

MAYOR OF LONDON

London:
The AI
Growth
Capital of
Europe



About CognitionX

CognitionX is the AI advice platform that connects every organisation with a global on-demand network of AI experts. The platform allows experts in AI from around the world to share invaluable expertise with organisations of any size and sector who want to tap into that knowledge.

Through the platform, organisations can find an answer to their AI question very quickly, regardless of where they are. AI experts can either share knowledge for free or charge a fee.

Founded in 2015, CognitionX's mission is to drive innovation in, and deployment of, AI by making expertise universally accessible, levelling the playing field for the millions of organisations who don't have access to strategy consultants or advisory boards, while also giving AI experts a new outlet for, and a way to monetise, their expertise.

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Mayor's Foreword

There are few areas of innovation that have the power to define our future economy and society more than artificial intelligence. As Mayor of London, it is my goal to ensure both that London is at the forefront of developing and capitalising on these new technologies, and that all Londoners can benefit from the opportunities they will create.

I commissioned CognitionX to undertake this research in order to discover the facts behind what many already know to be true - that London is the AI capital of Europe, and that our supportive and welcoming tech ecosystem is the best place to build and scale an AI company. It's fair to say that our city is at the forefront of a global revolution in AI and data science.

Alongside our welcoming tech ecosystem, we have a strong pipeline of AI innovation and an academic and investment base geared for the long term. London is home to one of the world's true AI giants in DeepMind, yet most of the 750-plus vendors are SMEs. London clearly provides companies of all sizes with the right mix of ingredients for success.

These strengths will also support my ambition to make London a world leading smart city, in which public data and AI will open doors for the public and private sectors to work together to improve the way that Londoners experience our city on a daily basis.

London's unique global status as a capital of finance, business, government and technology is our standout asset. Everything entrepreneurs need is in one place - not least access to clients, something London boasts in abundance.

But perhaps the finding that will come as the least surprising to those who live and work here, is London's reputation as a diverse, open and tolerant city. This is a huge draw for an industry as global as the tech sector, as it is for so many of our other key sectors.

Unavoidably, the context of the UK's relationship with the EU looms large. As Mayor, I will continue to fight for the best deal that not only protects London's tech sector, but which can ensure it continues to grow. But come what may, I am clear that London's core strengths will remain. We will always be an open, cosmopolitan, global city.

I stand with the investors, entrepreneurs, innovators, and academics who are betting on AI in London for the future. London has the talent, the access to market, the investors and, most importantly, the openness to ensure that this is the place the world looks to for AI growth and innovation.



Sadiq Khan
Mayor of London

Executive Summary

CognitionX was commissioned by the Mayor of London to map AI innovation across London and identify **the capital's unique strengths as a global hub of Artificial Intelligence**. The findings of this research will inform the actions the Mayor will take to support the future growth of AI across different industries to drive innovation, productivity and growth.

AI is a huge opportunity. **As the AI growth capital of Europe, London is well placed to maximise the substantial economic benefits of AI over the long term.**

With **758 companies**, 645 of which have a London headquarters, London has an AI supplier base that is double the size of Paris and Berlin combined. London has stronger global positions in AI in its leading industries, especially finance, insurance, and law. The rate of new **AI supplier formation in London is 42% per annum**, significantly faster than the global rate of 24% per annum.

London's skilled talent pool provides the capital's AI suppliers and their customers with a pipeline of technical and entrepreneurial talent. **London's open, tolerant and multicultural society is a powerful draw** for AI founders, talent and investors who see the city as a great place to live and work. This is reflected in the fact that 43% of London AI suppliers have a non-UK national as a founder. **Community and peer support for London's start-up community is the best in Europe** and London's founders enjoy strong connections with international entrepreneurs, second only to Silicon Valley.

Investment in London's AI sector is growing. It exceeded £200m in 2017, an increase of over 50% on 2016 levels. There is considerable excitement among global investors about London's AI suppliers, reflected in rising international investment.

London's USP is demand, which is large, local and competitive. This fuels growth in the AI supplier base. Leading edge demand is innovative, working with AI startups to develop cutting-edge applications. Demand for AI is primed for growth in London's leading industries, especially education, finance, healthcare, insurance, law, media and entertainment, retail and sales and marketing.

London and the UK are committed to AI for the long-term. London's world-leading universities help grow the AI cluster. **The influence of UK AI research is second only to the US.** This is backed by government and industry commitments to enhancing the supply of AI talent. **Government is investing in AI** with a long-term commitment to leadership reflected in the £950m AI Sector Deal between government, industry and academia.

London is investing in world-leading AI ethics expertise through the Centre for Data Ethics and Innovation, the Alan Turing Institute, the Ada Lovelace Institute and industry initiatives. Putting ethics at the core of AI provides London's AI supplier base with the ability to build trust and understanding of technology that can provide a competitive advantage and position the UK as a long-term destination for investment.

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**A big
opportunity:
AI has huge
potential for
London**

CognitionX was commissioned by the Mayor of London to map artificial intelligence innovation across London to identify the capital's unique strengths as a global hub of AI. This included mapping the AI supplier base, conducting expert interviews and running the Mayor's London AI Innovation Census, which received 312 responses as of 18 May 2018. The census provided rich insights into the views of London's AI community on the strengths of the capital and opportunities for future development. The findings of this research will inform the actions the Mayor will take to support the future growth of AI across different industries to drive innovation, productivity and growth. Our research shows that London is well-established as a global leader in AI and has the capacity to build on its strong foundation to maximise the economic potential of AI on the London economy.

AI is unquestionably a big opportunity and one of the world's fastest growing technology sub-sectors. Globally, the number of AI startups created has grown by 24% year-on-year between 2008 and 2016. In London, our data shows that the rate of AI supplier formation over the same period is significantly higher at 42% year-on-year. Total VC funding for AI startups grew by 463% from 2012 to 2017.¹ We estimate that the global market for AI applications is worth \$3.4bn in 2018 and is forecast to grow to \$50bn by 2025. We estimate the global number of AI suppliers today is over 12,000.

The potential economic impact of AI is huge but estimates vary. This research builds on existing analyses of the potential economic impacts of AI in the UK and globally which demonstrate the scale of the prize. One estimate puts the total global potential economic impact of AI at \$1.49tn to \$2.95tn by 2025² while another forecasts that it will then grow to \$15.7tn by 2030.³

¹ Startup Genome, 2018, *Global Startup Ecosystem Report 2018: Succeeding in the New Era of Technology*

² Analysis Group, 2016, *Global Economic Impacts Associated with Artificial Intelligence*

³ PwC, 2017, *Sizing the Prize: What's the real value of AI for your business & how can you capitalise?*

Estimates of the potential economic impact of AI in the UK paint a similar picture of a large prize to be seized. One forecast UK GDP could be up to 10.3% higher in 2030 as a result of AI, the equivalent of an additional £232bn.⁴ Another forecast that AI has the potential to raise UK GDP growth from 2.5% to 3.9% by 2035 while increasing labour productivity by 27%. This would add an additional \$814bn (£570bn) to the UK economy.⁵

The UK Government has recognised the transformative potential of AI and has stated that the UK should remain at the forefront of AI research, innovation and industry. *Growing the Artificial Intelligence Industry in the UK*, an independent review conducted by Dame Wendy Hall and Jérôme Pesenti, argued that it is crucial for the government to support AI "because (for now) the UK is one of a group of countries leading in AI. That advantage could be built on successfully, or it could be lost".⁶ Similarly, the House of Lords Select Committee on AI argued that the UK is "in a strong position to be among the world leaders in artificial intelligence" which "handled carefully could be a great opportunity for the British economy".⁷ Andrew de Rozairo, Vice President of Customer Innovation and Enterprise Platform, SAP, in evidence to the Select Committee said: "if we adopt AI, given the strong skill sets that we have in the UK, we have a huge opportunity to boost productivity".⁸

In November 2017, the Government published its Industrial Strategy which set out the government's commitment to strengthen the UK economy and boost productivity. Putting the UK at the forefront of AI and the data revolution was one of the four "Grand Challenges" outlined in the strategy.⁹ This included an AI Sector Deal that was announced in April 2018. The deal committed

⁴ PwC, 2017, *The Economic Impact of Artificial Intelligence on the UK Economy*

⁵ Accenture, 2016, *Why Artificial Intelligence is the Future of Growth*

⁶ Professor Dame Wendy Hall and Jérôme Pesenti, 2017, *Growing the Artificial Intelligence Industry in the UK*

⁷ House of Lords Select Committee on Artificial Intelligence, 2018, *AI in the UK: ready, willing and able*

⁸ Ibid

⁹ Department for Business, Energy and Industrial Strategy, *Industrial Strategy: Building A Britain fit for the future*

£950m to AI from government, academia and industry, recognising that “creating an economy that harnesses artificial intelligence and big data is one of the great opportunities of our age”.¹⁰ This is a clear sign that the UK is committed to AI for the long-term, a success factor we explore in the final section of this report.

In London, this report builds on the *Mayor’s Economic Development Strategy for London* which described the city as “already one of the world’s leading hubs for digital technology, with particular strengths in specialist fields such as artificial intelligence, financial technology (FinTech) and digital health”. Our research supports the Mayor’s view of the “thriving artificial intelligence and machine learning cluster” in London and recognises the potential to harness AI for economic development and to design solutions to the city’s challenges.¹¹

¹⁰ UK Government, 2018, *AI Sector Deal*

¹¹ Mayor of London, 2017, *The Mayor’s Economic Development Strategy for London*

A Smarter London Together

'A Smarter London Together' is the Mayor's new roadmap to make London the smartest city in the world. It sets the foundations for future innovation through five missions and outlines the Mayor's commitment to better digital services, open data, connectivity, digital inclusion, cyber-security and innovation - and City Hall's plan for the growth of the city to more than 11 million by 2050.

A smart city is a collaborative, connected and responsive city. It integrates digital technologies and uses city-wide data to respond to citizens' needs - and the Mayor's ambition is to make London a better place to live, work, and visit for everyone.

Data underpins advances in new technologies in artificial intelligence, cognitive computing and sensors. Through the work of the London Datastore and TfL, London is a global leader in the use of data for public service delivery. The Mayor's roadmap has a strong focus on city data standards and data sharing, and ultimately will rely on partnerships with universities and London's world class AI sector:

- 1 More user-designed services – through leadership in design, common standards, inclusion, and diversity as well as the Mayor's Civic Innovation Challenge
- 2 Striking a new deal for city data – a new London Office of Data Analytics (LODA) programme and building trust in how data is used

- 3 World class connectivity and smarter streets – a new Connected London programme and a new generation of smart infrastructure
- 4 Enhancing digital leadership and skills – promoting better data skills and leadership to make public services more open to innovation
- 5 Improving city wide collaboration – more seamless work with boroughs, the NHS, universities and the tech sector

The potential to collaborate further with London's AI sector for a smarter city presents a truly exciting opportunity.

Theo Blackwell
Chief Digital Officer for London



Defining AI

There are many competing definitions of AI which have changed over time as technologies have evolved and understanding has improved. No single definition applies in all contexts; indeed the House of Lords Select Committee on AI received dozens of different definitions. In other reports on AI, it has variously been defined as:

- “ **A collective term for computer systems that can sense their environment, think, learn, and take action in response to what they’re sensing and their objectives**”¹²
- “ **Technologies with the ability to perform tasks that would otherwise require human intelligence, such as visual perception, speech recognition, and language translation**”¹³
- “ **The ability of machines to exhibit human-like intelligence**”¹⁴

¹² PwC, 2017, *Sizing the Prize: What’s the real value of AI for your business and how can you capitalise?*
¹³ Department for Business, Energy and Industrial Strategy, *Industrial Strategy: Building A Britain fit for the future*
¹⁴ McKinsey Global Institute, 2017, *Artificial Intelligence: The Next Digital Frontier?*

For this report we have used the CognitionX definition of AI which is domain-centric and pragmatic. We used the below list of technologies to set the parameters of what is considered AI. This has the practical benefit in this report of helping to define what is meant by an AI supplier and an AI product. This approach avoids attempting to craft a single comprehensive definition which would further muddy the debate on how to define AI.

Decision Support & Reasoning	Natural Language Processing	Computer Vision	Robotics & Autonomous Vehicles	Gaming & Simulations	Knowledge Management	Artificial Creativity	Automation & Control
Forecasting & Predictive Analytics	Chatbots	Image Processing	Cognitive Robotics	Game AI	Data Mining	Video Generation	Planning & Scheduling
Machine Learning Systems	Natural Language Understanding & Generation	Object Identification	Cybernetics	Path Finding	Knowledge Representation & Reasoning	Image Generation	Target Recognition
Classification & Labelling	Speech Recognition	Facial Recognition	Autonomous Robots	Virtual Reality	Topic Modelling	Linguistic Creativity	Automatic & Intelligent Control
Recommender Systems	Speech Generation	Object Tracking	Vehicular Automation	Swarm Intelligence	Information Extraction	Visual & Artistic Creativity	
Cluster Analysis	Text Summarisation	Optical Character Recognition	Intelligent & Multi-Agent Systems			Musical Synthesis	
Diagnosis & Expert Systems	Machine Translation						
	Sentiment Analysis						

Defining an AI supplier and an AI product

A core part of this research is to build an evidence base of AI suppliers in London and understand London's relative international standing in AI. We have defined an AI supplier as one who sells at least one AI product whether or not they also sell non-AI products. We have also included organisations that carry out AI research even if they do not offer a product or service to customers. We have defined an AI product as one which uses AI to some degree. Where the use of AI is borderline we have adopted a policy of including it. This avoids setting an overly restrictive threshold for AI and ensures we capture the full breadth and diversity of London's AI supplier base.

Within this report, the CognitionX classification of London AI products covers two variables:

- 1 The industry within which the customer buying the AI product operates, e.g. financial services, healthcare, or insurance; and
- 2 The function within the customer where the AI product is used, e.g. HR, sales, or procurement.

The worked examples below illustrate the classification approach.

Product Description	Customer Industry	Function in Customer
Seldon AI deployment framework	Any	Software development, IT (devops)
Kwiziq AI language coach	Consumers	Consumer
AlgoDynamix risk forecasting	Finance	Risk
Fractal Labs financial assistant app	Finance, Any	Finance
Limejump energy usage management	Energy	Operations
Recordsure voice monitoring	Finance	Compliance
Benevolent AI research analysis	Pharmaceuticals	R&D
Eigen Technologies text analysis	Finance, Law, Prof Services	Legal, Compliance, Operations
HireVue video interviewing	Any	HR (Talent Acquisition)
Firedrop AI website builder	Any	Any

London is well placed in AI

London is well placed as the AI growth capital of Europe and has the foundations to maximise the substantial economic benefits of AI over the long term. We set out these foundations in three sections:

- 1 London's strengths as a startup ecosystem including talent, tolerance, diversity and community support;
- 2 London's USP of demand, which is large, local and competitive;
- 3 a long-term commitment to AI ethics and leading research & education.

