MIDLANDS ENGINE

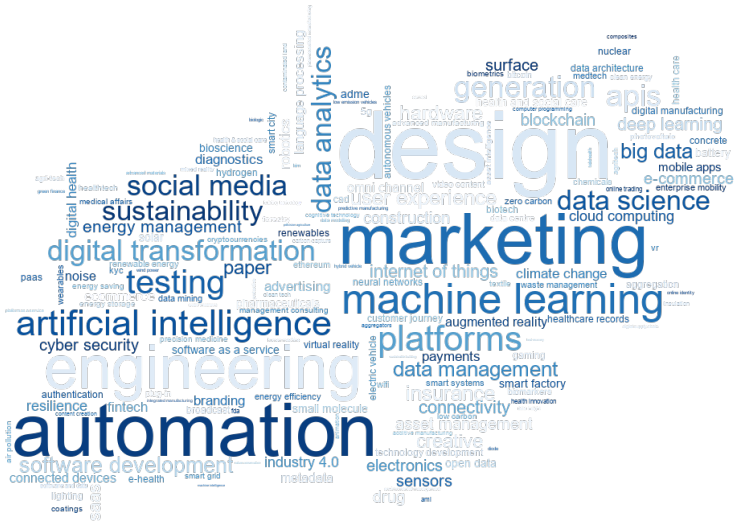
ARTIFICIAL INTELLIGENCE IN THE MIDLANDS

Investigating the potential of AI businesses across the Midlands

NOV 2024

Midlands Engine

Regional Economic Transformation through Artificial Intelligence: Investigating the potential of AI businesses across the Midlands Engine



3/10/2024

Keele UNIVERSITY

Executive Summary

1.0 Overview

Purpose of The Report

This report provides an overview of the current state of artificial intelligence (AI) businesses within the Midlands. This report considers AI businesses as those businesses that use artificial intelligence (AI) to improve their operations, provide customer solutions, and achieve business goals. The report aims to identify the progress of the AI-driven economy within the Midlands and to explore the barriers and drivers of AI-based businesses in the Midlands. The report provides recommendations for the UK government, and Midland's local governments and industry stakeholders to increase its capability to develop an AI driven economy.

Context and Importance

"Artificial intelligence (AI) is technology that enables computers and machines to simulate human learning, comprehension, problem solving, decision making, creativity and autonomy"[1]. AI is an emerging highly disruptive technology which will affect industries globally. The effects of AI technology can already be felt as the world's largest companies have invested large amounts of capital into its research and development. The technology has the potential to vastly increase productivity and replace jobs in some traditional sectors. It is essential to harness this technology to drive innovation, productivity, and national and regional economic growth. This requires not only the development of this technology but also its applications. Taking appropriate steps to foster businesses and institutions working with this technology, the Midlands will have a voice in shaping how it affects applications, capital investment, and industries.

1.1 Key Findings

Current AI Landscape

The study has found that the Midlands has some AI integration in over 300 companies using the technology to varying levels in comparison to the national count of over 3,170 active AI companies identified in the DSIT report[2]. It was shown that the majority of these companies focused on providing software and AI development support to other businesses in advanced manufacturing, with healthcare and transportation also having a strong presence in the data analysed for this study. Despite this, when compared to the overall size of the Midland's economy the number of AI companies identified, makes up a negligible percentage (0.02%), suggesting room for development across all economic sectors.

Economic Impact

The economic impact of using AI technology is currently small. When it arrives, this impact will most likely not come directly from businesses creating AI products or AI based services for consumers. Instead, the impact will be potentially strong from increased productivity, efficiencies and supply chain efficiencies as a result of using predictive modelling algorithms. As AI technology improves and proliferates, it will introduce both new career opportunities as well as a risk of job displacement in some sectors. For example, customer service roles are facing competition from AI chat bots and this trend could continue to other white-collar professions as the technology develops.

Social & Educational Insights

The literature suggests a skills gap within the Midlands with 41.5% (just over 2.55m) of working age residents in the Midlands Engine educated to RQF 4+ levels compared to 47.1% UK-wide in 2023 - a further 345,411 of the working age Midlands Engine residents are required to obtain an RQF 4+ qualifications to equal the UK average**.** This could be disadvantageous as further growth and

[1] https://www.ibm.com/topics/artificial-intelligence (accessed 13/09/2024)
[2] Artificial Intelligence Sector (publishing.service.gov.uk) (accessed 13/09/2024)

innovation in AI requires a skilled, often highly educated workforce. While the Midlands has around 20 universities and most of them have an AI or AI-related course, these education programmes need to be enhanced using the relationship between industry and educational institutes. Teaching applications of AI technologies within the courses could be improved so that learning aligns with industry requirements.

1.2 Challenges and Opportunities

Barriers to AI adoption & Innovation

The primary challenges faced by organisations in the Midlands to foster AI innovation are the gaps in large scale developments in infrastructure, and AI skills shortage. Furthermore, competition from other regions like London and the South East which have far higher levels of innovation within this field make it challenging for the Midlands to become a hub as well. Further public and private investment is required as well as incentives to retain talent cultivated locally.

Strategic opportunities

The Midlands has a strong identity with a history founded in manufacturing. This can be leveraged to position the region as a potential new hub in AI innovation with a focus on manufacturing. The presence of existing manufacturing hubs and world-renowned universities shows sufficient potential. The Midlands also has growth opportunities within service industries and agricultural production.

1.3 Recommendations

1. **Enhancing AI Literacy and Education within the Midlands**
   To develop the Midlands as a UK hub (enterprise area) for AI innovation then all stakeholders within the Midlands will need an increased understanding of artificial intelligence. For businesses this will mean knowing what forms of AI are best integrated into their operations. For other stakeholders it will be useful to increase their confidence to utilise the technology thus driving innovation as well as dispelling possible resistance to adoption. This enhancement could be in the form of standard university courses, but also other mechanisms for training and application.

2. **Infrastructure Investment for the growth of AI capability**
   The Midlands needs to improve its digital connectivity and infrastructure because the growth of AI is also reliant on digital infrastructure. As AI technology embeds into the operations and service offerings of businesses, further infrastructure developments will be required to grow the AI driven economy. The research in this report has identified that a good digital infrastructure (gigabit broadband connectivity, and a 5G network) will be useful for startups and to attract companies from outside the Midlands and internationally.

3. **Change of HMRC Standard Industrial Codes (SICs) to represent AI companies.**
   When undertaking research for this report, it was evident that it is extremely difficult to identify AI companies or AI related companies from Companies House and other business datasets. It is recommended that the government / HMRC setup a separate SIC code for companies working within the AI domain who identify as AI or AI related companies.

4. **Ethical and Sustainable AI Development**
   Implementing ethical and sustainable policies is extremely important as the use of AI increases within new products and service offerings. Ethicality has wider implications of Equality, Diversity, and Inclusion (EDI) and hence it is important for the Midlands to lead on embedding ethical policies within the use of AI. Sustainability considerations in relation to energy, circularity, and carbon emissions will need to be considered as the Midlands grows its AI based economy.

5. **Venture Capital and government support**

For the growth of the AI sector, and especially for startups within this sector, it will be useful for the Midlands to setup a funding / venture ecosystem. Research respondents discussed the lack of venture funding in the Midlands and the impact this has on the growth of technology companies when compared even to other regions on the UK, let alone compared to Silicon Valley in the USA.

1.4 Conclusion

The report highlights the advantages and drivers of using AI technology within a geographical region. The report also discusses the barriers for the Midlands to adopt AI to drive business growth and the economy. Generative Aritificial Intelligence (Gen AI) has been the focus lately with the release of OpenAI's ChatGPT. Gen AI *refers to deep-learning models that can generate high-quality text, images, and other content based on the data they were trained on.*[3] As Gen AI gathers momentum with its vast areas of applications it will be useful to deep dive into the individual sectors identify the developments. Through an analysis of the limited data available, this report has identified emerging hubs of AI activity within the region which have the potential to grow into centres of excellence following the recommendations (provided in section 1.3).

[3] https://research.ibm.com/blog/what-is-generative-AI (accessed 16/09/2024)

Contents

1.0 Introduction

The report is intended to reach a broad audience including, but not limited to, industry leaders, academic researchers, public policy professionals and investors. By providing insight into the Artificial intelligence (AI) landscape in the Midlands, this report aims to support decision making that will affect the future economy of the region. AI has developed rapidly with the world's largest tech companies racing to develop their own AI models both for commercial and internal use (Stanford University 2024). This is evident since Open AI's Chat-GPT public release in 2022, which made artificial intelligence more accessible to the general public and created a flurry of media headlines (Abdullah, Madain, and Jararweh 2022, Lund and Wang 2023). The UK government has identified AI as one of its major areas of future investment outlining a 10-year plan to incorporate it into the economy (Kazim et al. 2021, Government 2021). The Midlands has a long history in manufacturing but has a growing economy in in the services, science and innovation, and Fintech. These industries could be heavily impacted by AI adoption. This report explores the current landscape of AI utilisation among businesses in the Midlands and appraises future investment. AI is an umbrella term that encompasses several advanced areas of data analysis and computing (Goodfellow, Bengio, and Courville 2016). Chat-GPT is known as a large language model (LLM) and is a multi-purpose chat bot that can perform a variety of functions based on prompts given to it (Zamfirescu-Pereira et al. 2023). Figure 1.1 provides a brief understanding of the nuances within this technology.

