

The role of intermediate RD&I institutes in building regional and sectoral innovation capabilities

A submission to the Independent Review of the UK RD&I Organisational Landscape

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Overview

The government announced on the 1 October 2021 a review of the institutional landscape in which research, development and innovation (RD&I) is carried out in the UKⁱ. In this paper we explore the role of intermediate RD&I institutes in enhancing innovation diffusion and creating new innovation capabilities to address regional industrial value capture opportunities, and argue that this dimension of the UK's RD&I landscape needs strengthening.

The place of intermediate institutions in the UK's RD&I landscape

National innovation systems have a complex landscape of different types of research institutes with different missions and goals. These include both research universities and institutes devoted to fundamental science, and public sector research establishments (PSREs), which support government strategic goals. A majority of research, development and innovation takes place in the private sector, in firms' own laboratories, and in for-profit contract research organisations. It is this private sector innovation that most directly drives productivity growth. Public and private sector R&D can be connected in intermediate RD&I institutes, which carry out more applied research, often as a public/private partnerships, as well as taking a wider role in building regional and sectoral private sector capability, through the promotion of innovation diffusion and skills development.

In the absence of government intervention, the private sector will systematically invest less in R&D than would be optimal for the whole economy, due to the inability of firms to capture all of the benefits. This market failure provides the justification for government investment in R&D. In many successful innovation economies, intermediate RD&I institutes play a vital role. Examples include the Fraunhofer Institutes in Germany, the Industrial Research and Technology Institute in Taiwan, and VTT in Finland.

In the UK, basic research is carried out in a strong university base, supplemented by some stand-alone institutes, such as the Laboratory of Molecular Biology at Cambridge and the Crick Institute in London. The PSRE sector has diminished in size over the past few decades, because of privatisations and absorption of some institutes into universities, but it retains some strong institutions such as the National Physical Laboratory and the Meteorological Office.

The perceived weakness of the UK's landscape in intermediate research and innovation institutions led to the development of the Catapult Network in the 2010's, modelled in some respects on Germany's Fraunhofer network, though not as yet commensurate with it in scale.

Discussion of the purpose of Intermediate RD&I institutions in the UK, such as the Catapult Network, has focused on their role carrying out applied research in collaboration with industry. The purpose of this note (which summarises the argument of a longer working paper current under preparation for the Productivity Institute) is to draw attention to the wider range of functions that such institutions carry out in other nations, and in particular their role in supporting economic development in regions with lower productivity.

In the UK, internationally leading discovery science coexists with bottom of the league productivity growth and very high regional inequality

By measures such as world share of highly cited academic papersⁱⁱ, the UK research system is highly successful. This success in discovery science does not translate into high economic performance. The UK is suffering from more than a decade of stagnation in productivity growthⁱⁱⁱ, with the contribution of multi-factor productivity – representing the role of innovation in its broadest sense – being close to zero. The UK also suffers from marked regional disparities in productivity^{iv}; the recent Levelling Up White Paper^v identifies the closing of these gaps as a government priority.

Any review of the UK's R&D landscape needs to confront the question of why the nation's unquestionable science excellence has not driven productivity growth across the whole country. Two potential factors have recently come into prominence:

- The focus of government policy has been on the creation of new knowledge and the “pulling through” of fundamental research to applications, rather than the diffusion of existing techniques at the technology frontier and the creation of the capacity of national and regional economies to absorb new technologies^{vi}.
- The UK's R&D landscape is highly geographically imbalanced, particularly in the public sector, with a preponderance of public spending concentrated in the parts of the country that are already most productive^{vii}. Large parts of the nation are thus left with weak innovation systems and lower absorptive capacity for new productivity-enhancing technologies. Public spending does not adequately support existing industrial clusters through R&D underpinning engineering development, system integration, and manufacturability.

The Hauser Review and the Catapult Network

The weakness in the UK's translational research landscape was clearly identified in the 2010 Hauser review^{viii}, whose recommendations led to the establishment of 7 Catapult Centres by 2014. A subsequent review^{ix} reasserted the original criterion for selecting mission topics for Catapult Centres. These were that the topic should command a large potential global market to exploit, a UK global lead in research capability, and the necessary absorptive capacity to commercially exploit the technology in the UK. Two further criteria have been added – their potential to attract and anchor the knowledge-intensive activities of globally mobile companies, and alignment with national priorities.

What's striking about this set of criteria is that it presupposes *existing* capabilities – in academic research, and in business capacity to exploit. Taken literally, it would mean that Catapult Centres should not have a role addressing challenges of slow innovation diffusion, or creating new innovation capabilities in economically-lagging regions (where the business base doesn't have the absorptive capacity to benefit fully from new technologies).

In fact, some Catapults have become involved in wider capability development activities. The most recent review of the Catapult Network^x noted that while catalysing local economic growth and developing skills were not among the core Catapult mission goals, some Catapult Centres have made significant contributions in both areas, and this was welcomed by many stakeholders. A lack of clarity remains as to whether their original core mission – applied R&D in emerging technology areas – can be expanded to encompass the kind of capability development that would be necessary for them to play an important role in technology diffusion, skills development, and the building of absorptive capacity in the weaker innovation systems of underperforming economic regions.

The UK's persistent problems of stagnant productivity and regional economic disparities re-emphasise the need to improve the UK's technology diffusion architecture and skills system, as recently identified by the Council for Science and Technology^{xi}. The role of intermediate RD&I institutes in developing innovation capability needs to be clarified. An expanded Catapult Network could fulfil this role, but this would need an explicit redefinition of their core roles and the criteria for establishing new centres, together with new funding streams to support these activities.

