Rising to the Challenge:
Mobilising university-industry-government
partnerships for an innovation-led recovery

Insights from the Oxford Summit 2021

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Acknowledgements

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Executive Summary

Since the onset of the COVID-19 pandemic in early 2020, countries around the world have faced unprecedented disruption and devastation to the health and resilience of their economies and societies. While we have yet to emerge from the health crisis, governments, universities and companies are planning for the economic recovery. Innovation is at the heart of many of these plans, with partnerships between universities and the private sector seen as a particularly important component for helping to drive the recovery and unlock new sources of economic and societal wealth.

In developing and implementing these plans much can be learned from how universities, companies, governments and societies came together to tackle the pandemic. The Oxford Summit 2021 convened 60 senior leaders from these organisations to reflect on their experiences in leading their organisations through the turbulence of the first 15 months of the pandemic. Crucially the discussions focused on co-creating ideas about how to move forward and better mobilise new and existing partnerships to lead the economic recovery and drive innovation at both pace and scale in the future.

This report captures key messages and insights emerging from the Summit on three key issues:

- What can be learned from our response to the COVID-19 pandemic to catalyse innovation at pace moving forward

- How governments can better enable international partnerships to drive innovation and tackle major industrial and societal challenges

- How partnerships involving universities, industry, government and societies can be better mobilised to develop solutions at pace and scale to tackle the climate crisis

Catalysing innovation at pace: lessons from the pandemic response

The pandemic induced many universities to respond to overcome the hurdles thrown up by the health crisis coupled with numerous operational, social and economic impacts of national lockdowns. Organisationally, many pivoted and reprioritised their resources and capabilities to support the COVID-19 response: through additional research and development to develop vaccines and therapeutics, diagnostics, and medical devices such as ventilators; to helping companies in local communities pivot their organisations to survive the turmoil; to working with local hospitals to help them manage the unprecedented demand on services. Key elements of the organisational response are shown in the box below.

Organisational responses during the pandemic

Organisations pivoted and reprioritised resources and capabilities rapidly. This was aided by funding that could be rapidly deployed; and reprioritising administrative, contract, and knowledge exchange support to focus efforts on pandemic-critical projects while enabling as much other activity as possible.

The urgency of the pandemic forced universities and their partners to act rapidly: to hugely accelerate negotiations and overcome bureaucratic hurdles that typically affect partnerships; to get projects up and running very quickly; and to move rapidly from idea to prototype to product.

The fight against COVID-19 has led to new opportunities for universities, companies and others to come together to tackle other innovation challenges. To take advantage of them, universities and their partners had to find new ways of operating given national restrictions.

Organisations shifted rapidly to remote working. This forced innovation in the delivery of operational activities and in the negotiation and development of partnerships. This brought new

opportunities but it also led to challenges that we are only just starting to appreciate.

Individuals and organisations from across academia, industry, government, charities and society came together around a single common goal: to collaborate to develop solutions to the crisis. This galvanised communities to action, stimulated creativity, and accelerated the translation of promising ideas into practical applications.

Organisations had to find ways of balancing the need to deliver pandemic-critical projects with the well-being of staff across all functions, many facing intense personal and professional pressures.

Universities and companies focused more on collaboration, rather than competition between partners, to accelerate the development of solutions to the COVID-19 crisis.

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Lessons from the pandemic for university-industry partnerships to catalyse and drive innovation moving forward

The Summit heard from many leaders involved in developing their organisation's response to the pandemic. Their experiences offer insights into what changes could be maintained post-pandemic to improve the ability of universities, companies, governments and societies to come together to catalyse and drive innovation. They also provide insights into where processes and approaches could be improved. Key insights are captured in the box below.

Learning lessons from the pandemic to inform future approaches

Build on the strategically important, high impact missions with clear stretch goals to galvanise communities and better coordinate efforts to tackling it.

Develop funding at sufficient scale able to unlock significant breakthroughs towards delivering on key challenge goals. The pandemic has shown what is possible when funding is largely unrestricted.

Celebrate and reinforce the value of the 'triple helix' for developing the solutions to real world problems. It was this partnership that led to the development of the major COVID-19 vaccines around the world. Its true value is often significantly underappreciated.

Continue to elevate the importance of science and engineering capabilities within senior decision-making positions in government and industry. This is important for enabling key decision-makers to understand the potential of scientific breakthroughs and how to invest to translate them to drive real world impacts.

Capitalise on the growth in public engagement with science to develop more user-engaged modes of research and innovation and raise public appreciation of the value of publicly funded research.

Improve coordination within government to funding research and innovation.

Maintain the flexibility of funding to facilitate a rapid response of the research system to tackle COVID-19 challenges. Take steps to place the research system on a long-term financially sustainable footing.

Develop new approaches to partnerships including: reproducing the intensity and focus of the COVID-19 response while ensuring staff well-being and work-life balance; enabling greater mobility between, academia, industry and government; and deepening engagement with non-traditional funders interested in developing solutions to specific challenges.

Better configure universities to pursue mission-oriented research, and accelerate the translation and commercialisation of ideas into applications.

Find ways of translating and applying the creativity and collaborative spirit developed to tackle COVID-19 to other societal challenge.

Invest in efforts to learn the lessons from remote working during the pandemic to inform the future of work to make improve both productive and well-being.

Insights for tackling other major societal challenges moving forward

The pandemic is but one of many major societal challenges that need to be tackled with urgency. Others include: the climate crisis; extreme economic, health and social inequalities; ageing populations; and increasing anti-microbial resistance (AMR). Discussions at the Oxford Summit explored whether their collective experiences could offer lessons for how to collaborate more effectively to tackle other complex societal crises. Key insights are captured opposite.

Tackling major societal challenges moving forward

COVID-19 a is particular type of crisis, one that is devastating, and immediately and visibly disruptive. It was likened to a 'burning platform' compared to other major societal crises which are more chronic, 'smouldering platforms'. This has implications for understanding how people and organisations behave and how a response could be developed.

Tackling other major societal crises at pace and scale requires finding ways of motivating and galvanising organisations to invest substantial efforts in developing solutions, but without resorting to instilling acute fear in people.

The scale of the economic cost of failing to act against COVID-19 quickly became clear. For other crises, it is hard for people to understand, let alone internalise, the full economic cost of inaction. This makes it harder for universities, companies and governments to invest the necessary resources and make behavioural changes to drive breakthroughs.

While funding is certainly not a sufficient condition for unlocking breakthroughs, dramatic progress can be made when it is largely unconstrained. Tackling other complex societal crises will require similar scales of investment and effort.

Given huge fiscal pressures on governments, public funders need to become more strategic about identifying core priorities for their funding, to ensure they can fund at sufficient scale to deliver substantive progress.

Complex societal crises are often systems-level problems and require the effort and involvement of many organisations along the research-to-innovation pathway. Ways of galvanizing organisations around a challenge, and better coordinating their efforts to find solutions, should be sought.

Other than funding, other important factors for driving change include: a strong 'pull' incentive (e.g. market or public demand); commitment from across the system; willingness to experiment, challenge traditional ways of doing things, and take calculated risks; greater flexibility from universities and companies on contractual terms to make things happen; more agile and faster decision-making; a more active and engaged leadership in delivering change; and much stronger incentives for societies to change behaviours.

The early pandemic response was hampered by a lack of key national infrastructure to enable research, innovation and scale-up to drive solutions at pace and scale. We need to improve how we anticipate these infrastructure needs.

Actively involving users of innovation and the public in the research and innovation process, and in determining funding priorities, can help to secure buy-in for difficult decisions regarding adoption of solutions, particularly where behavioural change is required.

Governments and the building of international partnerships to drive innovation

How can governments better enable international partnerships to drive innovation and tackle major industrial and societal challenges? Summit delegates saw substantial opportunities for unlocking economic and societal wealth from getting countries to work more effectively together. By collaborating, the chances of achieving the end goals are much higher and progress can be made more quickly.

Among other things, international collaborations can enable a scale and scope of frontier research that no nation could achieve alone: the ability to leverage complementary resources, including funding, expertise and facilities that exist in different countries; the strengthening of scientific and diplomatic relations; the training of a science and technology workforce capable of solving global problems; and access to international students and scholars who contribute significantly to the national research endeavour.

Drivers and enablers for developing effective international partnerships

Discussion at the Summit explored key drivers and enablers for the role of governments in supporting the formation and nurturing of international partnerships to catalyse and drive innovation. While not exhaustive, important drivers are captured in the box below.

Drivers and enablers for developing effective international partnerships

International R&I partnerships requires much more than funding programmes. Crucially, it requires people with the ability to nurture relationships across borders, cultures and organisations; a willingness to engage; and a set of technologies and infrastructure to make them work.

In seeking to develop international partnerships we need to move beyond thinking about research collaborations, and instead think about partnerships that can accelerate the translation and commercialisation of research into impactful applications. This will determine not just where the potential for value is created, but where it is realised.

Countries are at different starting points in terms of their experiences in developing and nurturing effective international collaborations. We need to learn from each other about what works, and under what circumstances, and be willing to experiment with new approaches for specific national contexts.

Global challenges such as climate change, extreme poverty, and global health would benefit from funds of substantial scale at the global level aimed at delivering breakthroughs at pace and scale. These make it easier to identify and assemble capabilities, wherever they exist in the world, to drive progress. It could also help to overcome the skewing effects of national political objectives that can make it harder to develop new collaborations.

Our start-ups and university spinouts must be driven by global ambitions. We need to ensure that the system does not lead these companies to settle for a 'good enough' national market but drives them to develop globally competitive value propositions aimed at changing the world. This needs to be backed by the range of resources (financial, human, physical, technological) to allow them to develop and scale ideas into products and services.

Challenges to developing effective international partnerships

Many challenges make it harder for universities and companies in different countries to collaborate across borders to accelerate progress towards tackling technological, industrial and societal challenges. Below are some of the key factors that emerged from discussions at the Summit.

Challenges to developing effective international partnerships

Concerns that government funding of international collaborations are becoming increasingly influenced by political rather than scientific and innovation objectives. Coupled with rising political uncertainty this created significant risks for academics in building international alliances.

National security concerns arise more frequently when developing international R&I partnerships. With new legislative requirements, effective and timely due diligence is critically important. However, it is often under-resourced and can lead to delays and frustrations amongst academics.

Countries can have very different national priorities and objectives for building international collaborations. This can lead to unbalanced partnerships.

There can be an imbalance of benefits between partners. More equal partnerships, rather than leader-subordinate collaborations, should be developed when working together to tackle global societal crises.

Bilateral agreements between governments can make it harder to initiate collaborations with researchers in other countries. This can make it harder to deliver on other important research and innovation objectives.

Limitations of current funding structures can make it hard to secure the funding to build and nurture international collaborations due to restrictions on who can be funded. The added complexities and effort can lead researchers to pursue domestic over international collaborations.

Despite progress over the past decade, tensions remain around incentives for individual researchers, incentives for universities as organisations, and incentives to deliver on the nation's strategic priorities for science, technology and innovation.

Many other challenges make it harder to develop effective international partnerships. These include: bureaucracy and high 'transaction' costs; the ability to adapt and reconfigure international partnerships as needs change; communication between partners, including uneven access to communications technologies; a lack of funding to translate and commercialise research outputs; and the ability to demonstrate the value of these partnerships within timeframes set by funders.

What more can be done by national governments?

Building on the insights on drivers and enablers, and on the major challenges hampering the development of international research and innovation partnerships, discussions at the Summit identified key actions that governments could take to make it easier for these partnerships to form and thrive and deliver breakthroughs in research and innovation. These include:

■ Bilateral agreements between specific countries should be complemented with a wider portfolio of relationships, including developing multilateral agreements. Steps must be taken to ensure that agreements do not make it harder for researchers to collaborate with countries not covered by national-level agreements

■ Decisions to form national-level agreements should be informed by the needs of the R&I community to ensure appropriate targeting of funding and to secure buy-in

■ Governments should work together to identify big, strategic challenges that could be pursued at the global level

■ More effort should be placed in developing mission-oriented approaches to investing in R&I to tackle global challenges. These need to be built around compelling challenges that can galvanise communities to commit time and effort. They also need to be translated into specific and tangible technical challenges to be solved along the journey. However, it is not clear who has the mandate and ability to do this at a global scale

■ Mission priorities need to be backed by substantial and sustained resource commitments to create critical mass to drive breakthroughs. Mechanisms need to be developed to pool resources more easily at a global level

■ Efforts must be increased to remove impediments to the global mobility of talent

Mobilising partnerships to accelerate the transition to a sustainable future

What can be done to better mobilise partnerships between academia, industry, governments and societies to tackle the climate crisis and rapidly accelerate the transition to a more sustainable future? Accelerating the process of innovation in all areas of the economy – across industries, supply chains, and product lifecycles – must be a central pillar of action for tackling the climate crisis. This must include not just new products and services, but also new ways of producing, distributing and supplying products. We must also rapidly accelerate the diffusion of successful innovations around the system to deliver widespread impacts.

The need for system-wide change and bold action

Discussions at the Oxford Summit identified a number of changes required at the system-level to accelerate the transition to net zero and enable university-industry partnerships to contribute more actively and effectively. These are captured below.

Transitioning to net zero: the need for system-wide change

The climate crisis is not a sufficiently major public concern in many countries, with large variations in acceptance between and within countries. In urgently raising awareness, we need a much stronger, more serious communications strategy. This should not be left to politicians alone but draw on leaders and influencers from different parts of societies.

Tackling the climate crisis will require major changes in the behaviour of individuals, organisations and societies, and we need much stronger incentives to drive this. This will be critical not least for accelerating the deployment and widespread adoption of breakthrough innovations. Understanding public acceptance needs to be part of innovation process.

The transition to net zero will likely lead to disruptions to the existing functioning of societies, with effects falling on the poorest communities. We need to take steps to mitigate these effects.

Transforming traditional sectors of the economy such as construction and manufacturing will be key to delivering net zero. Yet these 'legacy' sectors face significant obstacles to innovation and are typically resistant to change. We need to understand the scale and nature of the obstacles to inform targeted action.

Accelerating innovation to tackle the climate crisis will require a greater tolerance of failure across all parts of the innovation system. Many potential solutions will fail, but this process of experimentation is a key part of the journey and needs to be encouraged and nurtured.

Tackling the climate crisis will require big and bold visions to be developed. These need to be ambitious, long-term and escape political cycles that drive short-term mindsets, create long-term uncertainty, and divert effort and investment. Visions need to be at the global level, backed by significant funding and a clear and concise communications strategy.

Big, bold visions need to be translated into ambitious and clear targets and stretch goals that can provide clarity to organisations over the direction of travel, reduce duplication of effort, facilitate collaborations and coordination of effort, and reduce uncertainties in investing in R&D, people, and infrastructure.

Tackling the climate crisis requires a whole-system, whole-lifecycle approach accounting for the multi-level nature of the problem: from the global-to-national-to-local level, across product and technology lifecycles, and across supply chains for each sector. Inclusive approaches will be critical.

Advances in R&D are important, but solutions will also require new skills, infrastructure to drive diffusion, standards and regulations, production processes, supply chains, business models, and incentives and support to nurture nascent markets.

Active planning is required now for the diverse skills needed to tackle the climate crisis. In addition to specific technical skills to develop and adopt new products and services, we also need to be training people to challenge the status quo and encourage entrepreneurial disruptors who can think outside the box and take risks when innovating. Tools should also be given to help people to develop their resilience and adaptability.

The urgency of the climate crisis requires development of solutions based on research advances that have already been made. We must improve our ability to translate this research and deploy emerging products and services at both pace and scale. This phase of the innovation process is currently hampered by lack of funding.

More flexible, longer-term funding commitments may be needed. Three-year programmes for building centres of excellence or larger scale collaborations can result in promising research and innovation activity being shut down before success can be demonstrated to raise follow-on funding.

