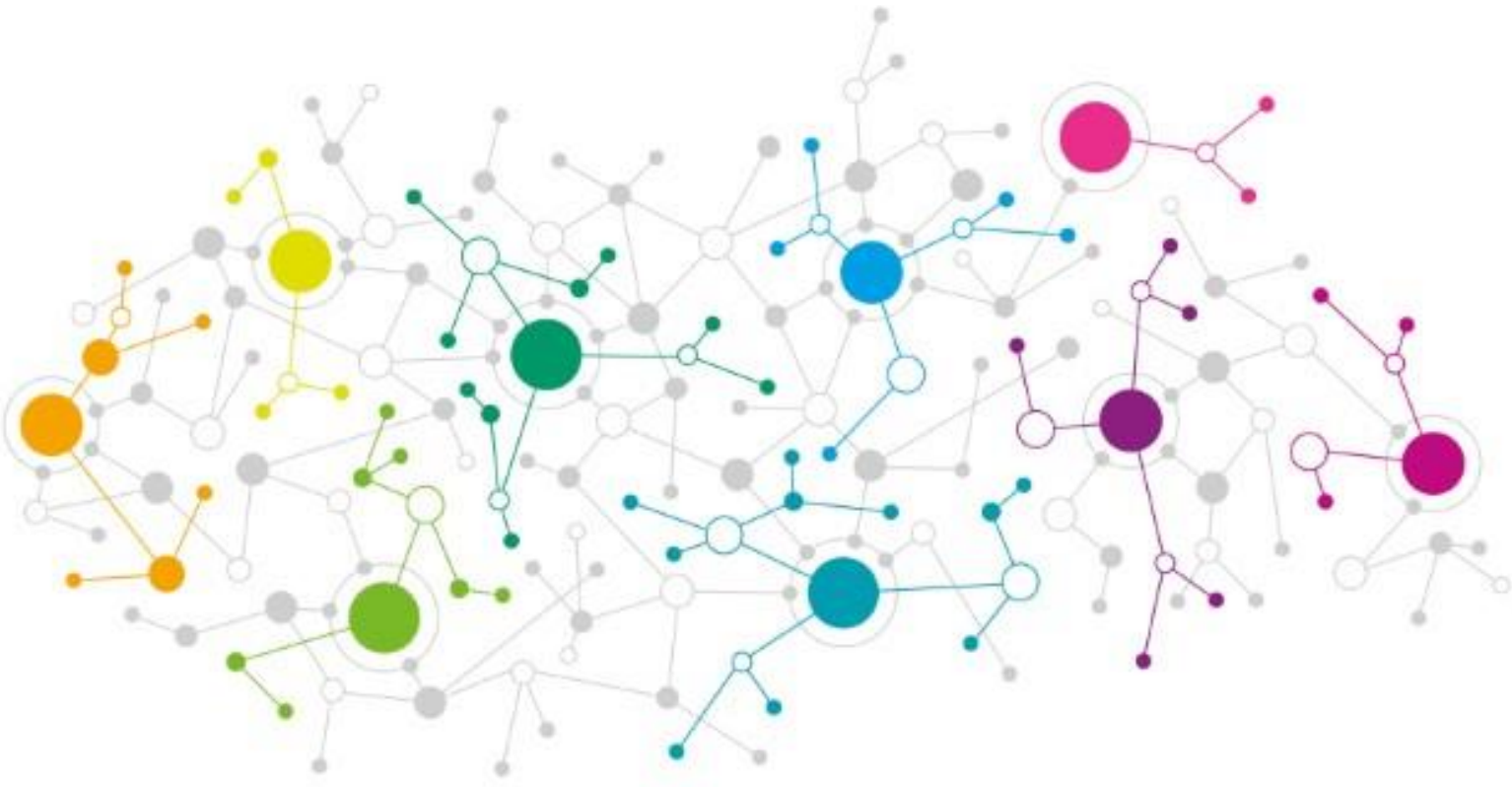
A Science and Innovation Audit Report for the Midlands Engine, sponsored by the Department for Business, Energy & Industrial Strategy

