INNOVATION FOR SUSTAINABLE AIRPORTS

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

Summary Report 2018

Innovation for **Sustainable Airports**

Department for **Business, Energy & Industrial Strategy**

1 | INTRODUCTION

At a national level, the UK has the biggest aviation market in Europe and the second largest in the world, with London having the busiest airport system of any city in the world. The prosperity of the UK is critically dependent on the health of the UK aviation sector. Aviation adds £52bn to the UK's GDP, supports substantial inward investment and almost one million jobs.[1] With 42,000 airports in the world, and world air passenger numbers set to double over the next two decades, there are substantial opportunities for innovative UK businesses that can support sustainable airports.

In Autumn 2015, the UK Government announced Science and Innovation Audits (SIAs) to catalyse a new approach to regional economic development. SIAs enable local consortia to focus on analysing place based strengths and identify mechanisms to realise their potential. In the Thames Valley and West London, a consortium was formed in 2017 to focus on our strength in Sustainable Airports. This SIA differs from others completed in waves 1 and 2 in that it takes a whole ecosystem approach around a specific business, London Heathrow Airport. In doing so, we view Heathrow as both an 'Anchor Business' for the 400 businesses that come together to operate Heathrow and their supply chains, and as a 'Connectivity Institution', enabling people and products from across the UK to connect with the emerging economies within Asia and South America.

This SIA has focussed on four themes; Sustainable Construction, Big Data and Cyber Security, Operational Excellence and Intelligent Mobility; and tested the hypothesis that:

Science and innovation excellence supporting 'Sustainable Airports' within our study area can be boosted to drive further innovation in the UK, and to enable global exploitation.

Our consortium, led by Brunel University London, includes partners representing the LEPs, SMEs, universities, research organisations, business and trade organisations, industry, and local and national government. Heathrow Airport Ltd and all the partners are committed to advancing the opportunities that have been identified. The Sustainable Airports SIA Study Area is illustrated by the map on the cover page. This report presents the results which include broad-ranging analysis of **West London and the Thames Valley's** capabilities, the challenges and the substantial opportunities for future economic growth.

The Study Area
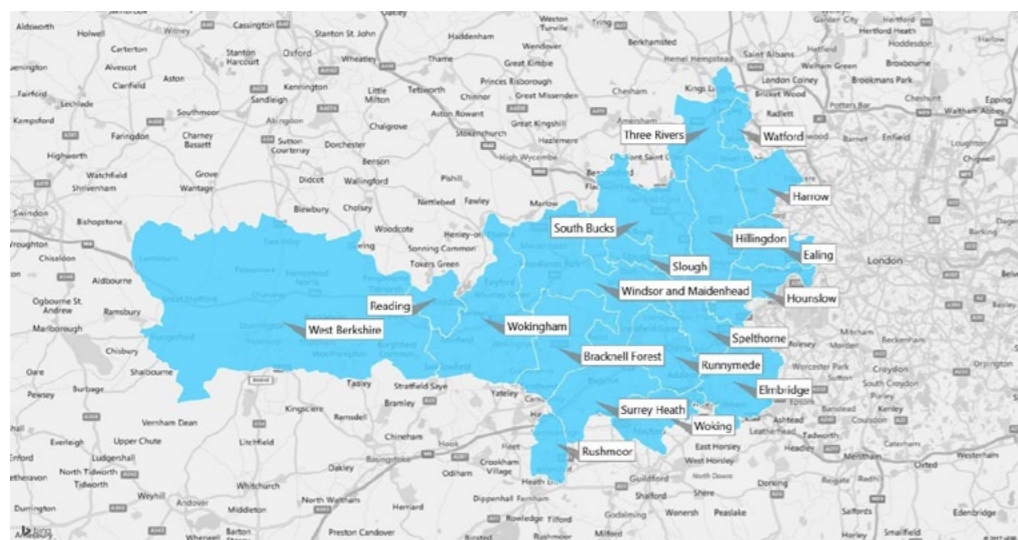
1   Working together for a thriving aviation sector, speech by the Rt Hon Chris Grayling MP,
    https://www.gov.uk/government/speeches/working-together-for-a-thriving-aviation-sector
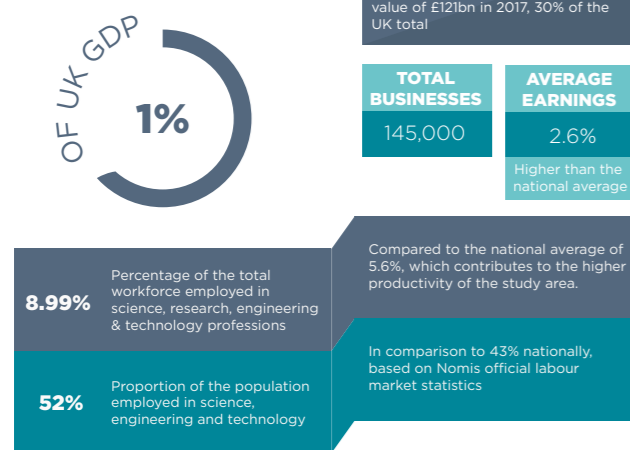
2 | OUR VISION