Governments need to leverage their procurement power to help reduce the market risks associated with emerging technologies by creating more certain demand for products and services.

We need to build much stronger and more effective international collaborations to tackle the climate crisis. These are necessary to mobilise the critical mass of resources and capabilities from across the world to accelerate the development of solutions at pace and scale. These collaborations need to happen at all levels, from vision setting to problem definition to developing solutions.

Greening partnerships to tackle the climate crisis

In addition to these system-level changes, we must innovate in how we mobilise partners to accelerate the innovation process to tackle the climate crisis.

Reconfiguring partnerships to accelerate the translation, development and commercialisation of technologies	Summit delegates highlighted the urgent need for new organisational environments within universities – or strongly linked to them – that can assemble the necessary resources and capabilities (including people, equipment, processes) under the necessary conditions (e.g. standards, contracts, IP arrangements) to accelerate the prototyping and demonstrating of emerging technologies. We need to develop more agile and multi-functional teams able to integrate the range of knowledge and capabilities required along the lab-to-market journey. Further, the social sciences have never been more important. We need to break down barriers and siloes to better integrate social scientists into research and innovation partnerships.
Leveraging the position and scale of universities in societies to lead change and provide test-beds for emerging technologies	Universities are typically some of the largest employers in their economies. They also work with many companies of all sizes and across many sectors of the economy. Further, many have strong local, national and global brands which can act to amplify key messages on societal issues of importance. Given this, they have significant potential to take a leadership role in the drive to net zero, not least through demonstrating to others how large and complex organisations with large real estates can transition to become carbon neutral.
Addressing long-standing issues that make it harder for universities and companies to partner to innovate	Building partnerships to accelerate the pace and scale of innovation to tackle climate change will require dealing with long-standing issues and barriers affecting the development of university-industry collaborations more widely. This includes among other things: ■ Developing better incentives to encourage academics to engage further in partnering (including looking at recruitment and promotions criteria) ■ Strengthening mobility of staff across the academia-industry boundary ■ Revisiting approaches to IP to consider whether the current IP regime is fit-for-purpose for incentivising innovation aimed at tackling major societal challenges ■ Improving understanding of each other's needs, capabilities, constraints, and cultures to improve the ability to work across boundaries ■ These issues have been highlighted for many years. We must increase our effort to improve on the status quo

Moving forward

The partnerships that form between universities, companies, governments and others have the potential to be a significant driving force behind an innovation-led recovery to drive national and industrial competitiveness, and to tackle major societal crises. As a community we must continue to deliver the long-term research that underpins many breakthrough technologies and innovation. We must also invest and develop our capabilities to accelerate the idea-to-innovation journey to ensure that breakthroughs are developed into real world innovations at pace and diffused at scale. Finally, we need to develop better ways for convening universities, industry, investors, governments and societies to identify collective and urgent strategic missions – and back these with significant funding – that can mobilise and galvanise this community to deliver solutions to problems at pace and scale, just as we witnessed in the fight against COVID-19.

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1 Introduction

Since the onset of the COVID-19 pandemic in early 2020, countries around the world have faced unprecedented disruption and devastation to the health and resilience of their economies and societies. While we have yet to emerge from the health crisis, governments, universities and companies are starting to plan for the economic recovery and 'build back better', with some taking bold steps to shape new ways of working.

To support these efforts, in July 2021 the Oxford Summit brought together senior leadersfrom universities, industry and governments to reflect on their experiences in leading their organisations through the turbulence of the first 15 months of the pandemic and co-create ideas about how to move forward. In particular, the Summit looked at how universities, industry, governments and societies can continue to mobilise new and existing partnerships to: develop solutions to problems facing us at both pace and scale; drive an innovation-led economic recovery; and tackle other critical global societal crises such as climate change, aging populations, antimicrobial resistance, persistent inequality and poverty, and the scourge of plastics in the oceans.

This report captures key messages and insights from the rich and wide-ranging discussions held at the Oxford Summit around the following core questions:

- What can we learn from our response to the COVID-19 pandemic to catalyse innovation at pace moving forward?

- How can governments better enable international partnerships to drive innovation and tackle major industrial and societal challenges?

How can we better mobilise partnerships involving universities, industry, government and societies to develop solutions at pace and scale to tackle the climate crisis?

- The Oxford Summit assembled 60 leaders and senior managers from universities, large companies, government agencies and other organisations. Table 1 provides a detailed breakdown of the attendees.

Table 1

Number, type, and country of delegates		Number of delegates	Share of total (%)
Total		60	
Country	United Kingdom	37	62
	North America	14	23
	Rest of Europe	9	15
Type of organisation	University	31	52
	Industry	12	20
	Government / funders / interface organisation	17	28

Catalysts for innovation at pace: lessons from the pandemic response

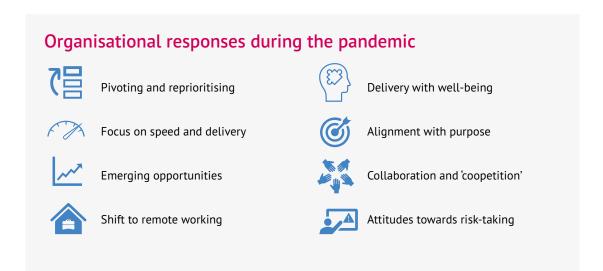# 2 Catalysts for innovation at pace: lessons from the pandemic response

The pandemic has presented society with urgent challenges. Across the world governments, universities, companies and others acted at pace to tackle different aspects of the crisis: from the provision of personal protective equipment and ventilators; to the development, manufacture and distribution of vaccines; to implementing schemes to support the short-term survival of individuals and companies. They had to innovate at pace – often working closely together – developing policy, legislation, products and entirely new research programmes at great speed. This often meant diverting people, resources and capacity to work on new projects, making quick decisions, and finding new ways of doing things. They also had to find ways of keeping as many of their core activities going as possible, with much transitioning online.

Some of the changes made during the pandemic will have longer term benefits for how universities, companies and government agencies can work together to catalyse and drive innovation.

This section captures the experiences of Summit delegates in navigating their organisations through the pandemic to catalyse innovation. It draws on their insights and ideas about what we can learn from their organisation's pandemic responses around delivering research and innovation during the crisis. It then considers what the delegates see as key lessons that could be carried forward to build more effective partnerships as we move beyond the pandemic to help universities and their partners jointly tackle other major societal challenges.

2.1 Organisational responses during the pandemic

The COVID-19 pandemic and the scale of health, social and economic devastation it rapidly unleashed around the world challenged universities, companies and governments to respond and adapt in ways that would have been unthinkable pre-crisis.

Organisational responses during the pandemic

Pivoting and reprioritising

Focus on speed and delivery

Emerging opportunities

Shift to remote working

Delivery with well-being

Alignment with purpose

Collaboration and 'coopetition'

Attitudes towards risk-taking

Pivoting and reprioritising

As the pandemic started to close down economies and societies in early 2020, universities and their many partners had to shutter much of their physical estate and move staff to working from home. This presented enormous challenges to continuing operations. With universities and their partners holding potentially vital knowledge, tools and technologies that could contribute to the fight against COVID-19, leaders and managers within these organisations had to make very difficult decisions on how to prioritise their available resources to deliver pandemic-critical research, innovation and support activities.

Delegates at the Oxford Summit revealed how they worked to **reprioritise internal funding** to support the COVID19 response. Some brought together pockets of funding from different sources to allow for more flexible, targeted and responsive support to pump-prime projects that could deliver key Covid-19 -related priorities. Funding was made available rapidly to those who needed it which, in turn, helped to secure further funding from external sources (including from public and private sources). Delegates noted that previous attempts to assemble such funding would have met with resistance from different stakeholders looking to protect their own local initiatives. The pandemic forced them to pool these resources at institution-level to enable a more coordinated and coherent response to tackling COVID-19.

The experience of assembling funding in this way demonstrated the value of funding pots being available at sufficient scale to enable portfolios of projects, focused on delivering against specific challenges, to be organised in a more coherent and coordinated way. Such funding needs to be responsive and flexible, with challenge-driven objectives and priorities set to provide strategic direction to those seeking to apply for it.

To underpin their COVID-19 responses, universities also **pivoted their administrative, contracting and knowledge exchange support functions to fully prioritise COVID-19 response projects and activities**. This meant that, for a while, support for non-COVID-19, non-urgent projects and activities was de-prioritised. At the same time, these support units had to deal with staff moving to remote working, sub-optimal home-working environments, finding new ways of delivering services, and suffering from significant capacity constraints resulting from national lockdowns and the shuttering many essential services (such as education and childcare provision) to all but critical workers.

Universities are typically home to a broad portfolio of capabilities and research. As a result, many academic, research and other staff were able to find ways of assembling and pivoting their capabilities (alone or in teams) to help tackle COVID-19 challenges. This meant that, while support functions prioritised activities urgent to the COVID-19 response, demand for this support was still very high. A major challenge for the leadership of these units was how to further prioritise requests for support within the COVID-19 related projects and activities that reached their desks.

Efforts to deliver projects were also reprioritised to support certain types of partners. This included most obviously those organisations directly involved in solving the health crisis (e.g. in developing diagnostics, vaccines and therapeutics; supporting hospitals in responding to unprecedented demand on their services; and providing scientific evidence to inform policymaker decisions). It also included companies (particularly SMEs), charities and others that were struggling to adapt to the incredibly difficult economic conditions. Many examples surfaced of universities pivoting their knowledge exchange services to help local companies find ways of reconfiguring their organisations to transition to new ways of working, finding new ways of delivering their products and services, and developing plans to pursue new market opportunities.

In addition to businesses that were in distress, there were also organisations – including SMEs – that were suddenly confronted with significant growth in demand for their products and services (whether health-related or driven by changing patterns of consumption during lockdowns). These organisations had to find new ways of working to meet demand. As the pandemic abates, these businesses may have to adapt once again if pandemic-induced levels of demand cannot be sustained.

Focus on speed, delivery and being outcomes-led

To ensure universities were able to play an active role in tackling the health, economic and social effects of the pandemic, they had to act very quickly and focus on operational delivery. The urgency of the pandemic forced staff to, among other things: rapidly accelerate negotiations with partners and the development and signing of contracts; finding ways to overcome bureaucratic hurdles that commonly affect the setting up of new partnerships; and working to get projects up and running as quickly as possible. This placed significant demands on knowledge exchange staff and the administrative functions of universities.

For some universities and companies this focus on outcomes-led delivery led to changes in their approaches to negotiating IP, with greater recognition of the need to vary terms and conditions depending on the planned use of the IP (e.g. for social good vs more commercially-driven application).

Furthermore, with partners focused on a common goal to develop of products and services to solve the many emerging challenges, negotiations around establishing partnerships and commercialising IP were very much driven by the scientific and innovation need and rapid delivery. Significant efforts were made to reduce commercial, legal and governance issues that can cause frictions during negotiations. Trust between partners, strong alignment of interests around the common goal of tackling the pandemic, and empowerment by senior leadership to deliver quickly, were seen as important factors for rapidly accelerating these negotiations. However, it did create challenges for legal teams who were being asked to quickly develop new types of contracts that had not been done before.

Emerging opportunities

The pivoting of universities and companies, and the reprioritisation of effort to deliver COVID-19 related projects and activities through the pandemic has led to concerns of the longer-term effects on non-COVID-19 activities. The delegates at the Oxford Summit had not detected a lessening of other priorities where these were able to proceed (e.g. given local restrictions such as access to facilities and ability to travel). Many of these projects were, however, disrupted, delayed and faced major challenges to delivery.

Summit delegates talked of how new opportunities typically emerge during periods of significant disruption, and the challenge was to be responsive and agile enough to grasp them. Rather than creating tensions between academics working on COVID-19 related projects and those involved in other areas, the pandemic has helped to inspire academics across institutions to be bolder about what can be achieved, particularly when teams comprising different capabilities come together around a common vision. Universities are now starting to see really ambitious, large-scale, challenge-led projects emerge, for example around the transition to net zero.

Shift to remote working brought benefits and challenges

As economies were shuttered, many staff within universities and their partner organisations had to transition rapidly to work from home. This brought significant challenges in the early days of lockdowns, particularly when the provision of essential services such as schools and childcare were significantly curtailed. However, as people became used to virtual working, they began to see some benefits emerge. For example, they found it easier to get hold of people, particularly those in senior leadership and management positions, driven largely by the lack of travelling freeing up significant time in their diaries. They also found it easier to reach much wider audiences, both to engage partners from further afield in projects, and to disseminate findings and insights to larger and more diverse audiences.

There was also recognition that home/remote working incurs significant challenges and costs, some of which are only beginning to emerge after two years of experience. These are discussed in more detail in the next section.

Balancing delivery with well-being

For universities and their partners, attempts to sustain as many of their activities and deliver as much output as possible during the pandemic led to incredible demands on their staff, who were themselves facing significant challenges in their home, personal and professional lives. Many staff worked well beyond the typical working day for long periods to get things done. This resulted in leadership and management of organisations facing major challenges around how to balance delivery (particularly where this was important for the fight against COVID-19) with the well-being and mental health of their staff. There is a recognition that the level of work demands on staff to deliver during the crisis period of the pandemic cannot be sustained long-term.

Strong alignment around a common purpose

The urgency and scale of the crisis, and its global reach, lead to a strong alignment of the motivations of individuals and organisations, and across academia, industry, government, charities and societies, to work together to innovate, develop, and deploy solutions to tackle the crisis. This alignment around a common purpose with a common strategic direction galvanised individuals, organisations and funders into action, enabled collaborations to form at pace, and stimulated people's creativity to come up with bold ideas. This made rapid progress in translating research into practical and deployable applications much easier.

Shift from competition to collaboration and 'coopetition'

The pandemic response saw organisations accelerate a shift from competition to much greater collaboration, or coopetition (collaborative competition). This shift was evident not just between universities and businesses, who worked closely together to co-develop solutions, but also between universities. Summit delegates noted that their organisations appeared to become more collaborative during the pandemic and focused less on competition (e.g. for resources) compared to pre-pandemic.

The delegates believed this acceleration towards 'truer' collaboration and partnership – with each partner driven by the objectives of the project rather than balancing personal vs project interests – helped to accelerate the development of innovative solutions to many of the COVID-19 challenges they tackled.

Some of the solutions would have been developed through pre-pandemic modes of competition and collaboration, but delegates suggested that they would have taken much longer. True and effective collaborations take significant effort to establish and nurture. They require individuals to mortgage some degree of individual freedom and individual success for wider team benefit and success enabled by working collectively. Typical justifications for inaction and not collaborating such as "I do not have the time due to other commitments" or "I cannot see how the collaboration will advance my objectives" were swept away as individuals and organisations could see the value of coming together to tackle the pandemic.

Summit delegates noted that, while this acceleration towards collaboration began in areas related to the COVID-19 response, they are now seeing this transition into other areas, particularly around working together to tackle other major societal challenges such as climate change.

Changing attitudes towards risk-taking in academia, industry, and government

Universities, companies and governments also became less risk-averse during the pandemic. Part of this was enabled by sign-off decisions within these organisations being elevated to more senior managers with the aim of driving faster decision-making. These managers were more able to see the wider risks and benefits of making a particular investment, or pursuing a particular course of action, and were empowered to take more calculated risks than more junior colleagues. However, delegates viewed this as unsustainable outside of the crisis period due to the demands it places on a smaller number of individuals and the potential for bottlenecks to form.

Some organisational changes made during the crisis period – such as the creation of targeted pandemic response groups and committees – helped to accelerate decision-making and enabled more calculated risk-taking. However, a challenge is now emerging around how to stand down organisational structures that were created in the urgency of the early stages of the pandemic to deal with specific, crisis-induced situations and decisions where these are no longer necessary. Some of these cut across pre-pandemic decision-making structures that were established for good reasons and are becoming resistant to being disbanded.