London's AI Ecosystem

Number of AI Suppliers	758 of which 645 have a London HQ
Example AI Suppliers	Iponweb, BenevolentAI, Improbable, Onfido, MiQ
AI Sector Strengths	Education, Finance, Healthcare, Insurance, Law, Media & Entertainment, Retail, Sales & Marketing
Demand for AI in London	Demand for AI in London is broad and interest is rising; Adoption is in its early days but expected to grow rapidly; AI will be transformational in London's leading industries
13 London universities offer AI, machine learning & related undergraduate and postgraduate degrees	University College London, Imperial College London, King's College London, Brunel University London, Queen Mary University of London, University of Greenwich, Goldsmiths University of London, Kingston University London, London South Bank University, University of East London, Royal Holloway University of London, City University of London, Birkbeck University of London
AI Policy Stakeholders	The Alan Turing Institute, The Ada Lovelace Institute, The Royal Society, Nesta, EPSRC, Innovation Research Centres, Tech Nation, Innovate UK, The RSA, House of Lords AI Committee, CBI, British Computer Society
Long Term Institutional Support for AI	£950m AI Sector Deal; £9m Centre for Data Ethics and Innovation; Government Office for Artificial Intelligence; AI and Data Grand Challenge to transform health-care; Action plan to unlock £20bn of "patient capital" over the next 10 years

London has a large and growing AI supplier base

CognitionX has mapped the AI supplier base in London. The data shows that London boasts 758 AI suppliers, 645 of which are headquartered in the capital.¹⁵ Our analysis shows that London's AI suppliers are primarily at a nascent state of development, in line with the global AI ecosystem. However, London does have three global AI leaders headquartered in the capital (Babylon Health, Onfido and Tractable) and a fourth, Darktrace, which is headquartered in Cambridge with an office in London. London is also the location for European offices of 13 non-UK companies in an AI top 100 list.¹⁶

London also sits at the centre of a wider UK AI ecosystem that provides talent, innovation and clients for AI suppliers with 80% of AI suppliers in the UK top 50 based in the capital.¹⁷ An opportunity exists for close collaboration with other AI cities, including Cambridge, Bristol, Manchester, and Oxford, to act as a key engine of growth for the UK economy. London also sits within a European AI ecosystem and has considerable opportunities to collaborate with other AI hubs across Europe. In April 2018, 25 EU countries, including the UK, signed a declaration of cooperation on AI to maximise the economic and societal benefits of AI and collectively address challenges.¹⁸

¹⁵ At the time of publication

¹⁶ CB Insights, 2018, *The AI 100*

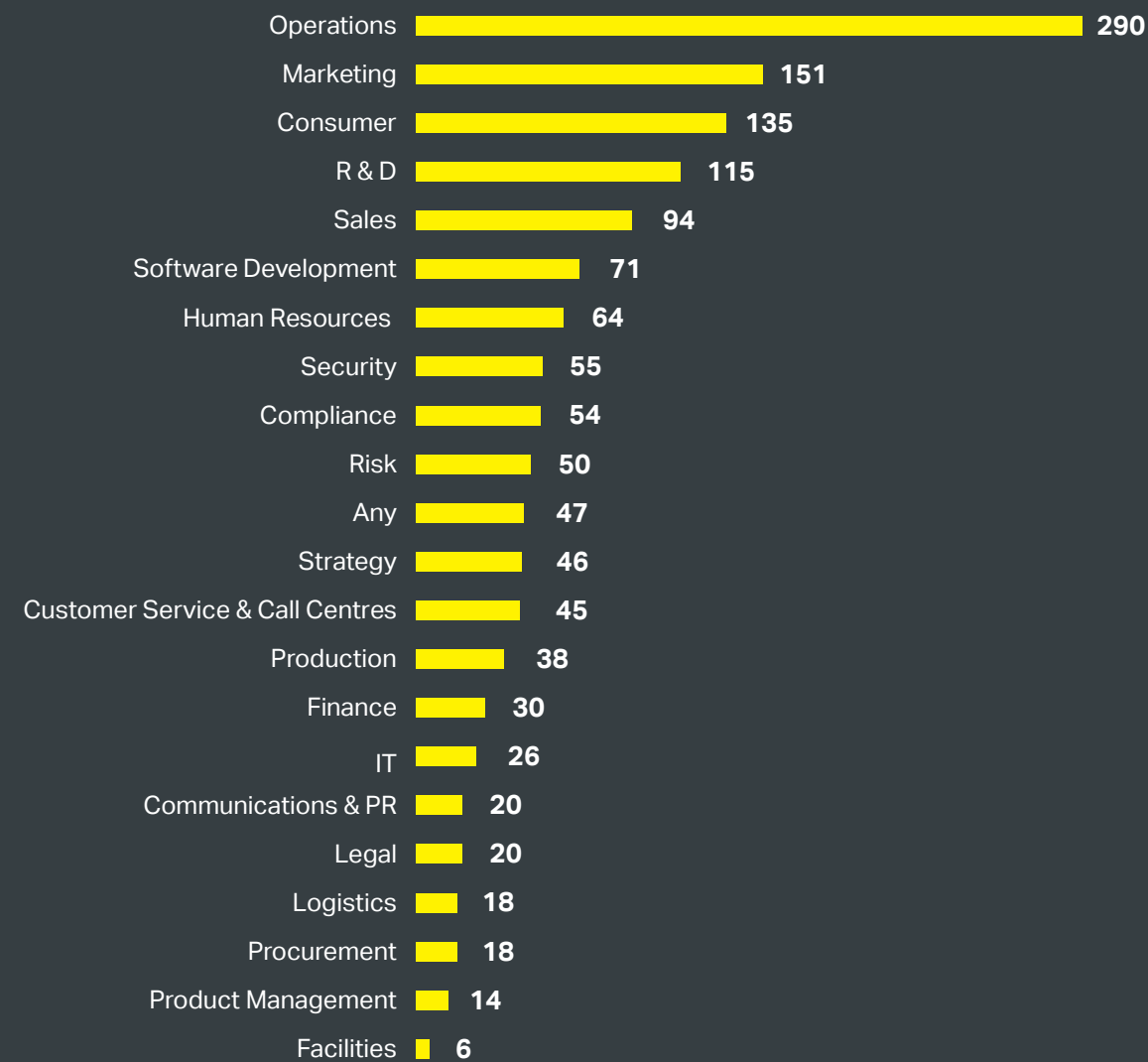
¹⁷ Sonovate, 2018, *The 50 Hottest UK AI Companies*

¹⁸ European Commission, 2018, *EU Member States sign up to cooperate on Artificial Intelligence*

The AI suppliers in London cover an impressively broad range of industry verticals and functional horizontals reflecting the diversity of the AI ecosystem. We analysed London's AI suppliers by vertical industry and customer function served which reveals four important characteristics:

- 1 **Functional specialists.** The largest segment of London's AI suppliers are functional specialists, developing products and services that cut across industry sectors. Operations, defined as the core activity of a business, is the top function served. Physical manufacturing is identified separately as a subset of operations. AI suppliers also serve supporting corporate functions such as HR, marketing, sales or customer service. These AI suppliers have the potential to achieve greater scale by cross-fertilising insights from one industry to innovate in another.
- 2 **Consumer focused.** Another large segment of London's AI suppliers provide AI-based consumer services, illustrating the strength of London's AI ecosystem in developing consumer-focused applications. Securing consumer confidence in AI will be crucial to the long-term success of these companies. As we explore in the final section, London's leading voice on AI ethics is an asset for its AI suppliers.
- 3 **Stronger in London's leading industries.** London's relative international standing is stronger in its leading industries of finance, insurance and law. There is a clear opportunity for London to build on its global presence in these sectors to develop a strong AI ecosystem.
- 4 **Growth in large industries.** London has a large number of AI suppliers in global industries such as retail and e-commerce, media and entertainment, IT services and technology and healthcare. These industries represent huge future growth potential for London's AI ecosystem.

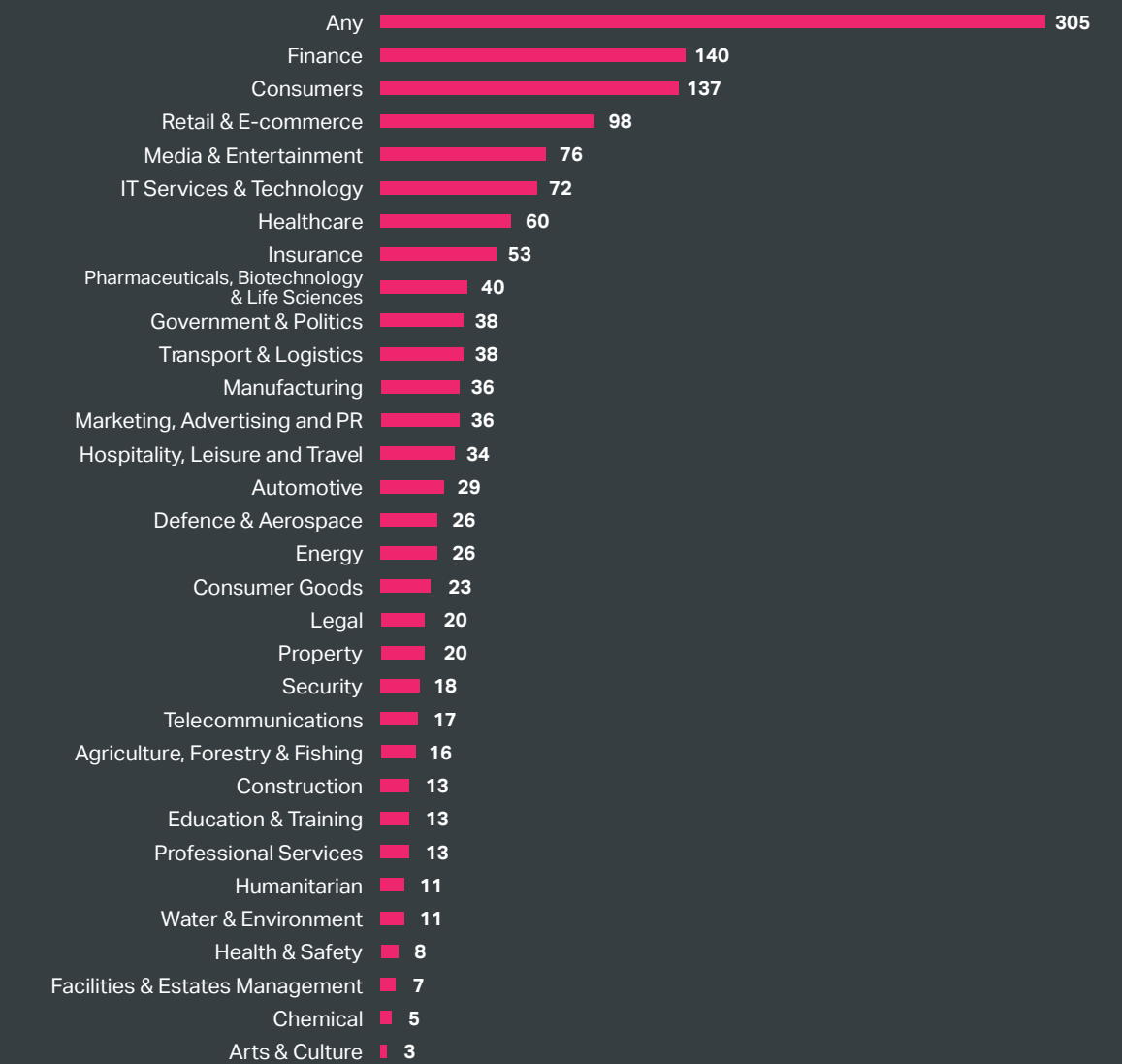
London AI suppliers by customer function



NOTES

- Suppliers classified by functions served.
- Some suppliers serve more than one function
- "Operations" means the core activity of an enterprise unless covered by a more specific function such as "Production". Trading in bank or medical services in a hospital are both classified as "Operations"
- Consumer applications are classified as serving Consumer

London AI suppliers by customer industry

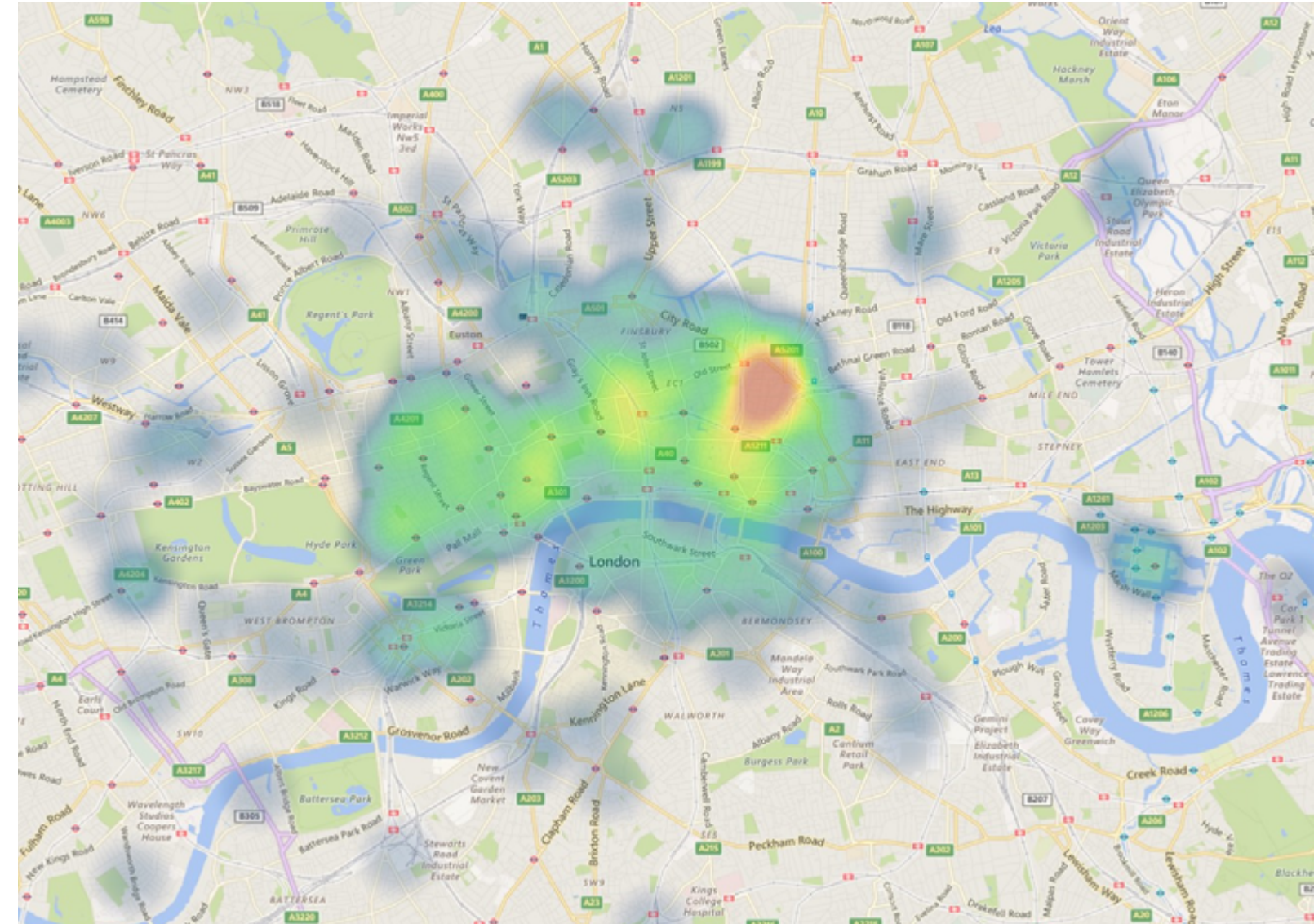
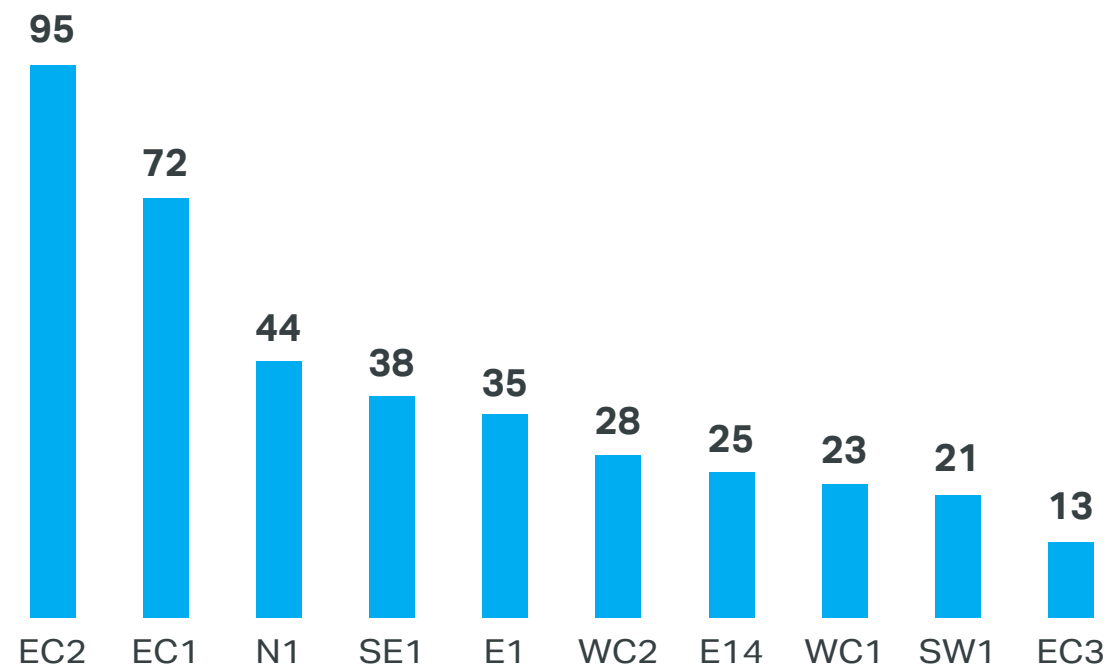


NOTES

- Suppliers are classified by industries served.
- Some suppliers serve "Any" industry. An example would be an HR application
- Some suppliers serve more than one industry (eg document review in Finance, Legal & Insurance) in which case they are classified under each.
- Some suppliers are consumer services using AI.

