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Report

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Interconnected Innovation: Physical connectivity as the missing ingredient in UK research and innovation policy

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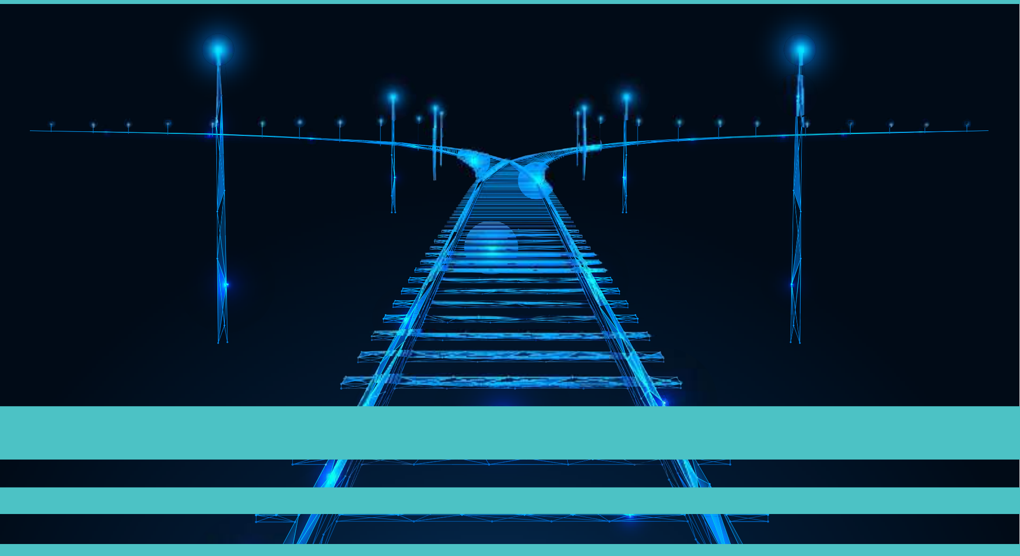

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Acknowledgements

We thank James Coe, Nick Hillman, Ben Johnson, Peter O'Brien, Graeme Reid, and Andy Westwood for their insightful comments on earlier version of this paper.

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Executive summary

The UK's research and innovation system is fragmented. It is rich in excellence but poor in connection. Worldclass capabilities exist across the country, yet the physical connectivity that allows them to work together is poor. As UKRI shifts towards priority-driven research and innovation investment, the evidence shows that transport infrastructure drives measurable innovation gains, which current policy largely ignores. There is therefore an opportunity to strengthen global competitiveness through greater integration of the UK research and innovation ecosystem. Physical connectivity – the infrastructure enabling people to move between places – is foundational to achieving this integration. It is not one consideration among many but a primary determinant of whether distributed research strengths can function as coherent national capability.

A connectivity-focused approach can shift policy debates away from zero-sum choices around concentration and distribution. The question becomes not where to invest, but how to enable different places working together. The UK's compact geography offers significant international advantage, with major research centres within hours of each other. Yet the infrastructure to link them and the incentives to use that infrastructure is lacking from UK policy. The result is a system shaped more by transport patterns than research strategy. To capitalise on this potential requires better alignment of research and innovation policy with transport, digital and capital infrastructure decisions.

Research investments should be assessed for both individual excellence and their contribution to the national ecosystem. Research funders need to prioritise not only investment in assets but in the connective tissue – networks, platforms, shared infrastructure and mobility schemes – that support connected capabilities. Infrastructure decisions must account for research and innovation impacts. Place-based funding should incentivise connection rather than self-sufficiency.

If the UK is serious about strategic research investment, it must be equally serious about the physical connectivity that makes national collaboration possible.

1. Introduction: The shift to 'choiceful' research and innovation investment

UK research and innovation policy stands at a crossroads. The renewed emphasis on specialisation, explicit priority-setting and strategic investment in specific capabilities marks a significant shift from previous approaches. Science Minister Patrick Vallance and UKRI Chief Executive Ian Chapman have challenged the publicly-funded research sector to consider how the UK can best leverage its national research capability to deliver on areas of strength.[1] Ministers and senior officials now openly discuss picking winners and making choices about which research and innovation capacities deserve concentrated investment to drive industrial strategy and national priorities.

Yet this renewed focus on excellence and selectivity risks overlooking a critical dimension: the interdependencies between different parts of the country's research and innovation landscape. Decades of academic research have established that innovation rarely emerges from isolated centres of excellence, but rather through networks that enable knowledge spillovers and collaborative learning. The answer may lie not in choosing between places, but in recognising how connectivity between them creates competitive advantage.

This requires a specific understanding of connectivity in research and innovation policy. Here we mean primarily physical connectivity: the transport infrastructure that enables researchers, entrepreneurs and investors to move between places. This is the foundation that creates the conditions for institutional relationships, knowledge exchange and capital flows. Digital networks and formal collaboration agreements matter, but they build upon and depend on the underlying capacity for face-to-face interaction. The argument is not simply that digital substitutes inadequately for physical presence. Empirical work on workplace collaboration shows that increased digital availability can actually reduce the quality of interaction: when people can substitute shallow electronic contact for deeper engagement, they do so. Sustained collaboration that generates breakthrough research and successful translation requires repeated in-person contact that physical connectivity makes practical and routine.