2.2 Learning from pandemic responses to drive more effective partnering moving forward

As universities, companies and government research funding agencies begin to look beyond the pandemic, questions are being asked about how the partnering landscape has changed: what we can learn from the experiences of responding to the pandemic; and what new ways of working and approaches could be carried forward to improve the effectiveness and efficiency of partnering in the future.

2.2.1 Emerging and accelerating trends

The socio-economic, political, innovation, and industrial landscapes were in flux even before the onset of the COVID-19 pandemic, resulting in pressures on what we prioritise as societies, and how we work and innovate. The shockwaves induced by the pandemic and the shuttering of economies and societies has both accelerated changes that were already underway and led to new trends emerging.

Key trends

🧠 Innovation and agility

🤖 Digitalisation and automation

🧗 Organisational resilience

🏛 Design and use of buildings

£ Focus on financial sustainability

The changes discussed in this section are drawn from the views of the Summit delegates, reflecting on how their organisations, and the sectors within which they operate, have changed because of the pandemic.

🧠 Innovation and agility have become key priorities for organisations

The first trend identified by Summit delegates was that the strategic importance of innovation and organisational agility became much clearer for many organisations (not just companies but also universities to government agencies). They had to deal with major changes to demand for their products and services – some facing dramatic reductions, others significant increases – as well as with significant challenges as to how to organise themselves to supply these. As a result, these large and complex organisations were forced to find ways of becoming more innovative and agile. They had to find ways of developing their products and services to pursue emerging market opportunities. Some also had to develop and implement new business models to tackle significant increases in costs, engage customers in different ways whose habits and preferences were rapidly changing, and find ways of overcoming restrictions on distribution channels to reach customers.

For example, in the agriculture industry, national lockdowns and severe restrictions on international travel meant that companies had to find new ways of inspecting their supply chains to ensure compliance with standards. Pre-pandemic this would have involved people travelling to visit sites and conduct their checks. The inability to travel drove demand for remote sensing and other technological solutions to perform these supply chain checks remotely. In a very different field, dentist education became very challenging due to restrictions on in-person contacts. This has driven significant demand for the development and use of virtual reality to augment practical, hands-on experiences.

A renewed focus on organisational resilience

The pandemic highlighted very publicly the interconnectedness of the world, particularly for the supply chains that underpin the production and distribution of many of the goods we consume. Pre-pandemic, delegates noted that much of the operational drive within their organisations was around delivering efficiency and productivity gains. The pandemic has forced them to re-evaluate the importance of delivering efficient, productive, and resilient operations.

A renewed focus on the value and sustainability of the research base

The pandemic has demonstrated the importance of the existing, cumulative stock of knowledge available within national and global research and innovation systems. This provided the essential building blocks that could be drawn upon and assembled rapidly to develop solutions to the many and varied COVID-19 challenges, from vaccines and therapeutics to diagnostics and scientific advice, to inform policymaking in times of great uncertainty.

The platforms for many of these solutions – such as technology platforms that underpinned both mRNA and adenovirus-based COVID-19 vaccines – were the result of many years of research in universities and industry, much of it underpinned by public research funding. The rapidity of the response was then a question of being able to take prototypes and rapidly demonstrate and test them in real world settings; move from lab-scale manufacturing to the ability to produce them at full scale production levels; and deploy them at both pace and scale around the world.

Given the importance of the research base to the pandemic responses in the UK, US and elsewhere, there is now a renewed focus on the long-term sustainability of the research system. This is not just in terms of its financial sustainability, but also in terms of its ability to build and sustain the capabilities and infrastructure required to deliver ground-breaking research and the translational and commercialisation activities required to move ideas along the journey to real-world applications.

The accessibility of the research system is also of renewed interest, given the importance of the partnership between universities, companies, hospitals, charities and others in the fight against COVID-19.

Acceleration of digitalisation and automation and implications for valuing and developing the workforce

With the move to remote working for large portions of the workforce, and significant restrictions on both domestic and international travel curtailing in-person operations and the mobility of the workforce, the pandemic has significantly accelerated the move towards digitalisation and automation. Summit delegates from large companies suggested that more progress has been made on this in the first 18 months of the pandemic than in the previous decade.

As organisations move towards greater automation and digitalisation of their operations, delegates argued that we need to be more proactive in considering the implications of these trends for how we educate, value, reskill and upskill the labour force. They suggested that many of the skills requirements emerging for a more automated world may benefit from different types of qualifications and experiences (such as apprenticeships and vocational qualifications) rather than traditional university degrees. An implication of this was the need to come together to rethink how we develop and evaluate education and career pathways for young people.

Summit delegates also emphasised the need to re-evaluate the value of different types of roles in the economy. The pandemic shone a bright light on the importance of key workers that kept our economies, societies, and healthcare systems functioning through the pandemic. These workers – such as nurses, teachers, childcare providers, food production and distribution workers, delivery drivers and many others – are generally some of the most poorly rewarded in society. As inequality grows not just between but within nations, we need to rethink how different functions are rewarded and how wealth is equitably distributed across different segments of the population.

Within higher education, the move to online learning for the best part of two years has prompted a debate about how best to design approaches to education for a generation of students that have grown up deeply engaged with digital technologies and online services. While delegates talked of the many benefits of in-person tuition and the value of having students physically on campus, there was also a recognition that the provision of educational resources and tuition online brought with it some advantages, e.g. in terms of accessibility and flexibility. Questions are now being asked about whether it is possible to bring on-campus learning together with virtual provision in ways that can lead to more valuable educational experiences and outcomes for students.

Rethinking the design and use of the physical footprints of organisations

The pandemic has forced organisations to rethink how they use their physical real estate to deliver maximum value to their operations. Among other things, it is forcing leaders to reflect on how physical proximity of their staff adds value to delivering core research and innovation activities, and whether pre-pandemic ways of organising office space remain appropriate as we look to the future.

Delegates cautioned of too rapid a move to reduce the physical footprint of research and innovation operations, particularly if driven largely by pressures to reduce costs. Creativity is a critical driver of both research and innovation. This is greatly strengthened by bringing people together in close physical proximity to share ideas and co-create solutions. Value is particularly derived from bringing individuals from diverse backgrounds, disciplines and perspectives together around tackling a common challenge. As will be discussed later in this report, while remote working during the pandemic has attempted to re-create these types of interactions virtually, most delegates believed that remote collaboration technologies were still not advanced enough to allow the benefits of in-person interactions to be fully replicated virtually.

2.2.2 Key lessons from the pandemic

The pandemic forced many organisations to change the ways in which they operate and deliver their activities (for example to deal with severely restricted access to buildings and travel). While some of these changes will have been less efficient and effective than ways of working pre-pandemic, some changes have led to improvements and more positive outcomes. This section presents the views of the Summit delegtes on those changes made during the pandemic that they would like to see maintained as we move beyond it.

Building on positive changes made during the pandemic

One-mission, one-goal	Public engagement with science
Funding at scale	Flexibility of funding and sustainability of research
Coordinated government action	Creativity and collaborative spirit
Importance of science and engineering	Future of work
Value of the triple helix	Developing new approaches

One-mission, one-goal

The pandemic made visible the benefits of having a focused challenge built around a strategically important, high-impact mission with clear goals to drive action. This can help to excite individuals and galvanise a community to work in the same direction towards delivering on the key goal. It allows for the mission goal to be dissected into more specific challenges that must be solved for progress to be made, and for these to be clearly articulated and communicated to provide concrete targets to drive specific research and innovation efforts. This can help researchers and organisations to see how their activities fit into a wider system of effort, improving coordination and reducing the risk of wasted effort.

Funding challenges at the scale necessary to deliver breakthroughs

The pandemic also showed what was possible when substantial amounts of funding – from governments, industry, philanthropy and elsewhere – are targeted at solving a specific problem. It enabled activities to be undertaken in parallel and at risk, and at a level necessary to deliver solutions at both pace and scale. Summit delegates – from universities and industry – argued that tackling many other societal crises similarly required a critical mass of investment in order to deliver the progress necessary in the timeframes required; to build up the necessary capabilities and infrastructure; and to attract co-investment by industrial and other partners. Concerns were raised that underinvesting can greatly hinder progress with many efforts sub-optimally funded.

As we move beyond the pandemic, delegates argued that we need to better understand the scale of the funding required to deliver significant progress, and what this means for how governments and others prioritise their resources. While the US, UK, European Union and others have committed to significantly increase spending on R&D and innovation, governments and organisations are facing huge fiscal pressures as a result of their spending to combat the health and economic consequence of the pandemic. Governments are likely to have to make very tough decisions about what to prioritise moving forward, with significant pressures to reduce spending in the short- to medium-term.

More coordinated government action for research and innovation

The pandemic response of some governments brought with it greater coordination of their investments along the research-to-innovation journey to ensure that COVID-19 specific research was rapidly translated into viable products that could be manufactured and delivered to points of need at pace and scale. Summit delegates were keen to see this more coordinated and coherent approach maintained and strengthened. This was particularly the case where resources to support the research-to-innovation journey are controlled by different government departments and funding agencies.

Elevating the importance of science and engineering capabilities within government and industry

Governments around the world often drew heavily on scientific advice to inform their policy response to the pandemic. In doing so it elevated the importance of having ready access to a broad range of scientists (broadly defined) who were able to engage closely with civil servants and politicians to inform their decision-making. While the Summit delegates saw this as a very positive development, a note of caution was raised: as scientists become more closely engaged to inform political decisions, it becomes critically important to ensure they maintain their scientific independence from political interference. Furthermore, this independence has to be real not just in practice, but also needs to be perceived as real by the public.

As with businesses seeking to leverage knowledge generated externally to their organisations to develop their products and services, **governments need to build their absorptive capacity to engage with scientists to effectively access, absorb and exploit their knowledge**. As we move beyond the pandemic, and governments – at least in the UK and US – look to invest in strategic

technology areas to unleash innovation and drive future industrial competitiveness, delegates suggested that governments would benefit from employing more scientists, engineers and technologists who deeply understand the technical challenges that need to be solved and the complexities of how they can be commercialised to deliver economic and societal value.

Within industry, delegates noted that research and innovation groups were also suddenly thrust into the spotlight as being crucial to helping companies navigate and survive the turbulence of the pandemic. They were being asked to help their organisations find ways of rapidly pivoting their operations; develop new ways of producing and distributing their products and services to overcome new market realities and challenges; adapt their new products and services to pursue new market opportunities; and in some cases, rapidly scale their operations to meet soaring demand. Moving forward, there is an opportunity for companies to position their research and innovation groups at the heart of their future competitiveness.

Mutually reinforcing the value of the triple helix

As has been highlighted in this report, the pandemic spotlighted how universities, companies, hospitals, public sector agencies and others came together to find solutions to a wide range of urgent pandemic-induced problems. The speed of the initial response benefited from not just relevant knowledge, but also the strength of existing networks between these types of organisations. Additionally, it benefited from the professional and experienced partnership and commercialisation support now typically available within universities.

While the past few decades have seen a growing appreciation for strong and effective university-industry-government partnerships, Summit delegates argued that the benefits and value of such partnerships need to be continually reinforced and celebrated. Absent of this, there are concerns that support for them could wane over time and it would harder to respond effectively to future crises.

Delegates celebrated the work of AstraZeneca and the commitment it made early on to work with the University of Oxford to deliver a COVID-19 vaccine for the world at cost. They noted that while other companies are making vast profits from their vaccines, AstraZeneca has made very little and, despite having produced an effective and safe vaccine, has suffered from significant backlash that hampered its ability to deploy the vaccine around the world. Concerns were raised that, unless all parts of the community stood up for these types of socially-driven partnership efforts, in future it would be much harder to convince industry to engage on these types of terms.

Capitalise on the growth in public engagement with science

The public appreciation of the value of science had been waning pre-pandemic with significant concerns, about the devaluing of universities and their potential to improve the human condition, raised at the 2019 Oxford-UIDP Summit[1]. The 2019 Summit delegates noted several major challenges in engaging the public. One was the significant time lags for fundamental research to find its way into the economy and society and impact on people's lives. Another concerned the difficulties in communicating the value of science to the public.

The pandemic demonstrated very publicly how decades of scientific endeavour and advance could be harnessed to develop breakthrough new products and services to solve the health crisis induced by the COVID-19 pandemic, whether through the rapid development and deployment (at scale) of new vaccines and therapeutics, diagnostics, or predictive modelling to inform policy and organisation (e.g. hospital) responses. It also showed, very visibly, the importance of a strong partnership between academia, industry, government and society in developing practical solutions to difficult problems. Furthermore, it reinforced the benefits of a strong coupling between the different stages of the innovation pathway from research to development, production and distribution.

Discussions at the Summit made the case that the sector needs to capitalise on this renewed public appreciation for science and its potential to make our lives better. Efforts to do this need to be sustained as the recent surge in awareness could easily dissipate if people do not continue to feel the benefits of investing in research.

[1] Ulrichsen, T.C., 2019. Developing University-Industry Partnerships Fit for the Future. Report for Oxford-UIDP Summit 2019. University of Oxford, Oxford, UK.

The pandemic also brought the scientific method into the public eye, perhaps most visibly with the clinical trials for vaccines and therapeutics, and the modelling of the trajectory of the pandemic to inform public policy responses. This raised a major difficulty for scientists – in academia, industry, and government – with a tension emerging between the public seeking clarity and certainty of message, and the inherent uncertainty of the scientific endeavour. Attempts to deal with this revealed a gap in the scientific community's capabilities to communicate breakthroughs and the scientific method, and a gap in the public's understanding of the scientific method. Both gaps need to be closed, with calls for greater public involvement in the research process to be part of the solution.

Maintaining the flexibility of funding and ensuring the sustainability of the research system

The pandemic forced many universities, companies and funders of research to think differently about how to deliver their products and services, including how to prioritise and fund research. Many became more agile and flexible in how they leveraged funding to invest in not just research projects, but also critically the translation and commercialisation of research outputs.

A spotlight was also shone on the long-term sustainability and resilience of the research system. This has raised questions about whether prevailing funding models deliver research systems that are sustainable for the long-term, not just financially, but also in terms of the skills, facilities and infrastructure, networks and other capabilities required to perform research and translate and commercialise it for societal and economic gain.

As we think about the sustainability of the research system (in both academia and industry), Summit delegates argued for the need to be more explicit about building resilience within organisations to tackle sudden and massive shocks, for example through capacity availability, decision-making processes and structures, and the ability to rapidly reconfigure resources.

Maintaining creativity and collaborative spirit in developing solutions to complex problems

Summit delegates from academia and industry were also keen to find ways of maintaining the creativity they witnessed among their staff and partners in finding solutions to complex problems. They suggested that this creativity – with staff more willing to propose and explore bold ideas, take risks, and push boundaries of traditional ways of working to accelerate the research-to-innovation process – has begun to spread beyond those directly involved in COVID-19 related projects. Examples were provided of how researchers, inspired by the response to COVID-19, are now coming together to propose bold collaborations to tackle other major societal crises such as the transition to net zero.

The pandemic also demonstrated what was possible when diverse teams came together around a common vision. Delegates were keen to build on this post-pandemic to further encourage more team-based, collaborative approaches that bring diverse sets of capabilities and experiences together aimed at tackling specific problems.

The future of work and the balance between remote, hybrid and in-person working

Universities and many companies were forced to move much of their office-based workforces to work from home as governments around the world introduced severe restrictions on social interactions. As of July 2021, while restrictions have eased in some countries such as the UK, many workers continued to work from home or have adopted hybrid working patterns, returning to the office for a few days a week.

The future of work was discussed at length at the Summit, with delegates reflecting on what they had learned through the pandemic of the balance of benefits and costs of remote working. Overall, they suggested that early enthusiasm for home working has given way to more measured positions with a recognition that there is much we do not know about how it affects not just productivity, but also well-being.