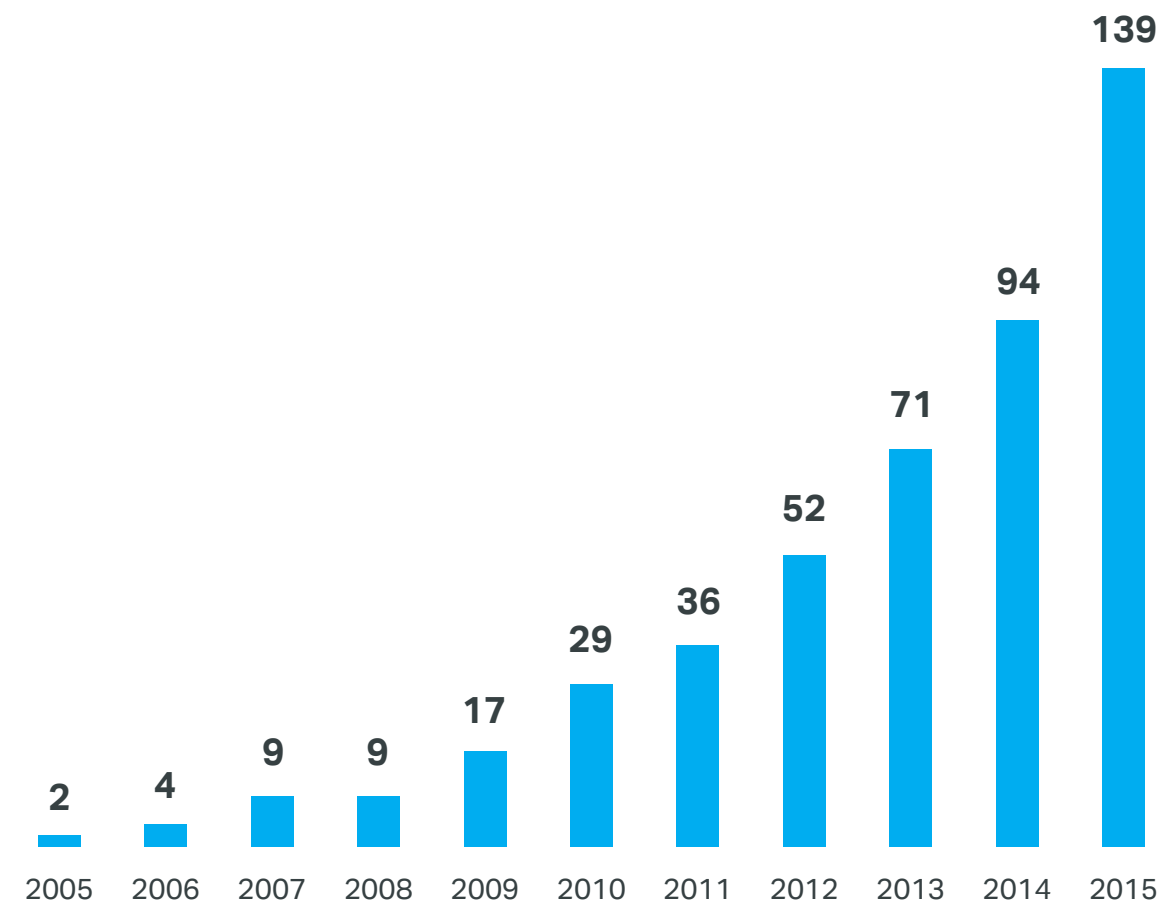
London's AI suppliers are spread across the capital with some emerging clusters. Of the 558 companies we were able to find office addresses for, 71% are concentrated in the top 10 locations. The largest cluster is in the EC1 and EC2 postcodes where 30% are located, followed by 11% in WC1 and WC2, 9% in N1 and 8% in both SE1 and E1. The EC1 and EC2 postcodes encompass the heart of the City of London, the capital's financial district, and the area up to 'Silicon Roundabout', home of London's technology cluster. This emphasises the importance of the proximity of London's AI suppliers to both the capital's technology sector and its leading industries such as finance and insurance.

Top 10 locations for London's AI suppliers



London's AI suppliers are primed for growth. The number of AI suppliers founded in the capital has increased substantially as interest and investment in AI has grown; 81% of London's AI suppliers were founded after 1 January 2012.

London AI suppliers by formation date



Source: CognitionX database, CognitionX analysis

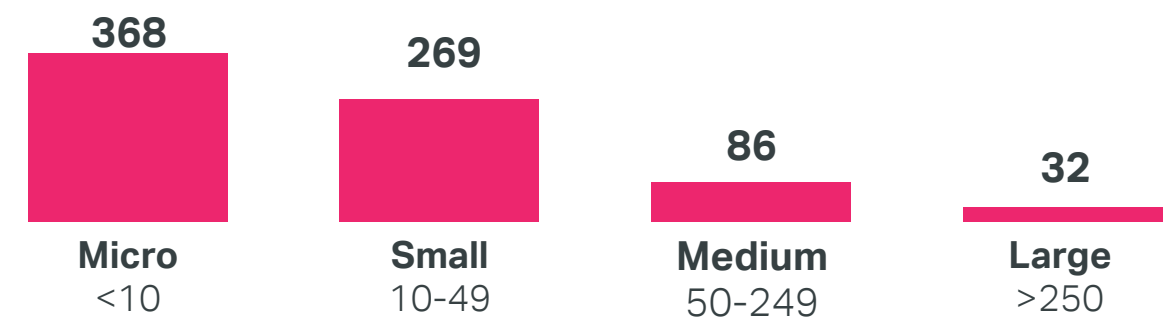
Notes

- Includes both London HQ suppliers and non London HQ suppliers
- Figures do not include suppliers where formation date is prior to 2005 or formation date is unavailable
- Data for 2016 and 2017 excluded as a time lag can occur between company formation date and the start of trading and/or the visibility of web-site

Our findings from the Mayor’s London AI Innovation Census and our conversations with experts suggest that the number of AI suppliers in London continues to grow, reflected in rising investment and growth in the number of new AI companies applying to accelerator programmes. There is often a delay in supplier formation rate data which is also seen in other AI hubs, such as the San Francisco Bay Area.

We also analysed London’s AI suppliers by their global number of employees, finding that 49% are classified as micro with fewer than 10 employees and 36% are small with between 10 and 49 employees. This reinforces our analysis of London’s AI scene as nascent but primed to take advantage of opportunities for high rates of growth over the coming years as demand accelerates. A further 12% are classified as medium sized with between 50 and 249 employees. This shows that London is already providing the conditions for AI companies to move from startup to scaleup and highlights the opportunity to build on the strong foundation for long-term growth in the AI ecosystem.

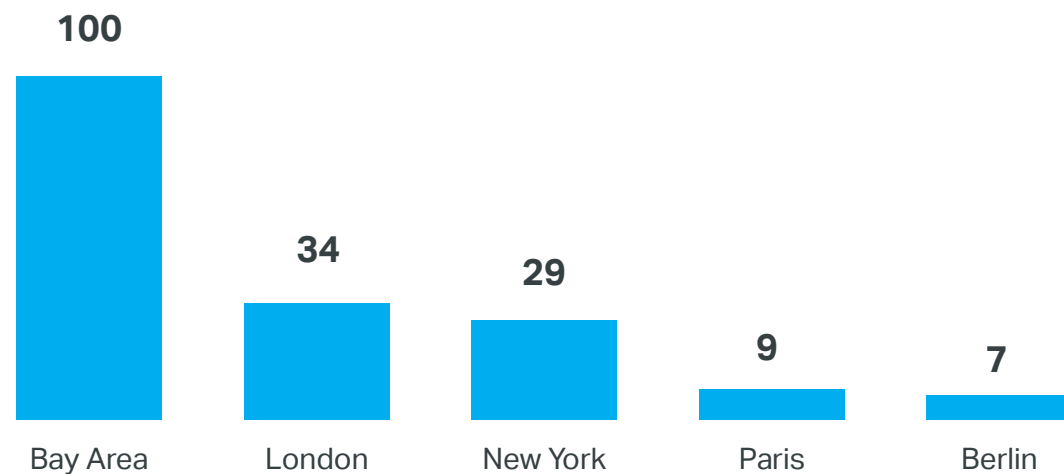
London AI suppliers by headcount



London is the AI leader of Europe

While the San Francisco Bay Area is unsurprisingly the global leader, London has a higher supplier count than New York. In Europe, London is the AI leader, ahead of Paris and Berlin which have the next highest numbers of suppliers. Our analysis of AI supplier headquarters data is based on the CognitionX directory of AI companies cross-referenced with other data sources. The analysis benchmarks London against the greater San Francisco Bay Area, New York, Paris and Berlin with the number of AI companies indexed to 100 in the Bay Area to facilitate like for like comparisons.¹⁹

AI supplier count index



Source: Crunchbase, CB Insights, CognitionX Analysis

¹⁹ An index rather than absolute numbers are used to facilitate like-for-like comparisons using multiple data sources including the CognitionX mapping of AI suppliers in London and internationally and third party data sources. International comparisons exclude China where it is difficult to get accurate data on the number of AI suppliers. For a full outline of our data methodology see appendix 2.

Analysis of census data and expert interviews reflects the positive perceptions of London as an attractive destination for AI talent. DeepMind remarked that:

“ There was no better place than London to build DeepMind. Many people told us that a new AI lab would need to be based in Silicon Valley to be successful, but we saw things differently. We wanted to be in a place where we could be part of, and experience, the diversity of the society we’re serving. Being based in London makes that possible; our multicultural surroundings ensure our approach remains globally-minded and socially-focused.

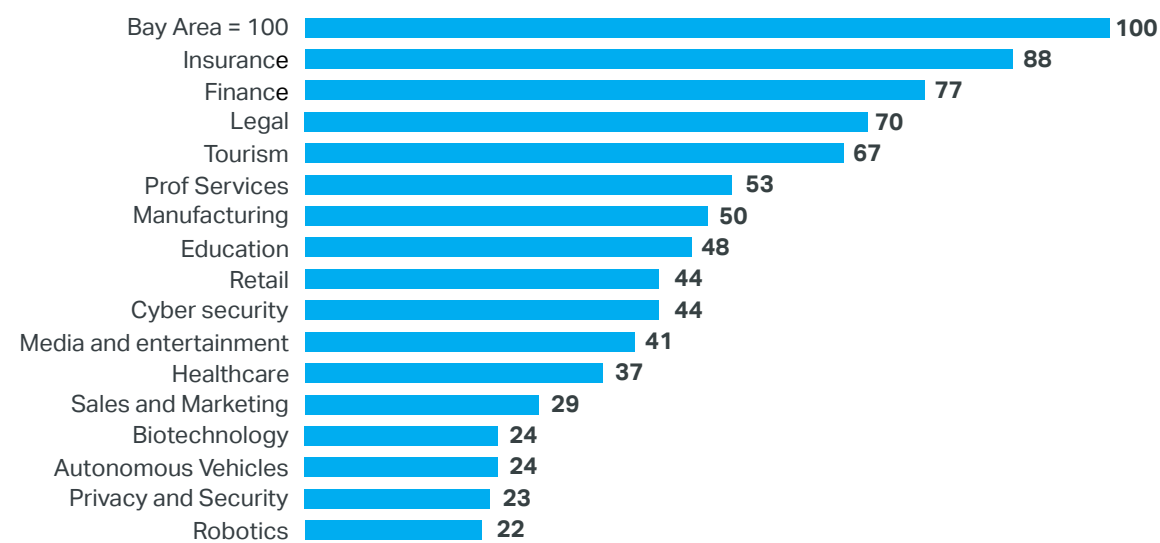
Deepmind

London has stronger positions in its leading industries

London's AI supplier base is stronger in its leading industry verticals of finance, insurance and law, positioning the city to capitalise on growing demand for AI products and services which will spur innovation. In our analysis of London's AI supplier base and its growth opportunities in leading industries, we again benchmarked the capital against the greater San Francisco Bay Area as the world's largest AI ecosystem. We have also used the global AI supplier count, indexed to account for differences across data sources, as an approximate measure of the global market size of AI in each industry. The data clearly show that London

London AI supplier count relative to the San Francisco Bay Area AI supplier count

Number of London HQ industry AI suppliers / Number of Bay Area HQ industry AI suppliers, indexed to 100



Source: Crunchbase, CB Insights, CognitionX Analysis

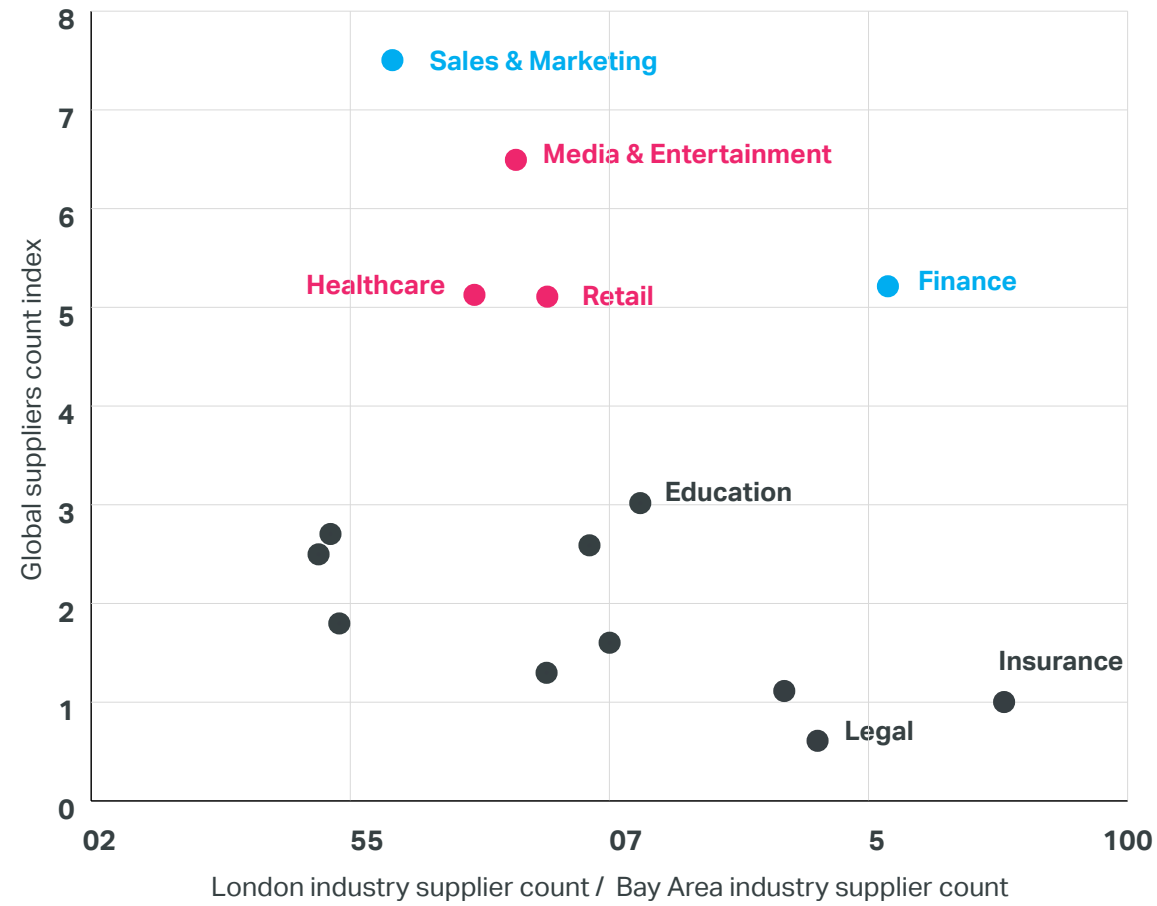
is competitive in large global industries and has considerable opportunities for growth.