Summary Report

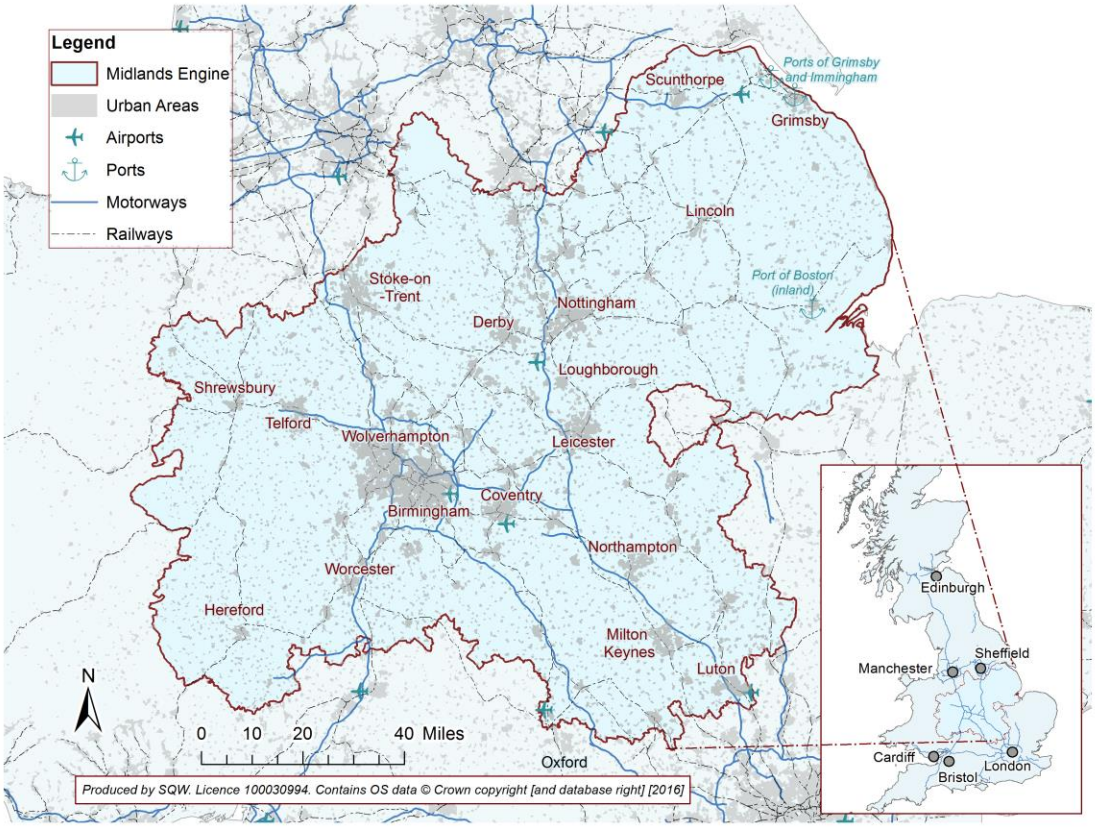
30 September 2016



Introducing the Midlands Engine

1. The Midlands Engine provides the heartbeat to the UK economy. A diverse and substantial area, the region covers 11 Local Enterprise Partnership (LEP) areas and includes internationally significant core cities such as Birmingham and Nottingham, growing regional hubs like Coventry, Derby, Leicester, Lincoln, Milton Keynes, Stoke-on-Trent, and Wolverhampton, and a high quality natural environment, including the Peak District National Park. The Midlands Engine region also includes market and county towns like Northampton, Shrewsbury and Stafford, serving as economic, leisure and service centres.

