. To remind voters of our nation's strengths in science and technology and its potential to shape the future of an uncertain economy.

His speech closed with a rousing crescendo, a call to 'build on the strengths of the British economy by embracing change, not hiding from it' and a headline-grabbing announcement he was committing to building one million homes in the region between Oxford and Cambridge. The ambition was admirable, but his mistake lay in not resolving to deliver one million new jobs instead.

The Arc has all the characteristics to be a leading region of world-class research and development and there is a remarkable opportunity to 'supercharge' its potential. But we must look at the planning of our region through a new lens by placing opportunity, vision and ambition at the centre of the planning system. Only then we will keep the best talent, persuade local people to turn down the lure of London and the US, and develop the sort of diverse and stable economy that offers opportunity for all.

An Intergenerational Endeavour

Digital Participation in Our Plan for the Future

Annette Jezierska, CEO and Founder, The Future Fox
Professor Mark Tewdwr-Jones, Bartlett Professor of Cities and Regions at the Centre for Advanced Spatial Analysis, UCL

As a nation, the UK faces compounding issues that will affect how we live and work today and in the future. New housing, social and connective infrastructure, the pursuit of carbon neutrality and the adoption of transformative technologies in areas like energy and automation are inherent demands of a developing population that strives to protect and raise the quality of life. Planning is charged with managing conflicting expectations of urban and rural change that needs to become more responsive to these pressures.

It is an intrinsic and sacrosanct function of our democratic process that local people have an influential voice in decisions about change. In practice, while public input into planning has been around for over five decades, the form that it takes today is archaic; selective opportunities for the public to comment on proposals that are often perceived by industry to slow down development delivery; and usually in a form that tends to privilege those well versed in legal and policy language, wrapped into a process that dissuades people from actively shaping their own places. The whole consultation process tends to be reactive, and therefore generates overly-negative comments from communities.

Planning has been slow to seize the opportunities that current and emerging technology may offer. For example, more data-driven decision making and tapping the wealth of advanced digital and creative technology that is already being used to foster smarter cities, such as cutting building emissions with intelligent energy management systems. With Arc-level ambition and the industry ready for change under the planning reforms, as well as the UK's strong performance in PropTech, we are facing a golden opportunity to transform how

we work with communities to design places and solutions for the future. The critical issues are whether those digital planning opportunities are accessible and visible to members of the public, and meaningful to all.

Redefining our success metrics with a digital-first approach

The planning system is known to be the privy of those who have knowledge of the complex system and its legalistic language, and can maximise their own interpretation of what development change means for them. This excludes many people from participating, even those who may have an opinion about their own places but are daunted by finding the right entry point and language to make planning work for them, or others who simply cannot afford the time. Research has shown that just 3% of people typically engage in the production of local plans. If planning is going to help secure the types of places we all want to see in the future, how can we start to make planning – and digital planning – more accessible to encourage more people to get involved? How can it become a platform to enable communities to be proactive and shape place change that they would be happy to see?

If current, more traditional planning consultations tend to attract mainly white middle and high-income residents in their 50s, 60s and 70s, digital technology tends to be used heavily by a very different cohort. The latest ONS figures reveal that the UK has one of the highest mobile phone ownership rates in the world with 96% of households owning at least one device. 98% of 16-24 year olds own a smartphone.

In consulting to help plan strategically and locally, and guide investment decisions across the area in the decades to come, it is also imperative to successfully engage younger people; they have valuable and key insight into the challenges that will, out of all groups, most affect them. Many young people today face a very different life and set of circumstances to their forebears, and are conscious of the challenges around affordable housing, disconnected communities and the need to protect our natural environment. Across all demographics, we know that most people only want to spend around five minutes on a planning consultation. The way to capture their insight is by meeting them where they are online and more specifically, by being very brief, through their phones.

Mark Tewdwr-Jones

Annette Jezierska

Making strategic spatial planning the most accessible, democratic and data-enabled it's ever been

The Government worked with The Future Fox to use our PlaceBuilder community engagement platform to include the Oxford-Cambridge Arc communities in the earliest stage of the project. Embarking on a first-of-its-kind digital engagement at this scale, communities across the region were able to have their say on what their vision was for the future of their area to 2050 and beyond.

Community involvement in planning had never been done like this before; for the first time, guided by the goal of inclusive digital planning, we were able to engage communities at scale for a strategic project, through digital means, and in an accessible way. The consultation purpose was to shape the Spatial Framework, which would govern decision-making by the wide array of actors for years to come and embed community preference in those decisions.

Thousands of people engaged in the consultation and provided their views. 2,933 people responded on our PlaceBuilder platform, providing a total of over 82,500 responses to different questions about the environment, economy, place-making, connectivity and infrastructure, and the delivery approach of the Arc. We achieved representation from across the region and age groups, including younger age groups. Supported by a careful social ad strategy, we heard from all demographics and 42% of respondents had never responded to a planning consultation before. These are exceptional results for strategic spatial planning. Through our statistical, spatial and algorithmic analyses, we now have a rich understanding of community preferences and concerns that can act as a guide to development in the region, to embed the community voice in strategic planning decisions.

What next for planning across the Arc?

Since the consultation was run, the advancement of the levelling up agenda has led to a reduced role for government. This will be much to the relief of many in the community; the consultation responses showed significant opposition to further growth of the south-east without the sincere consideration of alternatives (which is now evolving). However, in spite of these governance changes, we don't expect growth to be dropped in the short-term; after all, EWR is going ahead, significant investment has already been made, and South East England is still an attractive, dynamic market without the additional government support.

Actioning communities' preferences to 2050

It can't be overstated that the community and its views are critical to the success of the region. The thousands of people who responded to the first consultation need to be heard, and we've only just begun the process. Perhaps the biggest opportunity from our digital spatial record of community feedback is that it is enduring. This is in contrast to traditional plan-making where consultation is staccato-like and often too high-level to be clearly actionable. By giving equal weight to the community voice as technical datasets for spatial planning, we can overcome the problem of communities not believing their voices have been heard, and close the feedback loop for good.

Essentially, this can be seen as a 'digital twin' for community preference that if made open, has the potential to help communities and developers forge their own ideas for change, or identify the most suitable places to protect. Combined with other data sources, there are opportunities to meet very local needs. For example, supporting schools neighbouring the East-West Rail link so they benefit from the Arc's connected enterprises; or addressing health and social care issues where these are most prevalent, by integrating plans for tech enabled dementia-friendly housing or assisted living developments.

More widely, many people, including those opposing targeted growth in the region, feel that some of their biggest concerns such as climate change and growth need to be addressed, but aren't. Mainstream discussion-based platforms like Facebook or Twitter, which are perhaps the most used outlets for this discussion, are shown to perpetuate pre-existing divisions in community opinions and have little contribution to advancing the debate. Ultimately, communities can, and will, exercise their ballot box power, but for a more coherent strategy to deliver in the Arc, it is essential that growth, its local focal points and impacts, positive, neutral or negative, on the diverse communities in the region, are discussed at a local level and digitally.

Through ongoing, meaningful and constructive engagement that leads to data-enabled decisions, we can embed the community voice and accelerate the delivery of shared and targeted benefits to support the huge potential of the region.

We Need to Look Local to Realise the Arc's Potential

Alex Robinson, Director of Development for Strategic Land, Grosvenor

If we want to unlock the Oxford-Cambridge Arc's potential to become a world-leading centre of innovation, then we've got to think local. The Government's ongoing development of a regional spatial framework is essential for creating a coherent vision for the area, but that top-down strategy won't be realised unless people living in the Arc buy into it.

On the one hand, gaining the support of local authorities in the region relies on them being reassured that they will be able to get constituents on side. On the other, investors and developers want a degree of certainty that plans will progress without facing significant local opposition.

The Government knows the importance of hearing from those who live, work and have an interest in the region and reflecting their views in the direction of its framework. Its early consultation work has already established some common priorities for development, including the environment, economy, connectivity and infrastructure, and placemaking. It shows that we have to broaden the conversation beyond the 30,000 homes target that was outlined in the original Arc vision.

It's also important to recognise that these issues will mean different things and have different weighting for people depending on where they live. Broad-ranging and comprehensive public engagement is therefore vital for understanding local nuances. It must be a pillar of decision-making around the Arc's future, not just for developing the spatial framework but for the creation of Local and Neighbourhood Plans through to the shaping of individual planning applications by developers and their partners.

Across these processes, dialogue with residents should be frequent and open. It should also be honest. Not all local aspirations will be achievable so government, local authorities and developers will need to explain where the trade-offs might be to achieve the ambition of turning the Arc into a world-changing R&D hub. They've also got to build local excitement and pride in what it will mean for people to be part of that transformation, and demonstrate what it will deliver for them and their children. If people can picture how they personally could benefit from regional growth and development, then they are more likely to accept that not all their local demands may be met. It will also make the wider initiative feel like less of a top-down imposition.

The long-term nature of the Arc project means that we must understand priorities for current generations and also for future ones too. Young people will arguably be the most impacted by the new places being created, so consultation programmes need to work especially hard to engage them in shaping the Arc's future and position them to become advocates for the project. As prospective future homeowners, renters or employees, their support is critical to encouraging investors, developers and businesses to commit to the regional vision.

Looking across the nation, our research shows that teenagers are significantly underrepresented in the shaping of new communities; 89% of 16 to 18 year olds have never been asked about the future of their neighbourhood before, while just 8% have attended a public consultation event. Grosvenor worked with Sport England, the TCPA and ZCD Architects to try to rectify this, establishing a best practice model for youth engagement called Voice. Opportunity.Power. Implementing the lessons from this toolkit – from how to make online engagement work for digital natives, to how to tailor strategies for in-person consultation with teenagers – could go a long way to helping get young people interested in and enthusiastic about the Arc.

Transparent and open engagement should be an essential ingredient in any major planning initiative in the built environment, although it's perhaps especially important for a once in a lifetime opportunity like the Ox-Cam Arc. The project's ambition and scale require us to work with communities and encourage them to take pride in it so they too want to see it become a success. People make a place, and unlocking the Arc's talent potential is a huge part of the ultimate vision for the region. The way we shape the Arc's future could also have major implications for how other large planning frameworks are brought forward and how well they are received by the public. Let's make the Arc a byword for what good looks like.

Present Made of Eddington: Designing Future Communities

Jo Cowen, Principal CEO, Jo Cowen Architects

England's ancient cities and the centuries of lived history baked into their bricks sets a high bar for placemakers. The likes of London, Oxford, Cambridge have the privilege of a 1000-year advantage of selectivity and experimentation; time to improve, learn, and relearn, like potters carefully shaping clay.

Future community-building carries the burden of great expectations, not only in the shadow of a long legacy but also when benchmarked against the original 'garden cities' of Welwyn and Letchworth located on the Oxbridge Arc's fringes which are built testaments to the idea that organic town planning is possible.

The challenge that emerges in creating new communities in the Arc, to meet the needs of a growing population and to house the industrial and research power of the UK economy, is how to plan for growth in a way that progressively builds upon – rather than dilutes – that collective culture.

In equal measure, when adding to the fabric of cities like Cambridge that for hundreds of years had extraordinarily measured and conservative growth, care has to be taken so those future spaces do not simply become absorbed by neighbouring communities, but standalone as modern places that own their identity. The 'future capital' of the Arc depends on striking this delicate balance, in a fraction of the time that our predecessors enjoyed.

Take Present Made of Eddington, the flagship scheme of Apache Capital's single family housing arm Present Made. Designed by Jo Cowen Architects, the £160m GDV project is part of the University of Cambridge's wider Eddington master plan. The development will help the University retain and attract talent by providing high quality housing that is flexible yet secure in tenure, aspirational but still attainable in pricing and has convenience, sustainability and health and wellbeing at the very core of the resident offering.

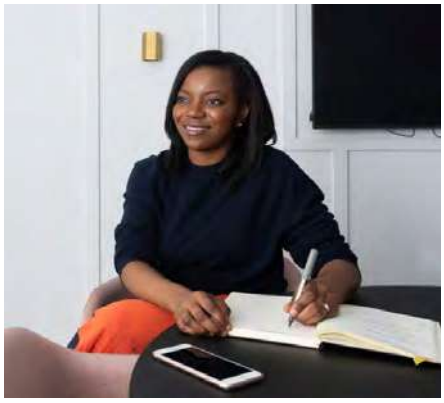
The vision for Eddington has always been one with a long-term outlook. This is partly down to the vertically integrated structure of Present Made, which will own, develop, and operate the homes for rent for the long term, but also to the philosophy of the development's namesake, the astronomer Sir Arthur Eddington, who advanced theories of the relativity of time.