London is stronger in finance than in its other leading industries. Finance is the third largest global market by AI supplier count as the chart below shows. London has a finance AI supplier base that is 77% the size of the AI supplier base in the San Francisco Bay Area. The proximity of London's finance AI companies to a globally leading and integrated financial sector, in contrast to the Bay Area which is far from the US financial hub in New York, provides a competitive advantage that is prized by AI suppliers in London. It also provides an advantage over Paris and Berlin whose AI ecosystems are considerably smaller than London's.

London also ranks close to the Bay Area in three smaller specialist markets for AI suppliers: insurance (88% the size of the Bay Area), legal (70%), and education (48%). Furthermore, although second to the Bay Area, London leads New York in three large sectors for AI: media and entertainment, retail and healthcare which all present opportunities for future growth. In sales and marketing, the largest sector for AI by supplier count, London's AI supplier base is 29% the size of the Bay Area and is behind New York. The importance of AI in sales and marketing is clear from the fact that London has 200 AI suppliers who serve either the sales and marketing function across all industries and/or who directly serve the marketing, advertising and PR industry. With a large and globally connected sales and marketing sector, London has the opportunity to attract long-term investment that will stimulate growth and innovation in the AI supplier base.

London standing and industry sector global size

Index of numbers of AI suppliers globally vs London supplier numbers / Bay Area supplier numbers, %



Source: Crunchbase, CB Insights, CognitionX Analysis

International comparisons and expert interviews further reveal the large untapped demand for AI in London in its leading industries. A company providing investment, tax and business services in London commented in the census that “there is huge demand amongst established SMEs to engage with AI technologies, but very little information regarding how this might be done”. Demand for AI products and services in large global industries could be unlocked by providing information and case studies of how AI has been deployed across industries. Another respondent, a startup providing custom conversational software, commented that “market timing” is crucial in tapping into demand, along with improving the “general awareness of AI, what it can do, case studies and results”.

Enter the dragon - China's rise

Our international comparisons exclude China, where the relative unavailability of accurate data on the number of AI suppliers prevents like-for-like comparisons. Nevertheless, China is a very important market for AI, home to innovative research and a rapidly growing AI supplier base. By one measure, China's AI startup scene received 48% of all equity funding in 2017 with the US taking 38% and the rest of the world receiving 13%. This represents a dramatic shift from 2013 when the US AI startups received 77% of equity funding.²⁰ In May 2018, SenseTime, a leading Chinese AI startup focusing on image recognition, raised over \$1bn from VCs, investors and technology companies in two back-to-back funding rounds.

China's ambition, outlined by the State Council in the 2017 New Generation AI Development Plan, is to reach parity with the US on AI by 2020 and become the world leader by 2030. The plan targets gross output from core AI industries of RMB1tn (\$150bn) with a further RMB10tn from AI-related industries by 2030.²¹ This is supported by regional and city-level investment in AI. As Jeffrey Ding of the Future of Humanity Institute observes, "competition between cities and regions is one of the key drivers of AI innovation and momentum in China. At a city level, there is an emphasis on innovation centres, makerspaces and industrial parks in an attempt to imbue and recreate Silicon Valley ideas". The Qianzhan Chanye Research Institute identified 12 Chinese provinces and cities with AI industry targets totalling RMB429bn by 2020, far exceeding the national target. Investments continue to rise; Tianjin alone recently announced a RMB100bn AI development fund.²²

²⁰ CB Insights, 2018, *The State of Artificial Intelligence 2018*

²¹ Jeffrey Ding, 2018, *Deciphering China's AI Dream*

²² Shanghai Morning Post, 2018, *Tianjin city in China eyes US\$16 billion fund for AI work, dwarfing EU's plan to spend US\$1.78 billion.*

One report predicted that Beijing will become an AI innovation centre to rival Silicon Valley, overtaking Toronto, Montreal and London in the process.²³ Beijing is certainly mobilising large resources, investing \$2.1bn in the west of the city to build an artificial intelligence development park, with room to house 400 AI enterprises.²⁴ Beijing already had 400 AI companies as of September 2017, placing it as the leading AI hub in China.²⁵ Over the first 9 months of 2017, 51 AI projects in Beijing received investment. With an overall value of \$1.62bn, this represented over 50% of the national total.²⁶

However, China's strength in AI may not necessarily lead to global expansion or cross-industry dominance. The managing partner of Zeroth.ai, Tak Lo highlights that "local economic specialisation, cultural factors and market size all shape the development of China's AI ecosystem. Its AI suppliers are innovating in a number of industries but are particularly strong in consumer applications where there is a huge domestic market." Furthermore, as Tak notes, "the size and cultural specificity of the domestic market allows Chinese AI suppliers to achieve scale without the challenges of international expansion."

²³ Eurasia Group and Sinovation Ventures, 2017, *China embraces AI: A close look and a long view*

²⁴ Reuters, 2018, *Beijing to build a \$2 billion AI research park*

²⁵ zhengwu.beijing.gov.cn: *Beijing's "Artificial Intelligence" New Deal Makes Businesses Thirsty*

²⁶ Yicai Global, 2018, *Former Google VP Heads Up New Beijing AI Institute*

London provides an attractive and supportive environment for AI suppliers

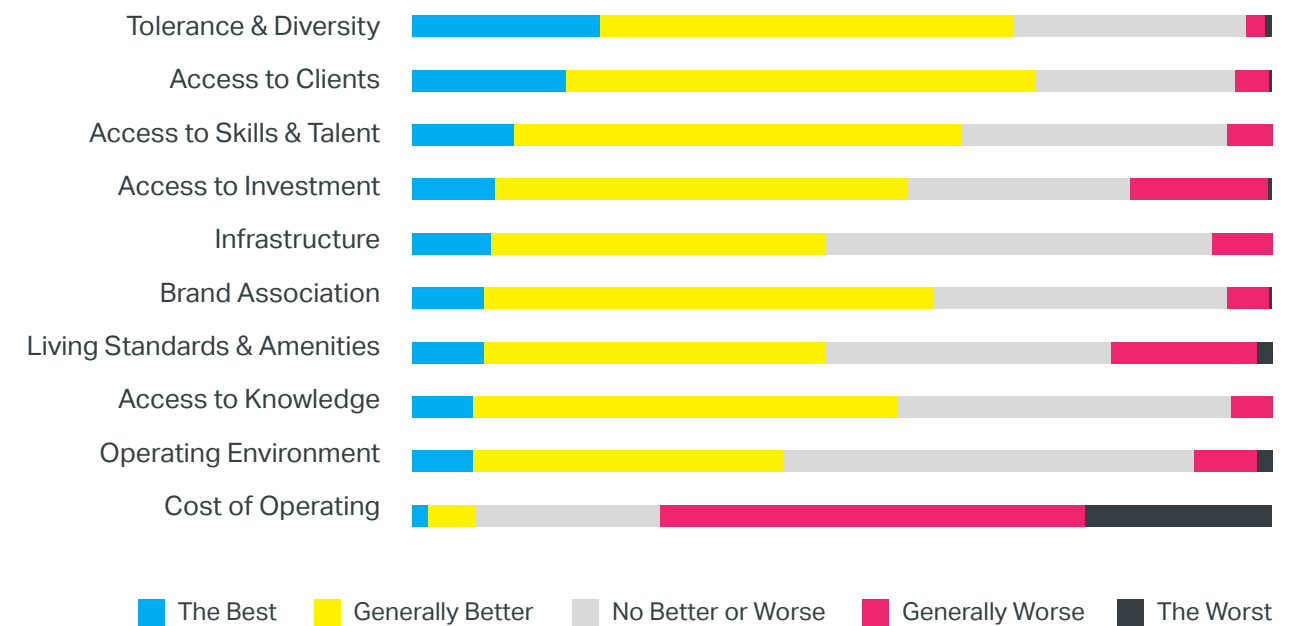
The large AI ecosystem developing in London reflects the attractive and supportive environment the city provides for entrepreneurs, startups and employees. Data from the census highlights that AI suppliers in London rank the city equal or better than other major AI hubs on nine of the ten factors considered, with a net positive favourability in six factors.²⁷

London was ranked most favourably against other major AI hubs on three important and interrelated factors: tolerance and diversity, access to clients and access to skills and talent. 68% of London’s AI suppliers consider London better than other cities for tolerance and diversity with 21% ranking London as the best, the most of any factor. Furthermore, 69% ranked London as better than other AI cities on access to clients while 62% view London as better on access to skills and talent.

The other three factors where London has a net positive favourability compared to other AI cities are: the city’s brand association, access to investment and access to knowledge. On a further three factors (physical infrastructure, operating environment and living standards and amenities) more respondents ranked London favourably than unfavourably compared to other major AI hubs. London only has a net unfavourable rating compared to other cities on one factor: cost of operating for AI suppliers. However, London does possess a cost advantage over the Bay Area, where software engineers are paid an average of \$112,000 per year compared to \$52,000 in London.²⁸

²⁷ We received a total of 312 responses to the Mayor’s London AI Innovation Census as of the 18 May 2018. The analysis presented here is on the 237 respondents who are AI suppliers headquartered in London. A full description of our methodology is provided in appendix 2.
²⁸ Startup Genome, 2017, *2017 Global Startup Ecosystem Report*

For each of the following factors, please rank London in relation to other major AI hubs (n=237)



The data highlights considerable opportunities for London to build on its strong reputation among AI entrepreneurs and positive perception in relation to other AI hubs. In particular, London has the opportunity to capitalise on its three key strengths: its open, tolerant, and multicultural society; the proximity of clients to suppliers and its ability to attract global talent, which together promote a strong community of peer support for entrepreneurs.

Talent is the top factor in location decisions

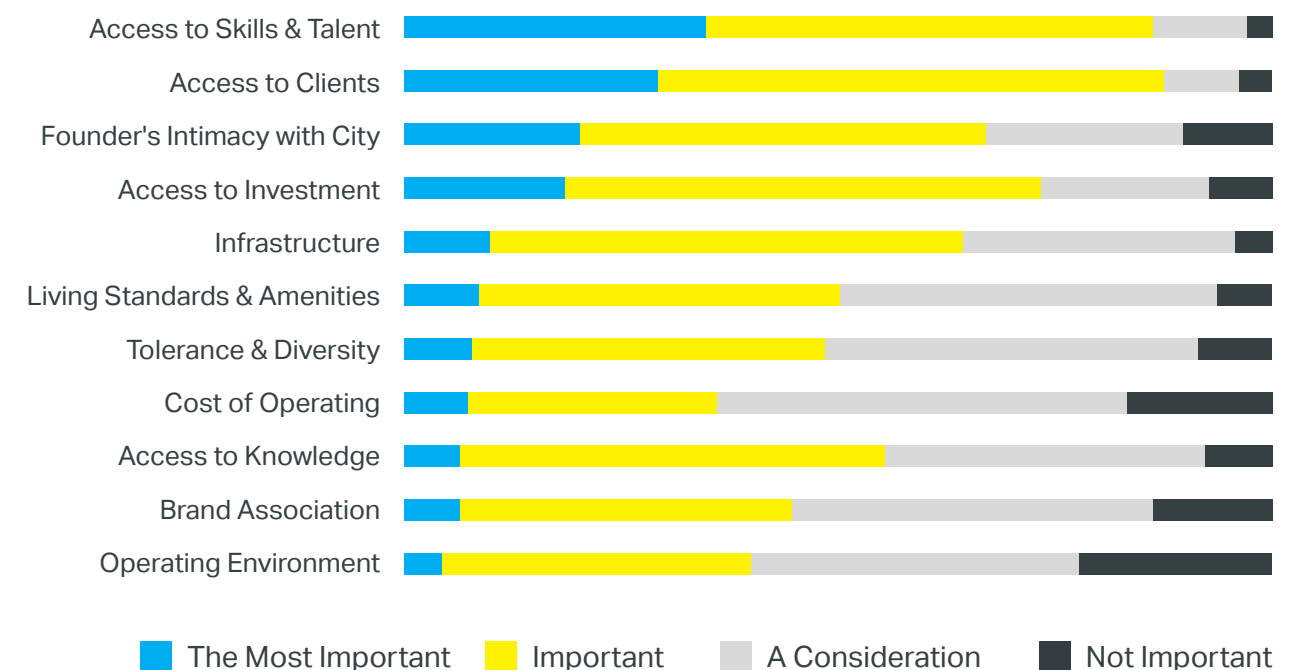
Talent is crucial to the long-term success of technology ecosystems. In a globally competitive market for AI skills, London is well placed in both the short and long term to attract the world’s best talent. Calculating the supply of AI experts is difficult and estimates vary considerably. In 2017, Tencent estimated there were between 200,000 and 300,000 active AI researchers and practitioners.²⁹ A more conservative approach by Element AI used LinkedIn to identify highly qualified AI experts with PhDs who mentioned AI or AI plus related keywords such as deep learning. Element AI found 22,064 global experts with the UK second only to the US with 1,861 individuals.³⁰ Although, as Element AI note, this data undoubtedly undercounts Asian AI experts, it is clear that the talent pool is relatively small and highly competitive.

The census highlights the importance of skilled labour to the London AI cluster. Respondents ranked, by importance, the factors they considered in choosing a city to locate their company. The data below presents the views of 237 AI suppliers headquartered in London, providing a rich insight into the factors they considered in choosing the capital for their company. Talent was the single most important factor for 34% of respondents while a further 51% ranked it as an important consideration.

Attracting a supply of global AI expertise is central to the UK’s vision to lead in AI. Rob McCargow, AI Programme Leader at PwC, described the “thriving ecosystem in London where the barriers to entry for founding a startup have fallen considerably. Talent and human capital is now the critical success factor for startups”. Rob summarised

²⁹ Tencent, 2017, *The 2017 Global AI Talent White Paper*
³⁰ Element AI, 2018, *Global AI Talent Report 2018*

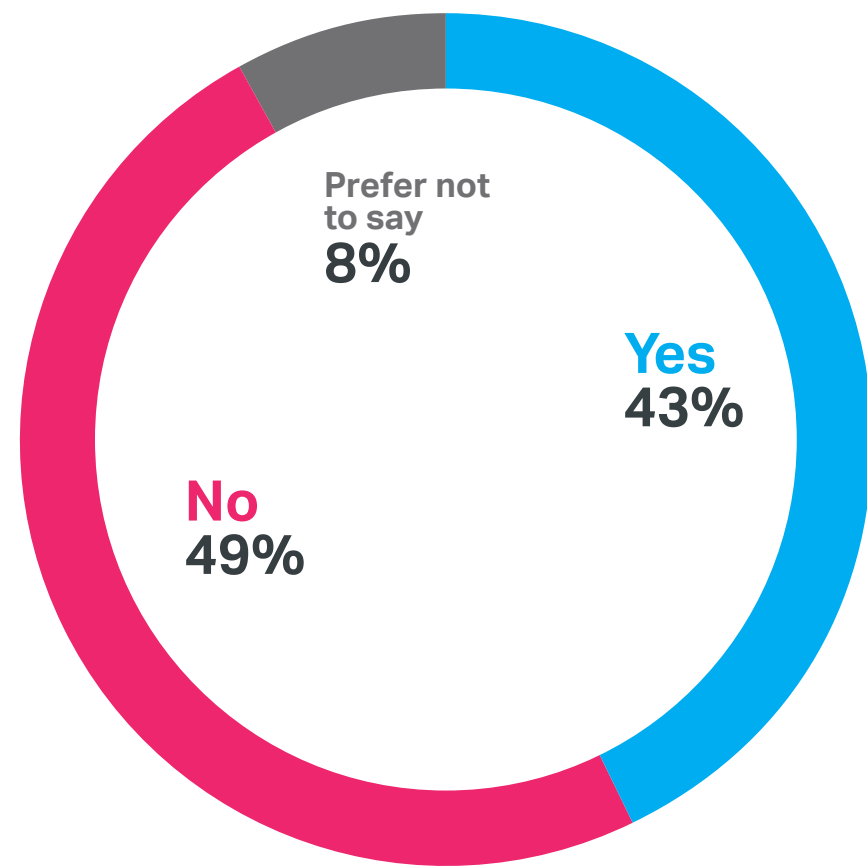
Factors for choosing a city (n=237)



the AI opportunity in London as “promoting a culture of entrepreneurship and growing and strengthening the talent and skills base to match rising demand for AI”. Josh Winterson, founder of DataNinjas, agreed on the “importance of London and the UK training and attracting talented data scientists, especially those who combine technical expertise with industry experience”.