Figure 1: The Midlands Engine



2. The Midlands Engine is a £230 billion economy, generating 15% of the UK's Gross Value Added (GVA), with five million employees, and approaching half a million businesses.[i] It is built on a globally significant advanced manufacturing base, with demonstrable strengths across multiple sectors and technology areas, drawing on world leading science and innovation capabilities. Our tier one businesses and their wider supply chains are highly integrated in international markets. Last year, Midlands Engine firms accounted for 17% of all UK exporters; notably, our businesses generated approaching a third (31%) of UK exports in 'Machinery and Transport' goods.[ii]

3. However, despite these clear sectoral strengths, like many other areas across the UK, we underperform on productivity. The latest data (2014) indicate GVA per filled job in the Midlands Engine at £44.6k, against £49.85k nationally.[iii] This Science and Innovation Audit (SIA) has sought to identify concrete market opportunities and underpinning competencies that offer real potential for the Midlands Engine to tackle its persistent productivity challenge and drive long-term growth. Additionally, the SIA demonstrates how the Midlands Engine can contribute fully to an exciting and vibrant UK-wide industrial strategy.

Understanding the SIA journey, added value and legacy

4. Underpinned by a robust evidence base, the Midlands Engine SIA has been an inclusive, transparent and substantial research process. The SIA has been led by a high-level Delivery Group – including representatives from businesses, LEPs, universities, translational research bodies, network organisations and science parks across the region – working on behalf of the Midlands Engine. Critically, the SIA unambiguously is focused on enabling and driving productivity growth.

5. Through a series of six workshops attended by over 150 stakeholders, and an online consultation exercise that secured responses from over 100 stakeholders from 65 separate organisations, we have engaged extensively with our science and innovation partners across the Midlands Engine geography. This engagement covered the full spectrum of science and innovation activity. Importantly, the private sector has been heavily involved in and throughout the process, including both individual SMEs and representative groups, and multi-national firms embedded fully in the region's innovation ecosystem.

6. Coming together as a fully integrated science and innovation community for the first time through the SIA – in a region stretching from Grimsby on the North Sea to Hereford on the Welsh border, and from the High Peak bordering Greater Manchester, to Luton and Bedford adjoining Greater London – we have used the SIA process to build momentum with, and trust between, partners and stakeholders. By fostering new relationships and identifying synergies, the SIA process itself has helped to identify, develop and embed both the concept and content of the Midlands Engine innovation ecosystem.

7. Crucially, the process has started to break down the barriers that previously constrained collaborative innovation and commercialisation activity across arbitrary administrative boundaries, notably thinking and acting from the perspective of the '*the east or the west*'. The process has also encouraged and developed linkages and relationships within and between industry sectors, technology areas, scientific research communities, and local decision makers, that were to an extent lacking just a matter of months ago prior to the SIA. We are now engaging together in creating new opportunities that will benefit our whole region within the broader UK ecosystem, through initiatives such as Marketing Birmingham and Birmingham Science City's Midlands Engine Conference on Medical Devices, the coming together of the Space LEPs to maximise our contribution to the UK's industrial strategy and our ambitions to create a truly integrated transport innovation hub across our region. It is vitally important that we sustain these linkages and relationships as we move forward together to action opportunities identified in this SIA.

8. Alongside our inclusive approach to partner engagement, we have been very focused in our analysis. The scale of the Midlands Engine provides significant opportunities – that we have started to see bear fruit already – by enabling collaboration across a diverse range of fields, and providing a critical mass of science and innovation competence with which industry can collaborate. However, this scale also provides a challenging backdrop for an SIA; put simply, the breadth of the science and innovation offer is very significant in a place with more people than London, New York or Singapore and almost four times the population of Silicon Valley.

9. The challenge is particularly pronounced in seeking to identify the specific target areas of opportunity and excellence within this complex and crowded landscape. Ultimately, this involves making tough choices on what to focus our effort and resources on – the evidence underpinning and informing these difficult strategic choices are the focus of the main SIA report.

10. Despite these challenges, encouragingly, the SIA opportunity has been seized fully by regional partners. However, there is recognition that the SIA forms the first step in a longer journey to develop a competitive and integrated innovation ecosystem for the Midlands Engine, and its constituent areas. More detailed and comprehensive action planning work will continue over the next few months and beyond, building on the platform provided by the SIA. We have also sought to ensure that the SIA

process and resulting outputs can be used to define investment priorities by our component LEPs and Combined Authorities. The Midlands Engine Innovation Group will be a very considerable force in achieving delivery success.