Widening conceptions of the role of intermediate RD&I institutes – from applied R&D to capability creation

In the UK, the activities of intermediate institutes are largely focused on the generation of applied research knowledge (mid-TRLs) generally in collaboration with industry partners or other stakeholders. Their missions are typically defined in terms of particular scientific fields (molecular biology), technology domains (e.g. compound semiconductors), industrial sectors (e.g. aerospace), or societal challenges (e.g. 'connected places').

Elsewhere, in contrast, the missions of intermediate R&I institutes are often framed in terms of developing national or regional *capabilities*. There is an understanding that new technological knowledge is not sufficient for industrial competitiveness and economic value capture. New technologies need to have a workforce that can develop them into applications and deploy them in real industrial contexts. Furthermore, regional competitiveness will require supply chains / value chains with the required engineering competences, facilities and resources.

Intermediate research institutes will only be able to make a significant impact on regional economic growth if they embrace a wider range of activities than applied research. Locally created R&D-based value can only lead to industrial economic value captured locally if technical knowledge resources are translated into industrial capabilities that are competitive with other national and international clusters pursuing the same opportunities.

A more complete categorisation of the different combinations of innovation activities and functions would include the following:

- **Knowledge development:** basic science, applied science, technology development, technology demonstration, application demonstration and product/solution scale-up
- **Knowledge deployment/capability development:** Skills & education (graduate students, vocational training, management programmes...); access to facilities & experts (test facilities, contract manufacturing...); advisory & incubation services (lean, supply chain management... incubation services for FDI corporate R&D labs)
- **Knowledge diffusion:** Network building (community seminars/workshops, consortium development); system intelligence (e.g. technology roadmapping services, international benchmarking...); standards & regulations (standards working groups, certification...)

There are many examples of intermediate RD&I institutes from successful innovation across the world which carry out this wider range of activities. A review of the UK RD&I landscape would benefit from a more detailed study of the way successful intermediate RD&I institutes support missions and functions that go beyond applied research in different ways. Here we list some examples:

- Regional missions, explicitly tasked with enhancing regional innovation capabilities or addressing regional gaps in key competences or resources. Examples include Kosetsushi centres in Japan, Fraunhofer Institutes in Germany, and RiSE Institutes in Sweden.
- Workforce missions/functions, addressing workforce development needs that are specific to the development of regional clusters, and fall beyond the facilities and remit of most

universities or FE colleges. Examples include Manufacturing USA, SIMTech in Singapore, and the National Institute for Bioprocessing Research and Training in Ireland.

- Supply chain / 'manufacturing extension' missions, designed to support the competitiveness of regional industrial capabilities through the diffusion and adoption of existing innovations within regional supply chains and SME clusters. Examples include SIMTech Singapore, MEP/Manufacturing USA, and Mittelstand 4.0 Competence Centres, Germany.

Conclusions and recommendations

The missing elements in the UK landscape of RD&I institutions are regional R&I institutes with a specific mandate to enhance and fill gaps in regional innovation capabilities. This places the UK at a disadvantage in supporting the high value industry clusters across the country that are crucial for productivity growth and reducing regional inequality.

Such regional R&D Institutes support existing and developing clusters by targeting those innovation barriers and bottlenecks that prevent firms within those clusters from taking advantage of existing and new technologies to capture high-value opportunities. These institutes need to be configured to respond to the existing business base, aligning distinctive local research strengths with distinctive industrial value capture opportunities. They must work with the grain of existing regional economies, avoiding the tendency, seen too frequently in the past, to establish generic research institutes in fashionable areas such as nanotech, biotech and ICT, which fail to take root locally.

What kind of institutions most effectively support regional economies? The appropriate geography should be defined in terms of 'regionally-clustered value chains', and the focus needs to be on enhancing the industrial and innovation capabilities of that cluster, connecting regional innovation systems with regional industrial value chains.

The missions of these regional R&D institutes need to be defined more broadly than simply in terms of applied research at mid-technology-readiness-levels. An explicit regional mission should be supplemented with programmes for workforce development and innovation diffusion. International examples offer a variety of possible institutional architectures for these institutes.

For the UK, it could be that institutions that are part of, or allied to, the Catapult Network can fill this role. However, to do this there would need to be some explicit modifications of their mission and of the criteria for creating new ones. There would also be a strong argument, in our view, for connecting such regional centres more closely with local and regional economic governance.

ⁱ [Terms of Reference: Review of the research, development and innovation organisational landscape, January 2022](#)

ⁱⁱ [International Comparison of the UK Research Base, 2019. BEIS \(2019\)](#)

ⁱⁱⁱ OECD (2021), [OECD Compendium of Productivity Indicators](#), OECD Publishing.

^{iv} See e.g. [Philip McCann \(2019\): Perceptions of regional inequality and the geography of discontent: insights from the UK, Regional Studies 54 256](#)

^v [Levelling Up the United Kingdom, White Paper, Dept of Levelling Up, Housing & Communities, Feb 2022](#)

^{vi} See e.g. A. Haldane, [The UK's Productivity Problem: Hub No Spokes](#), Bank of England Speech, 2018

^{vii} T. Forth & R.A.L. Jones, [The Missing Four Billion](#), NESTA, 2020

^{viii} H. Hauser, [The Current and Future Role of Technology and Innovation Centres in the UK](#). Dept of Business, Innovation and Skills, 2010.

^{ix} H. Hauser, [Review of the Catapult network: Recommendations on the future shape, scope and ambition of the programme](#), Dept of Business, Innovation and Skills, 2010.

^x [Catapult Network Review: How the UK's Catapults can strengthen research and development capacity](#). BEIS Research Paper Number 2021/013

^{xi} [Diffusion of technology for productivity: Advice to the Prime Minister on addressing barriers to business uptake of available technologies that could improve their productivity](#). Council for Science and Technology, 2020.