The UK's research and innovation landscape comprises many distributed assets: universities, research institutes, catapults, clinical facilities, manufacturing capabilities and specialist expertise located across the country. The critical policy question is whether these function as isolated nodes or as an integrated system. The answer depends largely on whether people can move between them efficiently. Journey times, service frequency and reliability determine which collaborations are feasible. They shape decisions about where to locate facilities, where to recruit talent and where to build commercial partnerships. They also impact business investment in research and innovation, among both UK and international companies. Physical connectivity is thus not a secondary consideration to be addressed after investment decisions are made. It is a primary determinant of whether those investments deliver their potential value.

If the UK wishes to invest in nationally and globally significant research and innovation to drive industrial strategy and other government priorities, greater consideration of the role of physical connectivity is required. Current policy frameworks are not designed to deliver this. Yet a more connected ecosystem could become a major competitive advantage for the UK in attracting investment and leveraging the full breadth of our research and innovation assets.

2. The persistence of proximity

A reasonable objection must be addressed at the outset. If connectivity matters for research and innovation, has the digital revolution not already solved the problem? Video conferencing, collaborative software and high-speed data networks enable instant communication regardless of location. The death of distance has been predicted for three decades.[2] Why should physical infrastructure still matter?

The pandemic provided an unintended natural experiment. Researchers worldwide shifted abruptly to remote collaboration. The outcomes were instructive. Existing collaborations largely continued, and teams with established relationships and proven working methods adapted reasonably well. But new collaborations proved far harder to initiate and sustain. For example, a study of Microsoft's own workforce found that remote work caused networks to become more siloed and static, with fewer connections forming across organisational boundaries.[3] Research on scientific collaboration during COVID lockdowns found similar patterns where established co-author relationships persisted, but new partnerships formed at significantly lower rates.[4]

These observations reflect something fundamental about how knowledge works. Much of what makes collaboration productive cannot be fully articulated or transmitted digitally. Laboratory techniques, tacit judgements about research directions, understanding of organisational culture: these transfer primarily through sustained proximity. Michael Polanyi's observation that we know more than we can tell explains why video calls work adequately for information exchange but poorly for the deeper knowledge-sharing and collective human endeavour that drives innovation.[5] The persistence of geographic clustering reinforces the point. If telecommunications had eliminated the friction of distance, knowledge-intensive industries would disperse. Instead, agglomeration has intensified. The Golden Triangle continues to capture a large share of UK research funding. Silicon Valley remains dominant despite decades of predictions about distributed innovation. Life sciences concentrate in

Boston, San Francisco, San Diego and London. These clusters persist and strengthen because physical proximity retains substantial value for the interactions that matter most.

There is evidence that improving physical connectivity leads to better research and innovation outcomes. For example, new high speed rail connections significantly increase inter-city co-patents, patent quality and collaborative partnerships.[6] Similarly, there is a 30 to 50 per cent increase in scientific collaboration after two locations are linked by cheap flights.[7] These effects are strongest for city-pairs within 250km. High speed rail also increases patent trade between cities, particularly from technologically advanced cities to technologically disadvantaged cities and especially for high-value patents.[8] Importantly, these studies all show that the effects are geographically constrained in a way that favours the UK's compact geography.

Digital connectivity complements rather than substitutes for physical connectivity. Indeed, the relationship may be reinforcing. Better digital tools increase the volume of interactions, which increases the value of repeated face-to-face contact for the subset of exchanges that benefit most from physical presence. Researchers who collaborate remotely still benefit from periodic in-person meetings. Investors who monitor portfolios digitally still want to visit companies and meet founders. The question is therefore not whether physical connectivity still matters, but which physical connections yield the greatest returns for research and innovation outcomes.

3. Beyond concentration and distribution

Debates around UK research policy have tended to focus on a binary question: should funding be concentrated in centres of excellence to maintain global competitiveness, or should it instead be distributed across regions to address economic inequalities?[9] This framing creates a zero-sum dichotomy that risks failing to maximise the benefits of research investment. It also sits uncomfortably with a growth mission to which both international competitiveness and regional economic performance contribute. Excellence in research increasingly depends on combining capabilities that no single institution possesses. It is therefore important to organise for national research excellence by considering how to multiply the returns to existing investments in excellent people and facilities.

This concentration-distribution debate currently treats connectivity as a second-order consideration, to be addressed after deciding where to put the research groups and technology platforms. But if physical connectivity is foundational, the framing should be inverted. Location then becomes contingent on infrastructure decisions. Research capabilities in different parts of the country that are connected need not compete but can play complementary roles within a national system. Investment decisions become about building systemic capability rather than backing individual winners.