Our designs for Present Made of Eddington acknowledge that the Arc's status as the UK's innovation capital will weigh profoundly on its future. New places have to be delivered with that context in mind, and ought to reflect the standards of sustainability, connectivity and access that the Arc will undoubtedly champion. These are all core pillars of the Present Made brand too.

Central to the organic-community concept is intergenerationality, and the idea of 'third places' essential to health and civic society, popularised by sociologist Ray Oldenburg in the 1980s. By blending the infrastructure needs of the young and the elderly and situating these together, Present Made of Eddington aims fosters interaction through demographically agnostic spaces to meet, relax and interact.

In its realisation of 'place', Eddington will demonstrate how developments can be built in keeping with the existing built environment and the architectural pattern of the region – an organic extension of historic places rather than the New Town approach of the post-war era which has muddied people's perceptions of planned development.

Empowering a Silent Majority



Olaide Oboh, Director, Socius

The Government's levelling up agenda includes a commitment to increase R&D funding by 40% outside of the South-East – but we must not overlook the enormous potential that still exists in the towns and cities within the Oxford-Cambridge Arc.

The Arc is not only the UK's leading science and technology cluster, but is renowned around the world. The combination of world-class academic institutions, blue-chip corporate occupiers and a long legacy of innovation has made it a major contributor to the national economy. According to Bidwells, the area's economic output is £115m – but has the potential to triple if we deliver the right space and infrastructure to support growth.

The shortage of lab and R&D space has been well-documented but for us, supporting the Arc is not simply about delivery of workspace. We believe in a balanced approach of mixed-use development that meets local needs and blends modern workspace with new homes, retail, culture and community uses to not only support businesses and grow the local economy, but to attract and retain the talented people towns and cities need to continue to thrive.

Our development at MK Gateway in Central Milton Keynes is a prime example. Working in partnership with long-term investor, Patron Capital, and award-winning architecture practice, Rogers Stirk Harbour and Partners, we have designed a scheme that retains Milton Keynes' heritage whilst delivering ultra-modern workspace and homes designed for post-Covid living. The workspace is being delivered through the sensitive repositioning of Saxon Court, a modernist building and local landmark, and will offer flexible floorplates that can accommodate businesses both big and small. The building connects via a new public square to a new building that comprises Build-to-Rent apartments, and which, in a UK first, will offer seven three-storey vertical gardens for people to use for outside work and relaxation. Innovation is part of Milton Keynes' DNA and we therefore felt it was vital that MK Gateway pushed the boundaries of urban mixed-use.

Similarly, in Cambridge we are taking a bold approach to transforming a former Travis Perkins depot into a mixed-use community of wellbeing-focused workspace and new homes, set in a new public park. Not only are we creating density in a city where there is a shortage of workspace and affordable homes, and land for development is scarce, we are delivering a significant increase in

Community-Building

green space, quadrupling biodiversity and creating an attractive – and sustainable – place to live and work.

To strike the right balance between commercial and residential uses – and enhanced public realm, it is vital we engage with the local community at every stage of our development plans. In keeping with the region's heritage of technological innovation, we are utilising new tech platforms to do this. Socius has collaborated with proptech company, Built-ID, to develop Give-my-View, a smartphone app that digitises community engagement, enabling the otherwise silent majority to fully participate in the consultation process. In Milton Keynes, digital outreach generated a massive 5,000 of responses, and we were able to host virtual town halls to get further feedback and local input. Genuine local engagement and co-creating with local residents, businesses and stakeholders will be vital for the growth and success of the Oxford-Cambridge Arc.

Community is at the Heart of Our Innovation Districts

Q&A with Anna Strongman, CEO, Oxford University Developments

What is the mission and purpose of Oxford University Developments, and why is it important that universities are actively involved in the growth of the Oxford-Cambridge Arc?

OUD is a joint venture between the University of Oxford and Legal & General, formed to provide exemplary development to support the future growth of the university, the city, university spinouts and enterprises and the world-class research and innovation that Oxford is known for globally.

There is a real need for the right kind of spaces to facilitate R&D and commercialisation. Alongside that, there needs to be the right housing availability and infrastructure for people studying and working at the university and within the wider economic growth story. For longevity, we need to deliver this to a very high quality, looking to meet current and future needs through strong sustainability performance in a way that contributes more generally to the future of the city.

Where you live is not just about the home you live in, but also the environment and local community nearby. The talent incubated within Oxford, attracted to its unique research activities, must feel welcome but also able to afford to live close to the areas where they work, in an attractive environment where they can raise families and integrate.

OUD's purpose is multi-faceted, but it's really about supporting the future position and outputs of the university, be that in science and technology, engineering, humanities or the arts, which are critically important to the innovation districts within Oxford itself.

One of OUD's projects is the development of the Innovation District at Begbroke Science Park. What should sustainable development look like and how do we simultaneously plan for students, staff and the world-class innovation taking place within Oxford?

Begbroke is a microcosm of aims and ambitions of both the University of Oxford and L&G. It will be a place which supports world-leading research and the community which generates it, but also a place where staff, students, entrepreneurs and innovators grow and develop and where their children will go to school, meet friends and call home.

Begbroke reaches out globally, but we're looking locally at the requirements the Begbroke community will require. This won't be a sole university campus, but rather a place where people will live, engage in a diversity of work and employment, and learn. We want Begbroke to stand on its own two feet and have a positive relationship with its neighbours, extending openness and inclusiveness to existing communities to allow everyone to make the most of the public facilities on offer.

Begbroke must also address some of the major climate change challenges of today; through how we build, design and operate to deliver a punch in terms of sustainability outcomes. Our interpretation of sustainability is purposefully wide, relating to transport, environment and biodiversity, civic and social infrastructure, and the public realm, meaning well thought-out parks and open spaces. Begbroke will deliver world-class research and we want it to be a 'living lab' and an opportunity to

innovate and explore, foster collaboration and develop new approaches and techniques to societal challenges, but it will also have its own sense of self, and be something which is a home.

Are we doing enough to attract the world's best researchers and student talent?

The quality of research and academic endeavour at Oxford attracts people from around the globe to be part of its research community, so there is a big pull to this part of the world.

At the same time, the availability of high-quality housing is a challenge. Housing, the cost of living and integration weigh heavily in the decision to relocate here and are deal-breakers, especially during a time when there is a war for talent. We need to provide housing and supporting infrastructure if we're to continue to cater to that 'pull'; things such as an inclusive public realm, restaurants, shops, and all the day-to-day facilities that support the city's evolution. Oxford must keep abreast with how other cities are growing so as not to fall behind.

Competition for talent in science, technology and materials is getting more and more intense. Gone are the days where a scientist expects their destination to be a science park; their options are immense, working in private companies, public companies, and universities all over the world. The lifestyle offer is a big factor in their decision-making, and as Oxford may not always be able to compete on salary, it must compete in respect of the local environment, compelling research, and collective community, which is what we're trying to support.

Does new development undermine the character of ancient cities like Oxford and Cambridge?

Cities that have lasted the test of time have responded to trends and challenges. The University of Oxford's opening in the 19th century, and the professionalisation of teaching and research, is what made the university a powerhouse, developing suburbs to support this mission.

Of course, we have to be sensitive to heritage and environmental considerations but if development is done sympathetically, it can be part of that future. It'd be good to see more pushing of the boundaries of architecture too. Growth is necessary to respond to the biggest challenges we face worldwide: health, poverty, climate, social inequalities – a lot of these can be addressed by the research coming out of the university.

What are the challenges involved in masterplanning, and how can we 'future-proof' the places that we create?

There needs to be regulatory frameworks to encourage the right outcomes. That's not straightforward, but good growth can be supported through standards of building design, building codes, quality, energy systems and operational approaches to buildings.

On infrastructure, there needs to be investment to create sustainable transport solutions, even for autonomous vehicles.

Most of all, we need to set out a compelling vision and framework for the future whilst building in sufficient flexibility and nimbleness to respond to a rapidly evolving innovation ecosystem.

Making the Arc Famous for a High Quality of Life

Dan Thorp, Director of Policy & Programmes, Cambridge Ahead

At Cambridge Ahead we have spent many years researching and understanding how the economic growth of a world-leading economy like Cambridge can be harnessed to improve the quality of life of existing and new residents alike. In short, how can growth be more inclusive and sustainable than has been managed previously?

We know through this research that the Cambridge economy, like others across the Arc, is vibrant and has been resilient over the course of the last two years. Recent research has showed that knowledge intensive sectors were growing employment at five times the rate of other sectors. Regions like the Oxford-Cambridge Arc have a valuable asset in our innovation clusters – but what is the right way to think about that asset in a way that improves quality of life for all?

We believe that the answer lies in the adoption of a new framework to guide growth based on the capitals and that now is an opportune time in public mood to implement a progressive new agenda - the Arc is the opportune place to do this.

This is a bold ambition that spans so many of the issues that our communities and industries are dealing with but it is for this very reason that we believe a new framework is the right strategic place to begin.

We have worked closely with the Bennett Institute for Public Policy at the University of Cambridge to explore how this bold ambition could be made a reality in a specific place.

The wealth economy framework that the Bennett Institute has developed is based upon the principle that as an area, we should focus on building and maintaining our stock of the following six capitals:

- Human (health and skills)
- Natural (environment, ecosystems and raw materials)
- Social (community cohesion, trust and social norms)
- Physical (infrastructure, homes, equipment and information & communications technology)
- Institutional (quality and reliability of governance)
- Knowledge (accumulated best practices and ways of doing things)

By having these capitals balanced and in good stock in our region, prosperity and productivity will follow. That is the governance we are advocating for both within public decision-making but also across industry. Across Cambridgeshire and Peterborough, we are piloting and working towards both and believe that this should be extended across the Arc as an integral part of the next period.

For example, in order that natural capital be prioritised in the next set of strategic plans for Greater Cambridge, we have contributed towards the development of the Cambridge Nature Network initiative. This has mapped available land across the area and assessed its suitability for biodiversity, nature recovery and public access to green spaces. The result is a detailed plan that would more than double nature in Greater Cambridge.

Thinking about human capital, over 2021, it became increasingly apparent that much more focus is needed in developing the pipeline of homegrown talent – so that local people are able to access the jobs being created in their area, and that employers have access to the skilled workforces they need to be successful. We are making the case that incorporating this human capital factor into decision-making should lead to far greater focus on, and investment into, career education in our system. Young people in particular are not being given appropriate education into the variety of career paths available to them, meaning that they are less likely to find rewarding local jobs, leading to a variety of negative outcomes for communities and the economy.

These are specific examples. The important point here is what we value. If our system values these six capitals and works towards keeping them in good stock, as an area we will deliver better outcomes.

Sowing Social Infrastructure

Q&A with Hugo Llewlyn, CEO, Newcore

What is social infrastructure and why is it important to the growth of the Oxford-Cambridge Arc?

Social infrastructure is the definition given to the essential physical assets that UK society needs to function, often without us even thinking about them. These include real estate linked to education, healthcare, waste management and civil uses (such as judiciary, prisons and other security uses); and for some include residential asset classes, though in Newcore's view, it is those that provide accommodation linked to some of the uses above that qualify.

The provision of social infrastructure is incredibly important to the growth of the Arc, as without it society cannot function. It also needs planning carefully at outset in the master planning of towns and cities as often it is forgotten or not properly catered for and this puts pressure on existing provision. Whilst councils and planners get to grips with the more day to day uses such as primary and secondary schools and care homes, other important but less well-known uses like special educational needs settings, life sciences, data centres, waste management facilities and (a rarer example) drug rehabilitation centres can come as afterthoughts, albeit demand for these increases proportionally when populations grow, particularly in urban settings.

What are the opportunities for further social infrastructure provision, and what are the barriers to its development?

As the needs of UK society change, so its property needs - both essential and non-essential - change. In the area of social infrastructure, emerging opportunities include food security - onshore fish farms, vertical farms etc, battery storage (moderating grid demand and supply), the return of cottage hospitals as rehabilitation centres taking pressure of the NHS, delivery vehicle storage and the like.

Obviously a number of these are untested venture capital businesses, which create hurdles to entry, but with decent structuring and apportionment of capital responsibilities, they can become interesting areas for real estate investors (for example, the ground lease of a vertical farm, where the tenant puts in all the structures and equipment).

What do you see as being the biggest need emerging within the Arc from a social infrastructure perspective, and are some areas lagging behind while others meet local needs?