"Artificial intelligence (AI) is technology that enables computers and machines to simulate human learning, comprehension, problem solving, decision making, creativity and autonomy"[4]. Figure 1.1 depicts that AI is an umbrella term that covers many computer algorithms and statistical methods that have a broad range of applications. In simplified terms, AI is any algorithm that can mimic human behaviour that requires thought. However not All AI work the same, some are more complex with others using more advanced methods

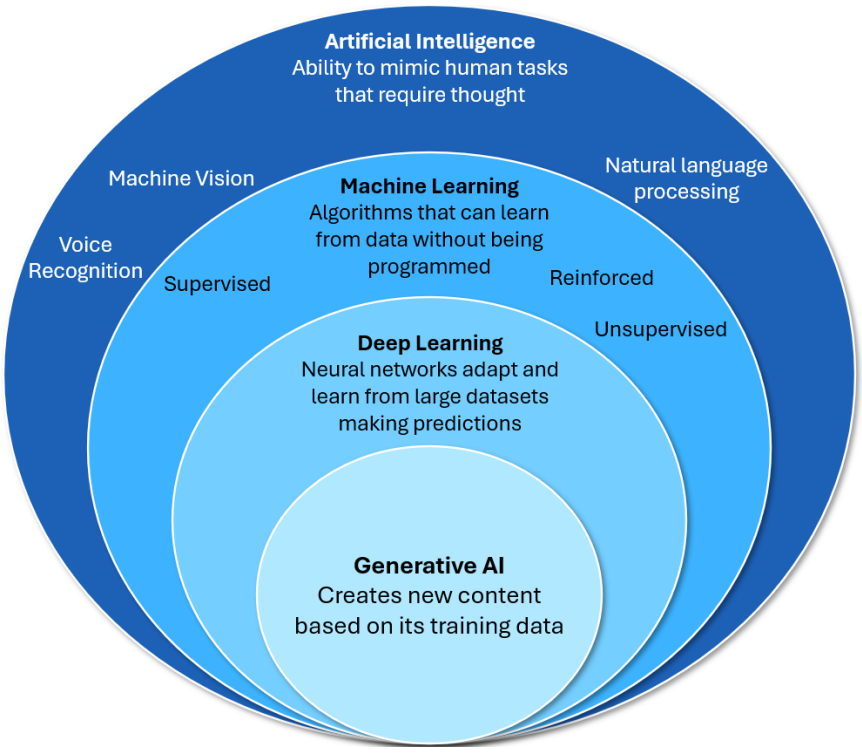


Figure 1.1: The classification of AI techniques

[4] https://www.ibm.com/topics/artificial-intelligence (accessed 13/09/2024)

Machine learning models (ML) is the principle by which AI functions. It is the statistical process used to train models on specific data sets, allowing the model to analyse and predict outcomes from new information it has not seen before, and then learn from it. This can be a useful tool for companies that specialise in analysing complex datasets with many variables. Some examples include: image recognition, dynamic pricing (as used by Uber (Gazi et al. 2024) and other vendors), as well as sentiment analysis which involves highlighting trends in customer behaviour to maximise sales. The Midlands presents itself as an emerging cluster for AI technologies[5]. Industries with a strong presence in the region that helped shape its cultural identity, such as the automotive, aerospace and agricultural sector, are already being changed by rapid adoption of AI within existing technologies for example using AI within use of digital twins or the use of automated drones in herding livestock (Bao and Xie 2022). The real question is not 'will the Midlands will adopt AI technologies?'; rather, will the Midlands region be a source for product and service innovation for the UK AI driven economy. Industry 4.0, (4IR), the fourth industrial revolution is meant to highlight the vast changes in manufacturing and society that have formed through the current digital revolution, where devices are interconnected and linked through cloud technologies. This also features advanced manufacturing techniques (Dalenogare et al. 2018) such as additive manufacturing which has become common enough that even small single-person businesses can utilise the technologies (Attaran 2017). PwC, one of the world's leading accountancy and consulting firms, predict that AI would contribute $15.7 trillion to the global economy by 2030 with a 26% boost in GDP to local economies in the same period (Rao and Verweij, 2017). A large part of this is expected to come from increased productivity with AI assisting workers in automating menial tasks. For example, the Adobe Reader software now offers a subscription service for an AI chat bot assistant that can analyse PDF documents and answer questions on them (Adobe 2024). Further innovation in this space will occur as generative AI becomes more accessible. The Office of National Statistics (ONS) report that public awareness of AI is on the rise (Farbrace, Warren, and Murphy, 2023). For example, 72% of adults surveyed could give a partial explanation on artificial intelligence compared to a previous survey in 2022 that found only 56% could. This increase coincides with the increased media coverage and awareness of chat bots like Chat-GPT showing the influence Open AI has over this space. In terms of businesses, 16% were found to be currently using AI in some form with the main use cases for AI being cyber security and improving efficiency (Farbrace, Warren, and Murphy 2023).

This report will investigate how businesses in the Midlands are currently using AI, the challenges facing further adoption and opportunities for the region to become a hub for AI development. By mapping the current landscape, this report hopes to provide stakeholders with insight that can drive policy and decision making towards fostering sustainable AI ecosystems.

2.0 Methods

The aim of this report was to gather and analyse data as part of a wider effort to assess the region's viability to become an economic centre for future AI development, as well as highlighting possible challenges in this endeavour. The research uses a mixed method approach to explore and investigate the depth of AI activity in the Midlands and the barriers associated with future development. Quantitative data was collected for analysis using databases such as The Data City and Dealroom, and further supported by searches using the Companies House registration database and Google, where available, to have a comprehensive perspective of AI companies in the Midlands. Qualitative data was collected using exploratory semi-structured interviews with six key stakeholders in the AI space within the Midlands.

2.1 Market research

A key factor in determining if the Midlands can be a viable area for AI innovation was to conduct a competitive analysis of the region (see Table 2.2). Initial scoping led to a focus on private sector

[5] https://midlandsengine.org/wp-content/uploads/2023/10/Midlands-Engine-AI-Cluster-Snapshot-October-2023.pdf (accessed 16/09/24)

businesses excluding other organisations and institutions, such as universities. From this decision two separate methods were employed. Firstly, a list of keywords was generated specific to sectors thought to be linked to or use AI. These keywords were used in The Data City (2024), generating a large list of results providing business names, websites, and registered address. Then Real Time Industrial classifiers (RTICs), specifically the Artificial Intelligence RTIC composed of 11 individual verticals were used to filter further. Real Time Industrial classifiers (RTICs) are proprietary industry classification created by The Data City as an alternative to SIC codes. The Data City searches were conducted during April 2024. The second method was a combination of searches through similar free websites like clutch.co (Clutch 2024), a business directory used primarily for B2B services and manual web scraping across other platforms. The same keywords were used to find other businesses that may not appear on The Data City repository. In addition, research was conducted to find some of the largest businesses within the region, as well as locating any PR / news articles related to their use of AI both as a product or internal tool. It should be noted that this was not a dynamic list and represents a snapshot in time when the search was conducted and so is subject to change. Following the use of The Data City information and general web searching, further data was gathered from Dealroom. Dealroom provides information on promising startups and high growth companies within a geographical region (The Data City 2024).

Figure 2.1 shows a streamlined visualisation for the data gathering process used to compile a database of AI companies in the Midlands. The method uses a mix of manual searches online as well as aggregating data from sources such as The Data City and Dealroom. This number is subject to change and is a snapshot in time of the region when the study was conducted.

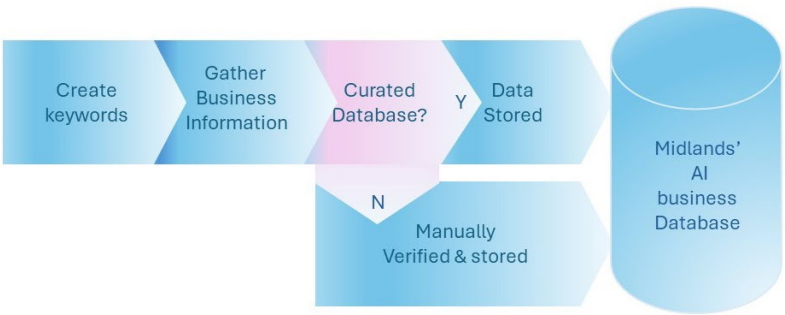


Figure 2.1: Data search methodology

The local authorities within the Midlands were the key locations used in search terms to determine what businesses to include when determining the presence of AI and AI related companies in the region.

2.2 Classification

Classification was needed to effectively segment the market. Initially broader categories were chosen and businesses were organised into four types (Table 2.1). The focus was to find Type 4 businesses, those that developed AI products and services that could be used as case studies to highlight innovation in the region. However, Type 0 and Type 1 business classification – those not related to or may be linked but don't employ AI as a customer value proposition respectively was used as a base for searching AI businesses. The businesses were classified using triangulation by qualitative analysis conducted by the researcher based on the information publicly available on their websites. For AI assisted classification, a smaller sample was taken and tagged manually on samples sizes 10 to 30 (as shown in table 2.2) before mass implementation on the whole dataset. GPT-4 then assessed the same set of websites, and the results were compared to gauge similarity Classes.

Classification	Description
Type 0	Companies whose operations and services are not related to artificial intelligence. This group includes businesses that focus entirely on non-tech areas.
Type 1	Companies that are involved with AI through consultancy, advisory roles, or education on AI, but they do not develop or directly sell AI technologies.
Type 2	Companies that use AI technologies to enhance their products or services. This includes businesses that integrate AI for internal processes or offer enhanced solutions to their customers through AI.
Type 3	Companies that offer AI-based products or platforms to customers but are not engaged in the development of new AI technologies. These businesses may customize or integrate existing AI technologies into their solutions.
Type 4	Companies actively involved in the development of new AI technologies, algorithms, or frameworks. These businesses contribute to the advancement of AI through research, development, and innovation.

Table 2.1: Classification of AI businesses.

Businesses were classified through accessing their websites and publicly available information then determined by qualitative means, including use of AI (as shown in table 2.2).

Classification method	Description
manual	A time-consuming method, requiring an operator to go through a company's website / social media to determine which of the categories it falls into.
AI assisted (5 at a time)	Feed a small list of company names+website to a general LLM, (gpt-4). It was also asked to provide a short reason as to why it chose that category, after which they were assessed by the operator.
AI assisted (10 at a time)	Same process as above
AI assisted (20 at a time)	Same process as above
AI assisted (30 at a time)	Same process as above
AI assisted (>30 at a time)	Due to the prompt or limitations in gpt-4 larger lists were difficult to process.

Table 2.2: Business classification methodology:

2.3 Mapping

Registered location data for each company was extracted from business information and converted into global latitude & longitudinal coordinates. Using Python (a programming language) and GeoPandas[6]. These location coordinates were plotted to create an interactive heat map of the AI based companies in the Midlands. The same technique can be adapted to only include AI businesses of specific industries, classification type, and SIC code. Mapping the location of AI companies was undertaken to provide a visual indicator for AI hubs. The dataset accessed using Dealroom was included within this mapping. The researcher specifically considered how many businesses appeared within the set that were registered outside of the Midlands, despite using a search criteria specifying the exclusion.

[6] https://geopandas.org/en/stable/- GeoPandas is an open-source platform that provides better mapping of geospatial data using python.

2.4 Similarity

To evaluate the effectiveness of accurately representing AI companies in the Midlands, the three datasets used in this study – The Data City, Dealroom, and Companies House – were analysed to assess similarities. Similarity was determined by calculating the overlap coefficient, which utilised metaphone encoding, a type of phonetic algorithm used to index words, and to account for variation in syntax, spelling and data layout between datasets. This analysis was then visualised into a set of Venn diagrams to demonstrate the similarities between sets. Further similarity tests were conducted by separating businesses into East and West Midlands groups, then creating frequency tables for the associated RTIC's (Real Time Industry Classification) used by The Data City in defining the sectors within which a company operates. A Pearson correlation was then calculated to provide a measure of similarity between two sets to provide a score that can vary between −1 (completely dissimilar) and +1 (completely similar). This was to gauge if there is any strong difference geographically between the industrial makeup of the two regions, with the West Midlands, home to Greater Birmingham - the UK's second-largest city - contrasting with the East Midlands, which consists of smaller towns and cities. A previous study conducted by the Midlands Engine (Green A and Rossiter W, 2019) investigated economic development based on regional geographies in the Midlands.