This reframing already has precedents. Germany's Clusters of Excellence have produced highly cited papers increasingly published from networked institutions across multiple locations rather than concentrated in single centres.[10] The National Science Foundation has observed that domestic collaboration between researchers across academic, government and industry sectors generates higher citation rates than single-institution work.[11] Scotland's Research Pooling Initiative, with £500 million of co-funding supporting 11 disciplinary pools, delivered measurable improvements in research excellence alongside critical mass in doctoral training.[12] These examples suggest that connectivity and excellence reinforce rather than trade off against each other.

The Francis Crick Institute was established partly to concentrate biomedical research excellence in a single location. It has succeeded on its own terms. But its future impact now depends substantially on connections to clinical infrastructure at University College London Hospital (UCLH), Imperial Healthcare Trust and Kings Health Partners, to patient cohorts across the NHS, and to manufacturing capabilities for novel therapeutics outside central London. The Crick's excellence is not self-contained. It is networked excellence that relies on physical connectivity to function.

The connectivity argument offers a different lens on questions of regional inequality and redistribution. It is agnostic about where resources go but asks instead how resources in different places can work together more effectively. For example, we might enumerate what complementary capabilities exist elsewhere; consider how researchers might access them; and research the journey times and service patterns that would make collaboration feasible. Connectivity investment might strengthen links between already-strong regions if that is where the complementary capabilities sit. It might equally support connections to emerging strengths in places that current funding patterns overlook.

4. A whole-UK approach

The UK's 'second-tier' cities possess emerging and established strengths that can be nurtured into distinctive and complementary regional specialisms as part of an integrated national research and innovation ecosystem. The Centre for Cities has identified a number of places with strong potential to become future innovation growth hubs, due to university strength, urban scale, skilled workforce and connectivity.[13] Yet at present, the UK's regional productivity divergence is among the most extreme in the OECD with the UK economy appearing as a 'hub with no spokes'.[14] Developing regional capabilities requires sustained investment not only in research facilities and talent pipelines, but also in the physical connectivity that enables collaboration across the UK.

The Knowledge Quarter exists at King's Cross not from scientific planning but because Victorian engineers built railway termini there. The UK has inherited a national geography shaped by 1860s infrastructure decisions. Such realities need to be acknowledged and used to national advantage, but strengthening inter-regional connectivity also supports wider knowledge networks which place individual cities and regions as integral nodes in a national innovation system. Evidence from the Innovation & Research Caucus reinforces this: while clusters generate local benefits, spillovers are not exclusively local.[15]

Yet system-level diffusion depends on the relationships between places and the circulation of research, commercialisation activities and talent across regions. Facilitating these cross-regional flows – through transport links, digital infrastructure, shared research platforms and inter-regional partnerships – would help to leverage the UK's distributed assets. For example, regional university groups such as Yorkshire Universities, Midlands Innovation, Universities for North East England and London Higher offer existing structures which can facilitate inter-regional collaborations to maximise value from research and innovation capabilities across the UK. Ultimately, this will make the national research and innovation ecosystem more coherent, resilient and globally competitive.

Germany and Switzerland have built national systems on this principle. Switzerland's Innovation Park network maintains competitiveness across multiple technology domains through coordinated locations tied to local research strengths and connected by efficient transport.[16] Germany's Fraunhofer network distributes 75 institutes across the country, connected by high-speed rail that makes most reachable within three hours of each other. Researchers move between institutes and industry partners access specialist capabilities wherever they are located. The system functions as an integrated whole, based on an infrastructure of collaboration. The network generates approximately €3.6 billion in annual research revenue, with over 85 per cent from industry contracts.[17]

5. Physical connectivity as innovation infrastructure

The UK's relatively compact geography presents a strategic international advantage. Unlike many countries, major research centres sit within two to three hours of each other. This enables combinations of talent, research strengths and business capabilities that can sustain long-term collaboration and attract global investment. But this advantage exists only in potential. Realising it depends on infrastructure that makes movement between places practical and routine.

There is robust evidence that transport connectivity improves productivity, economic growth and access to opportunities.[18] Consider what connectivity enables for research and innovation. A breakthrough in advanced materials might require fundamental research conducted in one location, specialist manufacturing capabilities in another and clinical trial infrastructure in a third. Particle physics might depend on detector development in one place, accelerator facilities elsewhere and distributed data analysis. Life sciences research draws on patient cohorts across the country, specialist facilities in multiple regions and commercial capabilities concentrated in particular clusters. None of these combinations will work if the people involved cannot easily meet.

Recent *Harvard Business Review* research has explored the increasing importance of the 'urban knowledge campus', anchored to transport hubs, which support both 'work productivity' and 'life productivity'.[19] The life sciences cluster around Euston and King's Cross demonstrates what physical connectivity makes possible. Analysis by Public First for UCL quantifies the relationship between transport infrastructure and innovation outcomes in unusually concrete terms.[20]

The cluster already generates substantial value. The 1.5 square kilometre area within 10 minutes' walk of UCL employs 12,000 life sciences workers and produces £8.35 billion in annual Gross Value Added (GVA). It hosts anchor institutions including UCL, University

College Hospital and the Francis Crick Institute, alongside companies working at the intersection of biology and artificial intelligence such as Google DeepMind and Isomorphic Labs.