Reflecting on the benefits of remote/virtual working (including in some instances at significant distance to the organisation including overseas), delegates suggested it had:

■ Helped organisations **access a wider talent pool**.

■ Made it **easier to work with partners located further away**, and reach much wider audiences than pre-pandemic.

■ **Freed up significant amounts of work-time** – previously lost to travel – enabling staff to engage with more people for a given amount of time and spend more time between meetings delivering work tasks. It made it easier for staff to access the time of senior leaders.

■ **Where individuals had strong personal and professional networks, they were able to transition relatively easily to remote/virtual working** and continue to develop new opportunities for university-industry partnerships and projects. Through leveraging their existing networks, they were able to continue to develop new contacts and relationships despite having never met the other party in person.

■ **Helped some people to thrive**, with certain types of people finding it easier to contribute in more virtual, less personal environments. This helped to bring different perspectives into discussions that pre-pandemic would have been less included.

■ **Helped to accelerate the pace of research and innovation**, particularly early in the pandemic. It made it easier to pull people together that would normally be hard to coordinate, not least those located across multiple geographies and time zones.

As the pandemic progressed, delegates noted that people were beginning to experience more costs to remote/virtual working and believed that some of the benefits identified in the initial phase of the pandemic were perhaps overestimated or were beginning to wane. It is becoming increasingly apparent that there is still much to learn about how to make remote or hybrid working patterns effective, and the long-term effects of remote working not just on productivity but also well-being. Delegates highlighted the following key concerns:

■ While remote working accelerated the pace of research and innovation early on – driven by the urgency of the crisis – **many tasks have become slower in the virtual world**. For example, routine questions about how to do something that previously would have been quickly solved by asking a colleague working in the same office, now typically involved a formal request for a meeting and took much longer.

■ **Collaboration technologies, platforms and equipment are not yet sufficiently developed** or robust enough to underpin effective remote working and virtual interactions. Furthermore, many staff do not know how to use and leverage these technologies effectively, with **huge variations in 'digital collaborative capabilities'**.

■ The proliferation of communications platforms (including continued use of email), and the lack of experience of many in working with them, can lead to **confused and inefficient communications**.

■ Challenges arising from **significant variability in the quality of internet connectivity and home working environments** across the workforce, for example due to personal circumstances, level of wealth, or lack of access (e.g. lack of availability of high-speed broadband in rural areas). This creates challenges to ensure equal opportunities, particularly for those staff on lower incomes.

■ The ease of organising virtual meetings has led to working days being consumed by back-to-back video conferencing with **no downtime between meetings to undertake other tasks**, rest, network, or think.

■ We know little about the **longer-term impacts of the loss of social interactions** (including the formation of professional networks and personal friendships) that are fostered by physically attending a workplace. Based on the anecdotal experience of the Summit delegates, these are likely to vary depending on where people are in their careers, their personal and economic circumstances, their prior professional networks, as well as potentially across different parts of society. For example, delegates talked about how more experienced staff have established professional networks and reputations found the transition to remote and virtual working much easier than those (typically younger) colleagues who were less experienced and networked.

- Working from home significantly **blurred the boundaries between work and home life**, with concerns for well-being.

- Concerns about the **loss of opportunities for serendipitous interactions** and conversations – the 'watercooler moment' – that arise when working in close physical proximity with others.

- **Difficulties in building 'emotional' connections** with other people online, making it harder to move from transactional interactions to more deep and meaningful professional relationships that are at the heart of effective partnering. While a more transactional approach to interacting may be enough in the short term to ensure things get done, delegates saw this as storing up problems for the longer run.

- **Hard to instil an organisational culture**, and benefit from the cultures of a place when staff are not physically co-located.

Overall, some delegates at the Summit raised concerns that organisations may have moved too fast into adopting new models of hybrid and remote working without fully understanding the longer-term benefits and costs, and the detailed routines and practices that can make it work effectively. Questions being asked included:

- What does hybrid working look like in practice, down to the routines for getting tasks done?

- How do we manage workflow?

- How much will it cost?

- What are the dependencies affecting our decisions regarding hybrid/virtual working? For example, how do the decisions of other organisations (e.g. key partners, customers) to either move to hybrid/remote working, or return entirely to office, impact on our decisions?

- Do we have the right technologies and collaboration platforms in place to deliver effective hybrid/remote working, and do staff have the capabilities to use them effectively?

Ultimately it is likely that different modes of working, and locations of work, will be better suited to different types of tasks. This requires urgent research to identify what works and when (including how to maximise the efficiency and effectiveness of business travel combining both face-to-face and virtual meetings), to help inform the development of effective strategies for hybrid working moving forward. This will inevitably require experimentation by organisations coupled with active efforts to capture their effectiveness and lessons learned, and to share these with the wider community.

Developing new approaches

Delegates at the Summit were asked to reflect on what new approaches they would like to see developed to drive more effective partnerships post-pandemic. Calls were made to:

- Find ways of **reproducing the intensity and focus of the COVID-19 response** that delivered solutions at both pace and scale to tackle other societal challenges, but in ways that are sustainable over the longer term (e.g. regarding staff welfare, work-life balance). Thought needs to be given to creating a positive framework for effective and efficient collaborations to be delivered at pace and scale, rather than one driven by fear.

- Find ways of **maximising the benefits of the immersive and virtual environments to build effective partnerships** and collaborative platforms. There was a view that the most effective technologies were not yet widely available or affordable. However, the pandemic has increased the demand for these technologies, and accelerated their early adoption. This should incentivise their further innovation and greater competition, which should improve functionality, usability, and affordability.

- Find new ways of **encouraging the movement of people between academia and industry**, and exposing academics to more commercial environments.

- Find ways of **better configuring and developing universities to pursue mission-oriented and challenge-driven research**.

- Find ways of capitalising on the growing shift of priorities amongst funders to **focus not just on investing in research but also in its translation and commercialisation**. This may require the building up of new incentives, types of capabilities, infrastructure, and partnerships, along with driving further culture change to legitimise this type of activity.

- Find ways of **deepening engagement with different types of funders**, such as Non-Governmental Organisations (NGOs), charitable foundations, 'philanthrocapitalist' organisations (for example the Chan-Zuckerberg Initiative), and venture philanthropy. In some areas of societal need these funders could be as large an investor as governments and may be less risk averse.

2.3 Tackling major societal challenges beyond the pandemic

The COVID-19 pandemic has consumed the attention and effort of many nations since 2020. However, it is but one of many major societal challenges facing the world that need to be tackled with urgency. Others include the climate crisis, extreme poverty and substantial economic, health and social inequalities, ageing populations, and increasing anti-microbial resistance (AMR).

The Oxford Summit examined what could be learned from the experiences of universities, companies, governments, and societies in coming together at pace to find solutions to tackle COVID-19to help accelerate the fight against other complex societal crises. This section captures these insights. The specific case of the climate crisis is explored in depth in section 4.

Tackling major societal challenges moving forward

- Covid as certain type crisis
- Coordinate effort
- Motivate and galvanise people to deliver
- Funding is necessary but not sufficient
- Economic cost of inaction
- Anticipate research and innovation infrastructure
- Fund at scale
- Co-create solutions with the public
- Prioritise funding

COVID-19 is a particular type of societal crisis

While there may be important lessons from the fight against COVID-19 that could inform approaches in other areas, Summit delegates noted that we must recognise that it is quite different from other crises. Delegates compared the acute nature of COVID-19: likening it to a 'burning platform', with the more chronic – though similarly urgent – 'smouldering platform' of many other major global crises such as climate change and extreme economic, health, and social inequalities.

Furthermore, tackling COVID-19 was – at least from a health perspective – a relatively simple challenge to solve. While technically challenging, it required the ability to diagnose the disease and develop the means to treat and/or prevent infection. Critically, the 'burning' nature of the pandemic meant that solutions had to be deployed globally at both scale and pace. Other societal crises are much more complex, with many different challenges that need solving, as well as whole technical, economic, and social systems that need to be rethought and transformed.

The acuteness of the COVID-19 crisis, coupled with the scale of threat it posed to people's lives and livelihoods, drove a scale and intensity of response that is hard to replicate for more chronic crises. Delegates argued that it will be hard to respond 'en masse' to other crises with the same level of motivation, singular focus, time commitment, and funding as we did with COVID-19. It raises big questions of how we prioritise effort and resources and better coordinate responses.

The need to motivate and galvanise people to deliver

Crucially important to the COVID-19 response was the strong motivation and commitment of people – across academia, industry, government, healthcare, the investment community and elsewhere – to pool their knowledge and expertise to find solutions to urgent COVID-19 related challenges. Summit delegates suggested this intense motivation was likely driven by fear individuals felt of potentially devastating health, economic and societal impacts to their own lives. For other global challenges, such as climate change, ageing populations, and extreme inequalities globally, they argued that there is a wide gap between what people know is important and what they experience personally.

This raises important questions of how to instil in people the sense of urgency that is required to galvanise people around tackling other crises, but without resorting to fear. Approaches driven by fear were not seen as sustainable for the longer-term. We need to develop environments, cultures, policy frameworks and investment frameworks that drive positive cases for change.

The need to understand and internalise the economic cost of inaction

More effort is also needed to create incentives for industry, governments, charities and universities to invest their resources and effort to innovate and drive change. For COVID-19, the economic cost of inaction became very clear, very quickly. This made it much easier to justify significant investments to develop solutions to the many and varied health, business and individual challenges that hampered the ability of organisations to continue to deliver their products and services.

For other societal crises, governments, companies and individuals have not yet sufficiently understood nor internalised the economic costs of inaction. As an example, Summit delegates highlighted antimicrobial resistance (AMR) as an increasingly urgent and global crisis. Unless we develop new forms of drugs to tackle the rising resistance of microbes to existing treatments, we can expect a growing number of deaths due to infections that would previously have been treatable[2]. A major review for the UK Government into this issue by economist Jim O'Neill, published in 2016, found that the estimated cost to the world economy of failing to tackle AMR was $100 trillion by 2050 (in terms of lost global production)[3]. When this report was published, delegates noted how this scale of loss seemed unreal; people were not able to internalise the scale of damage. It did not lead to the scale of global funding commitments that are required to develop breakthrough therapeutics.

An important effect of the pandemic has been to show very visibly that massive economic losses due to an inability to fight disease and infection – even for a relatively short period – can be of the scale highlighted by the review of AMR.

We therefore need to find ways of increasing understanding of the economic and social costs of inaction for each societal crisis and ways to fully internalise them. Doing this would make it much easier for politicians and funders to justify to their constituencies the need for significant investment and help to drive the necessary changes to behaviour to help tackle the crises. Returning to the AMR example, if we fully internalised the $100 trillion economic loss it would make it much easier for governments, industry and charities to justify investing the $5-10 billion that is needed to drive breakthrough therapeutics.

The need to fund at scale

The COVID-19 crisis demonstrated that, while funding is certainly not enough condition for unlocking breakthroughs, dramatic progress can be made when it is largely unconstrained.

2 **https://amr-review. org/background.html,** accessed on 3rd March 2022

3 O'Neill, J., 2016. Tackling drug-resistant infections globally: Final report and recommendations

Tackling other complex societal crises will require similar scales of investment and effort. Summit delegates noted the scale and global scope of many of these crises, coupled with the scale of funding required and that developing breakthroughs would benefit from greater international collaborations. Delegates raised the question of whether we should focus on developing global-level funds, rather than having many sub-scale national funding pots driven by national self-interest. Examples raised by delegates for delivering supra-national funding at scale included:

- the European Framework/Horizon funding programmes for its ability to pool resources from many nations to fund research and innovation in their collective interests.

- the Wellcome Trust's Leap programme which is pursuing the 'DARPA' model to deliver breakthroughs in human health within a much-accelerated timeframe than previously, and has now raised over half a billion dollars[4].

- the Dementia Discovery Fund, which assembled funding from the UK government, charities and philanthropy, large pharmaceutical companies, and pension funds, to fund the development of breakthrough technologies to combat a very clear priority, dementia. Rather than being run by traditional funding agencies, it is managed by an investment fund working to clear milestones, with clear routes to market for solutions.

Summit delegates also highlighted the growing importance of non-traditional funders for investing in developing breakthroughs to tackle major societal challenges and crises. This included non-governmental organisations (NGOs), charitable and private foundations, the emergence of 'philanthrocapitalism'[5], and venture philanthropy and social investors. Delegates argued that these sources have the potential to offer game-changing amounts of money to address major societal crises and may be less risk averse than traditional governments and corporate funders. For example, they suggested that finding one ultra-wealthy individual or foundation with a passion and commitment for tackling a specific challenge (such as ocean plastics, rare medical conditions, anti-microbial resistance, or a specific climate change problem), who is also willing to invest substantial resources, can really help to accelerate the development of solutions.

A key conclusion from the Summit discussions is that we really need to move on from the triple helix, university-industry-government metaphor in describing the way in which universities and other organisations interact and partner to innovate to solve societal challenges. We need to move to more inclusive metaphors and language that capture the many different stakeholders crucial to success, including not least charitable foundations and the public.

£ The need to prioritise funding

Given significant and growing fiscal pressures on governments around the world, Summit delegates also argued that governments and funders need to become more strategic about identifying core priorities for their funding and ensuring that these are funded at a sufficient scale to deliver substantive progress.

Delegates noted that smaller economies – often out of necessity – have done this for many years. For example, Ireland introduced a prioritisation policy in 2012. Although the priorities were relatively broad, it shaped the allocation of resources by funders to key strategic areas, while also signalling to the research and innovation community where efforts – backed by resources – were being channelled. From their experience, Summit delegates suggested that the nature of the priority should drive the development of frameworks to guide delivery rather than attempting to develop one-size-fits-all frameworks.

The need to better coordinate effort

Furthermore, the challenges thrown up by complex societal crises are often systems-level problems and require the effort and involvement of many different organisations delivering inputs along the research-to-innovation pathway – from idea generation to technology development and its scale-up and diffusion into the economy. No single university or company

4 **https://wellcomeleap.org/**, accessed on 7th March 2022

5 Limited Liability Companies (LLCs) and private foundations set up to invest resources to achieve philanthropic goals using business models and processes developed in the for-profit world. Prominent examples include the Chan-Zuckerberg Initiative and the Bill and Melinda Gates Foundation, both set up to channel vast proportions of the founders ultra-wealth to philanthropic causes they are passionate about

will be able to do everything on their own. The COVID-19 response showed what is possible when organisations from across the research-to-innovation pathway come together around a common vision and strategically and operationally commit to delivering it.

Moving forward, we need to find ways of creating shared visions around other crises that can galvanise organisations towards addressing them. We also need to develop better frameworks and processes to improve coordination of effort across the research-to-innovation pathway.

On many occasions throughout the Summit delegates highlighted the value of challenge-led funding to not only help galvanise people around a specific problem but also help organisations prioritise investments and enable greater coordination and coherence between activities.

£+ Funding is necessary but not sufficient

Making available funding at scale to target specific global challenges was seen as necessary but not sufficient to deliver breakthrough technologies with global impact in an accelerated timeframe.

For example, the pandemic experience highlighted the importance of demand for solutions for driving innovation at pace. While many sectors of the economy were devastated by the pandemic, COVID-19 created insatiable market demand for certain types of products and services, such as vaccines and diagnostics, personal protective equipment (PPE), and virtual collaboration tools, as well as for services such as entertainment, and home deliveries of food, drink and other products. This led to a willingness by organisations to invest in increased capacity and created incentives to drive both incremental and more breakthrough innovations to develop solutions to meet demand.

In highly regulated markets crucial to the fight against COVID-19, the demand for solutions also helped organisations to challenge critical barriers that traditionally slowed the innovation process. For example, Summit delegates noted that in areas such as the development of therapeutics, regulatory approaches – while critically important to ensure public safety – had not kept pace with innovation and could slow the process. The urgency of the pandemic incentivised researchers, innovators and regulators to come together and invest time and effort to find ways of tackling key bottlenecks in the process.