To create a world leading research and innovation ecosystem, focussed on the needs of sustainable airport development and operation, anchored in the West London and Thames Valley area, driving UK economic growth and productivity.
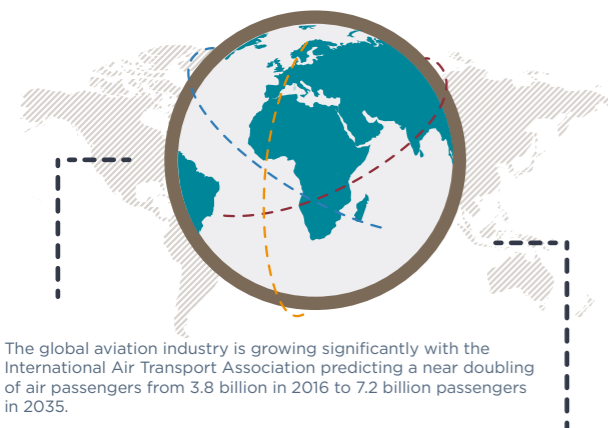
3 INNOVATION FOR SUSTAINABLE AIRPORTS

OUR STUDY AREA

Heathrow is the largest hub airport in Europe, with 476,000 aircraft movements annually, an exemplar in the 'industry' as the world's most efficient 2-runway airport, because of the systems, processes and culture that support Heathrow's daily operation. Our study area of West London and the Thames Valley, includes 5 LEPS which are, Buckinghamshire Thames Valley, Enterprise M3, Hertfordshire, London and Thames Valley Berkshire.
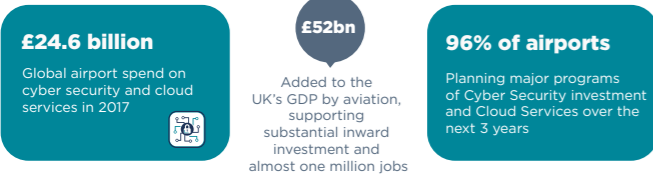
HEATHROW

1% OF UK GDP

Heathrow is the UK's most important port, with a total trade value of £121bn in 2017, 30% of the UK total.

TOTAL BUSINESSES	AVERAGE EARNINGS
145,000	2.6%
	Higher than the national average

8.99% Percentage of the total workforce employed in science, research, engineering & technology professions

Compared to the national average of 5.6%, which contributes to the higher productivity of the study area.

52% Proportion of the population employed in science, engineering and technology

In comparison to 43% nationally, based on Nomis official labour market statistics

MARKET OPPORTUNITY

The global aviation industry is growing significantly with the International Air Transport Association predicting a near doubling of air passengers from 3.8 billion in 2016 to 7.2 billion passengers in 2035.

There are 42,000 airports across the world and currently over 400 major construction projects going on, with between 20 and 30 new airports under construction. It is estimated that £1trillion in airport infrastructure projects are planned or under way.