What distinguishes this cluster, even from others in London, is its connectivity. Euston and King's Cross together provide direct rail access to Birmingham, Manchester, Liverpool, Leeds, Newcastle, Edinburgh and Glasgow. Cambridge lies 50 minutes away. Well over 200 million passengers currently pass through the King's Cross / Euston railway stations.[21] This matters because the cluster's value depends on integration with complementary capabilities distributed across the country. Clinical trials draw on patient cohorts nationwide. Manufacturing partnerships link to facilities in Stevenage and beyond. Talent flows along rail corridors.

The Public First analysis models what accelerated growth would mean. If the cluster matched the employment growth rate of comparable districts, it could add between £2.7 billion and £3.5 billion in additional annual GVA by 2035, creating up to 20,000 new life sciences jobs. More striking is where the productivity gains would land. Using the Department for Transport's WebTAG methodology for measuring agglomeration effects, the analysis shows spillovers reaching Manchester, Liverpool, South Yorkshire, Edinburgh, Glasgow, Cardiff and Bristol. The benefits follow rail lines, and places with stronger physical connectivity to this London cluster capture larger productivity gains.

This is not a study showing a London cluster extracting value from the regions. It demonstrates how a well-connected cluster with hub connectivity creates returns that spread through the national network. The consolidation of activity in one location generates productivity improvements that flow outward through shared supply chains, knowledge exchange and deeper labour markets. Strengthening the hub strengthens the network, but only if the physical connections exist to transmit the gains.

The parallel with Tokyo is instructive. The Otemachi-Marunouchi-Yurakucho district was built around a redeveloped central station with high-speed rail links to other major cities. The Shinkansen network means researchers and investors can reach Osaka, Nagoya or Kyoto in hours. The cluster grew at nearly 7 per cent annually in knowledge-intensive employment despite already high density. The infrastructure decision is therefore also an innovation policy decision.

This is well recognised by Singapore's government, which launched one-north in 2001 as part of the National Technology Plan. This is a 200-hectare research and development and high-technology cluster incorporating housing, shops and transport, aimed at promoting interdisciplinary collaboration and co-locating start-ups, incubators and venture capitalists. In other words, it is engineering physical proximity as an innovation policy tool.[22]

The concept has been taken even further by the Danish and Swedish governments in the form of the Medicon Valley Alliance. The building of the Øresund Link, a 16-kilometre bridge and underwater tunnel system linking Copenhagen with Malmö has enabled a transnational life sciences cluster which combines the strengths of Copenhagen, Lund and Malmö into a thriving cross-border ecosystem (comprising nearly 600 life science companies, nine research universities and 32 hospitals).[23]

There is a strong argument that the most innovative regions combine strong local ecosystems with extensive external networks.[24] In other words, they depend on both spatial proximity and strategic connectivity beyond the immediate locality (what has been termed 'local buzz' and 'global pipelines').[25] This confirms earlier insights into innovation networks across multiple countries on the importance of knowledge spillovers as a critical driver of innovation and economic growth,[26] and the importance of connections between institutions as well as individual excellence.[27]

This analysis raises an uncomfortable question: does strengthening connectivity paradoxically strengthen London's centrality? Current concentration in London delivers limited national benefit because connections to distribute those gains are (comparatively) weak. A well-connected London hub creates value that flows to Manchester, Edinburgh and Cardiff along transport corridors. The choice is not between London dominance and regional self-sufficiency, but between London concentration that benefits London alone versus London integration that benefits the entire network. And the same analysis – and benefits of better physical connectivity – applies to regional partnerships from other major centres such as Manchester or Edinburgh.

Northern Powerhouse Rail would transform connectivity between northern research centres in Liverpool, Manchester, Leeds and Hull. Currently, a researcher at the University of Liverpool seeking to collaborate with colleagues at the University of Leeds faces almost a half-day journey each way. Manchester to Sheffield is quicker but still awkward. The result is that northern universities collaborate more easily with London than with each other. Northern Powerhouse Rail would create a connected northern research system for the first time.

6. The cost of poor connectivity

The case for connectivity usually emphasises potential gains. But there is also a cost to the status quo. Poor connectivity does not simply mean foregone growth. It actively shapes research and innovation outcomes in ways that weaken national capability.

The most visible cost is geographic concentration. The Golden Triangle of London, Oxford and Cambridge captures a disproportionate share of UK research funding, and that share has increased over time. This concentration reflects genuine international excellence. But it also reflects connectivity. Oxford and Cambridge are an hour from London by rail. Universities elsewhere in the UK, where there is poorer physical connectivity, face structural disadvantage in building the sustained relationships that attract funding, talent and commercial partnerships. A researcher in Edinburgh or Manchester can collaborate with each other or with colleagues in London. But the friction is higher, with fewer informal meetings, fewer chance encounters and fewer chances to build the trust that underpins productive collaboration. In time, this friction compounds.