Tackling other societal crises such as climate change will similarly require new approaches to developing and deploying innovation, including developing new ways to research, innovate, produce and regulate. However, where there lacked significant demand for solutions, Summit delegates suggested this could weaken incentives for different stakeholders to come together to redesign processes and overcome key bottlenecks.

In addition to a strong 'pull incentive', the COVID-19 response has highlighted other factors that help to accelerate innovation. These include:

- A **strength of commitment** at all levels of the system and within organisations, from the strategic to the operational, to solve a problem

- A willingness for stakeholders to come together to invest time and effort to find ways of **overcoming bottlenecks and traditional barriers to innovation**

- A willingness of decision-makers within organisations – from research and innovation performing organisations to funders – to take more calculated risks and focus on the portfolio of investments rather than specific projects

- A research and innovation **culture that enables and incentivises researchers to take risks and be ambitious**, and promotes team efforts bringing people with different knowledge sets and capabilities to accelerate the development of a solution

- **Greater flexibility** from companies and universities on contractual terms governing research and innovation-focused partnerships and activities, with a focus of negotiators on 'how can we make this happen'

- **More agile and faster decision-making** with companies, universities and government funding agencies and departments

- A **more active and engaged leadership** of organisations in research and innovation to motivate and galvanise staff around strategic goals

- **Incentives (formal and informal) for societies to change behaviours** to act in the collective interest rather personal self-interest. Delegates noted that while there is some role for lawmakers and regulators here, we need to help individuals understand and internalise the costs of inaction to help drive collective incentives. Economic (price) incentives were seen as powerful tools in shaping individual behaviours in market-driven economies.

The need to better anticipate research and innovation infrastructure

We need to get much better at anticipating the sets of national research and innovation infrastructure and capabilities required to build national resilience to potential societal threats. Going into the pandemic, Summit delegates argued that the early pandemic response was hampered by the lack of key infrastructure to enable research, innovation, and scale-up/industrialisation to drive solutions at pace and scale.

For example, UK delegates noted that, for the past decade, there has been significant pressure on the UK government to invest in a Vaccine Manufacturing and Innovation Centre (VMIC) to enable the rapid development and industrialisation of novel vaccines. Despite these calls, funding for the first phase was only allocated in 2018 with temporary offices set up at the Oxford Science Park. By the time the pandemic hit in early 2020 construction of the full-scale facility had yet to begin. To support the vaccine development effort VMIC received significant investment from the UK Government in May 2020 to establish a 'virtual VMIC', partnering with industry to dramatically expand production capacity for a COVID-19 vaccine in the UK. The full-scale facility, with the necessary equipment validated and tested, was not completed until 2022. Delegates noted that the UK arguably has a national vaccines manufacturing centre two years too late, at least for this pandemic.

The need to co-create solutions with the public

Finally, tackling major societal challenges will require not just significant investment and efforts to develop new technologies, products and services, production process and business models, but will also require significant behavioural change on the part of both organisations and the public. Summit delegates noted that there is a growing recognition that there are benefits to involving innovation users and the public more actively in decision-making to help determine funding priorities as well as in the research and innovation process itself. This can help to secure wider buy-in for difficult decisions regarding funding prioritisation as well as facilitating the acceptance and adoption of potential solutions, particularly where behavioural change is required for success.

One experiment highlighted by the Summit delegates is the 'Creating Our Future' initiative in Ireland. This was launched in July 2021 to begin a national conversation regarding how research can help to meet the opportunities and challenges facing Ireland over the coming years. The hope is that the ideas submitted by the public will inspire research projects that will deliver a positive impact on Irish society[6].

Another initiative of note is the Public Impact in Research Initiative[7] developed by the US Association of Public and Land Grant Universities (APLU). This aims to strengthen the connection between research and the public. It seeks to raise the capabilities and motivation of the research community: to better communicate how their research impacts the public; and engage more actively in research that more directly engages and impacts the public.

[6] **https://creatingourfuture. ie**, accessed on 8th March 2022

[7] **https://www.aplu.org/ our-work/research-science- and-technology/public- impact-research/index. html**, accessed on 8th March 2022

Governments and the building of international partnerships to drive innovation

3 Governments and the building of international partnerships to drive innovation

The second core question explored at the Oxford Summit 2021 focused on how governments can better enable international R&D and innovation partnerships to drive innovation and tackle major industrial and societal challenges. While the keynote speakers focused on recent government experiences and trends in the US and UK in seeking to enable international partnerships, the subsequent breakout discussions broadened to explore the experiences of other countries represented at the Summit.

Discussions at the Summit highlighted a range of benefits from international collaborations, including that they:

- Enabled the scale and scope of cutting-edge research that no nation could achieve alone
- Enabled the leveraging of complementary of resources, including funding, expertise and facilities that exist in different countries
- Strengthened scientific and diplomatic relations
- Train a robust science and technology workforce capable of solving global problems
- Enable access to international students and scholars who contribute significantly to the national research endeavour

They also reflected on the recent G7 Research Compact[8], agreed at the 2021 meeting of the G7 in the UK, which committed nations to:

- Collaborate on specific opportunities, recognising that tackling major global societal challenges such as climate change, biodiversity loss, and health requires assembling the widest possible range of resources, expertise, and perspectives to unlock solutions that will benefit the world
- Promote international research cooperation and the conditions of freedom, independence, openness, reciprocity, and transparency under which it flourishes
- Develop strong, diverse, and resilient science and research communities
- Work together to maintain policies, frameworks, and programmes to promote research collaborations involving scientists, research institutions and innovative businesses
- Researcher independence, openness, data sharing and transparency
- Strengthen incentives that recognise and reward interdisciplinary collaboration and drive a culture of rapid sharing of knowledge, data, software, code, and other research resources
- Build more flexible, agile research collaborations that facilitate rapid, interdisciplinary, and evidence-based responses to future systemic crises and natural disasters

The consensus view from the Summit was that opportunities were enormous from getting countries to work more effectively together. By collaborating the chances of achieving the end goals are much higher, and progress can be made more quickly.

Building on the keynotes, discussions at the Summit turned to the drivers and enablers for initiating and nurturing international collaborations, and the many challenges that exist to getting them up and running and delivering value. The views of the delegates on these two topics are now discussed.

3.1 Drivers and enablers for developing effective international partnerships

This section presents the views of Summit delegates on key drivers and enablers of international partnerships. It is not meant to be exhaustive, but rather to highlight discussions as particularly relevant as we move through the pandemic and look to strengthen our ability to partner internationally to address major technological, industrial and societal challenges.

Drivers and enablers for developing effective international partnerships

£+ More than just funding

The need to move beyond research to think about translation and commercialisation

Fostering global entrepreneurial ambitions

Learning from experiences

Global funding at significant scale to unlock significant breakthroughs

More than just funding

Building international partnerships for research and innovation requires **much more than just funding programmes** and structures. It requires **people with the ability to form and nurture relationships** across borders, cultures, and organisations. If the people and networks are not in place, this is another layer of development that must be invested in when considering what funding is necessary. This can add significant extra effort that needs to be resourced.

While many collaborations emerge from researchers meeting one another at conferences and other events, delegates emphasised the value of having initiatives designed to accelerate this process of **bringing people together** to share ideas and co-develop potential projects to tackle challenges. From experience, delegates also noted that 'top-down' approaches, for example where organisations declare "this is the problem we want you to work on" and expect people to come together, do not work very well in university settings. Similarly, expecting people to come together in a very 'bottom-up' approach was also not seen to work. Delegates argued that putting in place initiatives designed to balance these two approaches can yield benefits, where structured processes are put in place to facilitate interactions and help to match opportunities and needs with available capabilities. From the experiences of some delegates, this process of facilitated co-creation between people from different disciplines, perspectives, organisations and cultures can lead to innovative and interesting projects and outcomes. We must recognise that these initiatives must be funded.

Collaborations also require a range of **technologies and infrastructure**, for example to enable effective communications, virtual collaboration, and secure data sharing and storage.

The need to move beyond research to think about translation and commercialisation

In talking about international collaborations, we typically focus on the bringing together of research capabilities. Delegates argued that we should also be proactively thinking about the translation and commercialisation of research into innovations, and how capabilities can be assembled and developed to accelerate the process.

In reflecting on this wider journey, delegates highlighted the importance of great leaders and innovative and entrepreneurial talent, as well as having access to the necessary capital to support the translation and commercialisation of the research into applications and its scale-up to deliver substantial impacts. Crucially, they argued that innovative and entrepreneurial talent tends to follow the funding (public and private) at all stages of the research-to-innovation process.

Also important for attracting talent was the strength of the entrepreneurial ecosystem and the ability to experiment with novel ideas and take calculated risks. Delegates also argued that

success begets success; as more companies start, grow and thrive in a local ecosystem, it is more likely that this will foster a culture of entrepreneurship leading to more companies starting up locally, attracting talent and funding. This can further attract other companies providing services to support their growth (e.g. professional and technical services) as well as those working in related technological areas or developing complementary capabilities.

There was a concern that unless we actively think about how to nurture these entrepreneurial ecosystems, many valuable ideas emerging from research may migrate elsewhere (either nationally or overseas) and along with it the potential to directly capture value from research commercialisation efforts.

Fostering global entrepreneurial ambitions

Delegates raised the importance for start-up companies to have global ambitions; to be driven to develop globally competitive value propositions rather than settling for being 'good enough' to compete nationally. However, having motivated entrepreneurs is not sufficient. We need to ensure that systems do not stand in their way of elevating their value proposition from being a nationally competitive one to being globally competitive. Once again, this requires easy access to the key resources and capabilities to develop and scale ideas, as well as easy access to key global markets. Absent of this, start-up companies are more likely to be acquired earlier, be acquired by overseas companies, or migrating overseas; all leading to value leaking out of the country.

Learning from experiences

Countries are at very different starting points in terms of their experiences in developing and nurturing effective international collaborations. Some, particularly those with smaller economies and research bases, have long collaborated out of necessity to access a broader range of expertise. In addition, some disciplines such as the medical sciences have long collaborated internationally to ensure good research design and develop good science to deliver effective and impactful research.

These different levels of experiences offer the partnering community an opportunity to learn from each other about what works and when, albeit in other contexts. Experiences and lessons should be shared and discussed, with careful thought given to how they translate into different settings and national/discipline contexts.

Global funding at significant scale to unlock significant breakthroughs

A common theme at the Summit was the increasing need for global approaches to combat major societal challenges, backed by substantial resources available at this level. Challenges such as climate change and global health (e.g. antimicrobial resistance) would benefit from global-level funds of substantial scale driven by the goal of delivering breakthroughs at pace and global scale. These make it easier to identify and assemble capabilities wherever they exist in the world to drive progress. Furthermore, elevating funding beyond individual nation-states may help to overcome national political objectives and concerns that can skew priorities and make it harder to form the necessary global partnerships to drive progress towards solutions.

3.2 Challenges to developing effective international partnerships

There are many challenges that make it harder for researchers and organisations to come together across borders to develop research and innovation partnerships that could accelerate progress towards tackling technological, industrial and societal challenges. Below are some of the key factors highlighted by Summit delegates.

Challenges to developing effective international partnerships

Political uncertainty and influence on collaborations

Unbalanced partnerships

National security concerns

Limitations of current funding structures

Differences in national priorities and objectives for international collaborations

Incentives for researchers to engage in international partnerships

Limitations of bilateral relationships

Incentives for researchers to engage in international partnerships

Political uncertainty and influence on collaborations

Scientific and science-driven innovation endeavours are long-term investments that benefit from stability of funding, partnerships, and strong international alliances. Summit delegates observed that efforts by governments to promote and fund international collaborations were increasingly being influenced by political objectives rather than scientific and innovation need and endeavour. They were becoming concerned that this, coupled with rising political uncertainty (exemplified by the aftermath of the Brexit referendum in the UK and the political rise of Donald Trump in the US) was creating significant risks for academics for investing significant effort and their personal and professional reputations to build international alliances. For example, they were concerned that funding programmes aimed at building links with specific countries could fall apart if government priorities or political interests, or key political figures, changed. In the UK context, some delegates were also concerned that science funding was increasingly being used as political collateral in wider negotiations with the European Union, and that commitments to increasing R&D spending were proving to be more symbolic rather than concrete.

National security concerns

The US and UK governments have recently introduced new measures aimed at minimising the national security risks that could arise through the operation of their research and innovation base, including the threats of espionage and the acquisition of technologies by foreign entities that could be deployed to the nation's detriment[9]. At the time of the Summit, delegates noted that national security concerns were coming up more frequently when developing international partnerships, driven not least by the growing pressures from governments to take active steps to minimise any risks to national security.

To address these rising national security concerns around building international partnerships, universities were having to invest more in undertaking timely due diligence to inform decisions and how to mitigate any risks that might arise. This important, yet time-consuming activity, can lead to frustrations for academics and others involved in putting the partnership together who may see additional delays.

Delegates made several key points regarding due diligence:

- Greater effort was required to help academics understand the need for this due diligence

- Given the importance of partnerships in driving research and innovation, approaches to due diligence must be developed in ways that do not stifle the ability to collaborate

- The capability to deliver timely due diligence needs to be properly developed and sufficiently resourced within universities.

[9] For example, the UK Government introduced the National Security and Investment Act in 2021 giving them the ability to intervene in acquisitions (including intellectual property, designs, software etc.) made by anyone – including universities and businesses – that could harm the UK's national security. The US introduced a National Security Presidential Memorandum (NSPM-33) in 2021 aimed at strengthening protections of United States Government-supported R&D against foreign government interference and exploitation, while maintaining an open environment to foster research discoveries and innovation that benefit the US and the world.

Differences in national priorities and objectives for international collaborations

Countries can have quite different priorities and objectives for seeking international collaborations to drive R&D and innovation which can shape where, why, and how they are willing to partner, and what they expect to gain out from them. There was a view amongst delegates that the US government sees strengthening domestic partnerships as more important than building international collaborations; perhaps unsurprising given the scale of the country and its domestic research, innovation and industrial base. By contrast, the UK and smaller economies such as Ireland, Denmark, and Belgium, have historically been much more outward looking in terms of their research and innovation partnerships.

Unbalanced partnerships

Concerns were raised by Summit delegates that the balance of benefits in bilateral agreements and international partnerships can often appear uneven, with one partner typically seen as the leader and the other as a lesser, subordinate. For tackling global challenges in particular, delegates called for governments to focus on true, 'win-win' collaborations where partners pool and co-develop resources, infrastructure and capabilities to deliver on common societal goals.

Limitations of bilateral relationships

In recent years UK government discussions around building international research and innovation partnerships have focused on building bilateral relationships with other nations. These agreements typically seek to make it easier to develop and fund joint projects across specific borders. However, Summit delegates argued that this can make it harder to initiate collaborations with researchers in other countries which can make delivering research and innovation objectives more difficult. Furthermore, as new research and innovation priorities emerge – which can happen rapidly as in the case of COVID-19 – researchers may have to rapidly assemble new sets of capabilities to make progress towards solutions. Countries may find themselves 'locked-in' to a set of historical bilateral relationships that are no longer appropriate given the need, making it harder for the nation's research and innovation base to pivot.

Limitations of current funding structures

Challenges also exist in securing the necessary funding to build and nurture international collaborations not least due to limitations in current funding structures around who can be funded from national funds. The added complexity and effort required to secure such funding meant that researchers often ended up pursuing large domestic grant opportunities.

For example, delegates discussed their experiences of hosting joint collaborative symposia with international partners which lead to promising connections and ideas for projects. They then struggled to find suitable funding structures to establish and develop these emergent research collaborations in a timely fashion. They argued that when cooperation agreements between countries are agreed, prospective partners typically still have to apply to their own nation's funders to secure funds. This leads to duplication of effort by the partnership teams in completing different sets of funding applications, challenges resulting from differences in application process timelines in the different countries, and the potential for local political and other influences skewing objectives.