£24.6 billion Global airport spend on cyber security and cloud services in 2017

£52bn Added to the UK's GDP by aviation, supporting substantial inward investment and almost one million jobs

96% of airports Planning major programs of Cyber Security investment and Cloud Services over the next 3 years

RESEARCH AND INNOVATION STRENGTHS

Heathrow acts as an Anchor Business for more than four hundred businesses that operate the airport (employing 76,500 people), and hundreds more across the UK in their supply chains. As the only UK hub airport, Heathrow connects UK businesses to global economies and opportunities.

- Four medium-sized research intensive universities are clustered around Heathrow, with a powerful combined research power:

  - Brunel University London
  - Royal Holloway University of London
  - University of Reading
  - University of Surrey

  Brunel's Engineering and Design capabilities are ranked amongst London's biggest and best.

- These universities are involved in a range of international research partnerships, including 175 Horizon 2020 research projects worth £156M, and with over 40% of their EU funding (by value) in ICT and transport.

- 230 research organisations in the study area

BRE
A world leading multi-disciplinary building science centre with a mission to improve the built environment through research and knowledge generation. Their Innovation Park - features over 300 construction innovations and emerging technologies being evaluated and attracts thousands of visitors from around the world every year.

DIGITAL TECH CLUSTER
The Thames Valley digital technology cluster comprises 7,800 digital technology companies, the highest concentration in the UK, employing 56,300 digital technology specialists and generating 600 new start-ups per annum.

RECOMMENDATIONS INCLUDE

- Innovation/Research Centre for sustainable airports
- An Airport Habitat Lab
- A West London Connected Autonomous Vehicle Cluster
- Export Strategy for sustainable airport technologies
- Research Cluster on Sustainable Construction
- Smart, sustainable, scalable supply chains
- Develop activities to meet innovation skills gaps
- The use of Heathrow as a demonstrator for multi-modal mobility as a service

4 OUR KEY STRENGTHS

The study area around Heathrow airport already enjoys strong economic performance in comparison with the rest of the UK, with a Gross Value Added (GVA) of over £100bn.[2] The study area is characterised by 3 complementary, but distinct, highly productive economies. The Thames Valley and Berkshire has a strong base of corporate headquarters and technical and scientific research specialists, Buckinghamshire and Hertfordshire's economies are driven by entrepreneurial SME and Micro business capabilities and the West London area is more typical of a capital city with a younger demographic, a more cosmopolitan and international workforce and established sector specialisms in industrial logistics.

Heathrow is both an 'Anchor Business' and a 'Connectivity Institution' providing a focus for businesses and growth.

Heathrow acts as an Anchor Business for more than four hundred businesses that operate the airport (employing 76,500 people), and hundreds more across the UK in their supply chains.[3] This includes businesses across a breadth of digital creative, technology and infrastructure areas that present huge opportunities for growth and technology exploitation. The Heathrow employment site generates 1.5% of UK GDP and in February 2017, Heathrow Airport Ltd launched Heathrow 2.0, a plan for sustainable growth.

Heathrow is the UK's most important port, with a total trade value of £121bn in 2017, 30% of the UK total.[4]

As a Connectivity Institution and Britain's only hub airport, Heathrow plays a vital role in supporting the UK's economy. Its importance in linking British innovation to the rest of the world cannot be underestimated. Nowhere is this more critical than across the Cambridge, Milton Keynes, Oxford Growth Corridor (CaMKOx) which adjoins this study area in Buckinghamshire and has been highlighted as a region which could provide Britain's equivalent to Silicon Valley.

The study area has world leading science and research capabilities.

There are 230[5] research organisations in the study area, and four medium-sized research-intensive universities are clustered around Heathrow to the west of London: Brunel University London, Royal Holloway University of London, University of Reading, and University of Surrey. If combined, these four universities would rank as the 3rd university in the UK for research power, with the 4th largest volume of world leading and internationally excellent activity.[6]

Brunel's Engineering and Design capabilities are ranked amongst London's biggest and best, including the National Structural Integrity Research Centre focusing on building structure and materials. Both Royal Holloway University of London's Information Security Group and Surrey University's Centre for Cyber Security have been recognised as one of the 14 UK Academic Centres of Excellence in Cyber Security Research and the University of Reading has a number of strengths in environmental sciences, construction and the built environment that support the creation of sustainable airports. Although

2 Data compiled by Technopolis available at: https://www.ons.gov.uk/economy/grossvalueaddedgva/datasets/regionalgvaibylocalauthorityintheuk