2.5 Location

Location data was extracted from the datasets and plotted to determine which AI businesses were present in different parts of the Midlands as well as their frequency. Additionally, this was also done for a larger dataset from Dealroom showing a snapshot of AI and AI related companies across the entire UK. This was done to compare the Midlands share of the National distribution of AI companies.

2.6 Funding

Using data from Dealroom the amount of funding awarded (from venture capital) to these startups and high growth companies was aggregated and mapped out against HQ locations for these businesses. This showed the areas of the Midlands that received the most funding for AI startups. In addition, this was also broken down by sector and investor type which was determined by similar metaphonic analysis on how companies within the dataset were labelled.

3.0 Results

3.1 Data Gathering

Table 3.1 demonstrates the time and return on investment for unique results in searching for AI businesses. Manual searching relied on accessing free open websites such as clutch, LinkedIn and general web searching of news articles. The process was very time consuming when compared to mass data aggregation from The Data City, but which tended to include businesses that were tangentially related to AI but based on further investigation, were themselves not involved in its application or development. This outcome was most likely due to the tags used and The Data City's algorithm. This is also related to how the businesses are recorded on The Data City data base and the link between RTICs, SIC codes, and status of the companies. Nevertheless, it is clear that in studies like this manual searching is a less viable strategy and that mass aggregation techniques should be used with other selection criteria applied later to help filter and refine the data.

Method	No. results not in the other's database	Time
Manual	23	3 hours
The Data City	321	5 minutes

Table 3.1: Comparison of time spent in searching for AI businesses manually and using The Data City

Figure 3.1 reveals the lack of similarity between Dealroom and The Data City's datasets. Initially it was suspected that the two sets should have a high level of similarity given that The Data City uses Dealroom as a source. Possible reasons for this is differences in how businesses are tagged and sorted into sectors by each site. The Data City uses RTIC's in its business classification which is not the case for Dealroom. Furthermore as Dealroom specialises in start-ups and high growth companies which AI innovation can often be linked to then its may have a better understanding when finding leading businesses in this space.

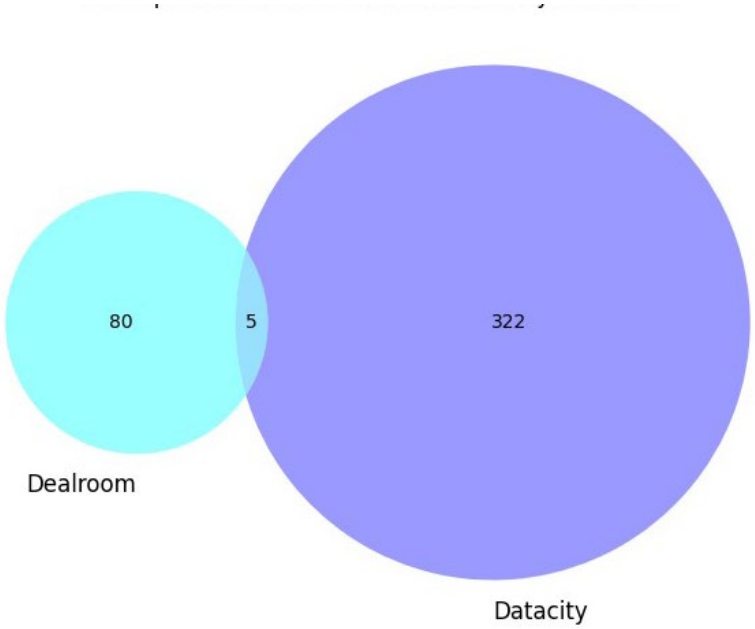


Figure 3.1: Overlap between Dealroom and The Data City searches

Figure 3.2 reveals there that a combination of The Data City and manual searching identified only two businesses excluded from the Dealroom dataset (check figure 31.), suggesting that while Dealroom can effectively find companies using AI, some of these companies are generating enough media attention for general search terms to pick them up too. This makes creating a picture of the AI landscape within the Midlands more difficult both for this study and stakeholders.

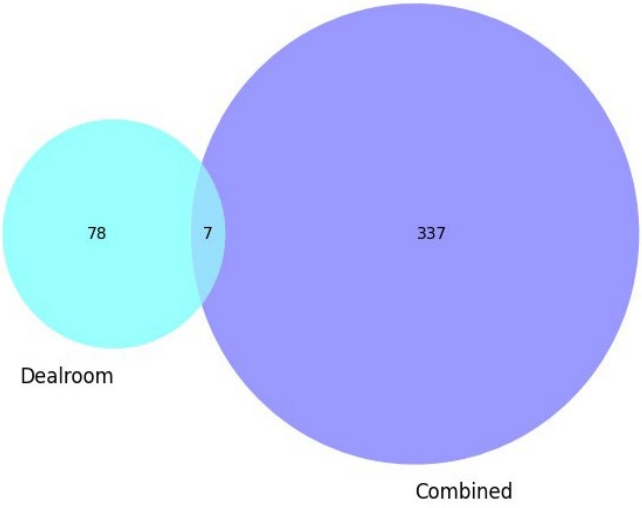


Figure 3.2: Overlap between Dealroom and Combined AI Midlands database

Figure 3.3. shows the number of AI companies identified through this study registered within the Midlands compared to the total UK population. Based on this study and The Data City National searches it would suggest that less than 10% of the UK's AI companies are within the Midlands.

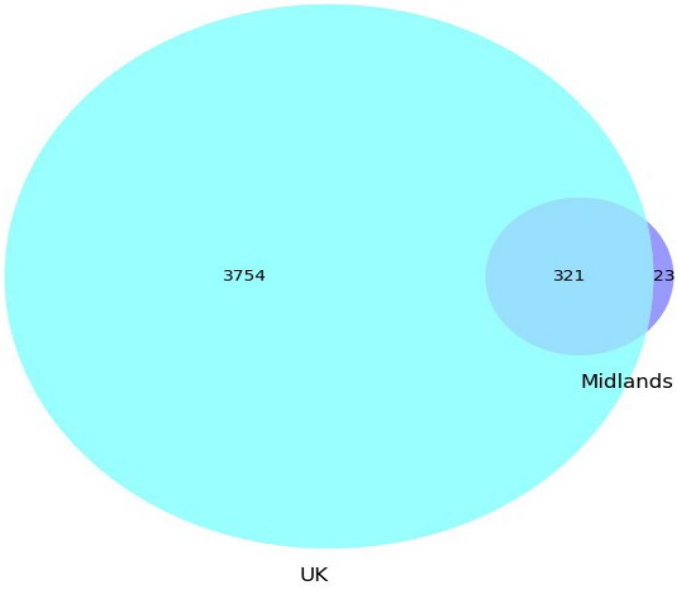


Figure 3.3: Midlands AI companies, when compared to the Data City National list

Figure 3.4 shows the number of companies in the UK found through The Data City that were identified as AI or AI related companies.

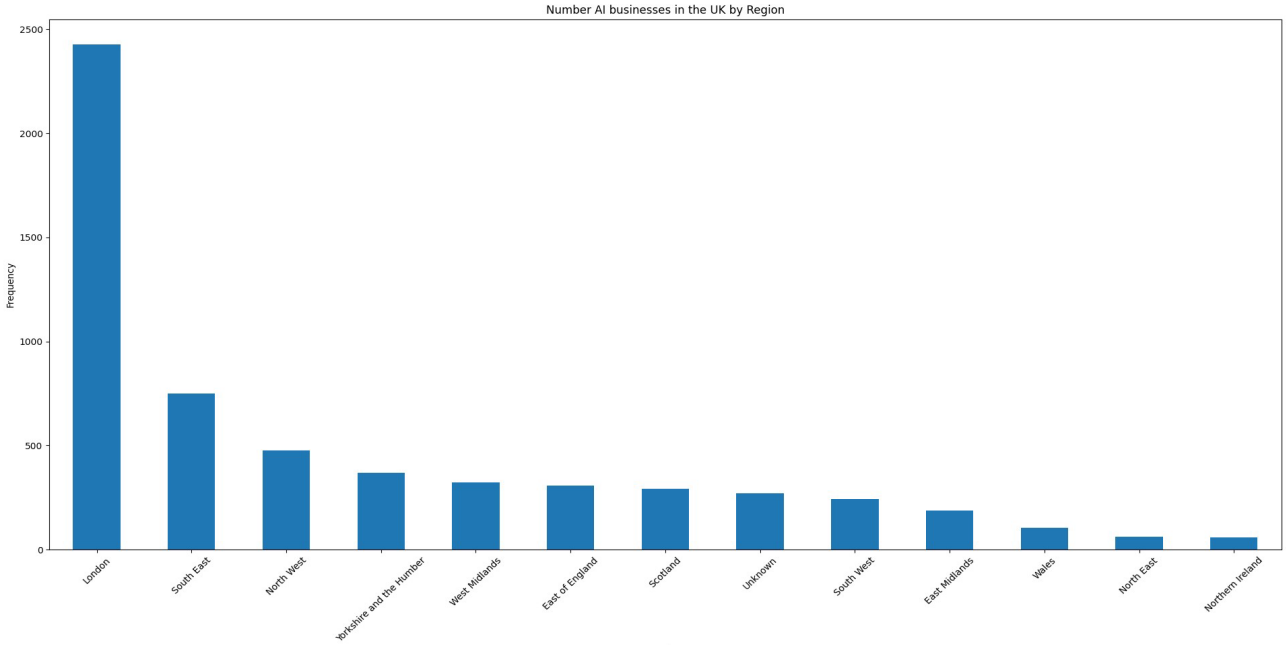


Figure 3.4: List of AI companies identified by the Data City in the UK

3.2 Analysis by SIC Codes

Businesses developing some sort of AI product were classified as type 4 using the classification system used for this study. There was a high concentration of such businesses in the following SIC codes: 62020,62012 and 62090 (Figure 3.5). Which relate to information technology consultancy activities, business and domestic software development and other information technology service activities. This makes sense given the definition used for type 4 companies in the report and shows most businesses in this classification are developing software for other companies to use. The AI's being developed at these companies is most likely some of machine learning algorithm for internal optimisation.