SIA hypotheses, Framework and Vision for growth

11. Six themes were identified in our SIA Expression of Interest: transport technologies; agri-food and drink manufacturing and production; advanced manufacturing and engineering; healthcare, life sciences and translational medicine; energy and low carbon technologies; and creative, digital and design. The themes were deliberately broad, reflecting the scale and diversity of the region, and to ensure that the SIA process did not 'miss' significant innovation assets or activity from the outset. The SIA was tasked with testing the themes, and drilling down to focus on particular specialisms where the region had genuine excellence (at national and or international levels), leadership, credibility and opportunity. Importantly, the SIA is unambiguously focused on driving productivity growth.

12. We adopted a process that identified **four market driven priorities** where there are clear economic growth opportunities and very strong alignment with the Midlands Engine's strengths and distinctive capabilities. Additionally, **three enabling competencies** that underpin and complement these market priorities, and drive our business competitiveness, emerged. The competencies are crucial for successful knowledge-based economies, and these are specific areas where the Midlands Engine, according to the SIA assembled evidence, has a critical mass of assets and expertise. These exist within a much broader **innovation ecosystem** of hard and soft infrastructures and structural factors. Together, these elements formed the basis for the hypotheses to be tested through our SIA Growth Framework (Figure 2). Our Framework is focused, but it is also sufficiently flexible so as to respond to emerging opportunities and contextual shifts.

Figure 2: SIA Framework and Hypotheses

Hypothesis 1: Effective innovation alliances and networks exist in specific areas of the Midlands Engine. However, there is an opportunity to strengthen, better integrate, and extend the reach of these so as to support and embed a more pervasive culture of collaboration and innovation excellence, spatially, sectorally and across different technology areas. Building on the highly successful SIA process, there is an opportunity to develop a more open, inclusive and market-facing science and innovation system.

Hypothesis 2: Across the Midlands Engine, its functional economies and strengthening innovation ecosystems, we have three stand-out core 'Enabling Competencies' which drive our global business competitiveness. Over the coming years, these competencies can be better developed, championed and leveraged to support faster innovation and productivity growth for the region and the UK.

Hypothesis 3: The Midlands Engine has world-class innovation strengths in four Market Driven Priority areas, underpinned by our Enabling Competencies. The potential of these four areas can be further unlocked by the exploitation of disruptive technologies and innovations in order to build long-term competitive advantage.

Source: Midlands Engine SIA

13. The definition and scope of the enabling competencies and market driven priorities are set out below.

Enabling Competencies

- **Advanced Manufacturing and Engineering**: covering the region's pervasive leading-edge technical knowledge, and practical know-how, in designing, validating, producing, and servicing new products and industrial processes, across a diverse and increasingly integrated range of sectors and markets.
- **Digital Technologies and Data**: covering the strengths in the region's academic, research and industrial base in exploiting and understanding data and information, including satellite-enabled data, and the use of digital technologies in product, process and service development and research commercialisation.
- **Systems Integration**: covering the strengths in the region's academic, research and industrial base on how increasingly complex systems – from energy and transport systems, through to manufacturing and service delivery – can be better designed, managed and operated.

Market Driven Priorities

- **Next Generation Transport**: covering aerospace/space, automotive, motorsport and rail sectors, with a focus on high performance system simulation/modelling; advanced digital design/physical validation; advanced materials/processes; and digital manufacturing, supply chain and service management
- **Medical Technologies and Pharmaceuticals**: covering medical devices, diagnostics (including in vitro diagnostics and diagnostic imaging), software as a medical device, and pharmaceuticals
- **Future Food Processing**: covering the areas of 'food processing efficiency', 'delivering a zero waste food chain'; and 'food product innovation' in the food and drink sector
- **Energy and Low Carbon**: covering geo-energy, thermal energy systems, nuclear, energy storage and smart integrated energy systems.