In my view, the biggest area of need in the Arc is the provision of good quality, modern educational facilities (councils do understand this, but often s106 contributions get whittled away), which are set up to educate children of the 21st century, having in mind rapidly changing curricula. These will facilitate the growing demand, be attractive to high-quality employees who are also parents potentially moving to the area and also attract a great workforce of teachers. Realistically, everything else in the long-term flows from this including health and living outcomes.

How does social infrastructure benefit people living, working and studying in the Arc?

Without good quality social infrastructure, society cannot function, full stop, as you will gather from the explanations above, whether in the Arc or elsewhere. This is why this sector has never been 'alternative' as an asset class, but, as it emerged in investible terms, might be described as a new core area, albeit very specialist in its delivery, operation and capital management.

Harnessing Institutional Capital to Deliver Housing for Future Talent

Richard Jackson, CEO, Present Made

Although residential real estate is the world's largest asset class by value, dwarfing commercial estate by some margin, residential is still considered an alternative asset class within the property world. This is despite houses predating both modern offices and shops by millennia, and having somewhere to live is a fundamental human need.

That said, Covid-19 may have finally moved residential from alternative to mainstream. Despite the global pandemic, house prices rose significantly in pretty much every major economy, while many residential tenants proved better rent payers than a lot of commercial occupiers.

Investor interest in specialised forms of residential, such as build-to-rent and student accommodation, was growing before Coronavirus. Attractive demand/supply dynamics combined with the promise of liability matching income streams that have defensive, counter-cyclical qualities saw institutional investors such as pension funds and insurers making big plays in both sectors.

Investor interest in the living sectors will only grow. Covid-19 revealed the vulnerability of mainstream property investments such as offices and shopping centres and likely accelerated the long-term trends that were inevitably going to challenge them. In sum, lockdown made most people realise they can work or shop from anywhere.

Covid-19 also shone a spotlight on life sciences with AstraZeneca and Pfizer now both household names thanks to their vaccine success. While pharmaceutical firms like these require highly specialised buildings typically backed up by a strong operating platform, that hasn't stopped heavyweights such as British Land looking to enter life sciences real estate.

The Oxford-Cambridge Arc is the undisputed heart of the UK life sciences industry. Bookended with two world class universities, the region hosts an interconnecting set of innovation ecosystems that have given us groundbreaking research and life saving treatments, including a Covid vaccine.

Life sciences real estate investors often talk about the triple helix of government, academia and the private sector, which is necessary for a life sciences ecosystem to emerge and flourish. What all three need is talent, but whether it is Cambridge, Oxford or San Diego, the talent cannot often afford to live where the opportunities are. This is where institutionally funded housing comes in.

Apache Capital's single family housing platform, Present Made, is the UK's first to design, develop, own and operate houses purpose-built and designed for rent. Of our initial £1.6bn development pipeline, the first three sites are all in the Oxbridge Arc. Our flagship development sits in the University of Cambridge's Eddington master plan.

This focus on the Arc is deliberate. Oxford and Cambridge have some of the highest housing costs outside of London, with average house prices far exceeding average local incomes. Affordability isn't the only demand driver. Many people, particularly talent that will emerge locally from the Oxford-Cambridge Arc's universities, are choosing to rent for lifestyle reasons thanks to the flexibility renting offers.

Yet despite substantial demand, there are very few, if any, purpose-built and designed family homes for rent in the region.

By creating a high-quality rental housing option that taps into consumer demands for healthy and sustainable living, we can

Richard Jackson

help the Arc capture and retain talent. Present Made homes will be well designed, accessibly priced and sit within master planned communities that come with a host of onsite resident amenities and services all focused on boosting mental and physical wellbeing.

Crucially, rather than acquiring existing stock, we are adding to a scarce supply of housing. Our decision to use modern methods of construction also means the homes can be delivered faster in a process that is less wasteful and disruptive compared to traditional construction. Precision engineered homes typically come with fewer defects and are more energy efficient than your typical new build.

Present Made's flagship scheme forms a key part of the University of Cambridge's Eddington master plan. The university recognised what we were promising - beautiful, sustainable homes set in an active, healthy neighbourhood - would help them attract, and more importantly, keep the scientists, researchers and doctors of tomorrow.

The UK's housing crisis is well documented and nowhere is the failure of not building more homes more obvious than the Oxford-Cambridge Arc, where sky high housing costs risk pricing out future talent, in turn threatening the region's long-term competitiveness and prosperity.

With investors radically reassessing their real estate portfolios, the government should be looking to harness the power of institutional capital to deliver modern, attainable and sustainable homes to house the next generation of talent.

The Arc is Greater than the Sum of its Parts

Andrew Taylor, Group Planning Director, Countryside

In the context of the Oxford-Cambridge Arc, economic development is but one ingredient that makes up the region's recipe for growth. Opportunities for local employment, bringing together a whole host of jobs and talent, skills and salaries, are only attractive if they co-exist with good quality housing, schooling, social infrastructure and open spaces. Exceptional, successful and sustainable places all blend a sense of community with economic and social capital.

Planning for growth of this kind calls into question existing assumptions that might be rather outdated. Many local plans (and council development strategies) prepare for a future within their tightly defined boundaries, yet our population is much more mobile than it has ever been. Innovators in the Oxford-Milton Keynes-Cambridge region, like AstraZeneca based in Cambridge, employ across Cambridgeshire, Essex, Suffolk and Hertfordshire. We also communicate differently, using collaborative tools such as Microsoft Teams and Zoom, which transcend spatial constraints. The Arc, as a broader concept, is useful not only as a means to better comprehend connectivity but should be the lens through which regional planning provides for growth and development.

Future generations now expect more from their towns and cities environmentally. While the aspiration to provide safe and secure places for families to grow up in has not changed, there is a new found emphasis on access and active nurturing of green spaces and sustainable modes of transport using the 15-minute neighbourhood as a working model.

New housing must interface and actively support these aims, creating communities and neighbourhoods which supply our daily needs without undue travelling, while enhancing biodiversity and providing for well-managed open land which is sensible and publicly popular.

In practice, design and master planning are the fundamental building blocks to create new communities. At the earliest stages of inception, we can prioritise landscaping, community exchange; a feeling of arrival, and character areas which are tied together by distinctive design cues and street furniture. Developers also need to work collaboratively with local councils, charities, churches and advocacy groups representative of community intergenerationality to support the organic development of community. The web of social networks, groups and support functions, which we take for granted in established communities, need to be allowed and supported to grow and thrive. Developers have a duty to create meaningful relationships with the groups which vocalise for new and existing residents.

The Arc is fundamentally a project of trust – trust that cuts both ways if we're to create something truly important to the future of the UK as a scientific superpower. Developers must prioritise public consultation and generate plans which are based on future community aspiration. In the same vein, engagement and the transparency of consultation cannot be curtailed by local pressures to resist open engagement.

Policy Recommendations

The Oxford-Cambridge Arc's reputation as a frontier of innovation and enterprise is founded upon a commitment to intellectual curiosity which has endured for centuries. Academic excellence and the prestige of its faculties for learning, the intergenerational transfer of knowledge and skills; the practice of constructive debate, and the propensity to test and challenge, are deeply woven into the region's cultural fabric, as is an approach to problem-solving which involves collaboration, experimentation and a willingness to take the ideas and imagination of future leaders seriously.

As we elevate the world-class standing of the Arc, it is imperative that decision-makers take succeeding generations with them on this journey. In the same way as planting an oak tree is done so knowing that the thickest trunk will only be seen by our children and children's children, the Arc is a multi-generational endeavour. As the fuel from which new and existing enterprise will first draw, the vocal and more expectant among us driving positive social change, and the people for whom new communities are often created, young people are the future that must participate in shaping the Arc today.

A commitment to investment in future capital encompasses a wide array of possibilities, including creating greater access to higher education for those least likely to achieve tertiary qualifications to setting new standards for the construction of our residential environment, producing genuinely accessible housing and meaningful tight-knit communities through innovative design, and a genuine social commitment to the next generation.

Supercharge

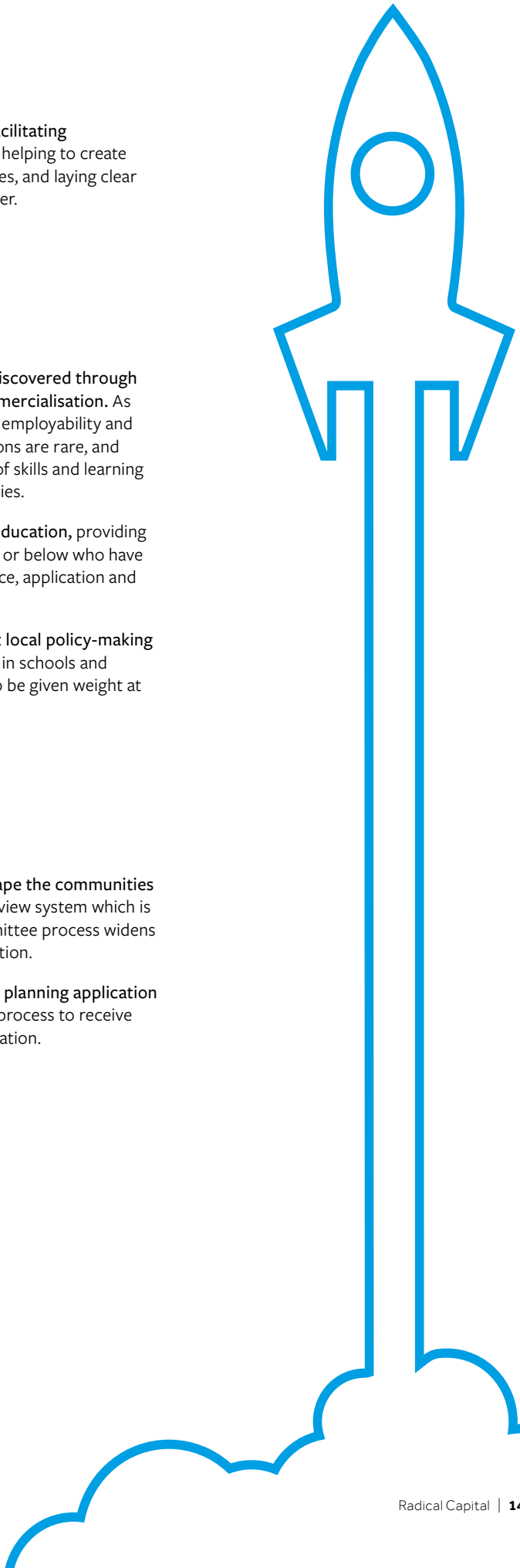
- **Establish a branch of government which acts as a clearing house, facilitating introductions between S&T enterprises and education institutions,** helping to create long-term connections between local schools, colleges and universities, and laying clear pathways to work placement and apprenticeships to ease skills transfer.

Advance

- **Training and work placement opportunities for young enterprise, discovered through regional science and technology competitions which major on commercialisation.** As it currently stands, sourcing young entrepreneurs in the Arc requires employability and financial education charities to partner with local schools. Competitions are rare, and the prizes awarded do not emphasise the intergenerational transfer of skills and learning otherwise available through work experience and training opportunities.
- **Make S&T apprenticeships mainstream as an alternative to higher education,** providing specific funding for employers who have taken on employees aged 21 or below who have completed qualifying work and can demonstrate and justify experience, application and career trajectory.
- **Mandate meaningful ways for young people to scrutinise and direct local policy-making which affects them,** including through presentations and workshops in schools and universities during the local plan-making process, and for feedback to be given weight at local plan examination.

Grow

- **Adopt a people's planning lottery to allow future generations to shape the communities around them,** introducing a jury-service style planning application review system which is more representative and sentiment-led. A digitally led planning committee process widens participation and would result in a more objective system of examination.
- **Create youth councils with the status of statutory consultees in the planning application process,** making it mandatory throughout the planning consultation process to receive consent from representatives of younger residents prior to determination.



Global Capital

As we approach an era of unprecedented scientific and technological change, innovation and our creative potential will form the core of our collective identity. Competing on the international stage and transforming the Oxford-Cambridge Arc into a scientific superpower that we can be proud of requires commitment – to investment, talent and its cultivation, and the patience to capture the Arc's long-term returns.

Gathering the essential ingredients to elevate the Oxford-Cambridge Arc's standing as the UK's capital of innovation connects us into a global network where the social value is infinite.

This is our edge and something that cannot be replicated anywhere else in the world. To take priority in a competitive world of global investment, attract skills and talent from afar and generate social and economic returns that benefit the wider nation, we need to take this opportunity with both hands.

How do elevate the Oxford-Cambridge Arc's standing as the UK's irreplaceable engine of innovation?