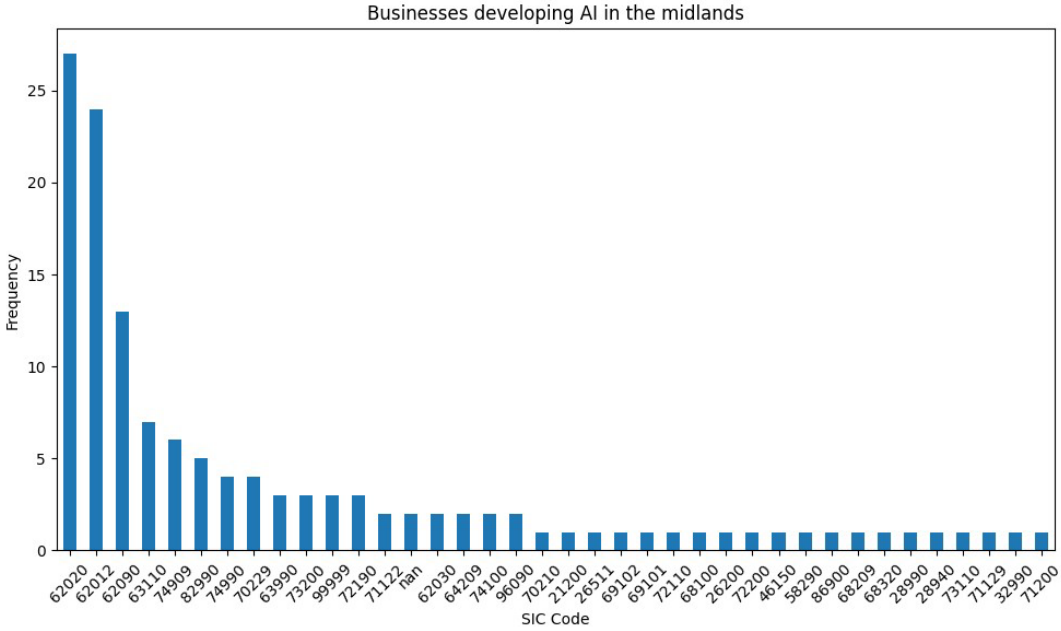


Figure 3.5: Businesses developing AI in the Midlands as per SIC codes

Businesses selling AI had similar SIC codes to those seen in the type 4 classification and it is possible there is cross over between the two groups. However, the main reason for separating the two was to show a distinction between companies developing their own software and algorithms in house versus those that were re-purposing or selling on pre-made chatbots and software licensed from another company.

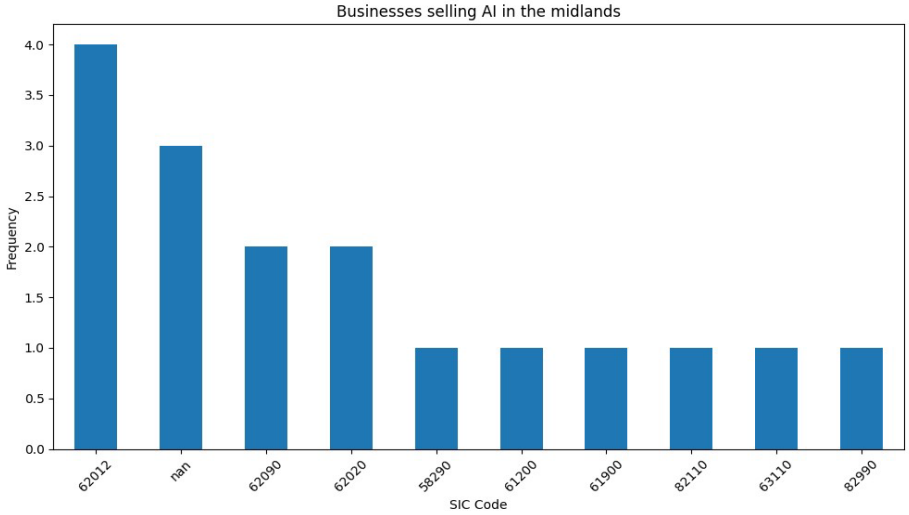


Figure 3.6: Businesses selling AI in the Midlands

Figure 3.7 uses the RTIC's associated with each business found in the search and shows their proportional representation for the East Midlands. This is important for understating the spread of sectors using AI in the East Midlands and can be compared to a similar spread of the West Midlands as shown in Fig 3.9. In the East Midlands, AI capability is being used in a variety of sectors, but data Infrastructure and Advanced manufacturing has high involvement followed by MedTech, Life Sciences, Research and Consulting, Omics, Pharma, and Energy.

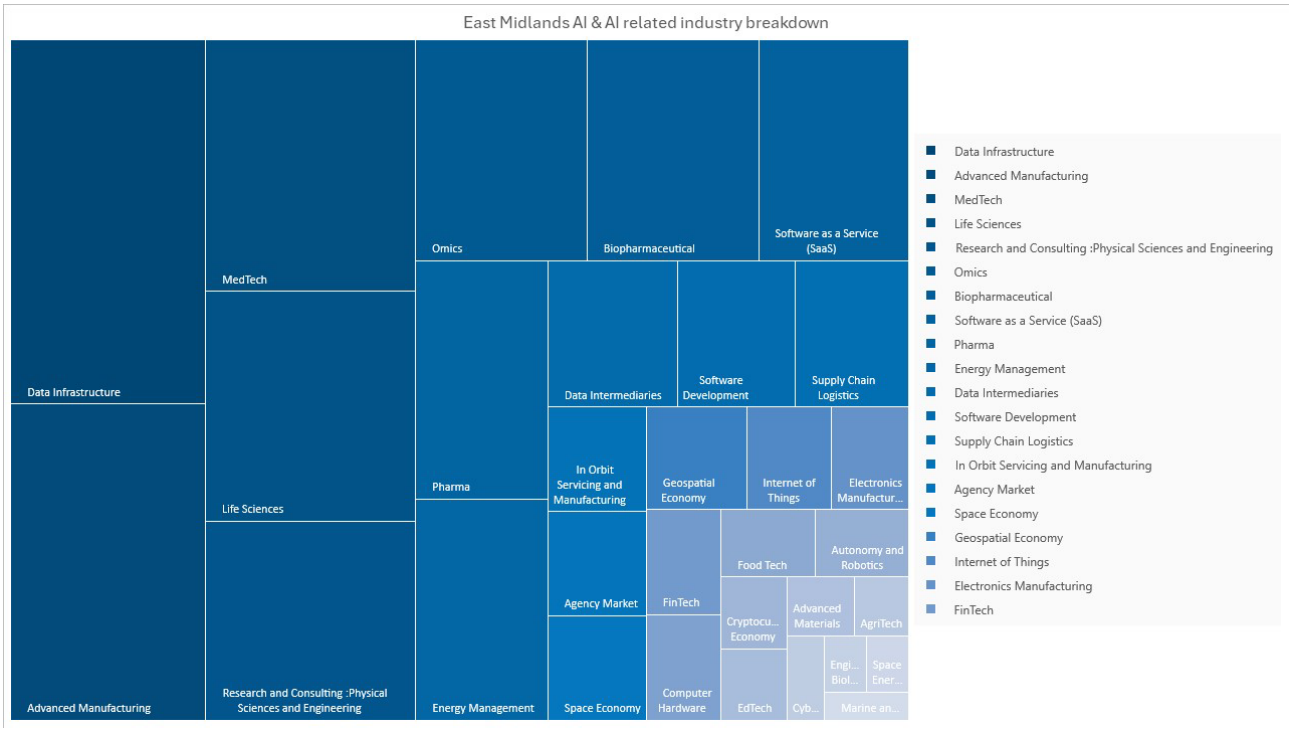


Fig 3.7: Spread of sectors using AI capability in the East Midlands

Figure 3.8 shows West Midlands AI related industry breakdown based on data provided by The Data City. When compared to the East Midlands spread, the high involvement within the West Midlands is in Advanced Manufacturing, and to an extent Data Infrastructure. This is followed by Software as a Service (SaaS), MedTech, and Software development. The spread is different between the East and West Midlands, with the West Midlands also is involved within the area of Sensor technology, Cyber security, and Data Intermediaries. The West Midlands also shows a focus on Fintech. Overall, the West Midlands seems to use AI for more technological focus than service sector.

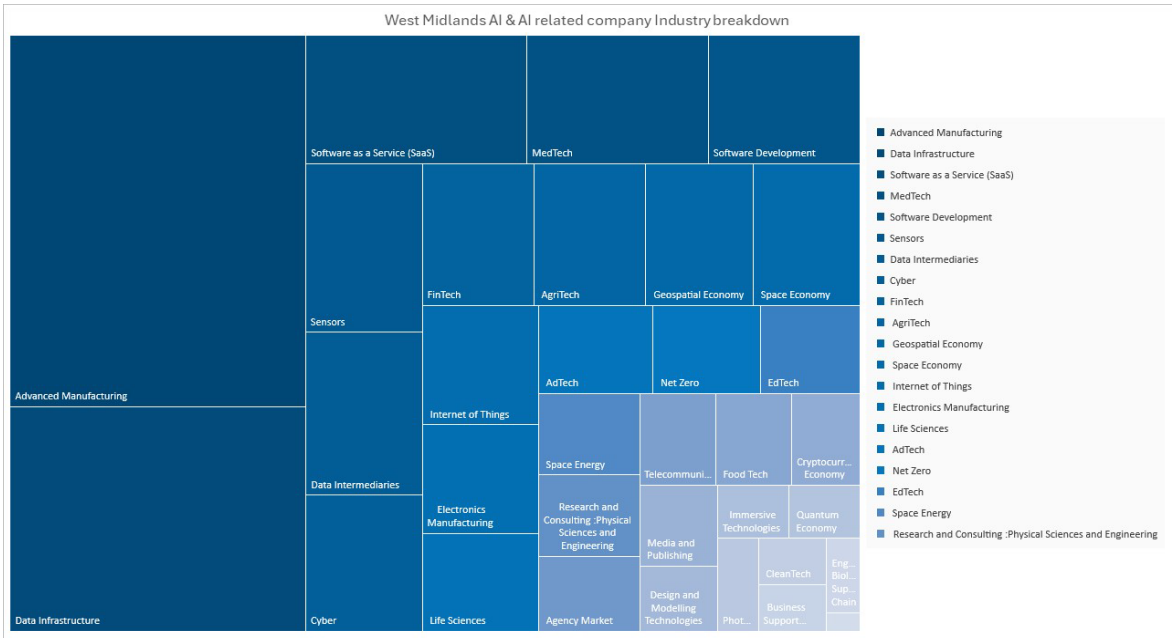


Fig 3.8: Spread of sectors using AI capability in the West Midlands

3.3 Startup Funding

This section discusses the funding available for startups based on data gathered from Dealroom. The data shows most investments were directed towards Birmingham, with the second highest being Dudley.