London has a well-deserved reputation as an open and multicultural city. It is a magnet for the best international talent who choose the city to live, study and work. The census reveals that 43% of London's AI suppliers have at least one non-UK founder, a figure that is comparable with other major technology hubs, such as the Bay Area.

Are one or more of your founders non-UK citizens?



London's AI suppliers are concerned that Brexit will impact their ability to attract and retain international talent. 16% of census respondents directly referenced Brexit and uncertainty over the UK's access to the single market as a factor holding their company back. More

broadly, 29% cited improved access to skills and talent as the one factor that would unlock their company's potential and improve London's AI ecosystem. This reinforces our analysis that, in a globally interconnected market for highly mobile talent, openness, tolerance and diversity are all crucial assets.

As an open, tolerant and multicultural society, talent loves London

Creating an open and tolerant environment that supports innovation and collaboration is a core component of a successful technology cluster.³¹ Research by Professor Richard Florida highlighted this in the success of the Bay Area and Boston clusters.³² Similarly, a study of diversity in London companies by Pivigo found that “businesses with similar sized boards (three-four directors) received almost four times more funding when they had two or more non-UK nationalities on the board (£13.8m) as opposed to UK-only directors (£3.5m).”³³

London’s open, tolerant and multicultural society is reflected in the census where the capital was rated most favourably against other AI hubs for tolerance and diversity. This is illustrated by the 32% of London’s AI suppliers in the census have one or more founders who consider themselves to be black, Asian and minority ethnic (BAME). This compares with 15% of UK tech workers and 10% of workers in the wider UK economy.³⁴

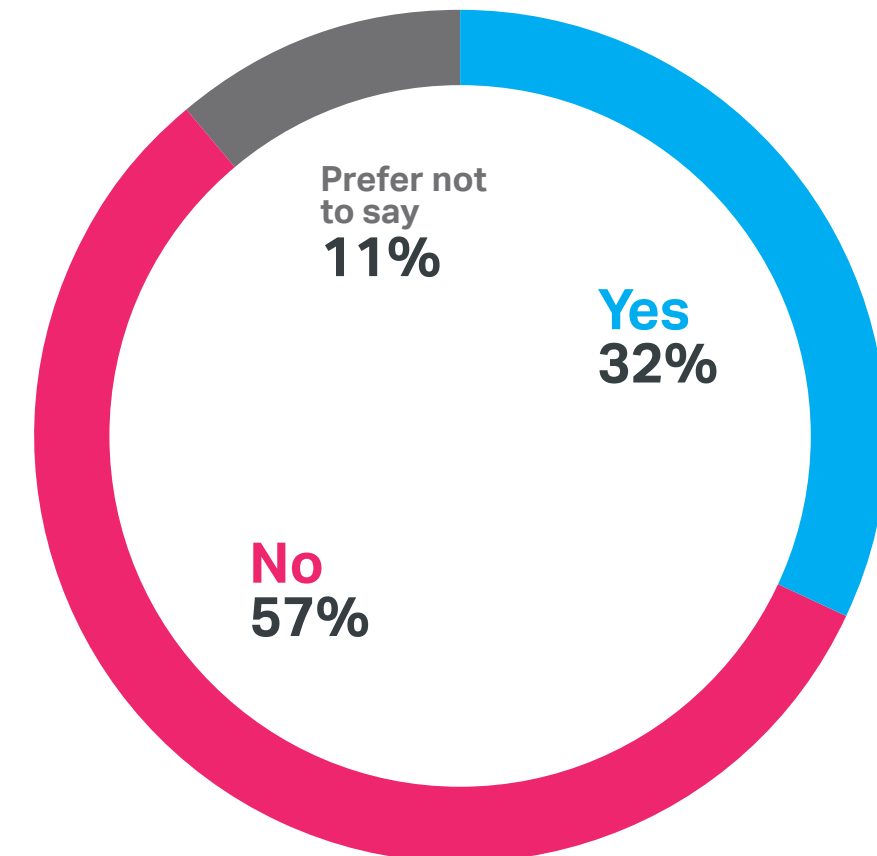
³¹ The Brookings Institution, 2017, *Clusters and Innovation Districts: Lessons from the United States Experience*

³² Richard Florida, 2002, *The Rise of the Creative Class*; Richard Florida, 2010, *The Flight of the Creative Class*

³³ Pivigo, *Startup London Together*

³⁴ Office for National Statistics, 2017, *Annual Population Survey*

Do one or more of your founders consider themselves BAME?



Stephen Pattison, VP Public Affairs at ARM Holdings noted that “by any measure, London is a terrifically successful multicultural city” and “retaining its multicultural atmosphere is crucial for attracting the best of the best of global technical talent who feel at home in a city that provides them with excellent education and employment opportunities”. Sarah Drinkwater, former Head of Google’s Campus London, echoed this: “London has one of the strongest, most diverse talent pools in the world combined with an open and tolerant culture which is a real asset”. This collaborative environment provides founders and entrepreneurs with the dense connections and networks that enable them to form successful businesses. Sarah argued that London should “cheerlead what is already here” especially its open and tolerant culture and its leading role in driving forward ‘Tech for Good’ initiatives which are “shaping the global conversation on the development of ethical technology, including ethical AI.”

London’s AI ecosystem outperforms the global technology average on another important factor: the percentage of female founders. Data from the census shows that 25% of London’s AI suppliers have at least one female founder compared with 17% of global technology startups in 2017, a figure that has remained unchanged for five years.³⁵ In the UK, women account for 21% of STEM employees³⁶ and 21% of UK SMEs are female-led.³⁷

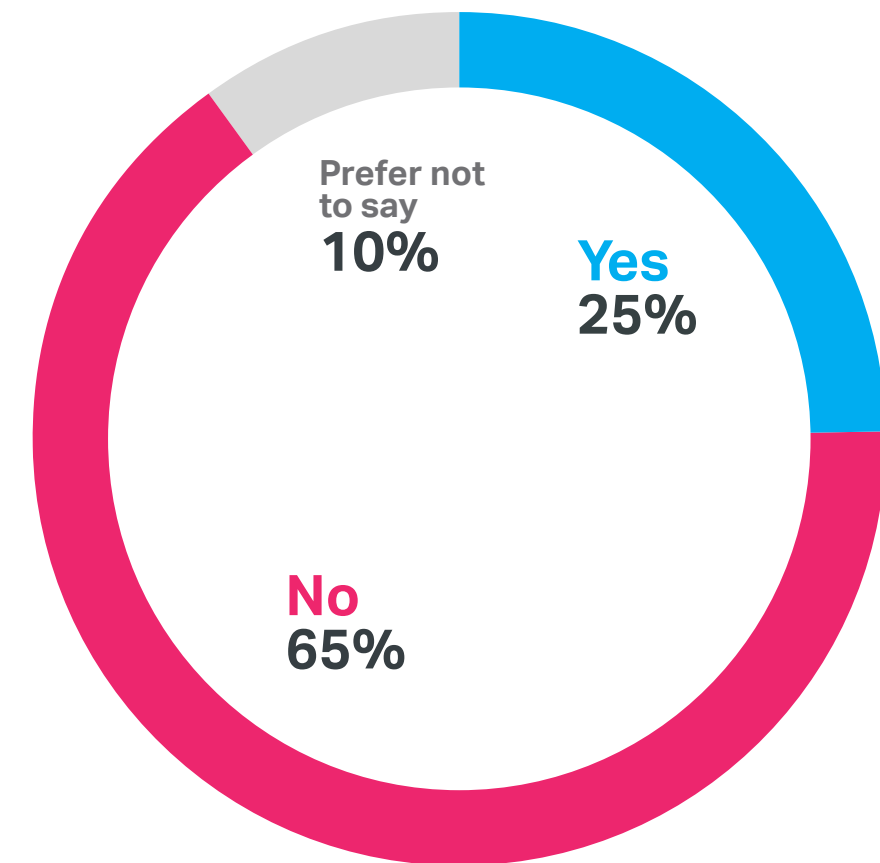
London has an opportunity to build a supportive startup environment that encourages higher levels of female participation in AI and across the technology sector. Professor Jackie Hunter, CEO of BenevolentBio, part of BenevolentAI, and former CEO of the Biotechnology and Biological Sciences Research Council stressed that “increasing diversity and female participation in AI, technology and data science would really enhance

³⁵ Crunchbase, *In 2017, Only 17% of Startups Have a Female Founder*

³⁶ Ebiquty, 2016, *Women in Innovation: Understanding Barriers to Innovation*

³⁷ House of Commons Briefing Paper Number 06152, December 2017, *Business Statistics*

Are one or more of your founders female?



London’s reputation as the destination of choice for world-class talent. Female maths graduate role models and the study of maths should be promoted at an early age in schools”.

London provides strong community & peer support for founders

London's entrepreneurs value the connections they make with other founders in the strong peer support community, exemplified in London's 83 startup accelerators and incubators.³⁸ Hugo Pinto, Managing Director Accenture Digital, described London and its technology community as a "melting pot of like-minded and interesting people. Nurturing this community is a massive opportunity for London to build a stronger and even more open ecosystem that extends beyond the capital and attracts the very best talent from Europe and beyond". David Snelling, Programme Director AI at Fujitsu remarked that "London is definitely the place for AI ethics, diversity and inclusion". This provides a strong foundation for growth, collaboration and innovation in the AI ecosystem.

London is the highest performing European startup ecosystem according to the Global Startup Ecosystem Report 2018. It is particularly strong on measures of 'local connectedness' which reflects how easily founders can develop quality relationships with each other, investors and experts. The report shows that ecosystems that develop a strong sense of community are more successful at producing scaleups.³⁹ Local connectedness is assessed against three metrics:

- **Sense of Community Index.** The degree to which founders informally receive support from fellow founders, investors and experts;

³⁸ Tech.London, 2018, *Incubators & Accelerators*

³⁹ Startup Genome, 2018, *Global Startup Ecosystem Report 2018: Succeeding in the New Era of Technology*

- **Number of Relationships Between Founders.** Emphasising quality relationships where the founder could call upon a fellow founder for help "this week"
- **Collision Index.** The number of events founders recently participated in and the number of collisions with startup community participants.

London performs strongly on all three measures in our comparison with the San Francisco Bay Area, Paris and Berlin.

London's Local Connectedness vs San Francisco Bay Area, Paris and Berlin

	London	Bay Area	Paris	Berlin
Sense of Community Index	7.1	8.6	3.9	5.0
Number of Relationships Between Founders	22.3	22.4	21.1	20.0
Collision Index	6.4	5.9	3.5	4.4

Source: Global Startup Ecosystem Report 2018

For founders, this sense of community sets London apart. Camille Rougié, co-founder and CEO of Plural AI and graduate of Entrepreneur First London, highlighted the open and supportive London startup community as an important consideration in her decision to found her company in the capital. She described the startup ecosystem in London as “generally more open and collaborative than other cities”. This provides founders with “greater access to support from fellow co-founders, business mentors and smart VC money”.

Tech meetup data further reveals the strong emerging community of AI knowledge and expertise in London and across the UK. Tech Nation found that 16% of the top 400 UK tech meetup groups by number of members, 323 of which are in London, had AI as a topic.⁴⁰ The impact of this growing community of AI experts, suppliers, clients and investors cannot be overstated. Ben Brabyn, Head of Level39, observed that:

■ simply measuring and ranking clusters by single variables encourages a kind of ‘top trumps’ approach to evaluating entrepreneurial ecosystems which misses more complex but important measures such as connectedness, inclusivity and favourable regulatory environments. It also misses important underlying values such as the right of individuals to control their own data. London has the opportunity to set the tone here and be a global leader.”

Ben Brabyn
Head of Level39

Investment in AI is growing

London's AI suppliers are backed by rising investment, which grew by more than 50% between 2016 and 2017 to over £200m.⁴¹ This represented approximately 10% of the record £2.45bn raised by London's technology firms in 2017. London's AI suppliers have significant scope to raise even higher levels of funding and they are well placed to do this. In April 2018, BenevolentAI raised \$115m (£86m), valuing the company at \$2.1bn (£1.6bn) and reflecting the ability of London's AI suppliers to attract significant investment.

Eamonn Carey, Managing Director at Techstars London, described access to investment as "one of the most important factors for startups". UK startups have access to "a lot of funding which is a great advantage" and "the last 12 months has seen a significant increase in US investment in the UK with US investors now looking seriously at London and AI in particular". Investment from Silicon Valley in UK tech companies has increased by 252% since 2011 with 2017 seeing 74 deals worth £1.08bn, the first time it has passed £1bn in a year. East Coast firms invested even more in London, £1.31bn in 2017. Together, London, Oxford and Cambridge received 79% of all US investment into UK tech companies, reflecting the strength of this cluster and its attractiveness as a destination for global investment.⁴²

London's AI companies also enjoy strong access to funding from VCs based in the capital. Our analysis found over 45 London-based VCs (either headquartered in London or with an office in the capital) who have invested in AI suppliers. Furthermore, five of the eleven most active backers of European AI and machine learning

⁴¹ London & Partners, 2018, *2017 record year for London and UK tech investment*

⁴² Penningtons Manches, *From the Golden Gate to the Golden Triangle: A Report on US Investment into UK Companies*

startups since 2015 (excluding accelerator rounds), are based in London.⁴³ Chris Wigley, COO of QuantumBlack, told us that "early stage VC funding is good and London-based startups enjoy good access to capital. Where London has a significant opportunity to improve the ecosystem is in "increasing the supply of funding to help startups scale-up and compete globally".

There is a huge opportunity for London to stimulate greater investment in its AI supplier base. London's AI suppliers used the census to call for a "less conservative" and "more ambitious" investor community that is willing to invest in deep tech and "early stage bold ideas".

This shift is happening. The number of London-based investors exploring investments in AI continues to grow alongside an increasing appetite to pursue longer-term AI investments. Jenny Tooth, CEO of the UK Business Angels Association, told us that "helping investors understand the AI market is crucial. Seeing successful AI suppliers and their growth trajectory will give investors confidence to increase AI in their portfolios". Jenny observed that there is "tremendous interest in AI from investors and the opportunity to showcase successful AI suppliers is a significant one that could really stimulate greater investment".

⁴³ Pitchbook, 2018, *The 11 most active VC investors in European AI and machine learning*

London's
USP is
demand

Demand is large, local and competitive

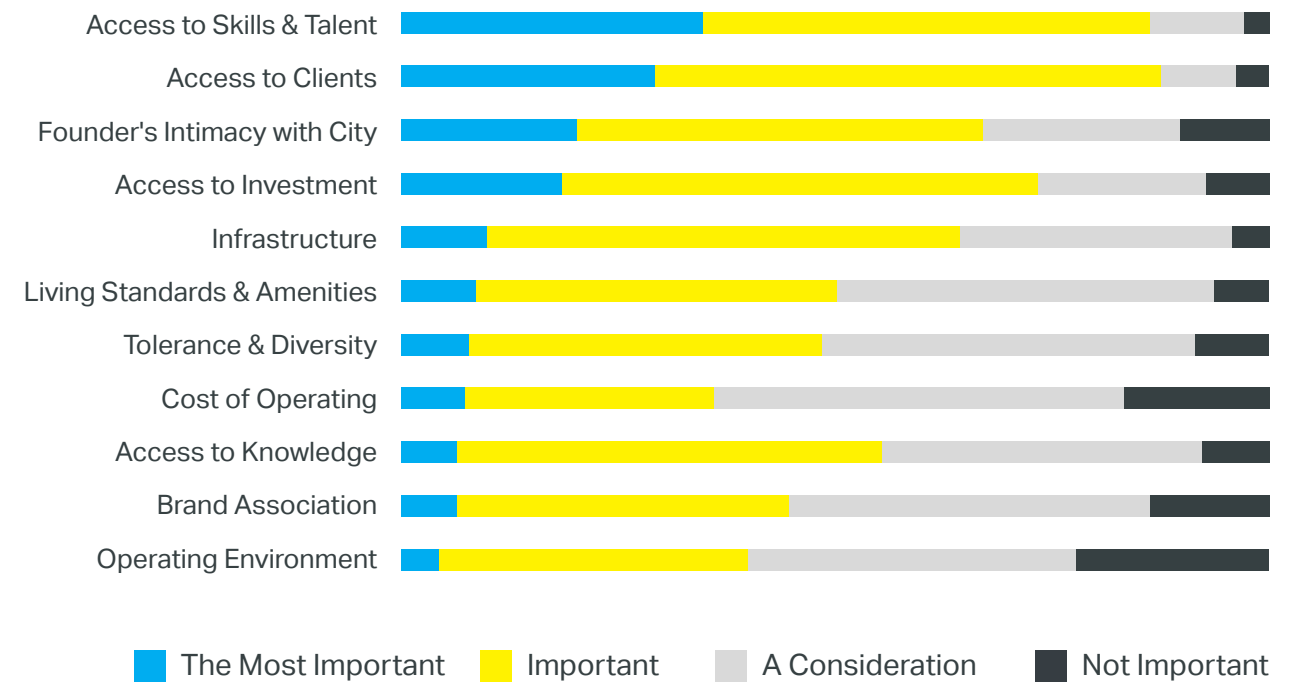
London's vibrant economy is an ideal market for the developing AI cluster. London is the technology capital of Europe and is a leader in areas such as FinTech, smart cities and AI. In 2017, 256,000 people were employed in digital technology jobs, providing a gross value added of £36bn to the London economy.⁴⁴ The capital's AI suppliers also have demand on their doorstep. This access to clients in a diverse range of industries is a major asset for London. AI startups across all sectors are able to develop innovative and practical AI applications for a large, growing and globally connected client base.