3bn

The total number of AstraZeneca vaccines ordered through pre-purchase agreements by March 2021 (Statista)

1940

The year Howard Florey's dedicated research team at the University of Oxford successfully isolated penicillin

2,200

The number of research scientists at AstraZeneca's recently opened Discovery Centre (DISC) in Cambridge

11,850

The number of jobs AstraZeneca supports in the East of England

£1.23bn

The GVA AstraZeneca's footprint in the East of England delivers per year to the regional economy

£850m

BioMed Realty's investment into office and lab space in Cambridge

£10bn

The estimated value of the UAE's five-year 'sovereign investment partnership' with the UK

Local Collaboration, Global Impact

Sarah Haywood, Chief Executive, Advanced Oxford

No one is safe, unless everyone is safe – this is the tagline of the World Health Organisation's COVAX initiative, and the statement of intent behind its rolling out of vaccines equitably to people and nations across the world. With large, unvaccinated populations around the globe not only contributing to needless suffering and death, but also acting as incubators of new variants, there are clear mutual benefits to the wide global implementation of an effective vaccination scheme against Covid-19.

The UK's contribution to the worldwide fight against Covid-19 has been considerable, no more so than in the development and delivery of the Vaxzevria vaccine: a collaboration between the Jenner Institute at the University of Oxford, university spin-out company Vaccitech, based at the Harwell Campus in Oxfordshire, and the British multinational pharma company AstraZeneca, headquartered in Cambridge.

While richer countries have looked to the full range of available vaccines in their fight against Covid, the Oxford-AstraZeneca vaccine has been effectively employed in the vast, dense population centres of India, Brazil and Mexico, and in other countries around the world that desperately need to boost their vaccination rates. Local manufacture – with AstraZeneca now supporting the operation of 25 facilities in 15 countries – is at the heart of delivering the vaccine to those who need it, with AstraZeneca and the Serum Institute in India striking an agreement to independently supply 1 billion doses of the vaccine to poorer countries. The vaccine's greater resilience and low price makes acquisition and implementation in poorer countries and in more challenging environments more attractive than its rivals.

Estimates from The Economist and Airfinity suggest that to date 2.2 billion doses of the vaccine have been delivered internationally, more than for any other producer, with the vast majority going to countries with the lowest vaccination rates. Statista put the total number of AstraZeneca vaccines ordered through pre-purchase agreements at over 3bn in March 2021, principally driven by the ability to deliver, to easily store and to transport vaccine without specific infrastructure. Having taken more than its share of political and regulatory knocks on the world stage, the Oxford-AstraZeneca offering may well end up being the most effective in saving lives. For some of the neediest and poorest people in the world, it represents a chance at protection for people who might otherwise have no chance of being vaccinated against Covid-19.

While the vaccine stands to deliver tangible aid internationally, it also underlines some of the fundamental strengths of the UK life sciences industry and the ability of the Oxford-Cambridge Arc to act as the catalyst for ground-breaking research and development. The Arc has always been the nexus for medical and scientific research for Britain and for the world – it was Howard Florey's dedicated research team at the University of Oxford that successfully isolated penicillin in 1940 and paved the way for its mass production. Supported by government aid in Britain and the US, the research at Oxford went on to save an estimated 15% of casualties in the Second World War and has continued to save countless others to this day.

The Oxford-AstraZeneca vaccine is a present-day demonstration of the same collaborative power that fuelled the development of the World's first antibiotic. The vaccine is an exemplar of the UK and the Arc harnessing the triple helix of public, private and academic expertise and investment.

Through the collaboration between academia and industry in Oxford and a life sciences multinational headquartered in Cambridge, the benefits of the close spatial dynamics of the Arc become clear. This is fertile ground for solutions that have a tangible benefit for local communities, for the UK, and for the international community. Just as the world needs to make a concerted effort to beat Covid-19 through mutual effort, the shared purpose and collaboration across the Arc has accelerated the development of a vaccine which is now being delivered to the places of the greatest need. When co-located initiatives work together to research, develop and deliver life sciences solutions, they have the potential not only to contribute tangibly to the regional and UK economy but to strike a blow against debilitating and deadly health issues around the world. This is the secret sauce that lies behind the success of the Oxford-AstraZeneca vaccine: a demonstration of the fundamental collaborative ability and potential of the Arc itself.

The Value of Cooperation Capital to the Oxford-Cambridge Arc

Dr Andy Williams, Vice President – Cambridge Programme & Strategy, AstraZeneca

As one of the most productive and economically active regions of the UK, the Oxford-Cambridgeshire Arc has the opportunity to become a world-leading innovation and enterprise zone, incubating businesses in the sectors of the future, including life sciences, ICT and high-tech (and green) manufacturing. Generating £110bn for the British economy each year – with £2.9bn (3%) of that coming from life sciences companies in the Cambridge cluster alone – and with higher growth rates than anywhere outside London, the Arc clearly has huge economic potential.

That is a key reason why we at AstraZeneca decided to consolidate our R&D efforts in the UK alongside our global headquarters at the Cambridge Biomedical Campus. Our recently opened Discovery Centre (DISC) represents a £1bn investment and will accommodate over 2,200 research scientists. Cambridge is undoubtably one of the most important bioscience locations in the world and we are proud of our legacy in the area – our footprint in the East of England delivers £1.23bn in GVA per year to the regional economy, directly employs around 3,600 people and supports a further 11,850 jobs. Across the whole UK – fired by our research in Cambridge – AstraZeneca provides £3.6bn in GVA per year, employs 7,897 colleagues (FTE), and supports a further 41,579 jobs across the economy.

Whilst the Arc benefits from many of the key factors that drive innovation – access to finance, world-class skills and talent and renowned research institutes – the critical reason for its success is cooperation. In Cambridge, and across the wider Arc area, we see real results derive from a shared outlook and ethos in seeking to solve problems. This 'cooperation capital' is a key ingredient for life sciences, as we have seen in recent times – with government, industry and academia working together to develop and distribute vaccines at unprecedented speed.

We believe that the best way to meet today's science challenges is to work openly and collaboratively. Working in conjunction with colleagues based at laboratories in universities and research institutions, AstraZeneca aims to generate high-impact science to support possible future advances in medical innovation. This includes the Functional Genomics Centre at the Milner Institute and the Antibody Alliance Laboratory, which are both collaborative partnerships with Cancer Research UK, the Medical Research Council Laboratory for Molecular Biology (MRC LMB), and the University of Cambridge.

But our investment in local and regional cooperation goes beyond scientific partnerships – we increasingly need to play a positive role in the community. Responding to the call from government to help bolster the national Covid-19 testing effort, for example, bought together 400 scientists and volunteers from AstraZeneca, the University of Cambridge, GSK and Charles River Laboratories to create the Cambridge Testing Centre (CTC). In just five weeks, and an estimated 2,292 hours, a few empty rooms in the Anne MacLaren building, located on the Cambridge Biomedical Campus, became a high throughput testing facility. In just 12 months the centre delivered over 3.25m samples and developed innovation that has now transferred to the new 'megalab' in Leamington Spa, which is led by one of AZ's leading scientists from the centre.

In addition, AstraZeneca's Early Talent Programme demonstrates our commitment to developing the next generation of scientists and researchers capable of transforming the lives of patients. Every year, we support more than 500 young scientists – including apprentices, undergraduate and graduate placements, PhDs and post-doctoral scientists. We have over 100 STEM volunteers in Cambridge, working with partners like the Cambridge Science Centre, Cambridge Academy for Science and Technology (CAST), and the Cambridge United Community Trust to inspire the next generation of local children and young adults into a science career. With CAST, for example, in 2021

Introduction

we provided around 60 year 10 students with presentations as part of the KS3 Medicine Maker course, including (virtual) feedback sessions with our scientists discussing the roles they play. We also now have over 250 apprentices in the UK in a wide range of business areas including our science groups, IT, manufacturing and supply chain, clinical research, HR, finance and legal. These activities would not be possible without the cooperation of local schools, colleges and universities, as well as national cooperation with government and education providers.

Being able to commercialise the wealth of incredible ideas harboured in Cambridge and elsewhere in the Arc is another vital component of a thriving ecosystem. As part of our commitment to encourage innovation and entrepreneurship in life sciences, we support a number of initiatives that help biotech entrepreneurs advance their ideas. To date around 75 start-ups have benefitted from this knowledge and experience. Activities we support include programmes run by the Cambridge Judge Business School's (CJBS) Entrepreneurship Centre, including Accelerate Cambridge and Ignite; Accelerate@Babraham; CMS Ventures, an early-stage collaboration and investment fund between AstraZeneca, China Medical Systems (CMS) and CJBS launched in 2020, as well as with Lucy Cavendish College, Cambridge.

We know these types of approaches are shared widely across the Arc, providing the region with rich levels of cooperation capital – that vital ingredient is simultaneously unquantifiable but also intrinsic to our success. It stems from shared values in problem solving, seeking to improve the world for the next generation, and delivering change to peoples live today, including in the local communities where we operate.

Cambridge, as well as the wider Arc, is fortunate to have the advantages it does. But these advantages may be eroded by accelerating international competition for investment in the technologies of the future – including life sciences – unless further steps are taken to make the Arc a genuine global contender for innovation and enterprise. Supporting public and private organisations to cooperate together to accomplish shared objectives is a vital component to achieving this.

Providing Space for the Pioneers of Life Sciences

Bill Kane, President – East Coast & UK Markets, BioMed Realty

As a world-leading developer, owner and operator of mission critical real estate solutions for the life sciences and technology industries, we're proud to have a strong presence in both Cambridge, MA, and Cambridge, UK. In these vibrant ecosystems, the innovators and enterprising companies to whom we provide the necessary space to thrive, are in search of accelerating breakthroughs that seek to solve the biggest healthcare and bioscience challenges of our age. They need the right assortment of equipment, but also curated laboratory and office environments to succeed — and it is these ingredients which we offer to the hundreds of tenant partners across our trans-Atlantic portfolio.

Being active in both Cambridge geographies makes it easy to realise that these two cities share much more than a name. On either side of the pond, both globally significant innovation clusters are underpinned by a similar 'triple helix' of academic research, government investment and private enterprise. Because innovation happens in proximity, not in isolation, life sciences hubs thrive by having access to a large talent pool, nearby academic and research institutions and close proximity to venture capital and other investors. The UK life sciences ecosystem not only has these key elements, but is also fuelled by the growth in tenant demand underpinned by funding into the sector – whether that comes from government funding, venture capital funding or the IPO market. That keeps capital in to develop and incubate the density necessary to sustain knowledge-intensive ecosystems.

Previously, therapies were commercialised in vertical organisational structures that occupied independent spaces throughout these regions. Now, with remarkable progress in science technology, better access to capital, and strong support from the government, life science users are seeking ways to optimise time and capital efficiency. They do this by clustering in areas that offer proximity to peers, support and optionality for growth. That is why all our locations are anchored by strong academic and research institutions,

Levelling the International Playing Field

deep talent pools and a wealth of capital providers and thriving commercial life science and technology companies.

The pace of innovation and speed at which life science companies are hitting critical research milestones has increased. This more streamlined pathway is driven by advancements in technology, greater cohesion of clusters, and the intersection between big data and research. We can now analyse and draw conclusions from the data at a more rapid pace, driving the pace of innovation. As a Blackstone portfolio company, BioMed Realty benefits from access to proprietary information and data through Blackstone Data Science and Blackstone Life Sciences.

The need for more lab and office space has never been so pressing in the UK as it is today: for the past few years, the life sciences industry in the Oxford-Cambridge Arc and the Golden Triangle more broadly has witnessed increased levels of funding, which has rightly been described as a 'boom.' Yet the lag from the funding dates to the tenant leasing/occupancy of the life science real estate means the industry has yet to experience the impact of the positive industry fundamentals on the life science real estate sector – a growth catalyst that could be unleashed in globally important innovation clusters like the Arc.

Of the 13.7 million square feet of research and workspace we own and operate in the UK and US, approximately one million square feet is in Cambridge, UK. This space is all fully leased, having recently welcomed two pioneering companies – Altos Labs and Bicycle Therapeutics – to our recently renovated Portway building at Granta Park, one of the largest purpose-built life sciences developments in the Oxford-Cambridge Arc and home to over 30 of the world's largest life sciences companies and research organisations, including Pfizer, Illumina and Cancer Research UK. This represents a formidable cluster of collaboration and innovation that employs more than 3,700 people.