3 Business Case and Sustainability Assessment – Heathrow Airport Northwest Runway. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/440315/business-case-and-sustainability-assessment.pdf

4 Data derived from HM Revenue and Customs Regional Trade Statistics. Available at: https://www.uktradeinfo.com/Statistics/RTS/Pages/default.aspx

5 Data compiled by Technopolis based on Digital Science's GRID (Global Research Identified Database, accessed September 2017). Available at: http://grid.ac/

6 Data derived from REF2014 submissions and results. Available at: http://results.ref.ac.uk/DownloadSubmissions/ByForm/REF1

some 20 miles outside of the study area, the new £65 million Digital Aviation Research and Technology Centre (DARTeC), which will be built at Cranfield University, will provide digital aviation technology research facilities unprecedented in Europe.

BRE is a world leading multi-disciplinary building science centre that developed the first bespoke standard for airport terminals to assess, recognise and encourage construction sites managed to reduce resource use, energy consumption and pollution. Morgan Sindall Construction, with staff based at Heathrow, link with supply chain partners to lead UK innovation in sustainable airport construction and maintenance.

The region also benefits from the presence of the Transport Systems Catapult and the Transport Research Laboratory, both involved in research, development and innovation in intelligent mobility. Conigital are scaling up their Midlands Connected Autonomous Vehicles Cluster (M-CAV) by replicating with a West London CAV, and establishing an International CAV.

TRL has recently been awarded £19.2M by the UK Government to develop a Smart Mobility Living Laboratory in London.

The Thames Valley digital technology cluster comprises 7,800 digital technology companies, the highest concentration in the UK, employing 56,300 digital technology specialists and generating 600 new start-ups per annum.[7] The Digital Catapult, based in central London, supports and promotes digital innovation in the UK. Their focus is on artificial intelligence, augmented and virtual reality and future networks such as 5G. Helios aviation consultancy (Hampshire) has specific expertise in airport Cyber Security, along with the related standards and policies, and led the major SESAR Cyber Security study "Addressing Airport Cyber Security" in 2015.[8] The London Cyber Innovation Centre[9] is a new £13.5M cyber innovation centre in the Queen Elizabeth Olympic Park (10 miles east of our 'Study area'). It will spur the development of cutting-edge technology and help to develop new talent through up to 2000 UK jobs in cyber security.

Given the significance of the noise impacts in the locality, Heathrow Airport Ltd has made significant investment to become an innovation leader that understands, and manages the noise envelope across the estate, and in the surrounding communities. The Noise Action Plan (NAP) sets out proposed actions to enable Heathrow to operate within defined limits,[10] and work closely with the community on a range of interventions. The range of measures and assessments have set Heathrow apart in this expertise area with transferable knowledge for other airports and sectors.

7 http://www.thamesvalleyberkshire.co.uk/getfile/Public%20Documents/Data/International/Digital%20Tech%20Sector%20Proposition%202017.pdf?inline-view=true
8 https://www.sesarju.eu/sites/default/files/documents/news/Addressing_airport_cyber-security_Full_0.pdf
9 https://www.plexal.com/cybersecurity/
10 https://your.heathrow.com/wp-content/uploads/2017/01/Heathrow2.0.pdf

5 GROWTH OPPORTUNITIES

There are currently over 400 major construction projects going on at airports worldwide, with between 20 and 30 new airports under construction.[11] It is estimated that £1 trillion in airport infrastructure projects are planned or under way[12] within a timescale that continues (in some extreme cases) for four decades into the future. These range from new terminals on green field sites, to new runways, pier or satellite extensions and refurbishments. 'Building' connections with Innovate UK's Core Innovation Hub for the construction sector and the Transforming Construction Challenge Fund will enable the sustainable airports construction supply chain to export and exploit these opportunities.

Air passenger numbers are predicted to increase from 3.8 billion in 2016 to 7.2 billion passengers in 2035[13]

The SITA Air Transport IT Trends Insights (2017)[14] report states that 96% of airports surveyed are planning major programmes of Cyber Security investment and Cloud Services over the next 3 years.