Source: Midlands Engine SIA

14. The framework is consistent with and sets the context for the vision articulated by the recently established Midlands Engine Innovation Group to:

> *Convert the great research from our universities and wider research community into commercially successful products and processes for the economic benefit of the country, and address market failures and market needs, creating a self-sustaining, long-term approach to realising the power of innovation in generating economic and productivity growth for the region. We will create a system that bridges the 'readiness' gap that traditionally exists between concept-proven research and commercial financial investment. We will generate the conditions necessary to build confidence for that investment, accelerating the adoption of technology by industry, and thereby begin a cycle of continual growth for the Midlands Engine region.*

Highlights of our science and innovation excellence

15. The Midlands Engine is home to a nationally and internationally competitive portfolio of academic, translation research, and industrial R&D assets and strengths. Our asset base includes 27 universities, over 50 research technology organisations, science parks and innovation centres, and R&D centres of major multi-national firms and a host of innovative SMEs.

16. Reflecting both the breadth and quality of our research base, across each and every one of the 36 Units of Assessment of the 2014 REF, at least one Midlands Engine university was in the top 20 nationally in research Power or Quality; put another way, the Midlands Engine is home to some of the UK's leading science and research across all disciplines.

17. Table 1 overleaf provides a headline depiction of some of our key assets and strengths, across the Technology Readiness Level (TRL) spectrum; considerable further detail is provided in the main SIA report.

Table 1: High level summary of key assets and strengths across the TRL spectrum

Experimental research	➔	Applied R&D	➔	Technology implementation
• 27 universities, with approaching half a million registered students • Institutions securing 30% of UK Research Council funding over 2010-15, with higher shares in areas including Energy, Manufacturing, Systems Engineering, Instrumentation, Sensors and Detectors, and Design • Universities outperforming the national average on citations analysis in subject areas including Chemical Engineering, Chemistry, Energy, Physics and Astronomy, Medicine, and Pharmacology, Toxicology and Pharmaceutics • Home to the £180m Energy Research Accelerator, a collaboration of Midlands universities designed to tackle some of the biggest energy challenges facing the UK	➔	• Energy Systems Catapult, Transport Systems Catapult, and High Value Manufacturing (HVM) Catapult based in the region • Significant RTOs including: East Midlands Satellite Applications Centre of Excellence; Manufacturing Technology Centre and Warwick Manufacturing Group HVM Catapult centres; Advanced Propulsion Centre; Aerospace Technology Institute; HORIBA MIRA; Rail Innovation and Development Centre; National Centre for Food Manufacturing; Institute for Translational Medicine • 25 science parks and innovation centres, across all growth sectors and industries	➔	• Midlands Engine businesses accounted for 17% of business investment in R&D, and 18% of employees in R&D in 2014/2015 • Midlands Engine responsible for 18% of patents submitted in the UK over 2004-13; increasing to over a quarter of UK patents in Food Chemistry; Engines, pumps, turbines; Materials, metallurgy; and Transport • Major multinational R&D intensive firms embedded in the regional economy including Rolls-Royce (*Next Gen Transport and Energy*), Jaguar Land Rover (*Next Gen Transport*), Mondelēz International, PepsiCo and Unilever (*Future Food*), 3M, Boots (*Med-tech and Pharma*); National Grid and Alstom (*Energy*).