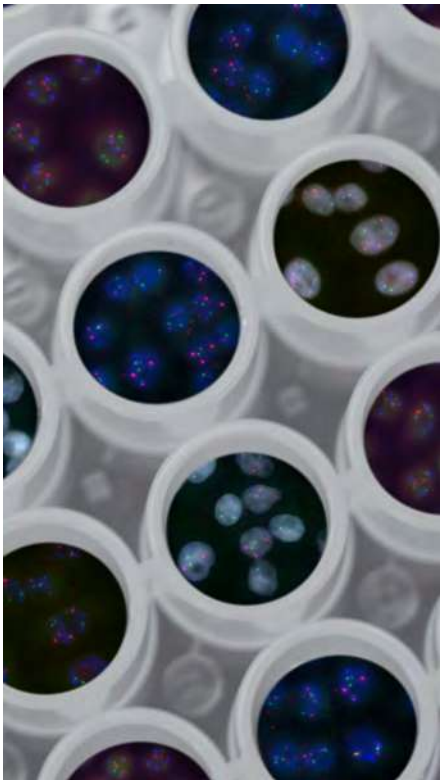
Market data we've followed also shows that heightened activity levels have driven down availability rates for office and lab space in Cambridge to a low of 2.2 percent. This risks potentially locking out promising start-ups and scale-ups. If the 'triple helix' is the lifeblood that fuels life-saving research and innovation, then it is our responsibility to create spaces which house and nurture the innovators aiming to break new ground. This means providing more than just work and research space. Occupiers want amenities that activate culture, health and the exchange of ideas.

In addition to the 13.7 million square feet of operational space, BioMed maintains a premier development platform with 3.5 million square feet of Class A properties in active construction. To extend the runway of supply for the burgeoning life science sector globally, we're also actively looking for ways to continue expanding this pipeline in all our key markets — including the UK — as represented by last year's announcement that we intend to nearly double the size of our portfolio in Cambridge.

Our planned £850 million investment to create approximately 800,000 square feet was welcomed by Prime Minister Boris Johnson, who called it "hugely welcome news" and added that he was "confident that the support of Blackstone's BioMed Realty will mean there are many more [great scientific discoveries] to come."

Our best-in-class portfolio, market-leading platform and growing pipeline allows us to meet rapidly increasing demand in the UK and Oxford-Cambridge Arc specifically.

The UK life sciences industry is world-leading and life-saving, as the Oxford



University and AstraZeneca COVID-19 vaccine demonstrated. The UK has consistently had strong government funding into the sector, with UK government spending on healthcare and R+D the highest in Europe and second in the world.

But it is not only the convergence of academic ties, government support and private investment that life sciences companies need. The pandemic has shown that some industries can operate successfully with remote workers, but essential lab work for drug discovery cannot be done from home. It requires highly specialised research and workspace. Having the right building in the right location is just as important as having the right talent.

The Oxford-Cambridge Arc: An International Perspective

Dr Tim Moonen, Managing Director, The Business of Cities

The scale of opportunity of the Oxford-Cambridge Arc is often viewed and debated through a domestic prism.

Yet the innovation economy is global. Connecting, as it does, a unique set of world-class UK institutions, industry capabilities and communities of practice, the Arc's competition and context is even more international than it is national. A wider view may instead observe the Arc to be one of a group of 10 or more corridors that connect and adjoin the world's most innovative regions and urban centres. These are found in North America, Northern and Central Europe, Israel and increasingly, in East Asia.

Over the last 50 years, nearly all of these places have grown and matured quite organically around shared infrastructure and research. Many have expanded from cities and research centres into 'corridors' and 'triangles' as supply chains and labour markets become more inter-linked.

Yet in recent years each of these locations have begun to benefit from more intentional approaches, driven by a sense of interdependence in their quest to be friendly to talent, business, communities and the planet. As such the global picture now shows a lot more momentum to bring forward quality and inclusive places that can serve high-levels of sustainable commuting and meaningful complementarity within and across industry clusters. This mindset shift has been no doubt accelerated by the distributive effect of Covid-19, the urgency to lead on climate change, the demand shift in new and established industries, and the expanding enterprise imperative of universities.

The Oxford-Cambridge Arc opportunity will benefit from pursuing its goals with a clear eye on how its counterpart locations in the rest of the world are adjusting. What other corridor locations deliver will very much shape what 'good looks like' for the scarce talent, investors, researchers, disruptive businesses and entrepreneurs who make location choices on a daily basis.

Connecting the Corridors

Building fast, frequent, high capacity rail services between cities and towns along the innovation corridor has been a top priority for more than a decade in many places.

The most advanced in this pursuit is China's Greater Bay Area where high speed rail is nearly complete: the litmus test there is for everyone to be within 45 minutes travel time to the three largest city centres. Meanwhile government and the private sector are now combining into a joint body to deliver rail between Vancouver, Seattle and Portland, shrinking commute times to no more than an hour. Also, Israel's Infrastructure Planning Council is now committed to doubling the rail capacity between Tel Aviv and Haifa, reducing travel time to 30 mins.

Big-ticket rail is not the only or immediate answer and elsewhere more agile solutions are providing interim solutions. Toronto-Waterloo innovation corridor is establishing a two-way, all-day bus rapid service to connect the cities in 90 minutes and double the number of stops to reach the estimated 1.4m jobs along the line. Free public buses, expanded shuttle services, 'park and pedal' hubs, mobile ticketing and advanced carpooling technology are all important parts of the North Carolina Research Triangle's and Boston 128's subsidised offers.

Of course digital connectivity has become even more critical to absorb the distributed demand. North Carolina created a microwave system linking the three universities and the Research Triangle Institute, and is building a fibre optic cable ring throughout the triangle. Toronto-Waterloo has just rolled out 5G to 13 cities and towns along the corridor.

Not progressing in these areas has become a competitive disadvantage for those who have been slower. The inefficiency of the private shuttle alternative in Silicon Valley has become a talent deterrent, while in Israel, the risks of bypassing intermediate locations along the new rail line are being observed in Tel-Aviv-Haifa corridor.

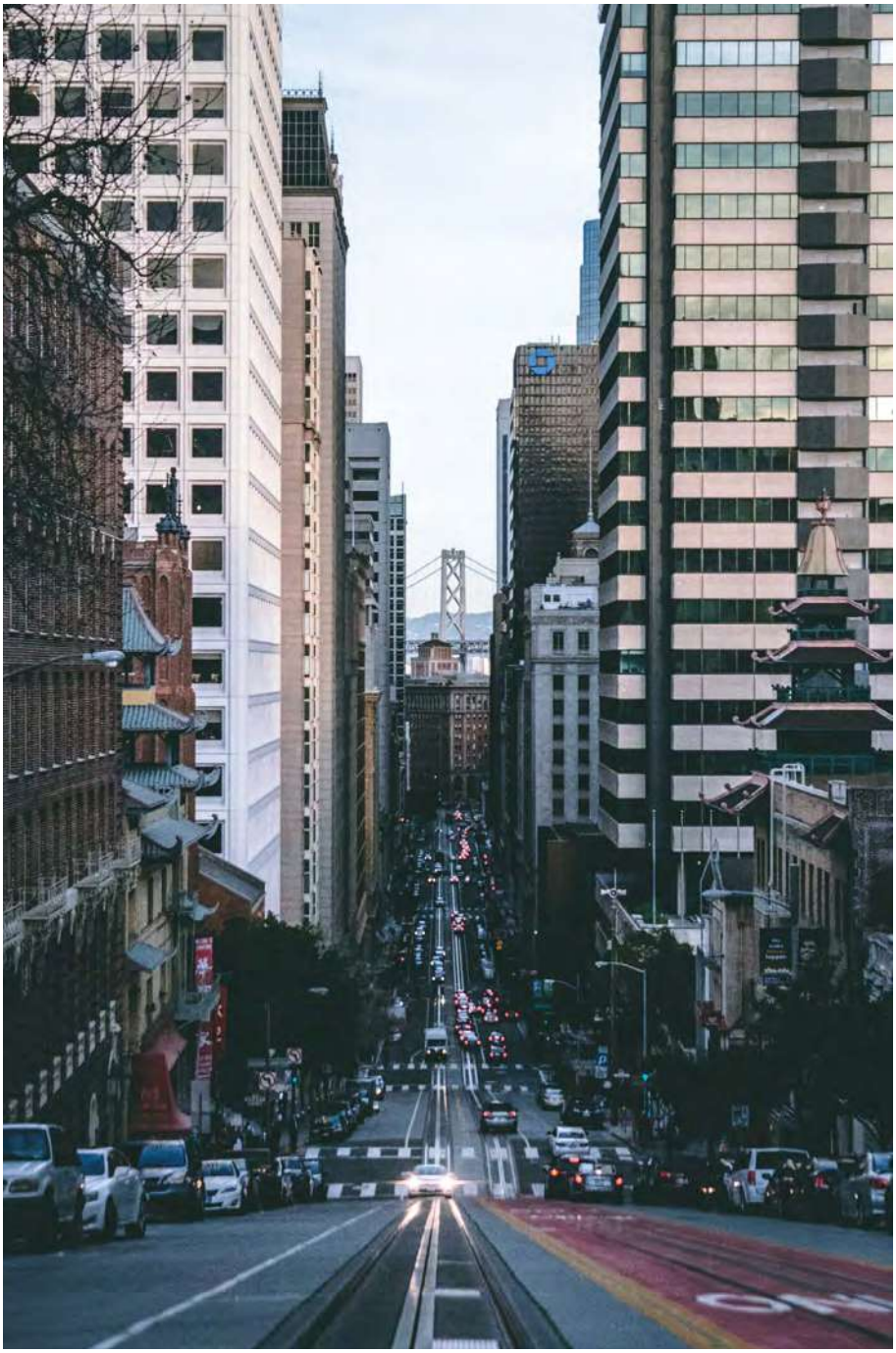
Shaping the Arc of Opportunity

Given the depth and breadth of assets they are home to, top tier innovation corridors increasingly realise they have to develop a more coordinated, economic development plan to guide the growth journey they are on.

This firstly means deliberate clustering – whether it is biotech (in many places), hydrogen fuel cells (Yangtze River Delta corridor), agtech (North Carolina) and much more. It is also means some spatial complementarity. The Cascadia corridor is benefiting from an Innovation Partnership Zones programme set up by the upper tier government to crowd in public labs and companies in eight key locations, spanning 5G, manufacturing and global health. This integrated approach also tends to result in certain towns and cities becoming recognised demonstrators and testbeds for new innovations being developed by local companies. As with drone deliveries in Tel Aviv-Haifa, and equity IoT in Silicon Valley, these create both an early customer base and social impact opportunity.

In some cases, the way clusters are currently dispersed is not viewed to be optimal for collaboration, so many

Dr Tim Moonen



are looking to relocate universities and institutes. A new campus along the Waterloo-Toronto corridor is pioneering planetary health entrepreneurship in collaboration with the small town of Milton and a further education college. The BioValley has brought together universities in neighbouring Basel, Freiburg and Strasbourg to set up a European campus without walls or borders and build a shared plan for internationalisation. In Southern China, the Greater Bay Area has even set up its own eponymous university which Is building two campuses in the fourth largest city in the corridor, Dongguan.

The Place and Habitat imperative

A committed, multi-stakeholder approach to places is becoming recognised as essential for corridors. This applies to both the key nodes and dense knowledge hubs as well as the locations whose place assets have been neglected. A number of life sciences focussed regions are bringing forward a much higher urban calibre of mixed-use campuses, retrofitted suburbs and urban districts along their corridors to respond to the needs of talent, communities, and disaggregating business.

After decades of single use locations, the Research Triangle in North Carolina is now unlocking environments that can host lab and biomanufacturing space alongside a serious 18-hour amenity and education offer, and in some cases medium-density apartment housing. Many larger companies voted to support a 10-year business levy to help finance the transformation. Here, as in Boston 128, larger firms are distributing their presence across four to five corridor locations to service future growth and be closer to homes, services and specialist facilities.

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	Rail, rapid bus and digital connectivity now being accelerated	Focus on mixed- use innovation - ready locations in smaller towns and cities	Deliberate relocation of universities, institutes and business anchors along corridor	Decisive Economic Strategy, Clustering & Complementarity	Testing Technologies Low Carbon in Local Places and Testbeds	Visibility and endorsement of Higher Tier of Government
San Francisco – Silicon Valley	**	*	**	*	*	*
Route 128, Boston	*	**	*	**		*
Cascadia Corridor – Seattle-Portland-Vancouver	*	**	**	*		**
Toronto – Waterloo Corridor	**	**	**	**	**	**
Research Triangle, North Carolina	*	**	**	*	**	*
Eindhoven & Dutch Delta	*	**		**	*	*
Bio Valley, Freiburg-Basle			**	*	**	*
Tel Aviv- Haifa	**		**	**	**	*
Greater Bay Area (G60)	**		**	**	*	**
Oxford-Cambridge Arc	??	??	??	??	??	??