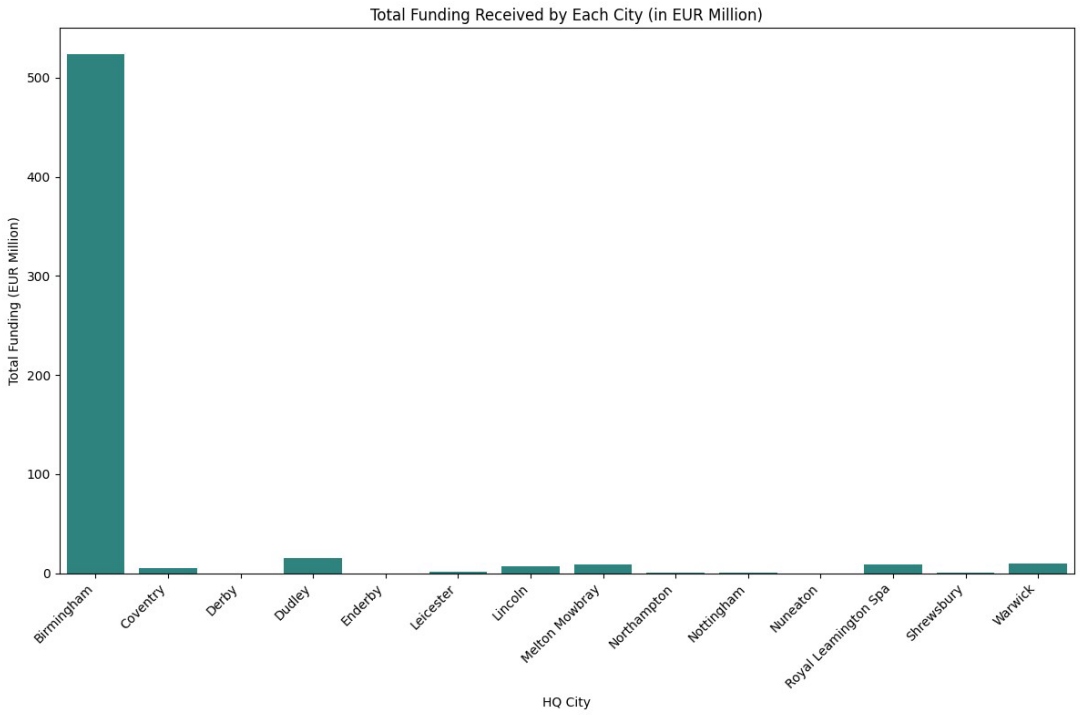


Figure 3.9: Funding spread for AI companies in the Midlands

Figure 3.10 shows the total funding by city excluding Birmingham shows 5 areas of relatively high investment within the Midlands. Some of these areas, like Warwick for example, have high ranking universities which are essential when establishing an innovation hub for any technology.

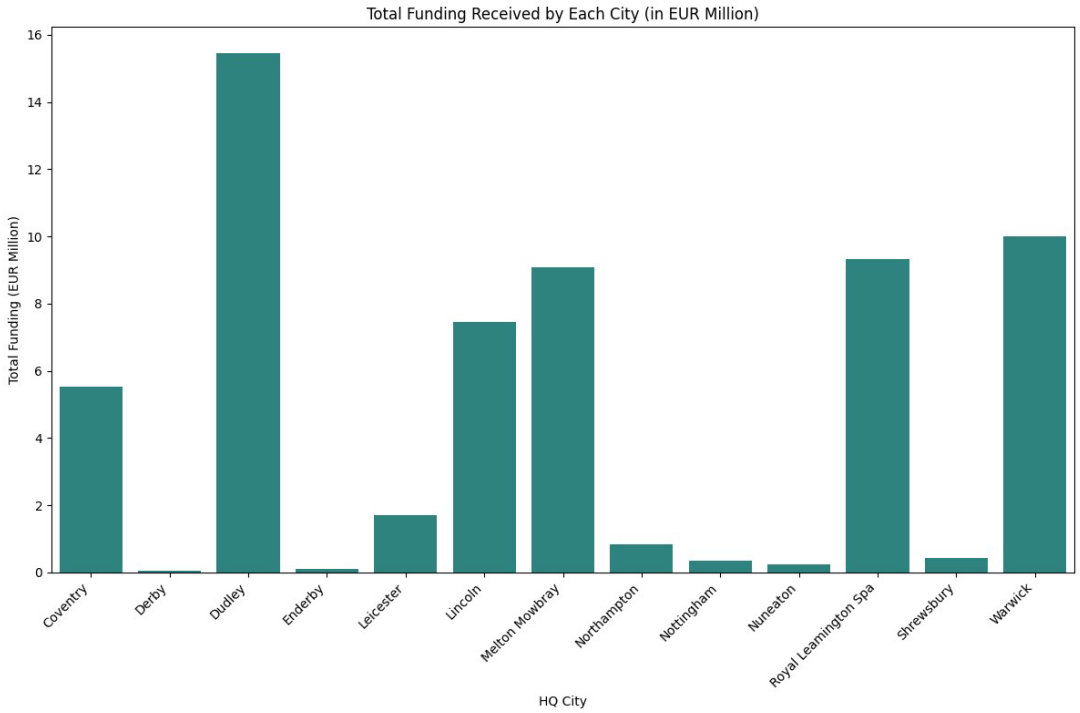


Figure 3.10: Funding spread across cities excluding Birmingham

Figure 3.11 shows a breakdown of funding by sector. This shows that the largest volumes of investment have been directed towards Transportation. Much of this was received by one large startup company that received €500,000 in investment for the development of autonomous vehicles. Other industries, such as energy and media make up a nominal amount, but the focus of investment is clear. The Midlands has a long history with transportation manufacturing so investment into AI that further develops this sector is perhaps not surprising.

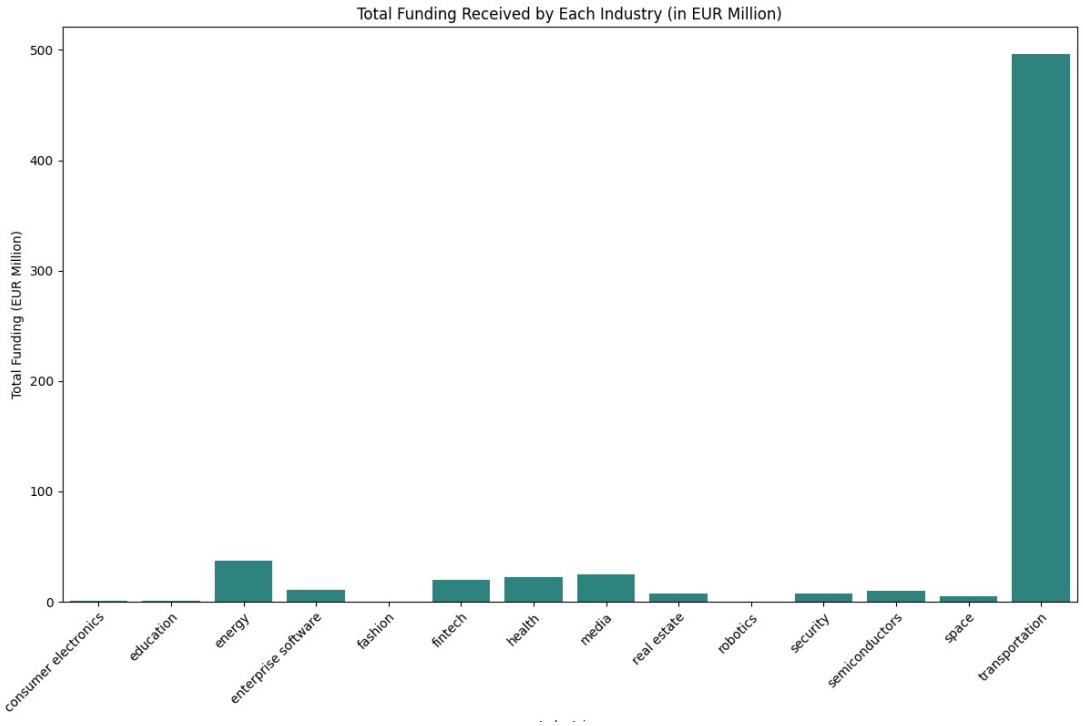


Figure 3.11: Spread of funding according to sector

Figure 3.12: shows the spread of funding after excluding transportation as an outlier within the dataset. The AI seed funding begins to look more diverse. The majority investment has been in energy-related companies, with many developing AI systems that monitor and predict usage. Similar amounts were also invested into fintech, healthcare and media. While the distribution of startup funding does not a clearly represent the wider industrial makeup of the region as shown in figures 3.6 and 3.7.

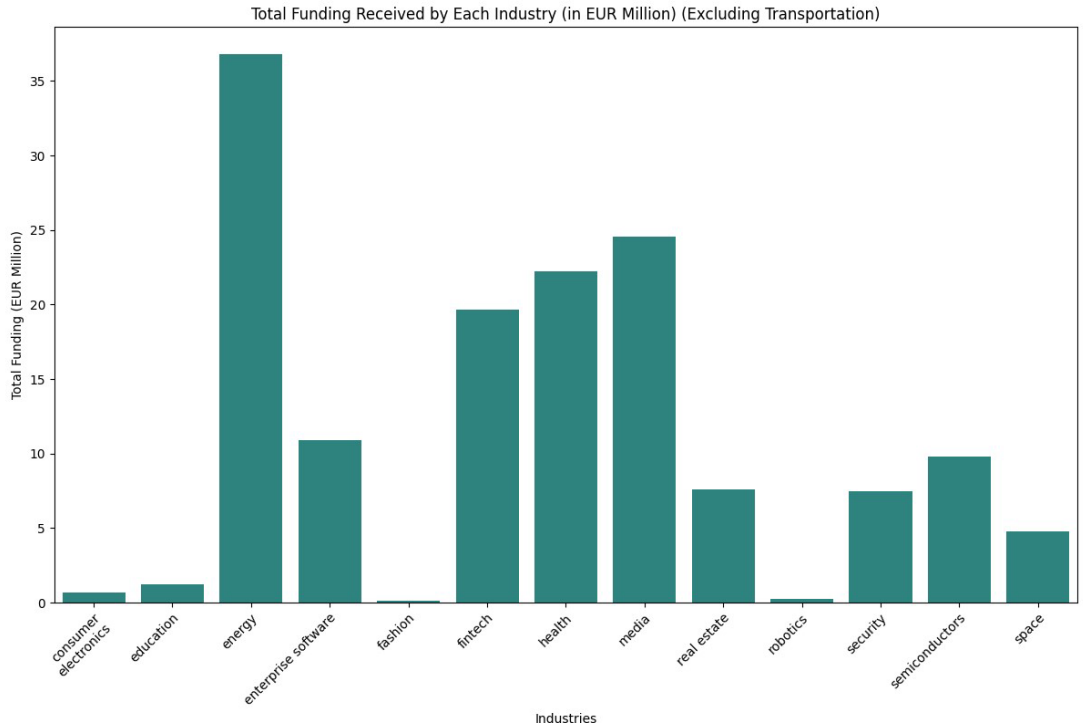


Figure 3.12: Sectoral spread of funding for AI companies in the Midlands excluding transportation

Figure 3.13: The graph shows a breakdown of the most frequent investors in AI within the Midlands. The majority of investment comes from Innovate UK and Tech Nation. Innovate UK is part of UK research and innovation (UKRI) and provides funding support for business-led innovation. Tech Nation [7]is a growth platform for tech companies which is supported by the Founders forum Group. The analysis reveals active investment by the public sector with Innovate UK distributing small amounts of seed funds across a wide range of projects. Tech Nation has some track record (figure 3.13) of successful investments within the Midlands. Nationally, 22% of UK tech company funding is through Tech Nation[8].