Source: Midlands Engine

18. The region contains concentrations of activity in our identified market priorities including[iv]:

- around 85,000 people employed in core transport technology sectors, of automotive, rail and aerospace/space, each with a Location Quotient (LQ) above one, and a further 75,000 employees in supporting technical and research disciplines. There are key clusters of businesses and innovation activity around Derby (rail and aerospace), Leicester (space) and Coventry/Warwickshire (automotive); the region is also at the centre of the High Performance Technology Cluster, one of the UK's leading concentrations of knowledge-based and internationally competitive technical and manufacturing-led businesses, centred around Silverstone, Northampton and Milton Keynes
- around 118,000 employees in food and drink manufacturing, with an overall LQ of over 1.5 demonstrating the high level of specialisation in food and drink manufacturing across the Midlands Engine, with significant employment across the region
- over 1,000 firms in the medical technologies and pharmaceuticals core and support sectors across the region, with particular concentrations in Nottingham and Birmingham, reflecting the presence of incubator facilities/services at BioCity Nottingham and the Birmingham Biohub, and across the east of the region, reflecting the area's legacy of pharmaceutical production, including opportunities around the Charnwood site in Loughborough
- around 180,000 employees in energy and low carbon technologies across the region, with particular concentrations of activity in Birmingham and Nottingham, and significant employment in energy and support disciplines evident across the region and its local areas.

Growth opportunities

19. There are clear growth opportunities within our four market driven priorities, underpinned by our three enabling competencies, created by the Midlands Engine's strengths and distinctive capabilities:

- **Next Generation Transport**: there are immediate opportunities around technology development (simulation and modelling; advanced digital design and validation; advanced materials and manufacturing; digital manufacturing, supply chain and service management) for aerospace/space, automotive, high value motorsport and rail, including significant complementarities and cross-overs with the Energy and Low Carbon opportunity
- **Medical Technologies and Pharmaceuticals**: distinctive opportunities exist around diagnostics and imaging, sustaining our activities in pharmaceuticals, using the region's stable ethnic diversity as a living laboratory for improving health outcomes, growing our success in trauma and rehabilitation, and combining health and environmental data to support innovation as next generation transport and low carbon economy opportunities are progressed
- **Future Food Processing**; the Midlands Engine region is the source of a significant proportion of the UK's primary food production. Opportunities for major productivity growth are particularly attractive in efficient food processing, zero-waste food chains, and food product innovation.
- **Energy and Low Carbon**; the recently launched Energy Research Accelerator and location of the Energy Systems Catapult represent major investments in energy in the Midlands Engine. We need to build on this and capitalise on our opportunities in geo energy, thermal energy systems, nuclear, energy storage and smart integrated energy systems.

Moving Forwards

20. This SIA has created the opportunity for the key players around the Midlands Engine area to come together and identify clear and current opportunities for growth. Unsurprisingly, in a region of the reach and vibrancy of the Midlands, significant efforts are already underway that provide a close match to some elements of the market opportunities we have identified. In particular:

- Midlands Innovation's thinking on 'Transport Innovation for a Low Carbon Economy' that takes forward aspects of the Next Generation Transport theme
- The proposed National Space Park, which would bring a step change to space research and space-enabled data service provision
- Proposals for Life Science Opportunity Zone status at Charnwood
- Emerging proposals for building on the significant investments made in the region through the Energy Research Accelerator (ERA).

21. These projects are welcome early steps in taking forward key elements of this ambitious audit and broader growth agenda. However, in order unleash our full productivity potential and deliver the economic transformation that this SIA has shown is possible, more will need to be done. The SIA has created a new and effective focus, drawing together the main economic actors across the Midlands. It has crystallised a shared set of opportunities, channelled energy and ambition, and illustrated where our true strengths and potential lies. The baton has now been passed to the Midlands Engine Innovation Group to take these analyses and the head of steam created around them, and configure them into major strategic priorities framed in the Government's developing industrial strategy. This is a task that the Midlands Engine will take forward over the coming months so that a truly transformative proposition can be brought to deliver on our full productivity potential.

[i] Subregional Productivity: Labour Productivity (GVA per hour worked and GVA per filled job) indices by UK NUTS2 and NUTS3 subregions (data for 2014); Business Register and Employment Survey (data for 2014); and UK Business Counts – Local Units (data for 2015)

[ii] UK Regional Trade in Goods Statistics (data for 2015)

[iii] Subregional Productivity: Labour Productivity data as above (data for 2014)

[iv] Sources: Business Register and Employment Survey (data for 2014); and Office of Life Sciences Strength and Opportunity dataset (data for 2015)