The knowledge that leading corridors produce, and the talent they are home to, creates great demand to translate into a thoroughgoing approach to sustainable habitat. These corridors are increasingly home to circular economy (Eindhoven & Dutch Delta) and nature-based solutions clusters (Research Triangle North Carolina), carbon-neutral districts (see Guelph in Toronto-Waterloo), and areas where sites are bundled for green investment and demonstration opportunities (as in China's Greater Bay Area).

Combined and distributed leadership

Finally, those who lead, plan and champion these corridors realise that in most cases, responsibility for these locations spans jurisdictions that used to have little in common other than a shared use of infrastructure. Now there is an impetus to run, lead, promote and organise the corridors to give them the profile and coordination and national priority they deserve.

North Carolina's Research Triangle Regional Partnership and Toronto-Waterloo's Innovation Corridor Business Council are two of several examples of a public-private partnership emerging that is focused on marketing and strategic economic development coordination for a previously fragmented geography. These are business-led, convening existing local and regional bodies, and provide a single interface for expanding businesses and international inbound and outbound opportunities. Other collaborative initiatives include match-making platforms in the cloud to allow companies and researchers to share their latest scientific findings and check on the availability of scientific equipment.

Given the obstacles many national governments face in prioritising and promoting their flagship corridors, business, universities and local government coalitions often find they have to lead the way in tandem with local communities. More civic and business leaders have become more proactive on boards for the future economy and mobility of the locality and the region. Over time, the result of the soft collaboration is that higher tiers of government are more inclined to provide co-investment to reduce co-ordination gaps, and create a more enabling planning and policy context in which the larger changes can happen.

Conclusion

The future of the Oxford-Cambridge Arc makes sense to be viewed and organised around with this global perspective in mind. Not only will it help those invested in the Arc's success to grasp what it will really take to stay on track to retain, renew and amplify its global excellence over the coming decades. Pursuit of global learnings will also be essential in understanding how best everyone can exercise leadership, custodianship, curation and influence amid the shifting sands of technology, politics and place that these special corridor locations have to be constantly alive to.

Sovereign Wealth, Regional Success

Iain Keys, Partner, Fund Management, Bidwells

Ancient institutions and the UK's giants of academia, like Oxford and Cambridge, are not built overnight. Over centuries, these ecosystems have cultivated a culture and global identity with a steady hand. This patience is a driving force of the past, present, and future of the Oxford-Cambridge Arc.

Patient capital – a long-term commitment to investment in the anticipation of greater financial, social and environmental returns – is faith in the principal, vision and outcome. To be world-leading, the disparate clusters curated across the Arc must come together with a regional proposition that harnesses its scale.

This is a 30-year mission that'll be worth the wait, requiring substantial investment into infrastructure, housing, and commercial space to support the growth of research and development, which needs domestic and international capital partners who can commit to the long-term outlook.

Whilst many institutional investors have short-to-medium term investment criteria, the patient capital of sovereign wealth funds is well-aligned to the challenge that scalability of the Arc presents. Some of the greatest examples of sovereign wealth funds – the Norwegian Government Pension Fund (SWF), the UAE's Abu Dhabi Investment Authority or the Singaporean GIC – are only a few decades old, but already manage assets in the hundreds and thousands of billions.

According to recent research by the Financial Times, Norway's SWF is now almost four times larger than the country's GDP and its annual payments represent a quarter of the state budget. Just as the Arc represents a magnet for UK inward investment, it's a long-term investment proposition for sovereign wealth funds, a significant asset to the British economy and the source of some of the cutting-edge research and start-ups in emerging sectors that will help to drive global growth and development over the next century.

Many leading sovereign wealth funds have already seen and contributed to similar growth opportunities in their domestic markets and are well aware of the benefits patience offers to deliver outstanding returns. Oxford and Cambridge's traditional college investment programmes demonstrate a similar commitment to long-term time horizons, with large portfolios and high volumes of liquidity, and gravitate towards partnerships with funds which factor in the same considerations in their forecasts. There's a natural symbiosis here, something which the Oxford-Cambridge Arc as a regional framework could take full advantage of.

Sovereign wealth funds are increasingly active investors in the UK economy. In March 2021, Mubadala Investment Company co-invested £1bn into the UK life sciences sector alongside the UK government Life Sciences Investment Programme. Similarly, Xeraya Capital, a venture capital company founded by the Malaysian sovereign wealth fund Khazanah Nasional Berhad, continues to invest heavily in UK healthtec most recently to the tune of $50m in digital health firm Congenica. Abu Dhabi's Future Energy Company invests in infrastructure, an area of investment which deeply needs patient capital and a long-term vision. These are global agents of change, both in their size and scope, but importantly in their goals that are future-oriented: investing reserves aiming at higher long-term yields and boosting long-term productivity by contributing to hard infrastructure and capital assets.

The new Office for Investment established as a collaboration with 10 Downing Street and the Department for International Trade will act as a conduit for the UK's sovereign wealth investment, whilst also serving as a flagbearer for investment in a Global Britain. With Britain re-establishing itself as a global hub for business, including recent trade negotiations launched in June 2021 with the £9 trillion Trans-Pacific Partnership, the Arc must be part of the 'sell' story that our trade envoys take internationally.

As sovereign wealth funds diversify their base and jurisdiction of investment, the Arc houses many of these opportunities that complement their presence primarily in London, and the right geography to benefit from a wider interconnected 'Golden Triangle'.

The Arc represents a tried and tested environment: it produces its own talent through its diverse universities and institutions, and attracts talent globally. Sovereign wealth funds will be a play a key role in attracting investment internationally, demonstrating the openness of Global Britain to flows of global capital and its continuing attractiveness as a free, fair, and stable place for investment. We'd be mistaken to think that sovereign wealth funds – with assets under management worth over $10 trillion under their control – are sideline considerations in the region's global future and the UK's ambition to become a scientific superpower.

Attracting the World's Greatest Minds to a Marketplace of Problems

Clark Dean, Executive Managing Director, Transwestern

Transwestern assists clients across more than 219 offices in 31 countries as part of a strategic alliance with BNP Paribas Real Estate and Encor. What does the Transaction Sciences team do, and how does your work improve the growth of new and existing innovation districts?

The Transaction Sciences team within Transwestern is best described as a team that plans, designs and executes transactions that contribute to human flourishing. We are a consultancy, a builder of echo systems, and principally a problem-solver, designed around several strategic anchors that drive solutions to complex problems in industries such as global life sciences.

On a basic level, we solve complex problems by building custom real estate solutions that are informed by data analytics and behavioural science. This means the provision of bespoke laboratories and spaces to innovate, mobilising a team with a diverse slate of capabilities that ranges from development; folks who have led large, real estate-reliant corporates like CNN, Warner Brothers and Invesco, to those with biomedical engineering, law and finance backgrounds. We bring expertise and an extensive network as an extension of executive teams, partnering with important enterprises like the Centre for Global Health Innovation and its Global Health Innovation District in Atlanta, in partnership with large global health institutions, corporations, universities, community groups and innovative start-ups.

Connecting people across disciplines, industries and geographie, is essential to catalysing innovation in science and technology that transcends real estate. The teams we build and the partnerships we create need to be as diverse as the vastness of these innovation districts.

What is the 'secret sauce' that makes a scientific community globally significant?

Communities everywhere are seeking ways to have an innovation district in their hands that has a truly global reach. Of course, we can't simply will these into existence and in a large part, the foundations are initially laid by research-led universities as world-leading conveners of science which have access to capital, academic resources and function as talent sinks bringing skills into areas in a highly-clustered fashion. The most authentic districts have been anchored by grand research institutions.

U.S. innovation hubs have long been reliant on these deep roots to develop organically. If we look to the Boston cluster as one example, MIT and Harvard might not have seen the obvious benefits of collaborating due to their very different compositions, governance and philosophies, even though they're very geographically proximate, but over time they forged joint curricula such as the joint-venture health science and technology programme which lowered the drawbridge for bright minds to enrol at both places and freely move between the halls of both institutions.

It helped that investment in transport infrastructure had already been made, making it easier to exchange knowledge and cultivate social capital in and around Boston. This makes it a lot easier for research institutions – that tend to receive government monies through grants that pour into programmes – to blend with and seed private enterprise and the broader ecosystem.

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Clark Dean

Cooperation between universities, research institutions and private enterprise – what we've come to understand as the triple helix of innovation – is the fuel for these districts to thrive. The challenge is to create neutral entities and spaces which allow for ties to form naturally, without any one party having a semblance of ownership that another might not have. Globally renowned institutions should carve out neutral ground to convene, bringing the best of what they have to offer, which is exactly what we're seeing in Atlanta between great universities Emory and GeorgiaTech, as well as prestigious colleges like Morehouse.

This requires leadership and doesn't happen by accident. Public-private sector engagement is essential and the value of social capital can bring about extraordinary returns if this is harnessed correctly and there is clear and unwavering commitment to building up the foundations.

The notion of 'social capital' is a critical factor to how Transwestern supports the creation of innovation hubs. What does this entail, and how can we capture it?

Social capital is the value of the interactions among people, a concept pioneered by Robert Putnam from the Harvard Kennedy School of Government. This can include 'strong ties' relationships, meaning who we work with or meet at school or college, but it importantly captures 'weak ties'; the intersection of disciplines, experiences, backgrounds, origin, race, skills; everything that manifests a necessary richness that we need to apply to solve globally important and complex problems.

Innovation districts like the Oxford-Cambridge Arc should consider facilitating these interactions as their ultimate objective. These pan-regional ecosystems need to be more than places which create jobs or real estate values, but instead places where big and complicated problems are solved because of the unique convergence of human, intellectual, financial and social capital, and the opportunity to work with people who challenge existing thinking.

These districts draw in what we call 'problem experts' that can articulate these problems and understand them well, and generate a marketplace of problems worth solving, attracting problem solvers who see profit potential and societal benefit on the other side of these problems.

What does the Oxford-Cambridge Arc need to do to stand out globally?

In the same way as the best universities lean into the problems they're best placed to solve; like Harvard MIT have done with life sciences, and universities across Atlanta in the area of global health, regions ought to adopt an 'edge' that allows them to bring to the table something that few other regions globally can say they're the best at. This spills out to the wider space around these idea factories, as we've seen in Cambridge, MA, and the seaport which has been brought into the vortex of this geographic expertise, and only serves to further embolden the case for international talent and funding to gather in these areas.

The issue for Cambridge and Oxford is that both universities and their localities are well-known for many subjects, and if anything, they've been successful as generalists. Leaders need to pick out and explore subject areas that can be majored on; unique things that no-one else globally can offer, to attract the best minds across the world. Dense markets have a tendency to become denser, and the popularity of these areas creates a virtuous circle that's increasingly difficult to compete against.

Houston is the greatest market for energy, Silicon Valley for tech and Los Angeles for entertainment. In each of these areas there is a strong thesis to show where the action is. Is there a thesis that the Arc can develop that sets it apart in its offering? Infrastructure like the JET reactor at Culham Science Park that is difficult to replicate elsewhere? This supports the process of curating world-class elements of an ecosystem, and it's how you lever those strengths which attracts investment and problem-solvers.

The bigger picture here is that the Arc's carved out edge can entrench its global reputation within a wider 'network of networks' – rich, fractally-aligned innovation districts that connect with each other globally, powering a world-wide ambition to solve the world's more complicated issues through regional specialisation. This enables the building of expertise horizontally, rather than entrenched in deep and long verticals, mining the expertise of one vertical that is undoubtedly translatable to another.

Collaborating with the Global Community

Q&A with Dr Jerry Wu, Head of Investment, TusPark UK

What is TusPark UK's history and ambitions for the Oxford-Cambridge Arc?

TusPark is a science, technology and science/business park provider, which began as a spin-out from Tsinghua University in 1994. TusPark now manages and operates nearly 300 innovation spaces and science districts across 22 countries, creating and contributing to vibrant knowledge ecosystems all over the world.

TusPark UK has a presence in Cambridge and Newcastle with an investment of £220+m, a footprint which we formed four years ago, providing space for new innovation and a platform for start-ups, businesses and organisations in the UK. In Cambridge we've partnered with Trinity College Cambridge to deliver science and technology space to specification while at the same time plugging occupiers and partners directly into our global services, providing hands-on support and education to founders and entrepreneurs within the Oxford-Cambridge Arc through incubation, investment and cross-border networking.