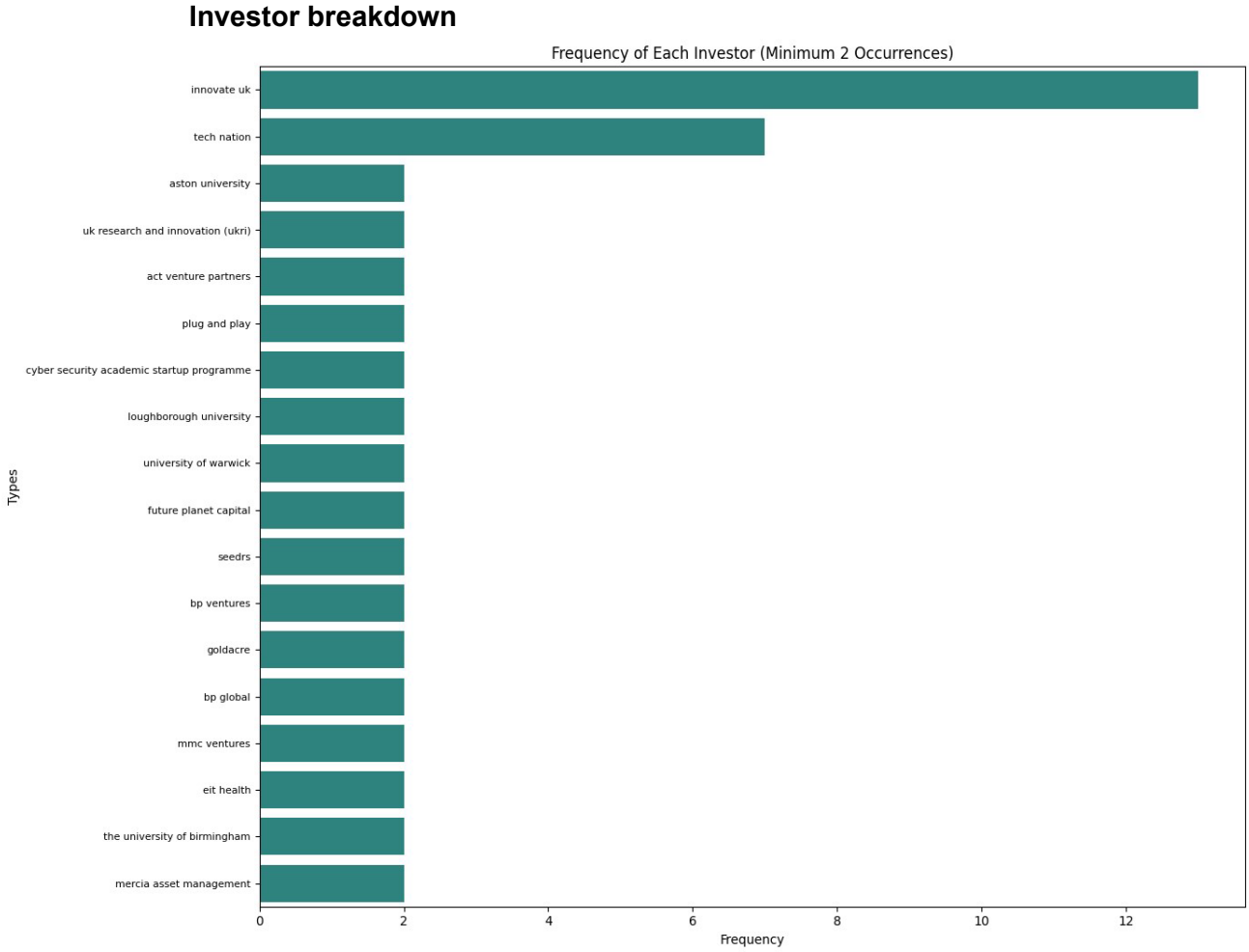


Figure 3.13: Investor types

Figure 3.14 shows that the majority of startup funds within the Midlands are funded by venture capital and accelerator programs. A number of start-ups are university spin outs funded by those institutions while crowd funding represents a less conventional avenue for investment.

[7] https://technation.io
[8] Ibid 7

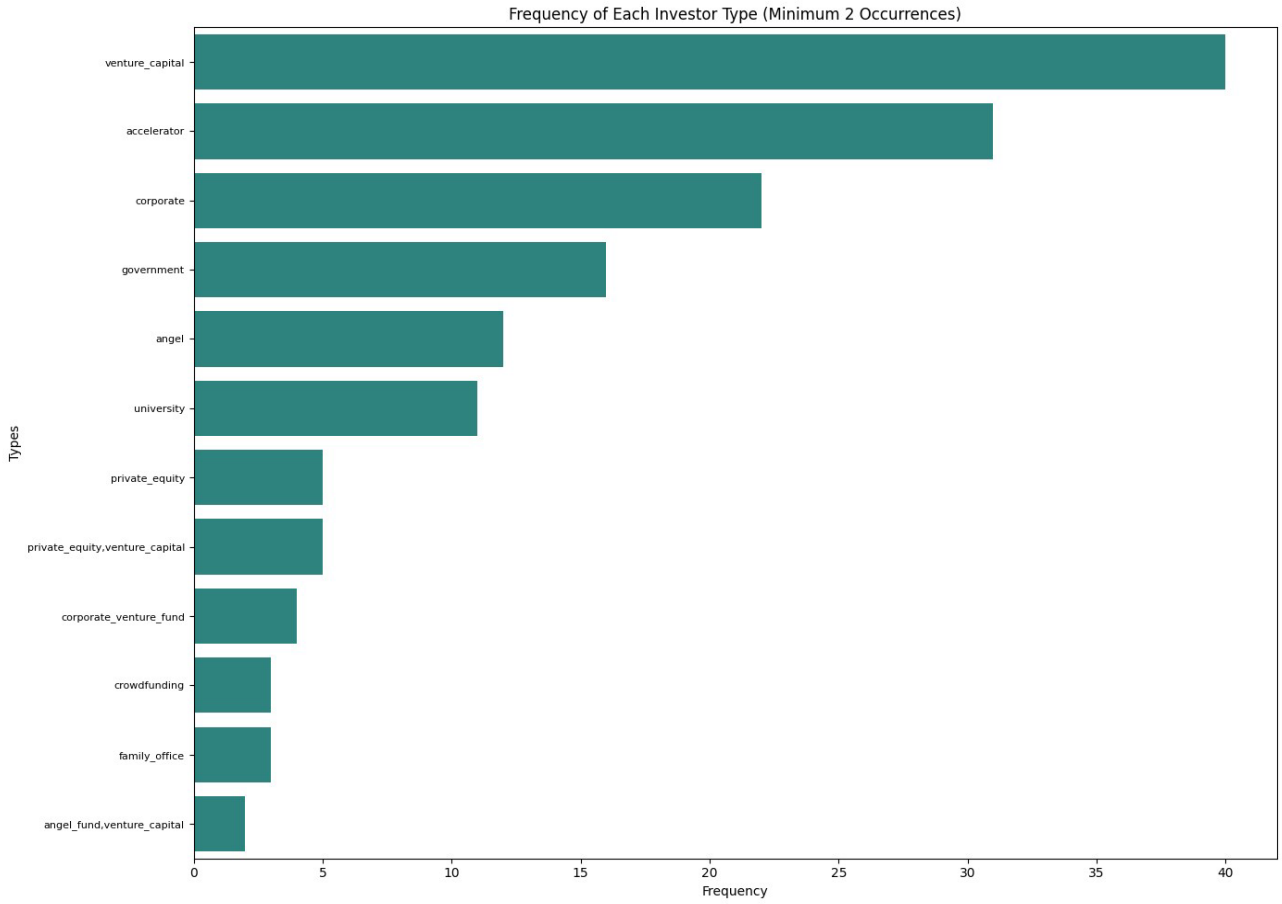


Figure 3.14: Frequency of investor type

4.0 Factors to consider when mapping AI span of activity

4.1 AI-washing

Part of the difficulty in measuring how much of the Midlands economy is involved in AI can be attributed to AI-washing. AI-washing is a term now used quite regularly in industry. The concept resembles that of green washing, where companies observe trends in consumer desire for more sustainable and ethically sourced products / services and then try to re-brand themselves as much as possible to fit this image while actually making little to no meaningful changes. This usually involves using green packaging, using words like ”natural” as well as misleading numbers to substantiate irrelevant claims (Freitas Netto et al. 2020). AI-washing takes the form of labelling well understood and relatively simple statistical methods as artificial intelligence. The reason for this is often to increase investment and inflate the perceived value of the company while the technology is considered a buzz word by investors and the wider media. In addition, companies with no previous ties to artificial intelligence can also claim they are researching its possible applications or seeking to integrate it into products / services (Leffrang and Mueller 2023). As a result, the meaning becomes diluted. The classification system employed within this study was done to gauge the quality of results found and see how many businesses within the Midlands were actively working with and developing some sort of AI technology. It should be re-iterated that even without AI-washing, a wide range of tools are used by companies, many of what were classified into the Type 4 category. Those developing AI were mainly developing machine learning algorithms for businesses to analyse data. The methodology used for this study has been effective to understand the depth of the activity as the sample size was less than 500 for the Midlands. However for larger datasets the methodology would

need to be modified further to identify the span of AI activity Likewise, the classification system may need to be modified too.

4.2 The geography of AI in the Midlands

Based on the information provided by The Data City and Dealroom, there exists a concentration of AI related activities focused on IT consultancy as well as business and domestic software development. There is a significant clustering of AI activity around Birmingham influenced by access to a highly qualified talent pool due to the number of universities in and proximate to the city, which offer degrees that directly relate to AI development and implementation. Furthermore, the City Council has enabled an environment for innovation through its digital city initiatives. There are plans to accelerate the city's full fibre coverage for businesses (Birmingham City Council 2023). In addition, the city has well developed transport links compared to other parts of the Midlands allowing it to access talent from outside the immediate region and to enable businesses to connect with other economic centres across the UK. However, concentrating all AI development in the city and surrounding area could be potential risk for long term sustainable development (Gordon and McCann 2005, Fujita and Thisse 1996).

As illustrated earlier, the majority of funding allocated to startups and high growth companies within the region was channelled to Birmingham (over €500 million) (see Figure 3.9), although the bulk of the funding was for just one tech company which specialises in the development of autonomous vehicles for use in supply chains. Excluding this one outlier, Birmingham nevertheless still captured the highest level of startup and high growth investment. Lower levels of investment were made elsewhere in the Midlands. Figure (3.10) shows over eight million euro was invested into each of the following towns / cites: Warwick, Leamington Spa and Melton Mowbray. As well as Lincoln and Coventry which received over five million euro each (Figure 3.10).

Excluding transportation, the majority of these companies as identified in this study (figures 3.9 and 3.10) are in the energy, media, health and fintech sectors. Healthcare is one of the key areas to see rapid changes due to the adoption of AI where it already serves a role used in the diagnosis of skin cancer while ML tools are frequently used in neurology and cardiology research, (Jiang et al. 2017). Nvidia, a driving force within AI, has recently demonstrated their 'virtual nurse' designed to perform post operation check-ups on patients making sure they are taking medication and recording any side effects or symptoms (Nvidia, 2024). The Midlands has some of the largest NHS trusts in the country, catering to a population of over 10 million (Office for National Statistics 2015). Therefore, the region has a massive interest in shaping how AI technologies will healthcare. Companies within this industry in the s study were found to be implementing facial recognition technologies to improve healthcare (AI 2024).