Incentives for researchers to engage in international partnerships

Some Summit delegates noted that, despite progress over the past decade, there are still tensions – at least in the UK – between the incentives for individual researchers (for example publishing in high impact academic journals), those facing universities as organisations, and the nation's strategic priorities for science, technology, and innovation. Combined with the added difficulties of developing international collaborations over domestic ones, this can often lead individuals to prioritise local or national collaborations over international ones.

Delegates noted that it is important to further demonstrate the benefits of international collaborations to individual researchers, as well as actively learning from other countries and disciplines (such as global health) where such activity is commonplace about how to make them work effectively.

Other challenges to developing international partnerships

- **Bureaucracy and transaction costs**: there is still a perception that the bureaucracy and transaction costs involved in developing international partnerships are too high – from securing funding from different national sources to overcoming immigration difficulties. Delegates also noted that there appeared to be increasing numbers of regulations and protocols facing researchers who want to collaborate, not least around data sharing and privacy, and national security. These added greater complexities to partnering internationally.

- **Scaling individual partnerships**: many international collaborations are based on specific individual-level connections between researchers. It can be hard to elevate relationships beyond the individual to institutions let alone nations.

- **Ability of collaborations to reconfigure**: the composition of the team and the types of disciplines, resources, and partners involved in collaborations may need to be reconfigured to reflect the specific technical challenges researchers face at a given stage of development; partnerships need to be dynamic not static.

- **Communication**: many academics have learned how to use communications technologies through the pandemic, making it easier to collaborate internationally. However, as has been discussed elsewhere in this report, while these can work sufficiently well for more transactional activity, researchers are still struggling to utilise these technologies to drive the more creative side of their work.

- **Uneven access to communications and collaboration technologies**: with the significant growth in use of virtual communication and collaboration technologies there are growing concerns around how unequal access to these technologies (e.g. by those nations with poor infrastructure) will affect the future of international partnering.

- **Lack of funding and talent to translate and commercialise technologies**: there were concerns that the development of international research partnerships was typically disconnected from discussions about how the research will be further developed, translated and commercialised into innovations delivering economic and societal benefits. This will require different types of resources, capabilities, and partners, and will shape where and how value is realised.

- **Demonstrating the value of collaborations**: it can be difficult to measure the impact of international collaborations within timeframes set by funders. This can make it difficult to secure follow-on funding, with consequences for the longer-term sustainability of collaborations, even for those that look promising.

3.3 What more can be done by national governments

Given the significant opportunities for international partnerships to deliver breakthroughs in research and innovation, governments are very interested in what more they could do to help initiate and nurture them. Discussions at the Summit highlighted the following key actions.

- **Building a wider portfolio of relationships**: governments should support not just bilateral relationships with specific countries but also look to form multilateral agreements. These agreements should also extend beyond advanced economies to include emerging markets and developing economies. In forming such agreements it is important to not make it harder for researchers to build collaborations with partners with other countries.

- **Understanding and aligning objectives, capabilities and experiences between nations**: differences in the objectives for, experiences in, and capabilities to, engage in international partnerships need to be better understood and acknowledged at the outset to ensure effective alignment between partners in their goals, expectations, and respective contributions.

- **Decisions to form relationships should be informed by the needs of the community**: in developing research and innovation agreements with other countries, governments should engage closely with universities, industry, and society to identify needs and opportunities. This can help to ensure appropriate targeting of programmes as well as to secure buy-in from stakeholders who will be key to implementation.

- **Governments should work together to identify big, strategic challenges that could be pursued at the global level**: it was easy for the world to agree that the COVID-19 pandemic was a critical priority to address with great urgency. However, there is much less agreement on what the next set of global priorities and challenges are.

- **Global challenges and roadmaps need to be communicated with clarity** to enable organisations to assemble teams and invest resources with greater certainty their effort – if successful – can be deployed and adopted.

- **Global missions**: Summit delegates, drawing on their experience, argued that mission-oriented approaches to investing in research and innovation to tackle global challenges were likely to be more effective than creating undirected infrastructure, capabilities and networks. These need to be built around compelling challenges that can galvanise communities to commit their time and effort.

- **Priorities need to be backed by substantial and sustained resource commitments** to create critical mass to drive breakthroughs. We need to realise that tackling global societal challenges will require funding in the order of billions of US dollars, not millions. As discussed earlier in this report we need to get much better at understanding and internalising the true costs of inaction (e.g. around climate change, AMR, plastics, poverty). This will make it easier for governments, companies, universities, investors, and individuals to invest the necessary scale of resources, effort, and behavioural changes to develop and implement solutions.

- **Pooling resources at the global level**: Summit delegates noted that it would be easier to assemble the scale of resources required to drive breakthroughs if they were pooled at the global level. However, they noted that we currently lack good mechanisms for doing this. This makes it much harder to assemble, for example, 10 billion USD to driver breakthroughs on a specific challenge (e.g. AMR).

- **Missions need to be translated into specific and tangible technical challenges** that need to be solved along the journey. Unlike Covid-19 which had a relatively clear and focused roadmap to inform what had to be done to deliver positive (health) outcome to the pandemic, other societal crises are much less focused, with a huge range of challenges that need to be addressed. For each crisis the global community needs to find a way of coming together to **identify focused priorities and targets that are ambitious yet tractable and investable. Who has the mandate and ability to do this at a global scale?**

- **Community / investor-led global funds to tackle global challenges**: a challenge with government-led initiatives is they are typically influenced by national priorities and interests which can lead to second-best solutions to make breakthroughs towards tackling major global societal challenges. Community or investor-led global funding programmes (such as the Wellcome Trust's Leap programme or the investor-led Dementia Discovery Fund) are less likely to shaped by national political priorities and boundaries in how they invest to deliver the outcome. A major challenge for this approach is their **ability to assemble the necessary scale of funds to unlock major breakthroughs at pace**.

- **Global mobility of talent**: the talent required to make scientific, technological and innovation breakthroughs is located around the world. Researchers and innovators need to be able to move easily between nations to deliver projects and share insights. Currently there are too many impediments to mobility of talent.

Mobilising partnerships to accelerate the transition to a sustainable future

4 Mobilising partnerships to accelerate the transition to a sustainable future

The third core question addressed at the Oxford Summit 2021 examined what we need to do to better mobilise partnerships involving universities, industry, government and societies to tackle the climate crisis and accelerate the transition to a more sustainable future.

While the world's attention in 2020-21 was drawn towards efforts to mitigate the health and socio-economic effects of COVID-19, the climate crisis continued to develop. As we begin to look beyond the immediate effects of the pandemic, efforts to accelerate the global response to climate change are returning to centre stage.

Over 130 countries have announced intentions to achieve net-zero emissions by 2050. However, delivering on these ambitions will require a profound energy transformation within national economies and across global industries. It will require transformative changes to our behaviours as individuals and societies, the development and deployment of a wide range of technologies at unprecedented pace and scale, and the ability to not just reduce but also remove greenhouse gas emissions from the system. Echoing the words of Alok Sharma, President of COP26, in a speech to the Net Zero Summit in March 2021, "it is time for the world to move from a decade of climate change deliberation to a decade of delivery".

Accelerating the process of innovation in all areas of the economy – across industries, supply chains and product lifecycles – must be a central pillar of action for tackling the climate crisis. This needs to include not just new products and services, but also new ways of producing them, organising activity, and new ways of distributing and supplying products. We also need to rapidly accelerate the diffusion of successful innovations around the system to deliver widespread impacts.

As the response to COVID-19 has demonstrated, universities – working in close partnership with industry, government, investors, community groups and others – have the potential to play a critical role in accelerating innovation to find practical solutions to help reach net zero. Most visibly, the development of novel and effective vaccines – a process that typically takes 10 years – was developed, manufactured and distributed in less than a year. Tackling the climate crisis requires a similarly dramatic acceleration of innovation.

4.1 The climate crisis: a complex and chronic crisis

Before examining what can be done to enable universities, companies and others to come together to develop innovative solutions at pace and deploy them at scale to tackle the climate crisis, it is first important to understand how this crisis differs from the Covid-19 pandemic. Summit delegates argued that climate change is much more a chronic, broader, complex and less focused challenge than COVID-19. Furthermore, unlike COVID-19 which had a relatively clear starting point for action, the 'whole systems' nature of the climate crisis makes it much harder to know where and how to begin to target effort and investment to drive change. And while we are witnessing an acceleration of the disruptive and adverse effects of climate change take hold, it is hard for many individuals, organisations and governments to fully internalise and appreciate the devastating costs of runaway climate change that future generations will bear over the long-term (e.g. 50-100 years).
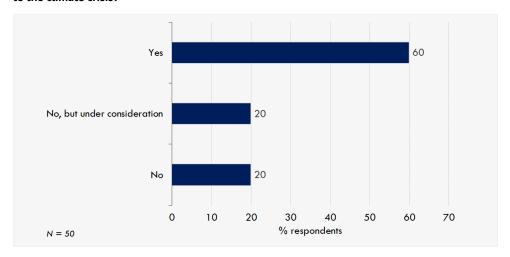
As a result of these features, Summit delegates noted that it is easier for those in leadership positions, as well as the individual citizen and organisation, to be less ambitious with goals for change: it seems less urgent than tackling COVID-19. It is easier for us to focus on developing incremental improvements to the system rather to take the difficult steps to deliver disruptive, whole-system change. While the former is important as part of the portfolio of effort required to tackle the climate crisis, delivering the latter is critical (e.g. it is important to continue to make production processes more energy efficient while pursuing fundamentally new ways of making things). Lastly, our inability to internalise the full costs of inaction makes it much harder for public funders and private investors alike to commit the scale of funds necessary to deliver breakthrough solutions.

4.2 Current organisational ambitions

To guide discussions at the Summit, the Policy Evidence Unit for University Commercialisation and Innovation (UCI) at the University of Cambridge, with support of the University Industry Demonstration Partnership (UIDP), surveyed universities and very large companies (the target audience at the Summit) on their current position regarding commitments to transition towards becoming net zero organisations by 2050. The survey generated 53 responses (35 from universities, 15 from very large companies and 3 from government agencies and other types of organisations)[10].

Figure 1. Has your organisation publicly announced ambitions for net zero by 2050 in response to the climate crisis?
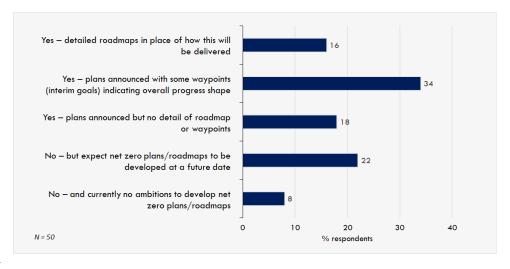

Source: UCI/UIDP survey of universities and large companies in advance of the Oxford Summit 2021

Figure 1 shows that, of the 50 university and very large company respondents to this question, 60% have already declared ambitions to become net zero organisations by 2050. A further 20% have not done so yet but are considering doing so.

While many organisations have ambitions to become net zero, Figure 2 shows that few have detailed roadmaps in place for how this will be delivered (just 16% of respondents). A third said they had plans with some waypoints (interim goals) to indicate progress. Concerningly, a half of organisations responding to the survey either had no plans currently in place, or plans with little detail (e.g. waypoints to capture progress or a roadmap for action). This suggests much work is still to be done to help organisations make the transitions needed to become net zero.

Figure 2. Does your organisation have specific plans or roadmaps, that lays out how it will achieve Net-Zero by 2050 or earlier?

Source: UCI/UIDP survey of universities and large companies in advance of the Oxford Summit 2021

[10] By region, the survey generated responses from 12 headquartered in Europe (including the UK) and 41 headquartered in North America. The sample is therefore dominated by US organisations, and to a lesser extent universities.
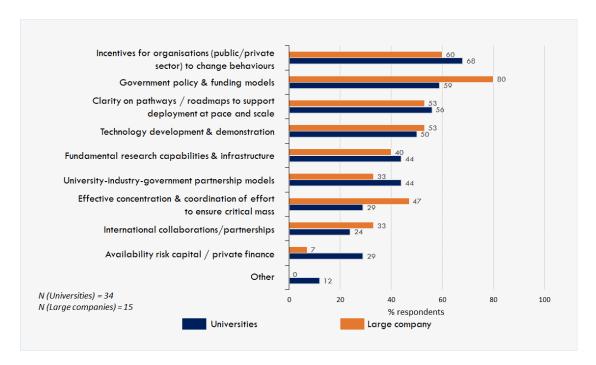
4.3 Barriers hampering the ability to mobilise partners to tackle net zero

The UCI/UIDP survey also examined the areas where universities and large companies saw the greatest need for change to improve their ability to partner to drive innovation at pace and scale to tackle the climate crisis. This question generated 35 responses from universities, 14 from very large companies, and 2 from government agencies and intermediary organisations.

The results are captured in Figure 3 below. Perhaps most strikingly, there was a strong consensus between universities and large companies on where we need to invest our time and effort to change and improve.

One of the most highly cited areas where we need to change is around creating better incentives for organisations in the public and private sectors to change their behaviours. We all know that tackling the climate crisis will require substantial changes to how we, as individuals and organisations, behave and what we prioritise. However, it is unlikely that the magnitude of change required can be delivered without changing economic or social incentives.

Figure 3. Areas of greatest need for change to better mobilise university-industry-government partnerships to develop solutions to tackle the climate crisis

Source: UCI/UIDP survey of universities and large companies in advance of the Oxford Summit 2021

The second major area highlighted was the need for better government policies and funding programmes, with almost 6 in 10 universities, and 8 in 10 large companies, identifying this as an important category. Accelerating the development of innovative solutions to climate change requires funding programmes and policies that not only enable the development of new technologies, but also work effectively to support their further development and demonstration to the point where the private sector is able and willing to co-invest and take them forward. It is also now well-known that government policies and procurement practices can help to de-risk the commercialisation process for emerging technologies by helping to create early demand for these products and services.

Almost half of large company respondents to the survey also highlighted that efforts to tackle climate change should be more concentrated and better coordinated to ensure a critical mass of activity. Note: by comparison just 31% of university respondents agreed. This may have implications for the design of future funding programmes to achieve net zero.

The third major area identified by the survey respondents was around the need for greater clarity on how we are going to get from where we are, to where we need to be. Among other things, roadmaps can help to provide greater certainty for companies, universities and others to invest; can provide clarity on what needs to be done and whether there are sequencing issues that need to be resolved; can help build communities and networks around key topics; and reveal how advances in one area depend on advances and changes elsewhere in the system for the solution to be deployed in practice at scale to drive real change.

To accelerate the pace of innovation to tackle the climate crisis, we also need to get better at technology development and demonstration (the phases of the innovation process beyond research where technologies are developed into prototypes and their potential functionality is demonstrated in increasingly real-world environments). In the context of university-industry partnerships, it is during this phase that technologies typically begin to transition out of a university environment and into a more commercial one, and where the drivers for continued investment and development become increasingly commercial. It is one of the most costly and risky stages of the development process where a key focus is on reducing the variety of technological, production, and commercial risks to produce a commercially viable product or service. Evidence suggests that it is during this phase that many technologies fail, leading to many referring to it as the commercialisation 'valley of death'.

Equally interesting are the factors that are at the bottom of the chart in Figure 3 – i.e. those that few respondents selected as important barriers. These included access to risk capital and private finance to invest in the development of technologies aimed at solutions to the climate crisis (7% of large company respondents and 29% of universities), and the ability to collaborate internationally (33% of large company respondents and 24% of universities).

4.4 The need for system-wide change and bold action

Building on the survey findings, discussions at the Summit highlighted a range of areas where change is urgently needed as part of efforts to accelerate the development of solutions to tackle the climate crisis. These are captured in the box below.