We actively invest in the UK market directly, injecting critical capital into early-stage ventures in the region and building academic and commercial partnerships along the way.

What is the investment appeal of the Oxford-Cambridge Arc?

Within the region there are several matured ecosystems, including clusters in deeptech and life sciences where the UK is world-renowned. What is special about the Arc, and its relationship with London; the Golden Triangle, is that these innovation districts cannot be duplicated elsewhere because they take decades to come together.

In the Arc there are world-leading centres of research, many spinouts and an investment community to support these ventures. There are also massive commercial innovators such as GSK and AstraZeneca, that are big players in the life sciences space globally. Cambridge is the third largest life sciences cluster next to Boston and San Francisco, and there is an opportunity to elevate this further through ecosystem-building, infrastructure, and investment in high-growth companies locally.

What does TusPark UK bring to the Arc ecosystem?

Early-stage start-ups, companies pursuing proof of concept, established and scaling innovators and even multinationals can struggle to enter the Chinese market. This may be important for reach, or for production, manufacturing and distribution, and in many cases it is essential if new innovation is to be commercially viable on a global level. TusPark UK bridges the gap between the UK and China in terms of working culture and environment through education, making it easier to source trusted partners and the soft landing into China's commercial landscape.

Both countries can see the benefits of promoting local business to a global level, and the need for a gateway into larger markets. This is a critical pathway that many enterprises operating in the Arc require. We've had strong support from both governments, and TusPark UK is an official partner of the Department for International Trade, organising training sessions to advance knowledge of what's required to take a product international, and demystifying perceptions.

What can the Arc learn from the way science parks operate in China?

We cannot compare apples to oranges, in the same way that the Oxford-Cambridge Arc's approach to clustering is entirely different to how it works in China. Of course, we can talk about innovation occurring across both countries but the local environments are essentially very different, and it's organic matter means we cannot lift and duplicate what works in one and graft it onto another.

This is because ecosystem-building is not just about injecting capital or creating infrastructure. Ecosystems are all about the talent of people and their compatibility with the ecosystem culture. You can spend millions building industrial parks but to attract talented people, there needs to be a local and organic approach to growth.

In the Arc, many hi-tech enterprises in the knowledge economy are spin-outs with close relationships with universities. The relationship between academia, enterprise and industry is different from China, and so the approach must be equally so.

What are the opportunities and challenges that the Oxford-Cambridge Arc faces?

The Arc benefits from world-leading research and dynamic clustering and collaboration, but the clusters between Oxford and Cambridge have a different culture and their focuses are distinct. Even between Oxford and Cambridge, we see a step-change in attitudes and approaches, which makes it challenging to create greater synergies regionally.

Science and technology, and the innovation behind it, is a very competitive space globally. Where a company chooses to locate is a vital commercial

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decision. Local leaders need to have a better understanding about the unique landscape of the Arc and the connections between its communities; and who those enterprises want to be close with including collaborators, investors and stakeholders in the science and technology sector. Government involvement is also needed to build the infrastructure necessary to promote greater connectivity between people, because it's not the capital which drives the growth but rather its people.

Similarly, while collaboration is good between key clusters such as London, Oxford and Cambridge, the central part of the Arc is not as activated. Foreign investors' first steps are often into London's innovation ecosystem and there needs to be a compelling story as to why they should begin to make their next step into the Arc and not elsewhere internationally.

How do we attract overseas interest in the Arc, and not just in London?

Leaders, government organisations, overseas businesses, their strategists, and other decision-makers need to understand why the Arc is special. DIT and other collaborative organisations have done a lot of hard work in bridging that knowledge gap to convey the benefits of the Golden Triangle, as have Cambridge Network and Cambridge Ahead, but there needs to be a stronger welcome.

It's foremost about being friendly. Cambridge is less conservative and Chinese investors in particular have been given a warm welcome and an opportunity to form relationships more quickly. We can thicken these networks if local leaders are committed to Arc-wide innovation, and elevate the standing of the region in turn.

Levelling the International Playing Field

Attracting Global Capital in an Era of Unprecedented Competition

Salah Mussa, Chairman of Mercantile Group

In an era of unprecedented competition for global capital, every nation needs an edge. Foreign Direct Investment (FDI) reached a total of $870bn (£620bn) in the first half of 2021 according to the OECD, with the UK receiving 5% of this figure - the third highest level of investment received by any country worldwide behind China and the United States.

New horizons present challenges, but also opportunities within a network of open and consolidating trading blocs. In an era of global Britain, to attract this kind of investment from abroad, the UK will have to differentiate itself to avoid losing out. FDI and the relationships we forge with other countries will be crucial going forward, with burgeoning industries like life sciences, advanced engineering, aerospace and software development set to play a major role in securing it.

FDI is replete with benefits. Inflows from countries like France, Germany and Canada were crucial to opening up new employment opportunities in the UK at the height of a pandemic that otherwise stifled job creation. Encouraging investment from abroad will be important to fulfilling the government's levelling up agenda by stimulating growth outside of the traditional regions of prosperity by adding to and creating supply chains, creating new networks and adding to our spending power, which paves the way for further investment opportunities.

One of the country's greatest opportunities for FDI comes in the form of the Oxford-Cambridge Arc. As the UK's emerging scientific and technological centre of growth, DIT-led FDI projects in the Arc led to the creation of over 26,000 jobs between 2015 and 2020. More broadly, the UK's market share in Europe for FDI set to break its record of 17.5% in 2020 owing principally to its vibrant knowledge economy.

International investment interest in the Oxford-Cambridge Arc has never been greater than now. Last year we witnessed a wealth of investment into the area including the acquisition by Singapore's sovereign wealth fund, GIC, of a 40% stake in Oxford Science Park, supporting the Magdalene College-owned park's ambitious development plans. In the life sciences sector, Blackstone's BioMed Realty recently added $1.12bn to its property portfolio in the form of Cambridge International Technology Park and a seat at Granta Park – a monumental vote of confidence in the Arc which is now responsible for a fifth of all innovation and spin-out activity stemming from British universities.

Potential trade partners seeking to deepen ties with the UK are acutely aware of its market sophistication, particularly in real estate. In 2021, the UAE pledged to expand investment in the UK through a five-year 'sovereign investment partnership' worth over £10bn, with an initial commitment to invest £800m in the UK's life sciences sector by way of Abu Dhabi's state fund Mubadala. This is the biggest foreign greenfield investment received in the current parliament, adding fire to a blossoming relationship with the Gulf Co-operation Council that already accounts for nearly nine-tenths of the UK's trade with the Middle East as a whole.

Key to the Arc's success in attracting global capital has been clustering, or the co-location of the businesses, academic institutions and public bodies that make up an industry within a relatively short distance of one another. This triple helix of innovation is the product of almost a millennium of measured growth of, and relationship-building across, the institutions which make up the region's knowledge economy.

The communities central to the Arc are among the fastest-maturing technological hubs in the country. Milton Keynes is consistently ranked by the Centre for Economics and Business Research as one of the most rapidly growing towns for IT and digital services in the UK, while Luton has carved out a pioneering role in advanced aviation engineering.

To attract foreign investment, people with experience of international markets – that understand their nuances, priorities and business etiquette – must play a key role. While much has been made of the traditional pull factors for FDI, the importance of prioritising social as well as economic returns needs to be elevated.

Looking Outward

Q&A with Sebastian Johnson, Head of Innovation and Inward Investment, OxLEP

How important is international investment to the Oxford-Cambridge Arc's success as a regional cluster?

It would be difficult to overstate how important international investment can be. Recently we've seen tangible evidence of the impact it can have: Singapore's GIC recently made a landmark investment into Oxford Science Park, where there is a clear master plan for extending the existing science park to provide the space necessary for ground breaking science and research to take place. Global investor, Brookfield Asset Management, have also had a real impact in the joint venture with government at Harwell Science and Innovation Campus in Oxfordshire, supporting some of the region's most promising innovators with access to world leading research facilities, offices, labs and talent. Over the 18 months they've been there, we've seen dramatic positive investment, growth and commitment in the cluster development already present.

Importantly, there's a real diversity and breadth of investment in the Oxford-Cambridge Arc, including emerging sectors such as quantum computing which has benefited from recent government investment. In turn, this backing from the public sector drives further investment from reassured private sector sources of funding, creating a vortex effect which draws in overseas interest. Brookfield, for example, have recently bought the science and technology real estate enabler Arlington in a £714m acquisition, who own a range of business parks across the Arc and the Golden Triangle. In the next few decades, it will be great to see how that investment translates into the ramping up of companies across Oxford and the Arc.

Kadans Science Partner is another excellent example of a company that has invested across the Arc: the appetite for investment is strong , driven by the extensive pipeline of University of Oxford and research centre spinouts supported by Oxford Science Enterprises who are providing early-stage finance, lending greater confidence to larger-scale investors. We need to continue to build that global leading innovation ecosystem – a delicate mixture of ingredients which drives growth and development and makes for a full financial investment journey. Many international companies are already here, operating in the Arc, and in need of greater real estate for expansion.

We talk a lot about the global interest in the Arc's leadership across life sciences. In which sectors does OxLEP see international investment having the greatest impact?

The life sciences sector is crucial as a vital strategic industry for the UK. In the last decades we've see the growth of medtech and life sciences in Oxford and across the Arc: the world-class facilities in the region have the power to drive results, with the Oxford-AstraZeneca vaccine collaboration the most recent innovation to have a genuine global impact.

From the Oxfordshire perspective, we have one of the largest space clusters in Europe at Harwell including open-source resources like the Satellite Applications Catapult. The National Satellite Test Facility is going to be vital for British based businesses looking for proof of concept for their research and development in the space sector, and businesses will want to be close to this facility to benefit from its utilities and the potential for positive spillover and collaboration between organisations. We've seen foreign direct investment be particularly strong in both the life sciences and space sector.

Other important sectors for Oxfordshire and the Arc include research and development into the future of mobility. These include enterprises working to create autonomous vehicles such as Oxbotica and in electric vehicles the fast growing Arrival, which has its main research facility in Banbury in Oxfordshire. Arrival is also leading the charge across the Arc for micro-factories and other highly-technical, highly-compact sub-assembly style operations. Enterprises including Oxbotica and Oxford based StreetDrone, will be at the forefront of the connected autonomous vehicle revolution, and we are already seeing big investment, and with battery technology and advanced engineering further enabling autonomous and electric vehicles, we expect to see this sector grow exponentially over the next decade.

Technologies developed in Oxford and the Arc more broadly represent one of the leading clusters in the world for sustainable investment, with foreign direct investment linked to prominence and reassurance of the Oxford brand as an academic and R&D powerhouse. We're home to the Culham Centre for Fusion Energy, the principal location for fusion energy research, where Canadian business General Fusion is investing to build and operate a Fusion Demonstration Plant. We have also seen huge interest in Tokamak Energy and First Light Fusion, two of our fast growing fusion energy companies based in Oxfordshire and attracting international investment. Fusion and the energy sector is a very hot investment opportunity and extraordinarily topical in the current environmental climate, in addition to the emerging technology to facilitate energy tech research including robotics, AI materials science and battery technology, to name a few. Through the Department for International Trade, we work closely with central government to identify international investment opportunities into these key sectors where the Arc and the UK are global leaders.

Finally we have the emerging field of quantum. Harwell in Oxfordshire will house the National Quantum Computing Centre, operated by UKRI and set to be operational by 2023/24. We are already seeing significant uplift in enquiries around these technologies in Oxfordshire, and quick growth of spinouts from the university. This close and seamless collaboration between the private, public and academic sectors, creating critical mass around research institutes for start-ups and spinouts to succeed, can help the UK maintain momentum in key industries of the future like quantum computing. It also highlights the importance of assets we have across the Arc: these are national strategic assets for the UK but also with a global scope and focus because of this vital proximity of research assets that are world-class.

Are we advertising the opportunity? How can we better internationalise the importance of innovation occurring within the Arc?

We are doing a lot better than we were historically but we could do better. As a private sector business, Brookfield Asset Management is certainly investing both in brand and place, and working on its business development to shout more loudly as to why people should be investing and bringing businesses both to Oxfordshire and Harwell. Collectively there have been some good pieces of work: accessible videos and explanations around the key sectors of space, life sciences and the future of mobility. We need to be stronger in partnership with central government, utilising their investment and trade officers based across the world. There is a real chance to help them to understand what opportunities exist across the Arc, why it's such an area of global significance for innovators and collaborators, so they can continue to broadcast the message of the Arc effectively abroad.