The census highlights that London's AI suppliers highly value their ability to access potential clients in the city. 29% cited access to clients as their most important consideration for choosing a city for their headquarters or satellite office. A further 57% cited it as an important factor in their decision. Furthermore, the AI suppliers who chose London for their headquarters or satellite office believe that access to large and local demand provides the city with an advantage over other major AI hubs. 70% of AI suppliers in London ranked the city as the best or generally better for access to clients than other major AI hubs.

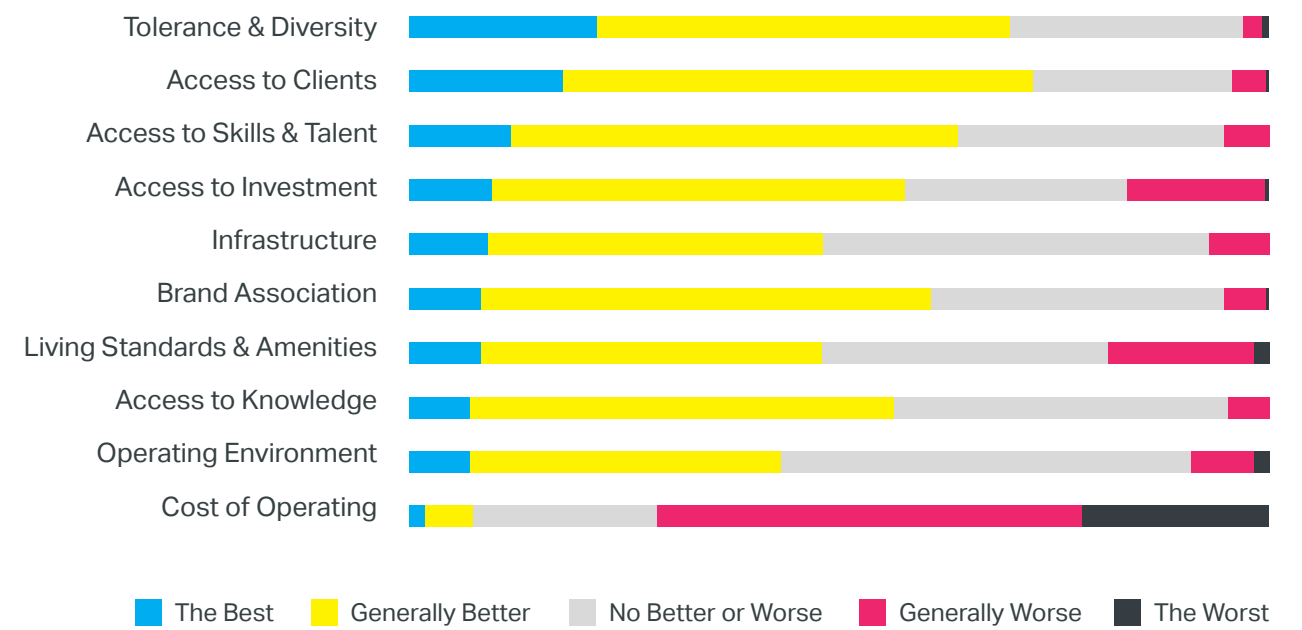
Joanne Smith, CEO of Recordsure, a compliance AI supplier with 75% of its business in the financial services sector, remarked that she chose London because "everything is within 20 minutes and our customers are often within walking distance of each other". London's 'Knowledge Quarter' - the area around King's Cross, Euston Road and Bloomsbury - along with the City of London and 'Silicon Roundabout' are prime examples of the geographic concentration of London's AI suppliers and their clients.

44 Tech Nation, 2018, *Tech National Report 2018*

Factors for choosing a city (n=237)



For each of the following factors, please rank London in relation to other major AI hubs (n=237)



Leading edge demand is innovative

London has a stronger position in its key industries, which demand leading-edge innovations to strengthen their competitive position. In some cases the specific nature of the innovation needed and the requirement for privacy lead to in-house development. In other cases they source innovative products and solutions from AI suppliers. This has led to the creation of industry-led incubators and accelerators where they can co-develop AI innovations with startups and move from proof-of-concept tests to wider adoption. The result is that the AI products developed for these demanding London clients can be world leading.

Census respondents recognised the importance of leading edge demand and called for “more AI-focused accelerators” and “AI incubators giving access to clients” both in general and in particular industries to bring startups and potential clients together. This would provide a stronger foundation for growth in the AI ecosystem and spur leading-edge demand by showcasing successful use cases of AI.

Expert interviews further illustrated the impact of leading-edge demand. Leading law firms have been using innovative AI products to improve recruitment of graduates. Strategy consulting firms have experimented with using game-based tests to identify and predict the performance of talent. Recruitment firms have explored the broad range of AI products now in use in HR. While predicting potential for promotion or new role performance is an area seeking innovation, our research has found over 300 AI products being sold into the HR function covering over 30 distinct use cases. Outside HR, a global news media organisation has adopted AI to enable personalised marketing to individual subscribers using previous purchase data, third party data and web browsing behaviour. A leading London insurer has sought out AI-based innovation in insurance claims handling.

Demand is primed for growth in London's leading industries

In general we found that adoption of AI in London is more often at the trial stage than deployment with some variation between companies and across industries. Interest in AI is increasing. A survey by the Confederation of British Industry found that AI is viewed as the single biggest technology set to impact companies across all sectors over the next five years.⁴⁵ Dominic Sando of MMC Ventures remarked that “AI is crossing the adoption chasm but remains at an early stage. Approximately 20% of AI-aware firms are adopters of AI”.

Specific use cases are the next stage in adoption. Examples include image analysis, product recommendation engines and algorithmic trading. Overall this means that demand for AI in London's leading industries is primed for growth. London's highly competitive industries including education, finance, healthcare, insurance, law, media and entertainment, retail and sales and marketing all present attractive opportunities for AI suppliers. Companies increasingly recognise the potential value of AI and are becoming more sophisticated consumers as they engage in proof-of-concept tests. This is driving innovation in the AI supplier base which further acts to spur demand, reinforcing a positive feedback loop that can accelerate the development of a globally leading AI ecosystem in London.

The potential global annual value that rising demand for AI could create in London's leading sectors is huge. McKinsey estimates the global potential annual value of

⁴⁵ CBI, 2017, *Disrupting The Future: How Businesses Can Embrace Artificial Intelligence, Blockchain and the Internet of Things*

AI as between \$3.5tn and \$5.8tn with some of London's key sectors represented in this analysis.⁴⁶ Forecasts by Accenture indicate a similarly transformative potential impact of AI, \$14tn across 16 industries in 12 economies by 2035, including many of London's key sectors.⁴⁷

Insights from the census and expert interviews highlighted a number of opportunities to accelerate adoption of AI. Respondents identified that the education of key stakeholders, including AI suppliers, their customers and investors, about successful case studies would improve knowledge, understanding and confidence in applying AI. This could be coupled with improved supplier discovery mechanisms to bring together AI suppliers and their potential clients. Building knowledge and skills for major corporates to work with AI startups would dramatically strengthen London's AI supplier base. So too would standardising and simplifying compliance, data ethics and bias reduction in AI development.

Greater access to high quality public and industry datasets using a streamlined and accessible process would also improve AI product development and promote industry, government and academia collaboration on AI, strengthening London's AI ecosystem. The Mayor of London's forthcoming 'A Smarter London Together' initiative promotes a new deal for city data to facilitate city-wide partnerships for effective and safe data sharing.

⁴⁶ McKinsey Global Institute, 2018, *Notes from the AI Frontier: Insights from Hundreds of Use Cases*

⁴⁷ Accenture, 2017, *How AI Boosts Industry Profits and Innovation*

There are also opportunities for cross-fertilisation of AI development across London's key sectors. These network effects are especially evident in London's finance, legal and insurance sectors. Cross-sector AI applications could be transformational. For instance, the legal market is testing sophisticated AI-driven document review solutions which have clear use cases in finance and insurance. AI suppliers that capitalise on these network effects will open up new opportunities for growth and innovation.

10 significant industry ecosystems from both a supply and demand perspective are:

- Education
- Finance
- Healthcare
- Insurance
- Legal
- Media & Entertainment
- Retail
- Sales & Marketing
- Specialist tools & components
- Travel

London's Education AI Ecosystem

Future Global Impact	Increase global gross value added by 10% to \$1.2tn ⁴⁸
Current Adoption and Rate	Low
Use Cases	Personalised learning, continuous multimodal assessment, sentiment analysis, student support and automation of education administration
Number of AI Suppliers to Education	13
Notable AI Companies	CenturyTech, Filtered, Potential.ly, BridgeU

The influence of AI on education will be of deep commercial, social, and philosophical impact. The potential education AI market is large - one report estimated the global education sector as over \$5tn, and estimated the global EdTech market to reach \$252bn by 2020.⁴⁹ AI will be used to analyse students and improve teaching; Sir Anthony Seldon controversially predicts that within 10 years, machines will reduce humans to teaching assistants.⁵⁰ Noting the ability of AIs to categorise and retrieve information, Professor Luckin of UCL foresees that "the nature of education itself must change; free and abundant information makes knowledge based curricula obsolete. Students must instead be

48 Accenture, 2017, *How AI Boosts Industry Profits and Innovation*

49 Prnewswire, 2016, *Global Report Predicts Edtech Spend to Reach \$252bn by 2020*

50 Times Educational Supplement, 2017, *"Machines will replace humans within 10 years"*

taught how to synthesise and critique information, how to evidence the basis of their knowledge and how to assess accurately the extent and accuracy of their own understanding".

With the UK EdTech market expected to reach £3.4bn by 2021⁵¹, local EdTech firms are well-situated to leverage London's advantages. London's education system provides the developing EdTech ecosystem with access to substantial domain expertise and world-leading brands with which to collaborate.⁵² Adoption remains low. Despite a "very fertile" EdTech scene, Professor Luckin notes that AI education is hampered both by a lack of funding and an underemphasis on user-based design: teachers need greater inclusion in product development.

Low adoption is not preventing London's AI education suppliers from innovating. Currikula uses machine learning to help students understand the quality of their written assignments. INTCAS, a course applications management platform, is developing an AI-powered 'discovery engine' to help people decide on career options. Century Tech uses AI to provide students with personalised and adaptive learning experiences. Emerge Education - an EdTech accelerator - and UCL's EdTech initiative 'EDUCATE' further illustrate London's potential.

51 Education Technology, 2017, *The UK ranks #1 in edtech venture capital funding in Europe*

52 Times Educational Supplement, 2017, *Ask TES Institute: What are the different international schools curricula?*

London's Finance AI Ecosystem

Future Global Impact	\$200-300bn ⁵³
Current adoption and rate	Steadily growing but varies widely by use case
Use Cases	Fraud detection, credit & payment data analysis, customer engagement, analysis of company data, algorithmic trading, market analytics, regulatory compliance, risk management
Number of AI Suppliers to Finance	140
Notable AI Companies	Acorn Machine (OakNorth), Moneyfarm, Heckyl, BMLL, Cube, Cleo, Previsio, Ravelin, Featurespace

Financial services is a \$11tn industry globally⁵⁴ and includes a broad range of retail and commercial businesses from payments, asset management and trading to capital markets. The potential impact of AI on the financial sector is significant and represents an opportunity for London's finance AI ecosystem. Crucially, they are located in close proximity to one of the world's leading financial centres which, combined with insurance, accounts for 18.9% of total economic output in the capital.⁵⁵

AI adoption in finance varies according to use case of which there is a very broad range. In retail banking,

⁵³ McKinsey Global Institute, 2018, *Notes from the AI Frontier: Insights from Hundreds of Use Cases*

⁵⁴ Sean Ross, *Investopedia*

⁵⁵ Greater London Authority, *Economic Evidence Base for London 2016*

expert interviews highlighted that AI adoption was still in its early days. Customer facing applications faced a number of adoption barriers such as regulatory and GDPR compliance while back-office applications faced fewer barriers. McKinsey estimates that 28% of financial sector firms, weighted by size, have adopted one or more AI applications at scale or as a core part of their business and the sector could see a 12% increase in AI spending over the next three years.⁵⁶ Joanne Smith, CEO of Recordsure, commented that "adoption of AI in finance remains nascent" indicating large untapped demand over the medium and longer term.

Globally, FinTech investment is increasing, mainly driven by venture capital funds and, to a lesser extent, by investments from established financial institutions. The size of the London finance AI opportunity is reflected by the 140 suppliers in London who serve the financial sector. This is 77% of the size of the finance AI supplier base in the San Francisco Bay Area according to our international comparisons. Financial AI is therefore clearly the most strategic AI sector in London, benefitting from scale and access to a large and local clients. OakNorth has raised £306m in funding of which some will be for Acorn Machine their machine learning based lending platform licensed to lenders.

⁵⁶ McKinsey Global Institute, 2017, *Artificial Intelligence: The Next Digital Frontier?*

London's Healthcare AI Ecosystem

Future Global Impact	\$200bn-\$300bn ⁵⁷
Current adoption and rate	Early stage
Use Cases	Diagnostics, personalised treatment, business and administration processes
Number of AI Suppliers to Healthcare	60
Notable AI Companies	Health Unlocked, Babylon Health, BenevolentAI, Medopad, Your MD, Kheiron Medical

Global healthcare spend was \$7.7tn in 2015.⁵⁸ Accenture forecasts that the global economic output of the healthcare sector could see a 17% increase from \$2.3tn to \$2.7tn by 2035.⁵⁹ PwC found that global investment in AI healthcare has grown considerably from fewer than 10 deals in 2011 to more than 70 in 2016, including a \$25m Series A funding round by London-based Babylon Health.⁶⁰ Healthcare is the most active industry for AI-focused investments. Funding for digital health startups has increased every year since 2012, hitting a record of \$6.9bn in 2016.⁶¹ This has driven explosive growth in the health AI market which is forecast to reach a value of \$6.6bn in 2021, an 11 fold increase from 2014.⁶²

⁵⁷ McKinsey Global Institute, 2018, *Notes from the AI Frontier: Insights from Hundreds of Use Cases*

⁵⁸ Emergo, 2016, *Worldwide spending on Healthcare*

⁵⁹ Accenture, 2017, *How AI boost industry profits and innovation*

⁶⁰ PwC, 2017, *What doctor? Why AI and robotics will define new health*

⁶¹ CB Insights, 2017, *Healthy & Wealthy: Digital Health Deals And Funding Hit Record Highs*

⁶² Accenture, 2017, *Artificial Intelligence: Healthcare's New Nervous System*

Healthcare AI covers three overarching categories: diagnostics, personalised treatment, and business administration. Expert interviews and reports suggest that AI adoption in the NHS is early stage with only a handful of examples cited.⁶³ Concerns over patient privacy and data security combined with the challenge of innovating in the NHS are barriers. Examples of adoption cited from the US included using machine learning to predict suitable tests for patients in Accident & Emergency. Nevertheless, if AI healthcare companies can address these issues, leveraging the UK's reputation for leading the conversation on ethical AI applications, the potential for AI in Healthcare in the UK and globally is significant.