This has implications for physical connectivity to distributed facilities. The UK has invested heavily in research infrastructure outside the Golden Triangle: for example, the Hartree Centre in Daresbury, the National Biologics Manufacturing Centre in Darlington and the Advanced Manufacturing Research Centre in Sheffield. These assets exist to serve national needs, but their utilisation depends on researchers being able to reach them. It is relevant to ask whether physical connectivity has been explicitly considered when deciding their particular location. A facility that requires a day's travel for most potential users will be underused relative to one accessible in two hours. Poor connectivity does not prevent access, but reduces access at the margin, repeatedly, across thousands of individual decisions about whether a trip is worthwhile.

The same logic applies to commercial partnerships. Venture capitalists and corporate R&D directors make location decisions based partly on which universities they can easily visit. A fund manager in London can meet Oxford spinouts over lunch, while reaching Manchester or Leeds requires a day. This does not prevent investment in northern universities. But it tilts the odds. Analysis of venture capital flows shows persistent concentration in the Golden Triangle despite policy efforts to spread investment. Connectivity is not the only factor. But it shapes which opportunities get seen. We need creative responses that exploit the existing connectivity and develop new connectivity to maximise the benefits of place-based investment.

There are also costs that compound over time through talent decisions. Doctoral students and early-career researchers choose locations based partly on access to collaborators, facilities and career opportunities. If the best opportunities require proximity to London, talent concentrates there. This further strengthens London's advantages in the next funding round. The cycle reinforces itself. Breaking it requires either exceptional local assets or improved connectivity that expands the effective geography of opportunity.

The Netherlands offers an illustration of what connectivity constraints cost. Brainport Eindhoven is home to ASML, Eindhoven University of Technology and over 5,000 high-tech companies. It is widely regarded as one of Europe's most advanced innovation ecosystems. Yet despite being less than 100 kilometres from the German rail hub at Duisburg, the train journey takes over two hours with multiple transfers, compared to 75 minutes by car. Belgium and the Netherlands have recently signed a letter of intent specifically to improve rail connectivity between Brussels and Eindhoven, with policymakers explicitly framing the region's transport fragmentation as a strategic constraint on a cluster of European significance.[28] The lesson is that even an internationally recognised innovation hub does not automatically attract the infrastructure investment its economic weight would justify. Connectivity gaps must be identified, argued for and resolved through deliberate policy.

The policy implication is straightforward. Connectivity investments should be assessed not only for their transport benefits but for their effects on the research and innovation system. A rail improvement that saves commuters 20 minutes has value. The same improvement that enables a researcher in Birmingham to maintain active collaboration with facilities in both Manchester and London has additional value that current appraisal methods do not capture. The cost of inaction is not zero. It is reflected in the continued accumulation of these invisible losses, year after year, as the UK's distributed research assets fail to function as the integrated system they could become.

7. Institutional mechanisms for connected research

Physical connectivity is necessary but not sufficient. Transport links create potential for collaboration but realising that potential for research and innovation requires institutional mechanisms: funding structures, coordination bodies, networks and platforms that actively connect researchers, resources and organisations. It is increasingly apparent that 'soft infrastructure' – the skilled individuals, processes and institutional systems that enable research activities and collaboration – are a crucial component for connecting researchers to each other and to research 'users'.[29] A holistic view of research infrastructure should recognise physical assets and connectivity alongside workforce capability, digital platforms and coordinating systems.

The National Institute for Health and Care Research (NIHR) Collaborations for Leadership in Applied Health Research and Care (CLAHRC) illustrate this. CLAHRCs brought together researchers, healthcare practitioners and patients to address the translational gap between research and practice. Evaluation showed their effectiveness depended critically on the quality of connections across these groups: ongoing interaction, trust-based relationships and the flow of tacit knowledge rather than linear transfer of findings.[30] The MIT Innovation Initiative provides another model, with explicit focus on connecting researchers, building networks and brokering collaboration. Its economic impact is estimated at annual revenues equivalent to the GDP of the world's tenth-largest economy.[31] Analysis of smart city innovation networks shows similar patterns: societal impact requires specific configurations bringing together business, government and civil society actors, with effectiveness depending on activities that bridge sectors.[32]

Of course, the UK does fund collaboration. Research councils support multi-institutional grants and Innovate UK funds business-university partnerships. Yet inter-regional connectivity funding is structurally weak compared to international comparators. UKRI's cross-cutting programmes support thematic collaboration but do not specifically resource the physical connectivity that makes collaboration practical. The assumption is that researchers will find their own way to meet, but often they do not.