We need to understand how we can team up more strongly with central government, as Local Enterprise Partnerships, site owners and cluster development managers to achieve a full and holistic approach to supporting the Arc. We have started to do more work from an Oxfordshire perspective in developing an internationalisation plan to promote and ramp up the level of international investment coming into Oxfordshire alongside our partners both in central and local government and the private sector. We need to focus not just on new investments but also support and maximise expansion opportunities of international companies already here.

The final point is that we need to convey the impact the Arc can have on solutions to some of the world's greatest challenges. Look at the success and global impact of the Oxford-AstraZeneca vaccine, but that's just one example - across the Arc we are creating solutions in the transport and mobility, communication, clean growth and renewable energy sectors. We have an awesome ability to collaborate, research, develop and commercialise – we just have to better present and sell that to the wider world.

How do we share the rewards of inward investment across the whole of the Arc?

The Arc has real potential to contribute to levelling up elsewhere in the country. Ipsen Bioinnovation, located at Milton Park in Oxford, employs around 100 researchers but also contributes to the operations of a drugs manufacturing biopharm in Wrexham in the Welsh borders, providing vital jobs in a rural area. This strong relationship is mirrored many times over across the supply chains and manufacturing opportunities that the Arc produces and gives us the basis for how we should be operating across the Arc and above that, the whole of the UK.

The space and satellite technology expertise we have in the Arc is partnering with launch capabilities being developed elsewhere in the UK; and the Fusion cluster and expertise we have in Oxfordshire is working on a cluster of clusters across the country in developing knowledge, supply chains and the UK's Spherical Tokomak Energy Production plant. Another example is Arrival, who have made strong use of innovative micro-factories. Although their research and development may occur in Oxfordshire, Arrival's ambition is to create a range of micro-factories across the UK where they can manufacture products for the immediate market. This is all part of the positive spillover the Arc can have across UK regions.

The Arc can also contribute to wider UK goals around carbon reduction. Innovation that happens in Oxfordshire and across the Arc can be scaled up elsewhere to have a massive impact on British business, the economy and in helping us meet our sustainability goals agreed at COP26. This is all about creating a strong, inclusive economy: Oxfordshire has strong knowledge-based innovation areas creating strong economies, but how do we ensure that wealth creation is mirrored across communities? For example, Didcot in Oxfordshire is only a stone's throw from Harwell and Milton Park but more one in 10 children there are living in poverty. There is much to do to ensure positive action to address this disparity locally as well as nationally. In Oxfordshire, OxLEP has been working with local authorities and other key stakeholders on an Oxfordshire Inclusive Economy Programme to try and address some of these issues.

What are the opportunities and barriers to attracting investment from overseas?

We need to understand that we are working in an incredibly competitive, global environment, competing with old and new ecosystems and clusters around the world. How do we articulate what is different and unique to the UK: the Arc provides the backbone for the UK to drive the science superpower narrative and with it the message that we are at the forefront of finding solutions to the globe's greatest challenges through our research capabilities, our innovation and creativity and our talent.

I welcome the Government's creation of the Office for Investment and the Investment Council, both of which will address UK competitiveness and the attractiveness of the UK for foreign investors. In the last few decades, the UK has fallen considerably behind some of its competitors in terms of incentivising investment. We particularly need to address that in areas where we have growing capabilities and expertise, and where we have the opportunity to be a world leader - such as in the fields of fusion energy or quantum computing. The commitment and government investment into both these areas has been great, but alongside that investment we need to make it as easy as possible for new companies to utilise research and assets and draw them in to the Oxford-Cambridge Arc.

Innovators and entrepreneurs across the globe will want to operate in these and other emerging sectors and nations will be quick to invest to secure a global lead. We need to work closely with central government to ensure that Oxfordshire and the UK continues to be a global leader in these fields and emerging technologies, committing fully in terms of resource to help us continue to play our part in the world as a science superpower.

Policy Recommendations

Innovation generates collective social prosperity. Attracting finite global capital and maintaining an edge is necessary to global Britain, but this is best advertised as a product of global collaboration. The knowledge sharing network across the Oxford-Cambridge Arc and it's status and reputation as a centre for R&D cannot be replicated at any other level internationally.

Supercharging the Arc and elevating its standing as the UK's scientific superpower is in our national interest. The spillovers that benefit the rest of the UK are immense, not only in terms of supply chain, job creation, education and collaboration, but in the way innovation solves deep societal challenges. The value created financially, economically, socially and environmentally is not to the benefit of the region alone. The Arc empowers, cultivates, incubates, advances and propels. The Oxford-AstraZeneca vaccine is just one example of the untapped potential we have a duty to unlock.

Supercharge

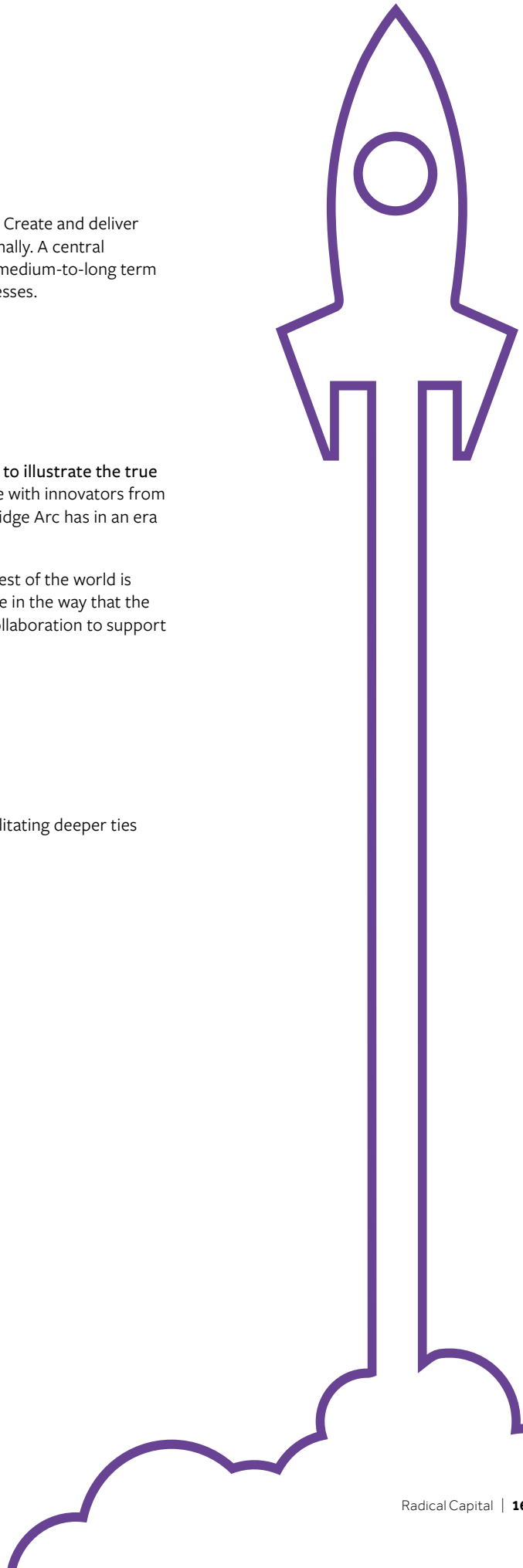
- **Create an Arc-wide promotion agency to continue telling the story.** Create and deliver a brand and a narrative to promote the region both locally and nationally. A central organisation leading the storytelling to different audiences over the medium-to-long term consistently reminds us of the pride we should have in our S&T successes.

Advance

- **Create a prospectus which brings together the greatest innovators to illustrate the true potential of the Oxford-Cambridge Arc.** Government must interface with innovators from every sector to convey the competitive edge that the Oxford-Cambridge Arc has in an era of global Britain.
- **Re-engineer the way academia works with the private sector.** The rest of the world is roaring ahead while we are struggling with scale. We need to be brave in the way that the triple helix invests in its partners, and promote active government collaboration to support our greatest ideas and innovations.

Grow

- **Establish a triple helix forum as part of the levelling up agenda,** facilitating deeper ties between academia, enterprise and public sector organisations.



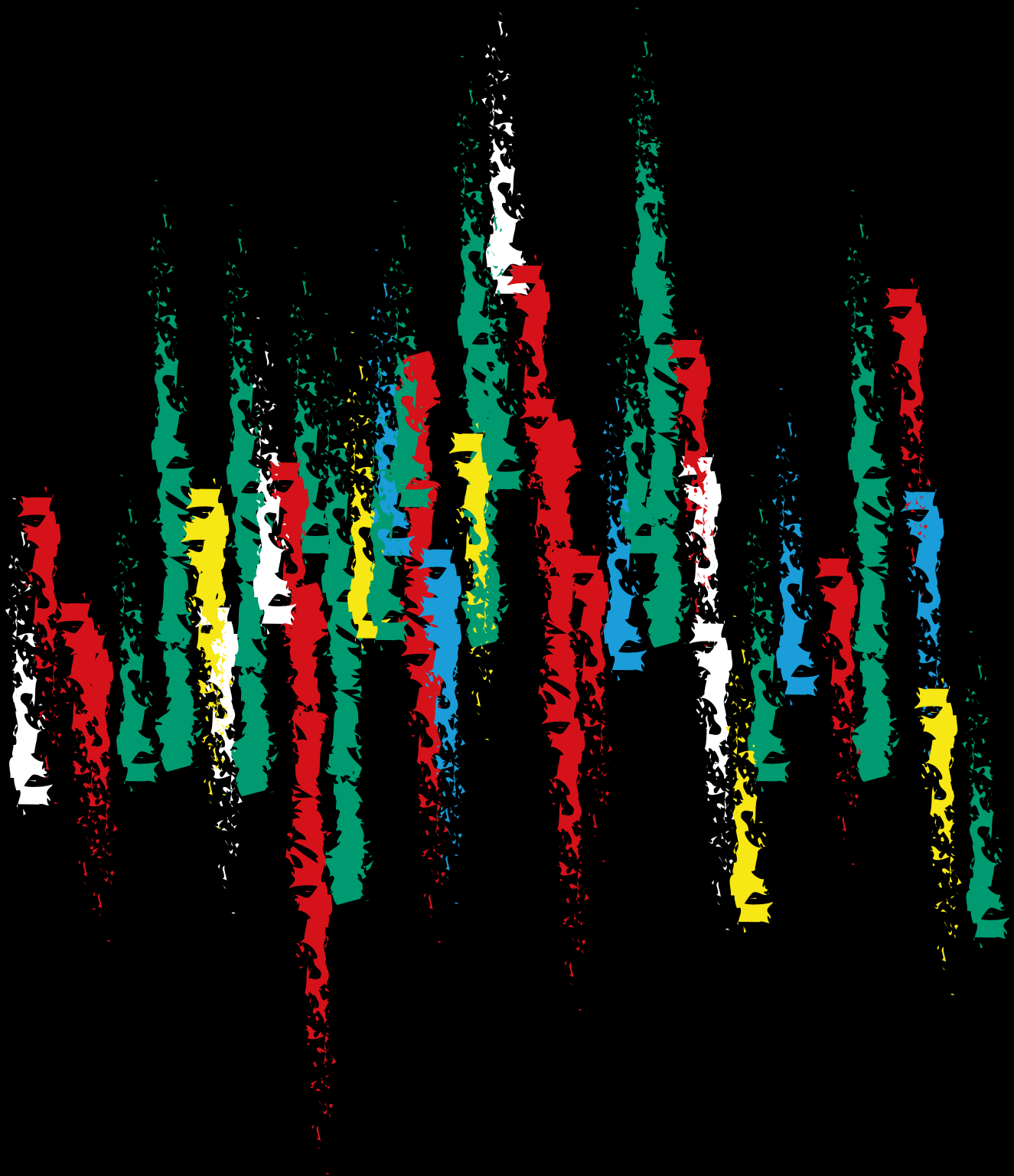
Acknowledgements

We'd like to thank the diversity of contributors to this piece for their ongoing support, ideas and insights, which have given this report the weight the Oxford-Cambridge Arc so greatly requires.

The depth of the recommendations made, and the range of backgrounds that this report has come to encompass, speak volumes of the desire to see national success and global prosperity emerging from the Arc as a wellspring of knowledge, talent, innovation and world-renowned expertise and industry.

The content of this report, its unique mix of high-level contributors, and the think-tank that has emerged is owed in no small part to Blackstock's Strategy and Policy Director Joshua Carson and Senior Policy Researcher Joseph Lee, who have worked tirelessly for eight months helping to produce this report.

Radical Capital



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