In summary, the concentration of AI activity in Birmingham is driven by a proximity to strong higher education institutions, infrastructure and sympathetic local government policy. The combination of these benefits has led to high levels of innovation in forms located in the city-region. However, there is also innovation across the other parts of the Midlands. As stated earlier, the data did not identify major employers in the region that are actively developing / working with AI. This highlights the difficulty of truly mapping the scope of a new technology with a wide array of applications, that has also been turned into a buzzword to attract investment globally (Wallach, Flohr, and Kaltenhauser 2020).

4.3 AI by Industry

The industries in which AI is actively being used are varied. Figures (3.9) and (3.10) show the makeup for the East and West Midlands based AI related businesses by industry. Across the Midlands, Advanced Manufacturing and Data Infrastructure make up a large proportion of AI activity. But differences between the East Midlands and West Midlands appears in smaller sectors: the East

Midlands has a secondary focus on MedTech, life science and the pharmaceutical industry whereas the West Midlands appear to focus on AI developments in software development, cyber security and sensors. Advanced manufacturing being the most popular industry for AI development within the Midlands aligns well with the regions' current wider economic trend and history of being a manufacturing hub within the UK. This is an area where further development is likely to continue as the region accounts for 25% of all manufacturing jobs within England[9]. This industry can be disaggregated into several clusters as outlined in previous Midlands Engine reports, (Midlands Engine 2023). These are the automotive, rail, and materials clusters. No large companies directly working in this sector were identified in the study. The spread of AI activity in the Midlands as identified by SIC codes was found to be largely associated with business-to-business (B2B) software development and IT consultancy. This is in contrast to the industry breakdown in Figures 3.9 and 3.10 that show a much more diverse makeup. One possible reason for this is how the RTIC codes are attributed to both to the providers and receivers of AI services. For example, the largest company found in the study was Dassault Solutions UK Ltd. This company creates software used across multiple industries, in particular SOLIDWORKS (Syst'emes 2024) which is used by engineers for product design, manufacturing and simulation across a wide range of fields. As such the company will often develop new tools to better suit client needs within fields such as advanced manufacturing. Thus, many developments within AI in these sectors will come from interdisciplinary co-operation between companies. The UK branch of the company is located in Leicester and has been actively integrating AI into systems for enabling predictive maintenance of robotic machinery used in manufacturing (ibid).

4.4 Absence of Large Employers

The absence of large companies from the dataset was initially confusing. However, it highlights a challenge in the quantitative methodology used. It points to how AI will probably impact the Midlands by being integrated into the operating procedures of existing companies more than tech startups specifically developing artificial intelligence. Big employers in region, such as Rolls Royce, Toyota, Jaguar Land Rover, Experian, etc., were found to be working with AI or actively developing this technology. This was identified only through manual searches. The databases used for this study did not classify such firms as having anything to do with AI directly. This presents a challenge for future research as to how an 'AI company' should be defined and how future searches should conducted, given that direct measurements are difficult to perform and give limited scope.

4.5 Influencers for creating impact

4.5.1 Industrial Impact operating procedures.

Currently AI does not have a strong presence within the Midlands region. HitHorizons data (European companies database) shows an estimated 837,561 companies operating within the West Midlands and 598,677 in the East Midlands. Hence, AI companies account for a fractional percentage of the regional economies' makeup (based on the previous data search). Currently it is unlikely that the impact will be in the form of job creation and innovation. Rather, as suggested earlier in the report, the value of AI for the Midlands will be from its adoption into existing businesses for increasing productivity. The largest general industry sectors in the Midlands are wholesale & retail followed by science, construction, administration and real estate (HitHorizons 2024). Based on the result of this study it is clear there is crossover between the regions' general industrial makeup and AI related businesses. While the terms used by Hithorizons are not identical to the RTIC's used by The Data City for industry classification, comparison can be inferred. The largest difference is the complete lack of representation of the wholesale / retail sector within the Midlands AI industry breakdowns (refer to figures 3.9 and 3.10). One possible reason for this could be the way in which AI is being used in these spaces. Often large retail companies will use some form of AI, usually machine learning algorithms to

[9] https://midlandsengine.org/sector/manufacturing/ (accessed 22/09/24)

analyse customer behaviour and buying habits. This sort of tool would only be used internally and possibly outsourced to a third-party company that manages the data on their behalf.

4.5.2 Workforce Talent

To support AI adoption in the Midlands, the skill gaps within the workforce will need to be identified and training programs initiated to train the workforce. The 2021 census showed that the East Midlands had the lowest percentage of skilled workers of any region in the UK, with higher education qualifications at just 36% of the UK regions[10]. The West Midlands fared similarly poorly with only 11% of resident workers and / or job seekers having no qualifications whatsoever. The outlier for the region was Warwick, where 55% of the working population held some form of higher education qualification (National Statistics 2024). This shows an immediate need for government and local businesses to invest in the regional education system to incentivise greater advanced skilling. Innovation in AI requires high levels of education in STEM subjects such as computer science, mathematics, engineering and natural sciences. Lacking this core skill set (related to mathematics, programming, data analytics, modelling), the working population will not have the requirements to pursue AI related jobs and companies may relocate to centres of innovation where these are better cultivated. Other concerns facing the Midlands workforce could be job displacement caused by AI when it is more widely used by businesses and its' role expands. British Telecom have suggested that as part of its cost cutting plans, it could replace 10,000 employees with AI within the next seven years (Sweney, M. 2023). Similarly, a US study conducted in 2022 found 14% of those interviewed had already lost their jobs having been replaced by AI (Dahlin 2022). In addition, even those with higher education qualifications could also find AI has a negative impact as it may de-skill professions, driving down salaries. This in turn, could discourage students from pursuing higher level qualifications in certain fields because the return on investment may be seen as not worth the loss of earnings or debt associated with pursing a degree.

5.0 Case Studies

5.1 Large Companies not present in the study

Rolls Royce

Rolls-Royce has successfully leveraged AI into its operations, using the technology to enhance operational efficiency and accelerating research. The company's aerospace and defence branches have a strong presence in the Midlands. The Raynesway site in Derby was approved for total redevelopment in 2023, and it is expected the site will create an additional 1,170 skilled roles in a range of STEM disciplines, especially in manufacturing and engineering (East Midlands Business Link 2024). In addition, the companies leads the COLIBRI project; an 11 partner consortium that aims to use machine learning and AI to reduce development time and enhance model based system engineering. Further collaborations with Aerogility, an AI developer that focuses on creating digital twins within the aviation and defence sector, show a long-term commitment to integrated AI solutions into the businesses structure.

JCB

J C Bramford Excavators Ltd, is a leading manufacturer for construction and agriculture equipment and has a strong presence in the Midlands, was founded in 1945 in Staffordshire. The business currently employs over 15,000 workers (IBISWorld 2023) with revenue in the region of £4 billion in 2022 (World 2023). Advanced manufacturing is a key industry for AI implementation and JCB has shown interest in the technology. A study commissioned by JCB has focused on autonomous

[10] https://www.ons.gov.uk/visualisations/censusworkforcequalifications/ (accessed 22/09/2024)

excavation using AI due to a significant skill shortage in excavator operators despite the fact they are integral to most construction projects (Rankin 2023).

Boots

Boots is one of the largest retailers in the UK and has its HQ based in the Midlands. As part of its efforts in digital transformation the company has looked to implementing artificial intelligence into its operations. For online shopping, Boots has implemented a 'AI-powered personal shopper', where a chat bot is adapted and licensed from Microsoft and uses Open-AI Chat-GPT as a base. Retail e-commerce has a challenge in abandoned shopping carts and AI could be used to solve this challenge. It is expected more businesses will adopt similar strategies to mitigate it (Alliance 2020, Kara 2023).

Toyota

Globally the company is well known for its commitment to research and development across many sectors not just the automotive industry but also robotics and advanced manufacturing systems. AI is being developed in all sectors of the Toyota business. However, most of this research happens overseas within its research institutes which have developed AI systems for discovering new materials to be used in vehicle design as well as onboard AI systems to monitor car performance. The UK branch of the company has recently (03/01/2024) submitted a project to the UKRI titled the Innovation Exchange challenge: Systems to measure and understand power usage at machine level". This project aims to utilise machine learning for monitoring energy consumption of various tools and equipment within the production line (KTN 2024a).

Aggregate Industries UK

Aggregate Industries UK (AIUK) is one of the leading suppliers of construction materials for the UK. The company's main areas of innovation in recent years have been to reduce its environmental impact and transition to more sustainable solutions. There is limited evidence of AI innovation actively being used by AIUK in these spaces despite active research into using AI for environmental monitoring actively taking place. The one example of AI being adopted by the company is in driver monitoring systems. All cement tankers operated by the business are equipped with in-cab cameras and sensor to monitor the drivers state of fatigue, to reduce any chances of falling asleep at the wheel or causing road collisions from lack of concentration, (UK 2024). This example of AI shows how monitoring and diagnostic tools developed initially in the healthcare sector can be utilised to unrelated industries such as construction and transportation.

Jaguar Land Rover

Jaguar Land Rover (JLR) has been actively contributing to AI innovation within the Midlands. The company invested £5.5M into autonomous vehicles. The initiative was managed through the UK Connected Intelligent Transport Environment (KTN 2024b) which used a 41 mile stretch of road around Coventry and Solihull as a testing centre for up to 100 autonomous cars (Interface News, 2016). JLR is using AI within its supply chain and risk analysis and in 2023 the company announced a deal with Everstram Analytics to monitor the supply chain in real time and predict when, if possible, shortages would occur (Rover 2023). This type of technology has become very common within the automotive industry due to the increased demand for electric vehicles (EVs) which require rare earth metals for the batteries that are often found in difficult to access regions and that can be delayed due to natural disasters, large demand and political instability. This is also true for other car components like semi-conductors and advanced chips which through the COVID-19 pandemic imports dried up heavily disrupting the automotive industry. This could also be highlighted as a potential risk for any company wanting to develop AI technologies moving forward.

Experian UK

Experian is a data analytics company providing valuable information for consumer credit, identity and fraud prevention, decision making, and targeted marketing. It provides services for consumers as well as businesses. The operating headquarters of the company on the UK is in the Midlands (Nottingham). Experian is engaged deeply in the use of AI and is also innovating within this area. Experian has several AI or machine learning-based products in the market, including its core credit score, fraud prevention, Aperture Data Studio, Decisioning service (Davenport, 2020).