Current funding interventions to strengthen the national ecosystem have focused on strengthening regional clusters and ecosystems within regions rather than developing connectivity across or between them. For example, the Research Partnerships Investment Fund supports shared facilities and co-location, but not connectivity across regions. The Strength in Places Fund aims to enhance place-based capabilities focused on benefiting local economies. The Connected Capability Fund has helped to build shared knowledge exchange (KE) capabilities across institutions.[33] While all are welcome, the evidence shows that they will have lesser impact if they do not consider physical connectivity between different regions and proactively facilitate that.

Contrast this with EU framework programmes which provide dedicated funding for travel, secondments and coordination across borders. Currently, a researcher in Manchester seeking to collaborate with a laboratory in Southampton faces a direct rail journey of over four hours each way – enough to make a same-day collaboration visit impractical rather than merely inconvenient. A researcher flying from Manchester to Munich, by contrast, faces a comparable or shorter door-to-door journey with Horizon Europe funding covering the travel cost. The gap is not in the principle of collaboration funding but in the specific mechanisms that enable researchers in different parts of the country to work together as easily as they work with international partners.

These institutional mechanisms work best where physical connectivity already exists, as they are 'software' running on 'hardware'. Initiatives such as the Catapults network, which offers national innovation capability spanning multiple locations, can incentivise collaboration, but collaboration requires people to meet. Coordination bodies can identify complementary capabilities, but exploiting complementarity requires movement between locations. The policy challenge is how to build both together: physical infrastructure that enables connection, and institutional frameworks that ensure connection happens. This is illustrated in a review of the Catapults, while the importance of enabling cross-Catapult and cross-ecosystem collaboration was noted, but it appears to be a work in progress.[34]

The shift to a more purposeful approach to UKRI's investment announced by Chief Executive Ian Chapman in November 2025 suggests the potential for advancing a more holistic strategy for public investment in research. This will, however, require a better understanding of national capabilities and their distribution.[35] As Amanda Wolthuizen at Imperial College London has put it, 'the UK must seize the opportunity to put in place the physical and digital infrastructure and funding mechanisms to connect [university-centred] clusters on a national level'.[36]

UKRI has set out a categorisation of 'four buckets': investing in curiosity-driven research; addressing government priorities; supporting innovation companies; and investing in infrastructure and talent. The fourth and final 'bucket' comprises funding intended to enable and strengthen the UK research and innovation ecosystem. This offers an obvious opportunity to respond to the OECD's observation that research infrastructure ecosystems are not achieving their full potential.[37] Specifically, UKRI should use the allocation in this 'bucket' to consider connectivity as a critical enabler which underpins and reinforces other UKRI investment.

At the end of last year, Science Minister Patrick Vallance launched the National Research Organisations Group, bringing together the Crick Institute, the Turing Institute, the Rosalind Franklin Institute and others under a coordinating framework.[38] The explicit goal of this group is to align capabilities for maximum impact. The implicit recognition is thus that fragmented excellence delivers less than coordinated excellence. But the same day, the Local Innovation Partnerships Fund continued allocating £30 million to each region separately, with competitive bidding that treats Manchester, Glasgow and Cardiff as isolated units competing with each other. We fund organisations to integrate but places to compete. This incoherence would benefit from resolution.

8. Integrating connectivity into investment decisions

Strengthening the UK's research and innovation capabilities is not solely a matter for the Department for Science, Innovation and Technology. Decisions made by the Department for Education (in terms of higher education and skills policy), the Department for Business and Trade (in terms of industrial strategy), the Department for Transport (in terms of physical connectivity) and the Ministry of Housing, Communities and Local Government (in terms of place making) all have an impact. Considering research investment, infrastructure and industrial strategy holistically offers an opportunity to improve joined-up policymaking across government.

This is true not only at a national level. The ongoing devolution of governance in England offers an important opportunity to align research and innovation (R&I) policy to support distributed capabilities enabled by physical connectivity. Metro mayors and combined authorities could play a key role in enabling better coordination between R&I investments and complementary areas such as transport, housing and workforce development as they shape regional economic strategies. At present, this is impeded by the current variation in regional governance architecture across England, with authorities at different stages of maturity and variable powers. Regional research and innovation priorities should be integrated with a clear national strategy for a connected system in which multiple centres of excellence contribute to national prosperity.

Business cases for infrastructure that ignore R&I connectivity systematically undervalue infrastructure investments. They capture commuting benefits and business travel but miss the knowledge economy effects that drive long-term productivity growth. A rail improvement that enables a pharmaceutical company to coordinate clinical trials across three cities creates value that standard appraisal does not capture. The same improvement that allows a quantum computing researcher to maintain active collaboration with facilities in both Oxford and Glasgow generates spillovers that extend far beyond the direct users.

It is welcome that the February 2026 revision of the Treasury Green Book places greater emphasis on place-based and long-term transformational change. But it still lacks recognition of network, agglomeration and knowledge spillover effects as legitimate sources of economic and social value and fails to offer specific guidance on quantifying knowledge economy effects.

The Department for Transport's WebTAG guidance for transport scheme appraisal operationalises the Green Book's cost-benefit framework.[39] This includes agglomeration effects. But WebTAG's wider economic impact modules are calibrated primarily for conventional business services. They neglect the specific dynamics of research and innovation collaboration, where value creation depends on combining tacit knowledge across locations.