By AI supplier count, our analysis shows that London has 37% of the number of suppliers in the Bay Area but London is ahead of New York. Two of London's most recognisable AI suppliers — Babylon Health and BenevolentAI — are developing AI applications for healthcare. Both companies have raised substantial investment, with BenevolentAI raising \$115m in April 2018 at a pre-money valuation of \$2bn. London-based DeepMind has set up DeepMind Health to explore the application of AI in healthcare.

⁶³ Reform, January 2018, *Thinking on its Own, AI in the NHS*

London's Insurance AI Ecosystem

Future Global Impact	\$100-300bn ⁶⁴
Current adoption and rate	Low, but increasing.
Use Cases	Improved underwriting accuracy, fraud detection, claims management, marketing and customer experience
Number of AI Suppliers to Insurance	53
Notable AI Companies	Artificial Labs, Cytora, Quantemplate, Tractable, Broly, Flock Cover

In 2016 the global insurance industry had total gross written premiums of \$4.6 trillion. AI is poised to transform the industry, one survey found that three quarters of insurance executives believed that AI would either significantly alter or completely transform the industry by 2020.⁶⁵ Predicted AI impacts include the near-disappearance of manual underwriting for personal and small business products across life, property, and casualty insurance⁶⁶ and the reduction of claims processing headcount by up to 90% by 2030.⁶⁷

Adoption of AI in insurance is growing, though varies widely across geographies and subsectors. One report found the UK's implementation maturity of AI in insurance to be at 9%, compared to 40% in the US and

⁶⁴ McKinsey Global Institute, 2018 - *Notes from the AI Frontier: Insights from Hundreds of Use Cases*

⁶⁵ Accenture, 2017, *Technology for People: The Era of the Intelligent Insurer*

⁶⁶ McKinsey, 2018, *Insurance 2030 - The Impact of AI on the Future of Insurance*

⁶⁷ McKinsey, 2018, *Insurance 2030 - The Impact of AI on the Future of Insurance*

24% in Europe.⁶⁸ In 2017, a global survey found only 28% of reinsurers had adopted AI analytics.⁶⁹ We anticipate further adoption.

With London at its centre, the UK is emerging as the leader in European InsurTech. \$364 million was invested in UK-based InsurTech companies in 2017, up from \$19 million the year before.⁷⁰ The US still leads in total value and number of deals, accounting for 46% of global transactions last year.⁷¹

With an insurance AI supplier base 88% the size of that in the San Francisco Bay Area and a thriving specialist community, London is in a good position. The dynamics of the London cluster offer opportunities to encourage this process. James Pilgrim-Morris of Hiscox Insurance highlighted the potential for cross fertilisation between London's financial and professional service organisations; as each industry must deal with large bodies of unstructured documentary data. This could spur further growth.

⁶⁸ Everest Group, 2018, *Artificial Intelligence (AI) in Insurance Moving from Pilots to Programs: Insurance IT Services Annual Report 2018*

⁶⁹ Insurance Nexus, 2017, *Insurance Nexus Global Trends 2017*

⁷⁰ Businesswire.com, 2018, *Investment in Insurtech Industry Surged in 2017, with Europe Emerging as Key Insurtech Hub, Accenture Analysis Finds*

⁷¹ Businesswire.com, 2018, *Investment in Insurtech Industry Surged in 2017, with Europe Emerging as Key Insurtech Hub, Accenture Analysis Finds*

London's Legal AI Ecosystem

Future Global Impact	'Radical' change within 10 years; 114,000 roles could be automated ⁷²
Current Adoption and Rate	Early days but increasing. 20-30 UK law firms using AI for specific applications
Use Cases	Due diligence and document review, research, legal analytics, business processes (e.g. billing), document automation, and litigation outcome prediction
Number of AI Suppliers to Law	20
Notable AI Companies	Luminance, Eigen Technologies, DoNotPay, Juro

The legal sector's value to the UK economy, £24.4bn in 2016,⁷³ and its international reach (the UK exported legal services worth £5bn in 2016)⁷⁴ puts it in a strong position to capitalise on the AI innovations that have the potential to reshape the legal industry. Jason Ku, founder of Aspirant Analytics, notes that "overcoming barriers to adoption and innovation reveals a huge growth potential for AI in the legal sector. The potential impact on the industry is large, changing the role of junior lawyers and reshaping the apprenticeship system".

CBRE surveyed London law firms, finding that 48% use AI compared with 23% across all industry sectors

⁷² Deloitte, 2017, *Developing Legal Talent: Stepping into the future law firm*

⁷³ Office for National Statistics, 2017, *UK Quarterly National Accounts*, Feb 2017

⁷⁴ Office for National Statistics, 2018, *International Trade in Services*

globally. Of those that use AI, 63% use AI for document generation, document review or e-discovery, 47% use it for due diligence and 42% use it for research.⁷⁵ Richard Tromans, a consultant and founder of Artificial Lawyer, estimates 20-30 London law firms are using AI, with document review a popular use case. He writes that: "The high volume of documents for due diligence in M&A in particular has seen a growing number of law firms turn to AI tools for 'process level' review work. The use of AI to do some of the work of junior or trainee lawyers raises challenges and opportunities around finding them more complex work to do". Emily Foges, CEO of Luminance, writes that "AI in the legal profession has come of age, and it is increasingly important for law firms to adopt technology in order to remain at the forefront of their field. London has made strong progress in legal innovation, but our unrivalled academic and science base must continue to be nurtured in the context of challenges such as Brexit and low productivity".

London's legal AI supplier base is 70% the size of the Bay Area and ahead of Toronto and New York. In London, supplier and client proximity has aided innovation. Exemplifying this are London-based legal AI suppliers Luminance and Eigen Technologies, which respectively have partnered with law firms Slaughter and May, and Linklaters. Other organisations have created innovation labs to facilitate the growth of London's LawTech sector.⁷⁶

⁷⁵ CBRE, 2018, *Law in London 2018*

⁷⁶ Barclays Bank, in partnership with the Law Society, created Eagle Lab, Mishcon de Reya LLP created MDR LAB, and Allen and Overy created Fuse.

London's Media & Entertainment AI Ecosystem

Future Global Impact	\$100-200bn ⁷⁷
Current Adoption and Rate	Significant
Use Cases	Media retrieval and manipulation, personalised user experiences, media search optimisation, AI-powered content creation and visual effects, gaming
Number of AI Suppliers to Media & Entertainment	76
Notable AI Companies	Foundry, Improbable, Snaptivity, Blippar, Jukedeck, Lobster

The global media and entertainment sector is large, diverse and rapidly changing due to the rise of digital technologies and social media. This is evident in the UK media and entertainment sector where total revenue is forecast to grow from £62bn in 2016 to £72bn in 2021.⁷⁸ AI has been taken up widely by both the legacy players as well as the social media new entrants. There are three broad areas where AI is being used, to:

- Create content automatically across a very wide range of media types;
- Provide AI based tools to analyse and manipulate content more effectively, and
- Personalise the media experience in a wide variety of ways for the consumer audience.

⁷⁷ McKinsey Global Institute, 2018, *Notes from the AI Frontier: Insights from Hundreds of Use Cases*

⁷⁸ PwC, 2017, *Global Entertainment & Media (E&M) Outlook 2017-2021*

Netflix, Facebook and other media, entertainment and social media companies are intensive users of AI. The focus on content creation and personalisation demonstrates that creating novel user experiences is crucial to the media and entertainment AI ecosystem.

Companies offering innovative AI applications in the media and entertainment sector have the potential to capitalise on significant investment opportunities. In 2017, Improbable, a London based technology company providing the software to build complex virtual worlds raised \$502m in a Series B funding round led by SoftBank. Census respondents called for "more financial support for creative industries such as AI in media, tech and entertainment" to fund innovations in these areas.

The media and entertainment AI sector is the second largest worldwide by supplier count. London has 41% of the supplier count of the Bay Area and is marginally ahead of New York. Advanced graphics are a particular strength in London. In the sporting area, Snaptivity use AI to provide pictures for fan engagement. Crowd Emotion is used by the BBC as face-scanning technology to shed light on viewers' tastes.

London's Retail AI Ecosystem

Future Global Impact	\$400-800bn ⁷⁹
Current Adoption and Rate	Moderate, growing rapidly
Use Cases	Sales & CRM applications, customer recommendation engines, logistics and delivery optimisation, payments and processing enhancements, sales forecasting, visual search and virtual retail assistants
Number of AI Suppliers to Retail	98
Notable AI Companies	Hoxton Analytics, Swogo, Cortexica, Edited, Metail, Snap Tech

Global retail will be a \$28tn industry in 2019.⁸⁰ AI will have a transformative impact on all levels of the retail value chain, automating manufacturing, logistics, and in-store operations alongside sales, recommendation and tracking processes. A report by The Store WPP in partnership with IBM predicted that "AI will have an even greater impact on retailing than all other digital technology to date".⁸¹ The report surveyed retail executives and found that 94% of those familiar with AI intend to invest in it and 91% believe it will play a disruptive role in their organisation. Gartner forecasts that by 2030, 30% of digital commerce revenue growth

79 McKinsey Global Institute, 2018, *Notes from the AI Frontier: Insights from Hundreds of Use Cases*

80 Research and Markets, April 2016, *Overview and Evolution of the Global Retail Industry*

81 The Store WPP and IBM, *How Artificial Intelligence is transforming the retail conversation*

will be attributable to AI and 60% of organisations will use it for digital commerce.⁸²

British retailers are adapting to the challenge. One survey found 38% of responding retail organisations identified themselves as using AI in 2017, with a further 48% using machine learning.⁸³ Ocado has created an AI-powered fraud detection system for online grocery purchases, increasing detections by a factor of 15.⁸⁴ Sports Direct's recommendation engines increased conversion by as much as 332%.⁸⁵ Tesco now runs an innovation lab, and in 2017, Net-a-Porter opened up a 500 person tech hub in London.⁸⁶ London's AI suppliers specialising in retail and e-commerce have the opportunity to capitalise on the impact of AI. For example, Swogo uses AI to automate product bundles and provide customised recommendations to increase customer engagement and boost sales. Cortexica, a provider of computer vision and machine learning for image and video analysis, is working to transform the retail and e-commerce experience by replacing keyword search with advanced image and video search.

82 Gartner, 2017, *Artificial Intelligence Set to Transform Digital Commerce Marketing*

83 Coresight Research, 2017, *Deep Dive: Artificial Intelligence in Retail - Offering Data Driven Personalisation and Customer Service*

84 Computing.co.uk, 2018, *Ocado unveils AI-powered retail fraud detection system*

85 Bijou Commerce, 2017, *Artificial Intelligence Opportunities in Retail*

86 Glossy.co, 2017, *Yoox Net-A-Porter's new 'temple of innovation' focuses on AI and mobile commerce'*

London's Sales & Marketing AI Ecosystem

Future Global Impact	\$1.4tn to \$2.6tn ⁸⁷
Current Adoption and Rate	Widespread and increasing but still early days
Use Cases	Reaching customers, prompting their activity, customer conversion, and engagement
Number of AI Suppliers to Sales & Marketing⁸⁸	200
Notable AI Companies	Qubit, LoopMe, Fospha, Codec, Ometria, Iponweb

A huge industry, sales and marketing is being transformed by AI. Key trends include using AI in areas such as airline ticket sales, programmatic buying of advertising, and personalisation of messaging. The creative function — the design and content of the marketing messages — will also change. Lorenzo Wood, Chief Innovation Officer of Publicis.Sapient, suggests the advertising creative function will become computational – and “much more swiftly than people think”. Increasing abilities to automate content creation will combine with user personalisation to transformative effect: “if you know where everyone is and can synthesise content, it is the endgame for traditional marketing”.

⁸⁷ McKinsey Global Institute, 2018, *Notes from the AI Frontier: Insights from Hundreds of Use Cases*

⁸⁸ Inhouse Sales and Marketing are combined with Advertising and Marketing agencies and deduplicated because of significant overlap.

Adoption of AI solutions in the sector is in its early days and “using London showcases to improve knowledge and understanding of marketing AI solutions would be gold dust” said David Abensour, CTO of Fospha, a marketing AI supplier in London. Half of brands and 58% of agencies do not think they currently have the marketing tools they need, but 40% expect their budget to increase this year, by an average of 10%.⁸⁹ Adoption of new marketing technology is currently hampered mainly by budgets and lack of understanding. 86% of respondents to a recent study on the use of marketing AI in retail considered that AI would make their marketing more efficient; 79% believed that AI will help shift the role of marketing to more strategic work.⁹⁰

With approximately 29% of the number of marketing AI suppliers operating in the Bay Area and just behind those of New York, London's position in sales and marketing technology is comparatively underdeveloped. However, the sector is by no means inactive, with companies such as Phrasee, which uses AI to improve email marketing; Qubit, an ad personalisation company, and Yieldify, a customer learning tracking company. Collider is a London and Amsterdam-based MarTech accelerator that has invested in over 50 startups.

⁸⁹ WARC, *Martech 2018 and Beyond*

⁹⁰ Forrester, 2017, *Building Trust and Confidence: AI Marketing Readiness in Retail and eCommerce*

Other AI sectors of note

Specialist tools and components

In addition to industry or functional specialists, London also has 64 specialist tool and component suppliers that we have grouped under 3 headings:

- **General purpose data science platforms** and tools for data scientists and devops such as Seldon's deployment framework for machine learning modules;
 - **AI-enabled tools and components for software developers** such as databases or easily integrated computer vision, voice recognition, or GPS-free location capabilities;
 - **Components for OEM manufacturers** such as operating systems for autonomous vehicles or systems for the gaming industry.
-

Travel

Machine learning has an impact at all levels of the travel industry, from driving sales to forecasting demand to personalising travel experiences for the customer. Computer vision can be used in aiding travel security, or for visual search of things seen on holiday; autonomous systems facilitate transportation. Adoption of AI within the London travel sector has been notable. In 2016 Edwardian Hotels introduced 'Edward', an AI-powered virtual host to deal with customer queries. The Dorchester Collection uses Metis, an AI-powered customer review analysis tool. Mr and Mrs Smith, the luxury hotel collection, has introduced voice-activated search of its online directory through Amazon Alexa.

The UK and London are **committed** to AI

The UK and London have a **world-class** research base

London's world-class universities are a crucial component of the AI ecosystem, acting as an important engine of growth and providing a pipeline of high-level technical and entrepreneurial talent. The Turing Institute brings together the UK's leading AI researchers in London, a ground-breaking model that has provided a focal point for AI research and is becoming a role model for other countries. It has three ambitious goals: to advance and apply world-class research towards a stronger economy, train the leaders of the future and lead the public conversation. Since 2017, the Turing has hosted over 300 researchers and produced 138 different research publications.

Companies value the UK's leading research base as a source of innovation and skills. As DeepMind told us "We have top talent right here on our doorstep from world-leading institutions such as UCL, Oxford and Cambridge, and we wanted to stay close to the academic community. London is a world centre for neuroscience research as well as technical innovation which has allowed us to build an interdisciplinary team that is doing things no one else can". London is well placed to use its universities to support the AI cluster and build on its reputation as a destination of choice for students. In 2018, QS ranked London as the number one student city based on its world class universities, its position as a global centre in finance and business, and its diverse, multicultural and creative society.⁹¹

The AI Sector Deal committed to creating an additional 200 doctoral studentships in AI and related disciplines a year by 2020-2021 with an ambition to reach 1,000 government-supported PhD places at any one time by

⁹¹ QS, 2018, *Best Student Cities Ranking*

2025. This will increase the supply of high-quality local talent, equipping them with the skills and expertise to thrive in AI. It also positions London as a destination for the world's best talent, attracting them to study and enabling them to launch startups using the knowledge, expertise and networks they develop.