Global airport spend on cyber security and cloud services reached £24 billion in 2017

The Future Aviation Security Solutions (FASS) programme[15] will improve aviation security by investing £25.5 M over 5 years in innovative science and technology.

The UK's Cyber Security Export Strategy,[16] provides a vehicle for UK cyber security companies to showcase their capability to find and secure export opportunities.

The Global Supply Chain Optimisation project GEMSTONE[17] completed by Brunel University, in collaboration with Caterpillar and Intel, won Caterpillar's Chairman's Innovation Award 2016 for innovation impacting business results. This demonstrated how the application of real-time data solutions to complex supply chains can achieve global efficiencies which deliver huge productivity gains and demonstrable competitive advantage.

The market for CAVs in the UK (specifically, for road vehicles with CAV technologies) is estimated to be worth £28bn in 2035, capturing 3% of the £907bn global market.[18] There would be an estimated 6,000 direct UK jobs in the production of CAV technologies, with a further 3,900 indirect jobs created in the supply chain for these technologies. 70% of these jobs are estimated to be in software related industries, where our capabilities are strong.

11 https://en.wikipedia.org/wiki/List_of_airports_under_construction
12 https://centreforaviation.com/insights/analysis/usd1-trillion-for-airport-construction-globally---but-its-not-enough-capa-database-356495
13 http://www.iata.org/pressroom/pr/Pages/2016-10-18-02.aspx
14 https://www.sita.aero/resources/type/surveys-reports/it-trends-insights-2017
15 https://www.gov.uk/government/groups/future-aviation-security-solutions-programme
16 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/693989/CCS151_CCS0118810124-1_Cyber_Security_Export_Strategy_Brochure_Web_Accessible.pdf
17 https://sites.google.com/site/brunelsupplychainopt/home
18 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/642813/15780_TSC_Market_Forecast_for_CAV_Report_FINAL.pdf

6 CHALLENGES, OPPORTUNITIES AND PROPOSALS

The SIA highlights the importance of this sector to the UK economy. However, four main challenges have been identified, which if addressed would ensure that the research and innovation excellence in the region is harnessed to guarantee that innovative technologies for future airports are developed, and then translated into increased productivity, increased exports and economic growth. The four challenges are:

- The connection between the research base and industry supporting innovation in sustainable airports could be stronger and more diverse, leading to higher productivity
- The economic competitiveness of our study area means that space for businesses to grow is at a premium
- There are no incubators or accelerators specific to our themes which relate directly to sustainable airports within our study area
- There are significant higher-level skills shortages to grow innovation in particular themes, e.g. Cyber Security for Aviation.

There are also barriers to innovation at airports, inherent to the operation of the airport, such as the regulatory environment, high safety standards and the difficulty of trialling something safely without affecting the efficiency of the airport. These barriers can be overcome to some extent through the facilitation of co-innovation across the whole supply chain, as well as infrastructures such as innovation centres embedded in the airport estate or digital twins to experiment with innovation away from the airport.

The SIA identified the following strategic and theme specific opportunities:

Opportunity 1

Sustainable Airports

Establishing a Research/Innovation Centre to work with all stakeholders to co-create research programmes addressing future sustainable airport challenges. It could use the airport as an innovation test bed, ensuring the airport and its supply chain partners establish the UK airports sector as leaders in global sustainability. Once successful the Research Centre and incubators would strengthen the case for an Enterprise Zone for Sustainable Airports, providing opportunities for SMEs developing the innovation technologies emerging from the Centre to expand whist remaining in the region.

Opportunity 2

Developing collaborative incubation and innovation facilities close to Heathrow, the natural meeting point of regional economic geographies, which will support wider collaboration, and provide space for micro businesses to grow.

Opportunity 3

Supporting and developing the provision of higher apprenticeships and graduates in areas of skills shortage such as big data, cyber and construction. This would include establishing a doctoral training centre to produce a cohort of researchers, able to work in universities or industry, attuned to the research challenges of sustainable airports.

Opportunity 4

Sustainable Construction

Consortium partners establish a formal Research Cluster on Sustainable Airport Construction & Maintenance – SEGRO, Brunel, BRE, Morgan Sindall and Heathrow focussed on the particular needs of the region.