Both instruments need to change: the Green Book should establish research and development (R&D) network effects as a recognised category of wider economic impact, and WebTAG should develop the methodology to quantify them in transport business cases. The implication is not that R&D considerations should override economic analysis, but rather that economic analysis is incomplete without them.

Infrastructure decisions are about economics – but they should also recognise the enabling, as well as stand-alone, impacts of infrastructure. The economics of an advanced knowledge economy like the UK include research connectivity. A recent evidence review of the economic impact of transport interventions for the Department for Transport focused on impacts on unemployment, gentrification and productivity. Consideration of impacts on research and innovation – despite this being a major driver of economic growth – was absent.[40] Business cases that treat R&D as a separate domain will consistently underinvest in the connections that matter most for long-term growth.

Equally, research investments which omit consideration of connectivity fail to leverage the UK's full competitive advantage. Current R&I funding frameworks do not reflect an integrated approach which considers distributed research strengths as part of an integrated whole. Investments intended to strengthen or develop capabilities take no account of connectivity implications. Connectivity is absent as a criterion for funding decisions. This is surely counter to Ian Chapman's remarks in November 2025 that 'our nation's future depends on us doing more, on sweating our research assets to their maximum'.[41]

9. Policy implications

The Chancellor of the Exchequer's Mais lecture in March 2026 offers some grounds for optimism.[42] She emphasises investment-led growth and the need for regional growth corridors to link research institutions and businesses. Four shifts in current policy and funding decisions would now make a difference.

- **Integrate research and innovation impact into infrastructure decisions**

Major transport investments should be assessed explicitly for their effects on the research and innovation ecosystem. This requires more than noting that HS2 passes near universities and research organisations. It demands systematic analysis of how journey time changes affect feasible collaboration patterns, access to shared facilities and the geography of talent markets. Current transport appraisal methodology captures commuting and business travel benefits but lacks frameworks for assessing knowledge economy impacts.

The Department for Science, Innovation and Technology should be a formal consultee on major transport infrastructure decisions, with a remit to assess research and innovation implications and publish its analysis. This would not give such considerations a veto over transport decisions, but ensure they are visible in the decision-making process.

The Department for Transport and the Department for Science, Innovation and Technology should commission joint guidance on research and innovation appraisal by the end of 2026. This guidance should update WebTAG's wider economic impact modules to include R&D network effects – specifically the impact of journey time changes on inter-institutional collaboration rates, shared facility utilisation by non-local users and researcher mobility between institutions. It should require application of this methodology in business cases for all major transport schemes above a defined threshold. The National Infrastructure Commission should incorporate these criteria in its assessment framework for the next National Infrastructure Assessment.

The immediate tests are Northern Powerhouse Rail and HS2. The rollout of future phases of Northern Powerhouse Rail should take account of implications for national research and innovation capabilities, with the Department for Transport working closely with the Department for Science, Innovation and Technology (DSIT). DSIT should submit formal advice to the HS2 review on research and innovation implications, identifying which connections matter most for priority sectors and quantifying the costs of truncation or delay. This advice should be published to inform public debate.

Assess research capital investments for network contribution

Major research infrastructure decisions currently focus on where assets should be located. Less attention goes to how they will be accessed and integrated into wider capabilities. A synchrotron, biobank or high-performance computing facility serves a national user base. Its value depends as much on connectivity as on technical specification.

UKRI should **revise its infrastructure fund guidance by the end of 2026 to require proposals above £20 million to include connectivity assessments**. These should analyse transport access for the expected user base, identify connectivity constraints and, where necessary, include investment in access as part of the capital case. The assessment should address both current connectivity and planned infrastructure improvements.

UKRI should **pilot a network contribution score** alongside scientific excellence criteria in the next round of major facility decisions. This score would assess how a proposed facility connects to and strengthens existing capabilities elsewhere in the UK. Facilities that enable distributed collaboration should score higher than those designed for local use alone.

Fund connectivity explicitly

UKRI's current funding model invests primarily in people, projects and institutions. The connective tissue that enables collaboration receives less systematic support. Networks exist, but often as by-products of other investments rather than strategic priorities.

UKRI should establish a Connectivity Fund of at least £50 million annually to pilot support mechanisms that link distributed capabilities. This should be drawn from existing cross-cutting budgets. Eligible activities should include: researcher exchange programmes between institutions with complementary strengths; shared equipment access schemes that make specialist facilities available across regions; coordination bodies that actively broker collaboration; and platforms that reduce friction in cross-institutional working.

The fund should be operational by the next financial year. It should prioritise proposals that connect institutions in different regions rather than strengthening existing local clusters. Success metrics should include cross-regional collaboration rates, facility utilisation by non-local users and researcher mobility between institutions.

Reform place-based funding to incentivise connection

Current place-based research and innovation funding often encourages regions to build self-contained ecosystems. The implicit model is import substitution: each area should develop local capabilities rather than depending on connections elsewhere. This works against the integrated national system that strategic priorities require.