The UK has 21 universities offering undergraduate courses in AI and AI-related programmes and more than 45 postgraduate courses in AI from 25 universities. In London, 13 universities offer at least 24 undergraduate and postgraduate degrees in artificial intelligence, machine learning, data science and other AI-relevant topics. This is complemented by short courses, professional training programmes, online courses and other types of education and training in AI and related disciplines. Expanding opportunities for education, both for students and professionals looking to develop knowledge and skills in AI, will enable London to continue to produce and attract a pipeline of expertise to support the growth of the AI ecosystem.

London and the UK's advanced AI research base produces world quality research, giving the UK global academic influence. Although the US and China produce a substantially larger number of widely cited AI-related papers, the UK's research remains more influential than China's and second only to the United States as shown by the H-index which measures the productivity of researchers and the citation impact of their publications. The UK has an AI H-index of 190 compared to 373 in the United States, 168 in China and 153 and 152 in Germany and Canada respectively.⁹² The UK's global competitiveness in the fundamental AI research that drives practical advances in AI is a key strength.

⁹² McKinsey Global Institute, 2017, *Artificial Intelligence: Implications for China*

The Centre for Doctoral Training in Financial Computing & Analytics⁹³, a collaboration between University College London, Imperial College London and the London School of Economics, is an example of how academic research can support industry innovation. The Centre provides fully funded PhD scholarships supported by 20 industry partners.

Professor Philip Treleaven, the Centre's director and a Professor at UCL, explained that UCL is a distinctive and significant source of innovation for financial institutions. Supervised by both an industrial and academic supervisor, the Centre's students are each given an industry project of solving a valuable customer problem. The students retain the intellectual property rights to their work, and when projects are implemented, students can form a startup with an initial customer. A support programme provides them with mentors and access to staff. An early project was building a system to detect insider trading for the London Stock Exchange. Later projects included building AI driven trading systems.

With some 400 Bachelor students, 400 Masters students and 80 PhDs, UCL has provided a large pipeline of talent into the London economy. Many go on to work in the City of London, which also provides a ready-made customer base.

This approach is a noteworthy model for how London's universities can support the growth of the AI cluster, and demonstrates the importance of universities to the technology ecosystem in London.

⁹³ <http://financialcomputing.org/>

The UK is committed to AI at all levels

The AI Sector Deal, announced on the 26 April 2018, is the latest government commitment to AI and a clear sign that London and the UK intend to remain a global leader. The deal has a clear goal to “put the UK at the forefront of the artificial intelligence and data revolution”. It is a response to the 18 recommendations made by Dame Wendy Hall and Jérôme Pesenti in *Growing the Artificial Intelligence Industry in the UK* and is designed to go further than this review by responding to the opportunities and challenges AI presents for society.⁹⁴ It also builds on the government’s *UK Digital Strategy* which outlined an ambition to use existing successes to develop a world-leading digital economy.⁹⁵

The AI Sector Deal represents the first joint commitment from government and industry specifically designed for the UK to realise the potential of artificial intelligence. It includes up to £950m of support for AI.⁹⁶ Wide-ranging commitments by government, industry and academia under the sector deal outline a clear objective to provide the UK with the skills and expertise to thrive in the AI era. These include: developing skills in AI and machine learning; ensuring the UK is an attractive destination for the best international talent; promoting UK AI globally; promoting diversity in the research base and workforce of AI; and working with industry and academia to drive innovation across all aspects of AI, from research to applications. This report shows that building on London’s strengths of tolerance and diversity, skills and talent, and access to clients will ensure the capital and the UK achieve the goal of remaining at the forefront of AI.

⁹⁴ Professor Dame Wendy Hall and Jérôme Pesenti, 2017, *Growing the Artificial Intelligence Industry in the UK*

⁹⁵ UK Government, 2017, *UK Digital Strategy*

⁹⁶ UK Government, 2018, *AI Sector Deal*

As well as investment in AI skills and talent, the UK is committed to ensuring AI suppliers have access to large, high-quality datasets for developing innovative applications. The London Datastore, a free and open data-sharing portal from the Mayor of London, provides anyone with open access to over 700 datasets on London.⁹⁷ London, through the office of the Chief Digital Officer, is committed to opening up data for research and application development. In addition, the Wendy Hall and Jérôme Pesenti review of AI in the UK recommended the creation of data trusts to promote data sharing and improve data availability.⁹⁸

Census respondents emphasised the importance of access to high quality data and the opportunity to make London a trusted destination for open data as crucial components of successful innovation in the AI ecosystem. One company developing AI tools for law firms, corporations and the public sector told us that: “greater public access to data in a sensible and controlled manner that protects sensitivities would massively assist any AI company”.

Government, industry, and academia have a large opportunity to lead on data ethics and set the standard for responsible and open access to data for AI. Samsung Electronics Research and Development Institute (UK) commented that “access to data is crucial for the development of AI. London sits on a huge amount of data, some of which has been made public through open data initiatives. Further opening up access to data through a streamlined process would benefit AI suppliers, corporations and universities and make London a very attractive destination for the research and development of AI”.

⁹⁷ Mayor of London, *London Datastore*

⁹⁸ Professor Dame Wendy Hall and Jérôme Pesenti, 2017, *Growing the Artificial Intelligence Industry in the UK*

London is investing in AI ethics expertise

London is seizing the opportunity to shape the future development of AI ethics and develop AI applications with ethics at their core. Government, industry and the third sector have all launched AI ethics initiatives. This community of AI ethics experts drawn from a range of backgrounds will be a strength in developing ethical AI.

It is important to note that the ethical debate cannot be separated from the conversation about the best means of supporting economic growth. As citizens and companies become more aware of the functional value of concepts such as privacy, protections must be in place from very beginning, otherwise the market will justifiably push back against certain uses and adoption.

The UK's Industrial Strategy announced the creation of a Centre for Data Ethics and Innovation which will review AI governance and advise the government on data ethics and innovation, including AI.⁹⁹ In industry, DeepMind created DeepMind Ethics & Society to develop AI applications with high ethical standards.¹⁰⁰ In March 2018, the Nuffield Foundation, in collaboration with a range of partners, announced the creation of the Ada Lovelace Institute to examine ethical and social issues from the use of data, algorithms and artificial intelligence.

⁹⁹ Department for Business, Energy and Industrial Strategy, 2017, *Industrial Strategy: Building A Britain fit for the future*

¹⁰⁰ DeepMind, *DeepMind Ethics & Society*

Positioning London and the UK as a global thought leader in AI ethics has the potential to help grow a successful AI cluster in the capital. In her submission to the House of Lords report on AI in the UK, Eileen Burbidge, partner at Passion Capital, made the case that:

AI suppliers or the companies employing AI technology — to the extent they demonstrate they have ethics boards, review their policies and understand their principles — will be the ones to attract the clients, the customers, the partners and the consumers more readily than others that do not or are not as transparent about that.”¹⁰¹

The Alan Turing Institute expanded on the idea of ethics leadership as an asset for London's AI ecosystem. The Institute commented that the UK's commitment to AI ethics is a genuine strength and is a "real opportunity to lead on AI ethics and shape global standards on the ethical development and deployment of AI". They noted that "maintaining openness and an ethical approach to AI can provide a competitive advantage for AI suppliers in London and the UK more widely". In addition, "the collaborative partnerships developed at the Alan Turing Institute act as a draw for AI academics to pursue innovative research projects with the potential to develop new applications with responsibility and ethics at their core".

¹⁰¹ House of Lords Select Committee on Artificial Intelligence, 2018, *Oral Evidence: Artificial Intelligence*



London has the foundations for **future success**

London, the AI growth capital of Europe, has the foundations in place to capitalise on the transformative potential of AI. Although international competition is growing, London is well placed for the future with a large and diverse AI supplier base; access to skills and talent; demand which is large local and competitive; and an open and tolerant society that fosters innovation and community support. Moreover, the potential economic value of AI for London and the UK is huge and AI can be harnessed to benefit citizens and ensure the UK remains at the forefront of digital innovation. The opportunity is there to be seized.



Appendix 1: Acknowledgments

Working Group

Dev Amratia, Co-Founder and CEO, nPlan; Kim Nilsson, CEO, Pivigo; and Ed Janvrin, General Manager EMEA, SparkBeyond formed our advisory group. We would like to thank them for all their time and advice in the preparation of this report.

Census Outreach Multipliers

We are grateful to a number of organisations who helped us share the Mayor's London AI Innovation Census.

Digital Catapult	Tech London Advocates
DigitalHealth.London	Tech Nation
Founders Factory	Techstars
Google Campus London	TechUK
Innovate Finance	The Alan Turing Institute
Level39	UK Business Angels
MedCity	University College London
Moving Brands	Wideacademy
Tech.London	

Census Contributors

The following companies responded to the Mayor's London AI Innovation Census and indicated they would be happy for their responses to be made public:

7percent Ventures	Capital Enterprise
Accenture (UK) Limited	CharacterISE
Accenture Liquid Studio	Chattermill
Access Partnership	Cog Labs
AI Seed	Cognitiv+
AI4THINGS	CognitiveScale
Aiden.ai	Consensus
AirNode	consumeAI
AJBurgess Ltd	Creavision Technologies Ltd
Albora	Crowdemotion
AlgoDynamix	Curvestone
Alibro Ltd	Cyberlytic
Analytics Intelligence Limited	Cynozure
ANDi Games Ltd	Data Ninjas
Anticipatory Health Limited	Data Research Laboratories Ltd
Arbor Education Partners	DataKind UK
Arctic Shores	Deep Learning Partnership
Arm Ltd	Deeson Group Ltd
AuditXPRT	Digital Taxonomy
Automorph Ltd	DigitalGenius
Babylonhealth	DILE
BenevolentAI	Echo Changes Ltd
BeTomorrow	Elcom
Black Square Media	Emerge
Blue Beck	Evolution AI
BMLL Technologies Ltd	Exii
Boldmind Ltd	Experto Crede
BoraCo	Exponential Technologies
BotsAndUs Ltd	Filament
Brainpool AI	Filament.ai
BSI Standards	Finch Capital
Bunt Ltd	FirstCapital
Cambridge Bio-Augmentation Systems	Fitwell
	Fluidly

Fordcastle
 Forestreet Ltd
 Forum for the Future
 FountainArc Technologies
 Future Thinking in Digital Marketing
 Futurice
 Gameway
 Geeks ltd
 Group Partners
 Grovelands
 GrowthIntel
 GTN Ltd
 HeraSpace
 Heron AI Ltd
 Humanising Autonomy
 Humanising Autonomy
 illumr
 iManage
 infloAi
 infloAi
 InformedActions
 InteriMarket
 intu
 KiteEdge
 kling klang klong
 Kluster
 Klydo
 Kortical
 Kvass.ai
 KwizIQ
 Levell
 LEVERTON
 LIFEdata
 Lily Innovation
 Lobster
 Loomi
 Lysa
 machineOS
 Mashtraxx Ltd
 MediaGamma
 Medimsight
 Mercanto
 Metafused
 Metageni
 Metail
 Mission Drive
 Mudano
 Mvine Limited
 mypeoplebiz
 Normally Ltd
 NowMe Infinity Limited
 nPlan
 NumberEight
 O2 (Telefonica UK)
 On the dot
 ORIAC Solutions Ltd
 Outlier Ventures
 Parallel AI
 Paremus Ltd
 PerchPeek
 Piccadilly Group
 PigeonLine
 Pimloc
 Pivigo
 PLATO Intelligence
 Plato Intelligence
 PLATO Intelligence
 PolyAI
 Practeria
 Projected AI
 Propportunity
 Quantexa Limited
 RAMM Science
 re:infer
 Recordsure
 Renters Union
 Resolver
 Retechnica
 Rise IQ
 RoboLab
 Runagood.com Ltd
 Saberr

Samim.ai
 Satalia
 Save your wardrobe
 SeeQuestor
 Semantic Evolution Limited
 Sensio Air
 Skive it, Inc.
 SMAP Energy
 Smartify
 Smartology
 Smith & Williamson
 SPARCK
 SparkBeyond
 Spirit AI Limited
 Spixii
 Spoon Guru
 Spore London Limited t/a Codec
 Spot Intelligence
 StoryStream
 Stratagem Technologies
 Sum&Substance
 SwiftERM
 Symphony Ventures Ltd
 Tata Consultancy Services
 TectumAi
 Teknitive Limited
 The Pioneers
 Third space auto
 ThisWay Global
 Thomson Keene Associates
 Thoughtonomy
 ubisend
 VAIX Limited
 Valkyrie Industries Ltd
 Verv
 Visii
 Vivacity Labs
 Vyking
 WeMoved Ltd.
 WeSee
 WilmotML
 workabout
 Yap Pet Supplies Ltd
 York Science Conference
 Zeroth.AI
 Zeus Electronics LLP

Appendix 2: Methodology

CognitionX Directory

The CognitionX directory of AI suppliers in London is based on an analysis of in-house datasets cross-referenced with publicly available information to produce a comprehensive directory. An AI company was defined according to the in-house CognitionX definition described in the introduction to this report. We have categorised all London AI suppliers according to the industry their customer operates in and the function within the customer where the AI product or solution is used.

International comparisons were made using data from CognitionX, Growth Enabler, Crunchbase, CB Insights, AngelList, Sonovate, F6S, MMC and other sources. The cities we used for comparisons were: the Greater San Francisco Bay Area, rather than just San Francisco city (to provide a more rigorous comparison with London), New York, Paris and Berlin. To enable like-for-like analysis, city comparisons are indexed to 100 in the San Francisco Bay Area which is the largest AI ecosystem in the world. The global number of AI suppliers, also indexed, provides an approximation of the market size of AI in each industry.

The comparisons exclude China where it is very difficult to obtain accurate data on the number of AI companies at a national, regional and city level. However, experts we spoke to provided insights on the relative standing of China in AI which are included in the report.

Mayor's London AI Innovation Census

CognitionX ran the Mayor's London AI Innovation census to obtain rich qualitative and quantitative insights on AI in London. Census responses up to 18 May 2018 are included in this report. The table below provides a breakdown of the census respondents.

Mayor's London AI Innovation Census Respondents as of 18 May 2018

Number of census respondents	312
Percentage of respondents who see themselves as part of the AI sector (AI at the heart of their business model or in a supporting role)	93.0%
Percentage of respondents headquartered in London	84.0%
Percentage of respondents classified as AI suppliers (including research, training and consultancy)	89.7%
Percentage of respondents classified as AI suppliers who are headquartered in London	76.0%

For our analysis of the census data we sorted respondents into London-headquartered suppliers of products and services (including training, consultancy and research) where AI was an element of their business offering (either as a core or secondary element). Of the 312 respondents as of the 18 May 2018, 237 met these criteria. This provides a detailed picture of the AI ecosystem in London and represents the views of the companies who chose London to start their AI company. The complete dataset of census respondents was used to inform qualitative insights throughout the report to understand how AI companies in London and internationally view the city as an AI ecosystem.

Census respondents were asked to rank the factors for choosing a city to found their company and compare London to other AI hubs using these factors. The categories included in these questions were:

- **Founders intimacy with the city.** Including whether the founder was educated or live and have networks in the city;
- **Access to clients.** Specifically access to big and/or many clients for their AI products and services;
- **Access to investment.** Including seed, angel and VC funding;
- **Access to skills and talent.** Including access to top universities, skilled labour, professional networks and a diverse talent pool;
- **Access to knowledge.** Including access to successful founders, recruiters, specialists and business services such as legal support;
- **Living standards and amenities for employees.** Including access to good education for children, leisure activities and a vibrant social and cultural scene;
- **Infrastructure.** Including access to data, communications networks and transport;
- **Operating environment.** Including access to regulators, government and decision makers;
- **Tolerance and diversity.** Including whether the city is perceived to be open and multicultural;
- **Cost of operating.** Including cost of setup, office space and overheads;
- **Brand association.** Specifically whether the city helps their company look more established.

Expert Interviews

CognitionX conducted over 40 interviews with experts from across London's AI community as well as international experts to gain a deeper understanding of key issues, including the strengths of the capital as an AI hub and the opportunity to support the development of the AI cluster. Insights from these expert interviews are included throughout the report. CognitionX also hosted two round table discussions with experts from AI suppliers, consultancies, government and academia. These workshops informed the development of the report and allowed us to test and refine our findings. We are grateful to the experts we consulted and the workshop attendees for their time and insights.



MAYOR OF LONDON