Opportunity 5

Big Data

Develop open models for data analytics, that are trusted or validated by a body or community which would be particularly beneficial to sustainable airports. These models when used by businesses will enable export opportunities (e.g. the ACI ACRIS Semantic Model).[19]

Opportunity 6

Cyber Security

Cyber Security for Sustainable Airports could be a key offer for the UK Cyber Security Export Strategy. Targeted effort could co-create huge export opportunities for UK businesses.

Opportunity 7

Operational Excellence

Given the importance of logistics and transport to the region, we recommend the research and innovation partners come together to develop best practice in the development of smart, sustainable, scalable supply chains. This would bring together cutting edge technologies from big data, cyber and operation excellence to create tomorrow's supply chains for smart circular economies.

Opportunity 8

Intelligent Mobility

Develop a 'living lab' with Heathrow communities, businesses and CAV experts to explore Mobility as a Service (MaaS) solutions in the context of sustainable airports.

19 https://www.slideshare.net/SegunAlayande/aci-acris-semantic-model-airport-ecosystem-knowledge-management

7 NETWORKING AND COLLABORATIONS

The process of carrying out this audit has led to new collaborations, plans and opportunities. This is what our collaborators had to say:

"Since publishing Heathrow 2.0 in 2017 we have been intensively focussed on the role of collaboration in identifying solutions to the sustainable innovation challenges our industry faces. The SIA has made a real difference to extending our networks with the business community, industry, government and academia and as a consequence has proven to be one of our most important tools in accelerating progress. The ideas and connections it has brought forward will have a lasting impact."

Matt Prescott, Interim Director, Heathrow Centre of Excellence for Sustainability, Heathrow Airport Ltd

"SIAs are designed to encourage investment in R&D by mapping places of potential global competitive advantage and identifying routes to realise that potential. TVB LEP is a consortium partner to three separate SIAs, including this one on sustainable airports. That involvement has been invaluable in helping us inform our asset base as we continue to lead the process of developing a Local Industrial Strategy for Thames Valley Berkshire."

Tim Smith MBE, Chief Executive, Thames Valley Berkshire LEP Ltd

"The SIA has raised the profile and momentum for Intelligent Mobility initiatives in West London. As a result we have started to form a 'West London Connected & Autonomous Vehicle Cluster' in partnership with West London Business. We have already expanded our ecosystem and generated good business leads as a result. It has given Conigital a great platform to voice its opinion and share its vision on the future integration of Intelligent Mobility in 'real world' scenarios. We look forward to further collaborations and joint initiatives with our SIA partners."

Monique Seth, Conigital

"Participation in the SIA has developed significant insight into emerging airport sustainability options and opportunities. The outcomes will better equip SMEs to focus on developing transformative solutions in Cyber Security and Big Data amongst other areas. Continued collaboration between universities and business will help make this happen."

Olu Odeniyi, Former Chairman & CEO Maidenhead and District Chamber of Commerce

"Working with the SIA and its partners, Morgan Sindall has developed strategic relationships and contacts who will work with us in the future. Innovation is a behaviour that needs to drive our thoughts, approach and delivery. It needs to be the lifeblood of how we work – our heartbeat. The relationships established through the SIA will help us achieve this goal."

Amanda Soundararaj, Proposal Manager, Aviation, Morgan Sindall

"The increased focus that this SIA has delivered on Heathrow Airport as an 'anchor business' has been extremely useful for BRE. The collaboration to connect more research with impact is a key priority for us, and the opportunities created by the SIA will support our aim to increase the dissemination of our world leading research for active skills development. "

Deborah Pullen MBE, Group Research Director, BRE

8 CONSORTIUM PARTNERS

The primary authors of this report have been Brunel University London, ICE blue, Conigital and Olu Odeniyi (Former Chair and CEO Maidenhead and District Chamber of Commerce). Our Science and Innovation Audit Consortium has also provided significant input, support and advice.

Brunel
University
London

Brunel University London
St Johns Building
Kingston Lane
Uxbridge, UB8 3PH

T: 01895 265609
E: sia@brunel.ac.uk

The full report is available to download from:
www.brunel.ac.uk/business/sia