Transitioning to net zero: the need for system-wide change

- Raise awareness
- Drive behavioural change
- Understand & mitigate social disruptions
- Transform traditional sectors
- Change attitudes to risk
- Develop big and bold visions
- Clear directions and targets
- Adopt a systems approach
- Rethink workforce skills
- Improve tech development and demonstration
- More agile and longer-term funding
- Government help to de-risk nascent markets
- Build stronger international collaborations

The urgent need to raise awareness of the threats and costs of climate change

There were significant concerns expressed at the Oxford Summit that the climate crisis is still not a major public concern in many countries. For example, delegates noted that when people are asked whether are willing to make significant changes to their lifestyles to tackle climate change, many still say no. They observed that there are often large variations in acceptance within countries, not least by age.

In raising awareness of the threats and costs of climate change, Summit delegates argued that we need a much stronger and more serious communications strategy than we have currently. This, they argued, should not be left to politicians but draw on leaders and influencers from different parts of societies and the world.

One way to help raise awareness is for organisations and individuals to calculate their own carbon footprint. For one delegate's organisation (a large multinational company), this proved a real eye-opener. It helped to identify hotspots of emissions across their value chain enabling interventions to be better targeted to reduce them. Global standards for doing this have been developed (such as the Greenhouse Gas Protocol[11]) along with guidance and tools to support organisations.

The need for behavioural change at the societal level

Tackling the climate crisis will require major changes in the behaviour of individuals and societies. Much attention focuses on how we, as individuals and organisations, can adopt more climate friendly behaviours (e.g. reducing consumption of environmentally harmful products and services, and increasing rates of recycling and reuse of materials). We need to empower communities to become drivers of change. This will create stronger 'pull' incentives for policy action, empower politicians to make difficult choices, and create more powerful demand signals to stimulate innovation.

Behavioural change is also critically important for accelerating the deployment and widespread adoption of breakthrough innovations that may result in completely new ways of working and consuming. Understanding how individuals and organisations may respond to the introduction of innovations, as well as anticipating issues around public acceptance and building legitimacy for solutions, should be seen as a core part of the innovation process. This needs to be fully integrated with the development core products and services. This suggests a much more active and integral role for social scientists alongside technologists and innovators in developing breakthrough solutions to tackle climate change.

We also need much stronger incentives to drive behavioural change. The power of economic incentives was emphasized by Summit delegates, as well as the role of standards and regulations in shaping behaviour. Appropriately developed, standards and regulation and drive positive change and accelerate the adoption and diffusion of innovation.

The need to understand and mitigate social disruptions arising from the transition to net zero

Another major issue is that the transition to net zero will likely involve significant disruptions to the existing functioning of societies. The greatest disruption and adverse effects are likely to fall on the poorest communities of the world, as well as within each country. In strategizing and planning for the transition, it is crucially important that we understand the potential social disruptions and take steps to mitigate them. Once again, this points to a crucially important role for social scientists.

[11] **https://ghgprotocol.org/** about-us, accessed on 30th March 2022

The need to transform traditional sectors

The economies of many nations are often dominated by traditional 'legacy' sectors that have very well-developed and stable supply chains, processes, regulations, and cultures. These types of sectors – such as construction, many manufacturing sectors, energy supply, and agriculture – are typically resistant to change and disruptive innovation[12]. They face particularly high obstacles to innovation beyond what is typical in other sectors resulting from the status quo. Key obstacles include[13]:

- Pricing and cost structures that favour existing technologies
- Established institutional architecture that imposes regulatory hurdles or policy disadvantages that favour existing technologies and discourage new entrants
- Powerful vested interests
- Financing systems geared towards incumbents
- Public habits and expectations attuned to existing technologies and ways of doing things
- Established knowledge and human resource structures that favour the existing technologies and incumbents
- Limited investment in R&D leading to a dearth of technologies ready for implementation at scale
- A range of market imperfections that favour existing ways of doing things

The magnitude of these sectors in many economies suggests they will be key to the transition to net zero yet their resistance to change will make them some of the hardest to transform. Summit delegates suggested that a good first step here would be to understand the scale and nature of the obstacles hampering innovation and change in each of the key sectors, to help inform targeted policy action.

The need to change attitudes to risk

Attitudes to risk also need to change. Accelerating innovation to tackle the climate crisis will require a greater tolerance of failure across all parts of the innovation system (from governments and policymakers to companies, investors, and universities) and at all levels (from senior leaders to managers and individual researchers). We need to accept that many potential solutions will inevitably fail, but this process of experimentation is part of the journey and needs to be encouraged and nurtured.

Some Summit delegates also argued that, given the relatively short timescales for making significant progress towards tackling climate change, we can't necessarily wait for the traditional innovation model, that sees start ups challenging incumbents to disrupt industries, to work. Rather we need to simultaneously enable and incentivise large incumbents to invest in and drive radical and disruptive solutions that may unsettle their own existing markets.

The need for big and bold visions

Throughout this report we have emphasised the importance of clear and compelling visions for galvanising organisations and individuals to action. Accelerating innovation to tackle the climate crisis will similarly require big and bold visions to be developed. These need to be ambitious, long-term and escape from the political cycles that drive short-term mindsets, create long-term uncertainty over direction of travel, and can divert effort and investment.

The global nature of the climate crisis also means that visions and targets would benefit from being developed at the global level, with a very clear and concise communications strategy to raise awareness and drive buy-in. Delegates talked of the importance of adopting a common language globally around the vision and what needs to be delivered, like that developed for the United Nations Sustainable Development Goals.

[12] Bonvillian, W.B., Weiss, C., 2015. Technological Innovation in Legacy Sectors. Oxford University Press USA, New York, NY.

[13] Ibid. pp. 20–21

Lastly, big and bold visions need to be backed by the necessary scale of funding to enable their delivery and unlock the development and deployment breakthroughs at pace. Given the global nature of the challenge, Summit delegates suggested that funding to drive breakthrough solutions should be assembled at the global level. This would help to elevate it above national politics and particular priorities. Global funding programmes could complement national programmes aimed at tackling nation-specific challenges and change, and local technology adoption and diffusion.

The need for clear directions and targets

Big, bold visions need to be translated into clearly articulated and ambitious targets and stretch goals that can provide clarity to organisations over the direction of travel, reduce duplication of effort, facilitate collaborations and coordination of effort, and reduce uncertainties around investing in R&D, people and infrastructure.

To help this process, Summit delegates highlighted the value of foresight tools such as road mapping and horizon scanning. These tools can help to identify and clarify where we need to get to (outcomes), route maps to getting there, and obstacles that need to overcome along the way. They can help us to anticipate changes to the technical, economic, and social system that are just over the horizon that may be required to successfully deploy and diffuse solutions. If developed appropriately, they can also play an important role in bringing together a community of interest and galvanising them around a set of common goals.

The need for a systems approach to tackle the crisis

The climate crisis is an example of a complex, global, system-wide problem that needs to be tackled urgently. It requires a whole-system, whole-lifecycle approaches that can account for multi-level nature of the problem, from the global-to-national-to-local level, across product and technology lifecycles, and across supply chains for each sector.

We must also recognise that while R&D to develop technical solutions is a core component, there are many other areas well where advances need to be made to enable new products and services to be developed, and the behavioural change necessary, to tackle climate change. This includes among other things:

■   Skills to enable organisations and individuals to adopt new products and services

■   New infrastructure to enable widespread diffusion at a global scale

■   New standards and regulations

■   New production and distribution processes

■   New supply chains and business models

■   New incentives and support to nurture nascent markets for emerging products and services

■   Changed behaviours of governments, organisations, and individuals

In developing systems-wide approaches, delegates noted the importance of involving the individuals and groups from across the system who will be key to developing, deploying, and diffusing innovations in key decision-making activities. This can help to make them feel part of the process, which in turn reinforces their commitment to deliver the activities and change necessary to drive positive outcomes. Engaging citizens actively in the process is important, particularly for politicians and policymakers, who will have to make very difficult decisions regarding where and how to invest and intervene in economic and social systems to bring about the changes necessary to tackle the climate crisis.

The need to rethink workforce skills needs

Our ability to develop, deploy, and widely diffuse products and services to tackle the climate crisis, and the ability of our economic and societal systems to adapt to the effects of climate change, will depend critically on the skills of the workforce and citizens. A key message from the Summit delegates is that we need to be actively planning now for changing skills needs.

Apart from the specific technical skills required to enable organisations to both develop and adopt new products and services, we also need to be developing and training undergraduates to challenge the status quo and encourage entrepreneurial disruptors who can think outside the box and take risks in developing new ways of doing things.

Graduates also need to be given tools to develop their resilience and adaptability. It is likely that during their lifetimes they will witness major changes to how our economic and societal systems are organised and function. Given this, we must recognise that over the course of an individual's career they will likely have to develop new skills. We must develop institutions, incentives and support mechanisms to help individuals to acquire new skills throughout their careers.

A major challenge in developing a workforce ready and able to tackle the climate crisis is the scale of change required to training. This may require new approaches to training that can scale easily and massively.

The need to get better at technology development and demonstration

The urgency of the climate crisis means that a core focus of our effort must be on accelerating the development of innovations based on fundamental research that has already been done (more use-driven and applied research may well be necessary to identify how it can be translated into applications and scaled). To accelerate the process, the pre-Summit survey, reinforced by discussions at the Summit highlighted the need to improve our ability to develop prototypes, demonstrate their economic and societal potential, and deploy them in applications at scale.

Summit delegates noted that part of the problem here was the lack of funding for this part of the innovation process – to fund development and demonstration of technologies, as well as solutions-focused, high-risk-high reward projects at the between research and development where the economic potential of research is beginning to emerge.

There is significant potential to learn from the experiences of sectors and organisations that have developed effective processes for rapidly moving from ideas to prototype to deployment. Examples cited included Formula 1 as well as the potential to develop 'lean start-up' models for R&D and commercialisation projects in which there are stage-gates in which early assessments of potential/value are made allowing projects to course correct quickly and 'fail fast' if necessary.

The need for agile and longer-term funding

There were also calls from delegates for more flexible, longer-term funding commitments, arguing that 3-year programmes for building centres of excellence or larger scale collaborations aimed at accelerating the research-to-innovation process can result in promising activities being shut down before they can demonstrate the success necessary to raise follow-on funding. Furthermore, given the nature of the research-to-innovation process for tackling climate change, those funded need to have the flexibility and agility to change the direction of effort and partnering as priorities and needs of the technology development change.

In seeking to develop more agile and longer-term funding programmes, Summit delegates noted that care must be taken not to reinforce existing biases and the status quo by favouring 'known' partners and researchers.

The need for government to help de-risk nascent markets for critical technologies

The potential for governments to stimulate innovation through their procurement power is becoming increasingly well recognised. This can help to reduce the market risk associated with emerging technologies by creating public-sector demand for emerging technologies where private sector markets are non-existent or in their early stages of emergence.

Summit delegates highlighted, for example, how government guarantees for COVID-19 vaccines and diagnostics significantly reduced the market risk for those investing heavily in the development of such products. This provided greater certainty for companies during a highly uncertain environment. Another example is the US Small Business Innovation Research (SBIR) and the Small Business Technology Transfer (STTR) programmes. These aim to encourage small businesses to engage in research and development with the potential for commercialisation.

In accelerating the pace of innovation to tackle climate change, Summit delegates called for governments to explore how they could leverage their vast procurement power to stimulate innovation and de-risk early market development for climate-related innovations.

The need for stronger international collaborations

Reflecting on the response to COVID-19, Summit delegates argued that even though people pulled together and collaborated to develop solutions, this happened much more across the public-private sector divide than across international borders. With the climate crisis a similarly urgent yet more complex global crisis than COVID-19, delegates suggested that we find ways of developing much stronger international collaborations to mobilise the necessary critical mass of resources and capabilities to accelerate the development of solutions. These collaborations need to happen at all levels, from vision setting to problem definition to developing solutions.

As discussed earlier in this report, a major challenge for building international collaborations aimed at tackling global crises is getting politicians and policymakers to commit to global priorities where these may result in some sacrifice in the degree of national autonomy in how and where to invest to develop solutions. Furthermore, even when nations agree to address issues of global concern, the ability to form international collaborations can be hampered by national funding and other structures that tend to focus on enabling domestic activity.

4.5 Greening partnerships to tackle the climate crisis

To better mobilise universities, companies, governments and others to accelerate the innovation process to tackle the climate crisis, we need to do things differently. Summit delegates highlighted three key areas: (i) reconfiguring partnerships to accelerate the translation, development and commercialisation of technologies; (ii) leveraging the nature, position and scale of universities in societies to both lead change and provide test-beds for emerging technologies; and (iii) addressing long-standing issues that make it harder for universities and companies to partner to innovate.

4.5.1 Reconfigure partnerships to accelerate the innovation process

A key challenge hampering the acceleration of the research-to innovation process centres on the ability to translate research ideas into functional prototypes and demonstrate their commercial potential (i.e. reduce the scientific and technical of the technology). Dealing with these challenges will benefit from new types of partnerships, infrastructure, and ways of working.

The need for new organisational environments

Delegates at the Oxford Summit argued for the need for new organisational environments aimed at prototyping and demonstrating emerging technologies; environments that can assemble different types of resources and capabilities (e.g. skills, facilities and equipment, commercial insights, and funding), and put in place increasingly commercial-like processes and standards. The experiences of delegates suggest that developing such environments can be difficult and slow when going through existing university structures and processes that have been designed for more traditional research and education activities.

Such organisational environments could be based either within universities or co-located alongside them. However, if they are developed as organisationally distinct from universities, careful thought needs to be given to how to strongly integrate them with the university research base, to ensure efficient and effective transition of ideas from research labs into these translational spaces.

The need for more agile and multi-functional teams

Related to this is the need for more agile and multi-functional teams that are able bring together the range of capabilities necessary to identify and overcome key technical, production and business challenges along the research-to-innovation journey. In doing so, co-location of these various skillsets was seen as important, as well as the need for strong communication within teams, flexibility, and developing mechanisms to rapidly identify what works and what doesn't – i.e. experiment fast and fail fast.

Teams also need to be agile and nimble, configuring rapidly around specific problems and reconfiguring as needs change. Delegates raised the potential for applying lean start-up methodologies to these types of translational R&D projects and partnership activities to help accelerate the process. Such methods can help to reframe questions around how to develop applications that meet specific unmet needs in ways that are commercially viable. They emphasise rapidly developing prototypes and 'minimum viable products', focusing efforts and experiments to demonstrate and validate their commercial potential. Based on this learning, teams may have to pivot and change course. Such approaches can also help to instil a culture of outcomes-driven thinking, setting milestones and deliverables to capture progress against targets.

The need to develop more agile and broader partnerships

Summit delegates also argued for the need to develop more agile long-term partnerships and consortia that were able to evolve as ideas progress along the research-to-innovation journey. This recognised that the resources and capabilities required to make breakthroughs in more fundamental and even use-inspired research were likely to be different from those required to transition ideas out of research labs and develop and demonstrate functional prototypes that can attract development partners and investors. Challenge-led consortia and longer-term partnerships that seek to build stronger links across this journey may well have to reconfigure as the needs of the technology evolve.

In addition, much of the discussion on partnerships for innovation focuses on bringing together universities with companies. Summit delegates were keen to point out that we need to broaden our focus to examine how other organisations could be valuably engaged to accelerate the innovation process. For example, as emerging technologies mature, it is important to plan for developing the workforce skills required to drive their adoption and widespread diffusion in practice. For climate change, mass adoption will be key. As such, developing training programmes that can operate at scale is very important. Further education colleges, community colleges and other forms of non-university training organisations could prove valuable partners to accelerate the mass adoption of disruptive technologies, products and services aimed at tackling climate change.