The Local Innovation Partnerships Fund should be restructured for its next phase. Rather than allocating fixed sums to each region with independent evaluation, at least 30 per cent of funding should be reserved for inter-regional bids. Assessment criteria should include contribution to national capability alongside local economic impact. Regions that propose connections to complementary capabilities elsewhere should score higher than those pursuing self-sufficiency.

Innovate UK should review its Smart Grants and other open programmes to assess whether current criteria inadvertently penalise cross-regional collaboration. If a Manchester firm partnering with a university in Bristol faces higher barriers than one partnering locally, the incentive structure works against connectivity. Revised guidance should ensure that geographic distribution of project partners is neutral or positive in assessment.

10. Research and innovation connectivity in practice

Several infrastructure decisions currently under consideration will shape UK research connectivity for decades. Applying a research and innovation lens to these decisions illustrates what the framework proposed here would mean in practice.

The most significant is the future of high-speed rail north of Birmingham. The original HS2 plan would have reduced journey times from London to Manchester to around 1 hour 10 minutes and created direct connections between Birmingham, the East Midlands, Leeds and Manchester. The truncated version currently under construction stops at Birmingham. Decisions on whether and how to extend high-speed connections northward remain open. From a research and innovation perspective, the question is not simply journey time savings for business travellers. It is whether researchers at Manchester, Leeds, Sheffield and Birmingham can collaborate more easily with each other and with London-based researchers, and about the connections between the different key national infrastructure in those cities. Our Knowledge Quarter analysis suggests productivity spillovers flow along rail corridors, so truncating those corridors truncates the spillovers. What this paper argues is that the research and innovation case should be made explicitly and weighted accordingly in the business case.

East-West Rail, connecting Oxford and Cambridge via Bedford and Milton Keynes, has more obvious research and innovation implications that have featured in public debate, suggesting a growing awareness of the importance of connectivity in research and innovation, including by the Chancellor.[43] The route would link two of the UK's highest-performing research universities directly for the first time. Current rail connections require travelling via London, turning a 90-mile journey into a three-hour trip, but East-West Rail would enable a Cambridge researcher to reach Oxford in under an hour. The combination of the two universities' strengths could create collaborative possibilities that distance currently forecloses and allow the ecosystems around those universities to access cheaper and more plentiful housing along the route.

None of these observations implies a particular policy conclusion. Our point is rather that infrastructure decisions are also research and innovation decisions, whether or not they are recognised as such. Current appraisal frameworks do not fully capture this. The costs and benefits calculated for these schemes do not always include the research connectivity effects documented in the Public First analysis. If those effects are real, which the evidence suggests they are, then current decision-making systematically undervalues infrastructure that supports research collaboration.

11. Conclusion: Towards a connectivity agenda

The renewed emphasis on strategic investment in UK research policy creates an opportunity to think differently about infrastructure. Rather than narrow considerations of laboratories and equipment, the physical connectivity determines whether distributed strengths can combine into national capability.

This reframing does not eliminate difficult choices about priorities and investment. Resources remain finite. Not every connection can be strengthened. But the guiding question changes. Rather than asking which places deserve investment, we ask how to build a national system worth more than the sum of its parts. Rather than treating connectivity as a secondary consideration, we recognise it as foundational to the integration that strategic priorities demand. Optimising the outputs and outcomes of a physically distributed network of excellence becomes the primary policy goal.

The UK possesses significant advantages because compact geography places major research centres within hours of each other and research-intensive universities distribute world-leading excellence across multiple regions. Historic infrastructure investments have created connectivity that many competitors lack. But these advantages exist only in potential. Realising them requires deliberate policy attention.

The barriers to achieving these goals are institutional and conceptual, not technical. Different government departments own different bits of the puzzle. Research funders focus on research quality, transport officials on transport metrics and regional policy development on local outcomes. Nobody owns connectivity in its own right.

The current moment offers an unusual opportunity. Ministerial interest in strategic priorities creates appetite for new frameworks, and many major infrastructure decisions remain open. UKRI's reorientation towards purposeful investment provides an opportunity for change. The question is whether connectivity can move from an implicit assumption to an explicit priority before the decisions that will shape UK research geography for the next century are locked in.

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The UK is home to world-leading research and innovation, but weak physical connectivity limits collaboration between centres of excellence. As investment becomes increasingly priority-driven, evidence shows that transport infrastructure plays a critical role in driving innovation and strengthening national capability. This paper, from Sarah Chaytor and Geraint Rees at UCL, argues that better integration of research, transport, digital and capital infrastructure policy can unlock the UK's competitive advantage, enabling a more connected and effective innovation ecosystem.

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June 2026
978-1-915744-65-4
Higher Education Policy Institute
99 Banbury Road,
Oxford OX2 6JX
www.hepi.ac.uk

Printed by Windrush Press, Witney
Typesetting:
Steve Billington,
jarmanassociates.co.uk