The need to better integrate the social sciences into research and innovation partnerships

We also need to develop partnership approaches that more actively integrate and engage the social sciences with the more technical research. Developing solutions that address the climate crisis will require breakthrough technologies as well as, among other things, new business models, changes to behaviours, and the development of new forms of public policy and regulation. They may also have significant ethical implications that need to be properly researched and understood to inform actions to mitigate any negative outcomes. These all point to a rapidly growing importance for the social sciences in driving challenge-led innovation, and particularly around the climate crisis.

Box 1: Actions to increase social science engagement in university-industry partnerships

How to engage the social sciences more actively in partnerships was explored in some depth at the Oxford-UIDP Summit 2019. At that Summit, delegates argued that several actions could be taken to help deliver this. These remain relevant and are reproduced here:

Universities

- Further cultural change around reward and recognition in academia, particularly in areas of social sciences that have not had a history of engagement with industry. This may require:
  o Changes to tenure and promotions processes
  o Changes to how appointments are made
  o New career structures and pathways that are inclusive of the expertise required to effectively engage with companies
- Investing in secure data facilities to give confidence to industrial partners seeking to engage in partnership with academics as big, and increasingly sensitive and private, data becomes central to a lot of research

Businesses

- Increase understanding of the potential value social science research can bring to the development of new products and services
- Reorient and adapt their organisations to confront emerging societal, economic and technical innovation opportunities and challenges. This includes responding to growing pressures to move beyond profits and encompass more socially and environmentally focused core motives and objectives
- Be willing to experiment with new ways of engaging with universities that involve social science researchers

Government agencies

- Greater promotion of convergence research bringing together scientific, technical, and social science research to address societal, economic and technical innovation challenges
- Promote the value of social science research, particularly within the scientific research community and take steps to rebalance the power imbalances and 'siloisation' of disciplines

Professional organisations focused on building university-industry partnerships

- Develop and share insights into effective practices for engaging social science research in university-industry partnerships by reflecting on the necessary incentives, working cultures, and infrastructure and facilities (e.g. co-location space, secure data facilities) required to underpin effective engagements

4.5.2 Leverage the nature, position and scale of universities in societies

Universities are typically some of the largest employers in their local economies, employing thousands of staff and operating large real estates. Through their partnerships with industry, they also work with many large companies and small and medium sized enterprises across many sectors of the economy. Furthermore, many have strong local, national, and global brands which can act to amplify key messages on societal issues of importance.

Oxford Summit delegates heard of examples where universities are seeking to leverage their position in society to take a leadership role in the drive to net zero. Through large-scale and highly visible investments and effort they are hoping to demonstrate to other large and complex organisations with large real estates how to transition to become carbon neutral. One example discussed involved a very large and coordinated investment to:

- **'Green' their campuses to deliver carbon neutrality,** for example, by investing heavily to reduce energy consumption, increase efficiency, and optimise use

- **Leverage their real estate and resources to create test beds for emerging technologies** to demonstrate what can be done under real-world conditions and identify further technical and commercial challenges that need to be solved to enable the commercial deployment of solutions. These may then require further research.

- **Work collaboratively with industrial partners** to help research, develop and commercialise new technologies, and investing effort to accelerate the journey between idea generation and deployment in practice

- **Train the next generation** of workers to be able to absorb these technologies

4.5.3 Address long-standing issues hampering university-industry partnerships

Building partnerships to accelerate the pace and scale of innovation to tackle climate change will also require further effort to deal with long-standing issues and barriers affecting the development of university-industry collaborations more widely. Summit delegates highlighted the need for:

- **Better incentives** to encourage academics to engage further in partnering to accelerate the application and impact of their research, including through co-created research with partners. There is a need to reflect on how recruitment and promotions criteria can be developed in ways to further legitimise this activity.

- **Greater mobility** of staff across the academia-industry boundary. Once again, there were calls for strengthening the ability of staff to move easily between academia and industry (in both directions). Barriers (including a lack of career incentives) exist on both sides, not just within academia. Joint employment models were highlighted by Summit delegates as being worthy of further examination.

- **New approaches to IP**. Summit delegates raised important questions around whether the IP regime that currently dominates many advanced economies is fit-for-purpose for incentivising innovation aimed at tackling major societal challenges. While they did not have any answers, delegates argued this should be investigated to ensure that the IP system was not hampering the ability of organisations to innovate at pace and diffuse at scale.

- **A better understanding of each other's needs, capabilities, constraints and cultures** to improve working across boundaries. Key to the building of effective university-industry partnerships is the ability for each partner to understand what needs of the other partner(s), what they can each contribute, what constraints they face, and how they work to deliver their activities. Among other things, this understanding enables strong alignment between the partners, the setting of realistic expectations, an appreciation of each other's value, and the development of appropriate working practices to build effective working relationships.

14 See e.g. Ulrichsen, T.C., O'Sullivan, E., 2015. Building Long Term Strategic University-Industry Partnerships: Lessons and effective practices from UK and US experiences. Centre for Science, Technology and Innovation Policy, University of Cambridge, Cambridge, UK, which captures key lessons learned from experiences in building effective university-industry strategic partnerships.

These issues have been highlighted for many years[14], yet they still emerge as key problems affecting the development of university-industry partnerships. These are clearly areas where we must increase our effort to improve the status quo.

Moving forward

5 Moving forward

Since the onset of the COVIDd-19 pandemic in early 2020, countries around the world have faced unprecedented disruption and devastation to the health and resilience of their economies and societies. While we have yet to fully emerge from the health crisis, governments, universities and companies are starting to plan for an innovation-driven economic recovery and 'build back better'.

This report explores what can be done as we move forward to better mobilise the university-industry-government partnerships to catalyse and drive an innovation for major economic and societal gain. It captures key insights gathered at the 2021 Oxford Summit bringing together leaders from universities, companies, and government agencies to share their experiences and insights both in navigating their organisations through the pandemic and in working to drive and support innovation over the longer-term.

As we begin to look beyond the COVID-19 health crisis, it is important that we renew our efforts to develop big and bold visions to tackle other major societal crises such as the climate crisis, extreme poverty and substantial economic, health and social inequalities, ageing populations, ocean plastics, and increasing anti-microbial resistance (AMR). These visions need to motivate and galvanise people to action as the urgency of the COVID-19 crisis did. Visions need to be translated into clear plans for action with clear targets and stretch goals that can help direct activity towards tackling specific challenges and enable organisations and individuals to invest with greater certainty.

Visions need to be backed by sufficient funding at scale. While not a condition to unlock significant breakthroughs towards delivering on key challenge goals, the pandemic response demonstrated what is possible when funding is largely unrestricted in many areas. Tackling other societal crises will require similar levels of investment of resource and collective effort. An implication of this is that, given the huge fiscal pressures on governments as we move beyond the pandemic, it is likely that public and other funders of R&D will have to become more strategic about identifying core priorities for their investments to enable funding at sufficient scale to deliver substantive progress.

While funding is a necessary condition for unlocking breakthroughs to drive innovation, it is often not enough. Other key factors that can help accelerate the pace and scale of innovation include a strong 'pull' incentive (e.g. created through the private markets or by leveraging public procurement to create public sector demand); commitments from across the system to invest and engage in innovation; a willingness to take calculated risks, experiment with new ideas, and challenge traditional ways of doing things; more agile and faster decision-making, and a more active and engaged leadership in delivering change; and much stronger incentives for individuals, organisations, and societies to change behaviours.

Universities also called for public funders to learn from their responses to the pandemic to provide sufficient levels of flexible funding – complementing project-specific funding – to enable organisations to respond rapidly to emerging research and innovation opportunities. The pandemic has also revealed challenges around the long-term financial sustainability of the research system. This needs to be addressed to enable the research base to continue to drive innovation breakthroughs to tackle key societal crises and an innovation-led economic recovery.

Tackling major societal crises such as the climate crisis requires a whole-system, lifecycle approach that can account for the multi-level nature of the problem: from the global-to-national-to-local level; across product and technology lifecycles; and across supply chains for each sector. In particular, getting to net zero will require significant effort not just to develop industries of the future delivering new products and services, but also to transform legacy sectors that are a core part of most economies (such as construction, legacy manufacturing, and healthcare). These legacy industries are typically much more resistant to innovation and change, yet their transformation will be critical for meeting targets.

In addition, while advances in R&D will be important for developing new technologies that can open up the potential for breakthrough solutions, it is not enough for delivering real-world impacts. Often the development, deployment and diffusion of new products and services will require new skills, infrastructure to drive diffusion, standards and regulations, production processes, supply chains, business models, and incentives and support to nurture nascent markets. In developing policy interventions and support programmes for tackling complex societal crises, systems-thinking becomes a critically important capability for policymakers, with careful consideration of how each stakeholder at each level of the system can play an active role in delivering key outcomes.

Turning to the level of universities and their partners in industry, the public sector and society, we need to get much better at developing and demonstrating solutions based on advances in research at pace and deploying them at scale. We need to give much greater attention to how to develop and configure universities and their partnerships with industry to rapidly accelerate the idea-to-innovation journey, and to engage much more effectively in challenge-led/mission-led research.

Linked to this is an urgent need for new organisational environments within universities – or strongly linked to them – that can assemble the necessary resources and capabilities (including people, equipment, processes) under the necessary conditions (e.g. standards, contracts, IP arrangements) to accelerate the prototyping and demonstrating of emerging technologies. We need to develop more agile and multi-functional teams able to integrate the range of knowledge and capabilities required along the lab-to-market journey. Further, the social sciences have never been more important. We need to break down barriers and siloes to better integrate social scientists into research and innovation partnerships.

We also need to develop new approaches to partnerships that leverage new ways of working and learn from the creativity and intensity of focus that enabled rapid advances in the COVID-19 fightback. We need to invest in efforts to learn the lessons from remote and hybrid working during the pandemic to inform the future of work that can deliver both increases to productivity and increases in well-being. These outcomes should not be seen as trade-offs, but as joint and synergistic objectives.

Lastly, the Summit identified several long-standing barriers to building partnerships that still need to be addressed, including incentives for academics to engage in these activities; the ability of staff to move between academia, industry, and government; and the understanding of each other's needs, capabilities, constraints, and cultures which hampers the ability to work across boundaries. In addition, delegates at the Summit suggested it was time to revisit whether the current IP regime is fit-for-purpose for incentivising innovation aimed at tackling major societal crises.

The partnerships that form between universities, companies, governments and others have the potential to be a significant driving force behind an innovation-led recovery to 'build-back-better' and drive national and industrial competitiveness, and to tackle major societal crises. As a community we must continue to deliver the long-term research that underpins many breakthrough technologies and innovation. We must also invest and develop our capabilities to accelerate the idea-to-innovation journey to ensure that breakthroughs are developed into real world innovations at pace and diffused at scale. Finally, we need to develop better ways for convening universities, industry, investors, governments, and societies to identify collective and urgent strategic missions – and back these with funding at scale – that can mobilise and galvanise this community to deliver solutions to problems at pace and scale, just as we witnessed in the fight against COVID-19.

Oxford Summit 2021 Sessions and Speakers

14th–16th July 2021

The past year has seen unprecedented disruption to our economies and communities. Through the difficult and dark days, it has been encouraging to see the many examples of universities, companies, government agencies, NGOs and others finding ways of working together at pace to develop solutions at scale to the many challenges the COVID-19 pandemic has thrown up.

While we have yet to emerge from the health crisis, many governments, universities and companies, are starting to plan for the economic recovery and a brighter future, with some taking bold steps to shape new ways of working. To support these efforts, the Oxford Summit 2021 aims to bring together senior leaders from universities, industry and government and others to reflect and co-create ideas. In particular we will look at how we can continue to mobilise new and existing partnerships; to develop solutions at pace and scale; to drive an innovation-led economic recovery; and tackle other critical global societal challenges such as climate change.

The Oxford Summit 2021 will bring together senior practitioners to focus on three key themes over three half days:

Day 1 –Wednesday 14th July – Catalysts for innovation at pace

13:30–14:50 | Welcome & Keynote

The pandemic has presented society with urgent challenges, with governments acting at pace to tackle different aspects of the crisis, from provision of PPE and ventilators to the development, manufacture and distribution of vaccines.

Companies, universities and governments have had to innovate at pace, developing policy, legislation, products and entirely new research programmes at great speed. This has meant diverting people, resources and capacity to new projects, requiring quick and decisive leadership. Companies in particular have responded very quickly to these needs, often working together with universities. Today's speakers will share examples of how their organisation has responded, and an audience Q&A will help participants understand what drove the changes, what difficult choices had to be made, and what was possible in a crisis that would have been more difficult before.

Speakers:
Prof Chas Bountra CBE, Pro-Vice-Chancellor for Innovation, University of Oxford
Dr Nick Scott-Ram MBE, Managing Director - Life Sciences, Sensyne Health
Dr Bryan Haynes, Senior Technical Director, Kimberly-Clark Corporation
Chaired by Dr Phil Clare, Deputy Director, Research Services, University of Oxford

14:50 – 17:00 | Research Focus Groups & Feedback

Taking the provocations from the keynote the research focus groups will identify which catalysts and new approaches they want and plan to continue in university-industry-government collaborations.

Day 2 – Thursday 15th July – A return to multilateralism

13:45–15:00 | Welcome & Keynote

A return to multilateralism: How are the UK and US Governments grappling with grand challenges in a multilateral way using international partnerships?

Speakers:
Prof Dame Ottoline Leyser DBE FRS, Chief Executive of UK Research and Innovation
Mojdeh Bahar, Associate Director for Innovation and Industry Services at the National Institute of Standards and Technology (NIST)
Chaired by **Dr Joe Marshall**, Chief Executive of the National Centre for Universities and Business (NCUB)

15:00–17:15 | Research Focus Groups & Feedback

With delegates from the UK, US and Europe in attendance there will be an opportunity to reflect on and discuss the practicalities of international partnerships in this new era of Post-Trump and Post-Brexit. The UK's Integrated Review of Security, Defence and Foreign Policy and the US' new National Security Strategy and Defence Strategy all set out how each nation intends to work with its partners and how they will tackle international challenges such as climate change and rapid technological change with a clear commitment to multilateral ways of working. This session will deliberately seek to develop practical ideas and suggestions from participants that UKRI and NIST (and others) can consider to develop more international partnerships in the future.

Day 3 – Friday 16th July – Transitioning to a sustainable future

13:30–14:40 | Welcome & Keynote

Transitioning to a Sustainable Future: Mobilising the University-Industry-Government Partnership to drive innovative solutions at pace and scale

Keynote speeches will provide examples of how partnerships are currently being leveraged to drive this transition and develop innovative solutions to complex problems at both pace and scale. They will highlight where universities, industry and government have the potential to come together to deliver significant positive impacts, for example through rapid demonstration and application of novel technologies as well as through repurposing existing ones, and through more effectively integrating social sciences and policy elements into the process.

Speakers:
Prof Rob Miller, Chair in Aerothermal Technology and Whittle Laboratory Director, University of Cambridge
Prof Dorota Grejner-Brzezinska, Associate Dean for Research, College of Engineering, The Ohio State University
Chaired by **Tomas Coates Ulrichsen**, Director of the University Commercialisation and Innovation (UCI) Policy Evidence Unit, University of Cambridge

14:40–16:30 | Research Focus Groups & Feedback

Explore specific topics identified in the keynotes in more detail. The discussions will be based on appreciative inquiry, drawing on the experiences of all participants in responding to a series of questions. Our aim is to identify examples of best practice and insights from different countries; specific issues that need to be addressed to further mobilise partnerships to drive the transition to a sustainable future; and actions that could be taken by government to facilitate this change.

Day 3 - Friday 16th July – Summit concluding remarks

16:30–17:00 | Summit Concluding Remarks

Prof Chas Bountra CBE, Pro-Vice-Chancellor for Innovation, University of Oxford