5.2 Companies included in the Data set

Blue Skeye AI

Blue Skeye AI is a company based in Nottingham focused on using AI to analyse human behaviour through face and voice recognition technologies. They strongly push for ethical development with primary application of the technology in the health and automotive industries. The company has won several awards for innovation in the medtech space, developing apps that interpret behaviour to help healthcare professionals and patients monitor their mental health, working in collaboration with Nottingham NHS trust (AI 2024).

Grid Edge Limited

Grid Edge is startup uses AI to enhance energy efficiency in commercial buildings. This is done by creating digital twins of the buildings that can provide real-time energy management responding to environmental and energy price changes. Furthermore, the ability for AI to make predictions based on the data allows for forecasting enabling businesses to plan out their energy usage (*AI for Flexibility* 2024). As a startup, the company has managed to raise significant investment from the public and private sector and is an example of a successful spin out from Aston University and is an excellent example of AI innovation in the Midlands tackling global issues[11]

Conigital Limited

Conigital Limited a company in the Midlands, focuses on developing autonomous vehicles that operate on AI, with a focus on self-driving vehicles within ports, yards and airports. The company has begun to branch out applications into commercial usage (Conigital 2023). The choice to focus on industrial setting like ports provides spaces with less drivers than public roads and can be more heavily controlled making them ideal training grounds for autonomous vehicles. The continuous investment for the company has allowed the startup to rapidly scale, with facilities now in Australia and India too (*Conigital Ltd - Company Profile* 2023), (*Conigital Company Profile 2024: Valuation, Funding & Investors* 2024).

6.0 Qualitative Results

This study also featured interviews with key stakeholders in the AI ecosystem. The intent was to use semi-structured interviews as a medium to discuss the growth of AI and potential for Midland's economic growth through AI innovation ecosystems.

Several companies were shortlisted for interviews based on initial information about the use of AI within the companies. However, there were few from the list active within this space, whereas others were starting to venture into this or aspired to venture in the future. A limitation of the interview process was the sample of West Midlands and Staffordshire based companies. It was difficult to recruit companies from the wider Midlands region, which will be the intent in the next phase of the study.

[11] https://www.uktech.news/energy/grid-edge-funding-20211208 (accessed 22/09/2024)

The respondent sample comprised of 5 individuals discussing 6 companies (one individual discussed two companies - a previous startup and the current company).

Table 6.1: Respondent Sample

Respondent	Company / Sector	Position
A	AWS Enterprise Consultancy	Founder
B	Automative product Design Consultancy	Chief Technologist
C	Media Video company	Founder
	Technology product company	Vice President- Product Development
D	Gaming Design Consultancy	CEO
E	West Midlands Tech community organisation	CEO

The interviews were recorded and transcribed. These were then analysed to form themes pertaining to AI growth within the Midlands

6.1 Increase AI understanding

The general population in the UK, and Midlands are oblivious to the developments of AI and may be influenced by what is presented in the media. There is a trend to only focus on the cutting edge and very expensive forms of AI, such as LLMs, that have become common place since the advent of Open-AI in the media. This can result in false information spreading in regard to the use and misuse of the technology increased levels of apprehension around the technology or as well as the other extreme where people believe AI can do almost any task.

- *I think that the challenge is on the supply side. Everybody's calling themselves an AI business, and often what we see is an interface on Chat-GPT and calling themselves AI. Then on the demand side, you don't see a lot of people are shouting about it [A]*

6.1.1 Education

The literature highlights the importance of having an educated talent pool in relevant degrees to facilitate growth in the AI industry. As more companies continue to adopt the technology there will be an increased demand for data analysts to train AI models, as well as more traditional IT roles to manage and maintain the systems they operate on. However, simply providing degree courses is not enough to develop the level of skill required to perform jobs (Radermacher and Walia 2013, Tuzun, Erdogmus, and Ozbilgin 2018). The future workforce needs further training through graduate schemes and boot camps. For many of these job roles, apprenticeship style courses would be ideal, it would allow for co-operation between employers and local educational institutions within the Midlands to create tailored learning that directly meets the needs of the region while also being open to a wider demographic, not just young workers entering the work force.

- *We need more people with skills to use AI technologies and apply it for creating business value [A]*
- *the skill sets just don't exist in the UK. We don't have that kind of easily accessible talent pool to do this kind of stuff [D]*

6.2 Investment

Easy access to large amounts of venture capital and government funding is crucial for innovation. The burn-through rate for some of the largest tech and AI companies is incredibly high and some companies take years to break even or start turning a profit (Janney and Dess 2006, Denis and McKeon 2021). Investors need to understand and be willing to accept that most projects will end in failure. Hence, collaboration with government bodies is crucial as the public sector can often provide subsidies for innovation development. Universities and other research institutes could be the source of IP generation and highly skilled graduates.

- *It is difficult to find funding in the UK. Funding flows freely in the US [C]*
- *I was telling somebody who yesterday who is a Birmingham based entrepreneur / investor and he was talking about the landscape as you know being particularly poor, we we're not well served so we have at a seed capital level. [E]*
- *there's just no viable funding stream (other than Innovate UK). I think that's my main frustration at the moment and I'm not trying to be critical because I do appreciate it. [B]*
- *You could argue that in Silicon Valley, funding is sometimes a little bit too easy to come by, and investors sometimes are little too credulous in terms of the schemes and companies that they'll buy in too. [D]*

6.3 Infrastructure

The development and innovation of artificial intelligence or any hub requires large investment into local infrastructure, this can take two forms; Primary infrastructure like reliable high speed internet, testing facilities as well as nearby access to educational and government institutes. The secondary infrastructure, also known as 'place making' (Davis et al. 2023), focuses on the wider area and quality of life it offers and is a crucial step in retaining talent but is often overlooked. An example of somewhere with both infrastructures is 'Silicon Valley'. It has strong links to government and educational institutions and promotes a diverse open culture with appealing lifestyles that make talent want to move to the region (Wonglimpiyarat 2006).

- *There are barriers for you to grow as a company in this field of AI? Hesitancy from customers to implement these technologies, the lack of technical knowledge within those organizations themselves [A]*
- *How do we create that sort of centre of excellence? I guess my fear is that the Midlands tends to view itself as manufacturing [E]*
- *We need some framework and I think that framework has got to link academia.in a much better way … I mean again the Midlands is hopeless at doing things together, you know and how do we get the universities to work as one and not see themselves as competing against each other all the time? [B]*

6.4 Midlands AI Cluster.

Applying the Porter's Diamond model to the Midlands, it is possible to design a potential AI innovation ecosystem / hub that can provide visibility, support, and an AI application space. The Porter's Diamond model is a framework that explains why a nation, region, groups, companies enjoy competitive advantage. The grey literature shows that an emerging cluster is developing around Birmingham. This is possible due to dense clustering of pre-existing businesses, connected infrastructure and strong academic presence as well as having a diverse culture. However, its development not without its challenges and in times of funding scarcity supporting smaller scale innovation projects that have minimal long-term impact is difficult (Brookes, Kendall, and Mitton 2016).

Figure 6.1 shows a representation of an AI innovation hub adapted from Porter's Competitive Diamond model. The diagram emphasises the need for pre-existing conditions as well as the inter connectivity needed between businesses and local government, (Porter 2001). The framework works as an interaction of 4 pillars or factors that determine the competitive advantage- Context for Strategy, Factor Conditions, Supporting and Related Industries, Demand Conditions. The framework in figure 6.1 identifies potential areas for activity under the 4 factors.

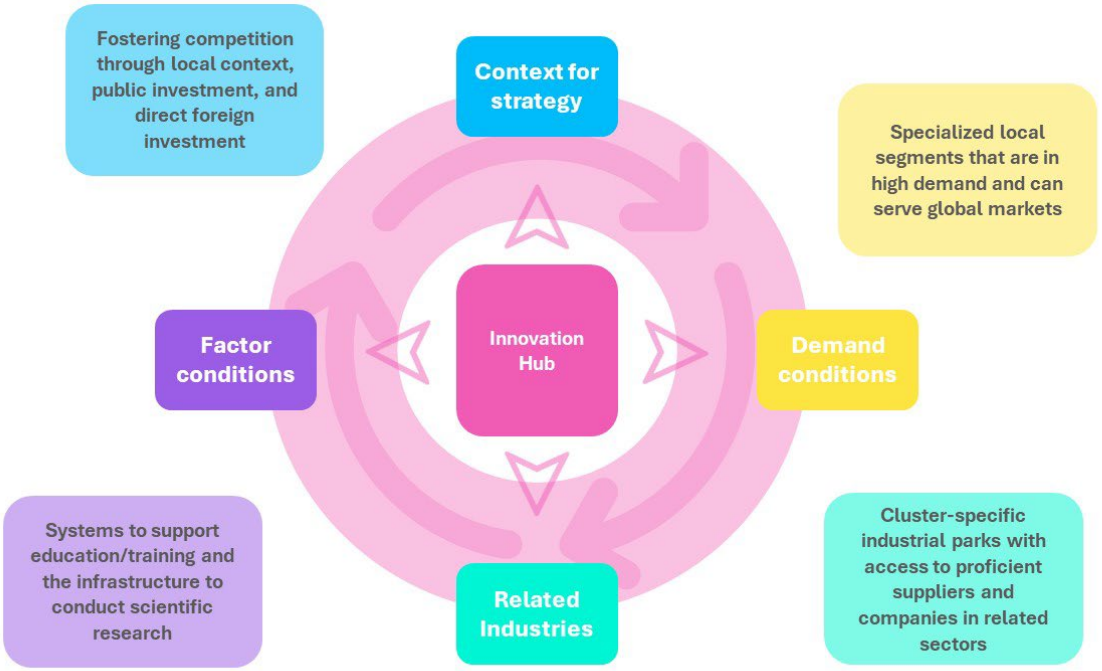


Figure 6.1: Using the Porter's Diamond model to develop an AI innovation hub

When developing the AI innovation hub, the short-term goal should be to support R&D in existing large businesses located in the region. Given the skill set of the Midlands, Advanced Manufacturing would be a preferred choice to develop AI capability initially. Ideally the short-term goal will be reached in under 5 years from conception and showcase successful samples of IP generated. If this short-term goal is met, then it can act as a catalyst for further investment into infrastructure and seed funding. Local industries will work with the institutes that developed the IP to commercialise it. The medium-term goal will be scale up successful AI start-ups spun out from research within the first 10 years. The long-term goal should be to setup a strong AI ecosystem in the Midlands. This maps on to the timeline that the Cambridge Science Park took from conception to becoming a thriving centre for innovation within many fields which spanned from 1970 to the 2000s before reaching a stage of maturity (F. C. Koh, W. T. Koh, and Tschang 2005.Etzkowitz and Zhou 2018). However, as technology grows and evolves rapidly (as seen from the recent explosion of LLM based businesses, since the entry of Open-AI), this timeline may need to reduce with extra support from both public sector and the private sector.

- *UK (govt) needs to create an environment that supports the scalability and retention of IP [B]*
- *We don't have any of the big technology companies in Birmingham. The reality is there's no Google, there's no Microsoft. So first of all, they need to have the actual AI companies working in the Midlands.[C]*
- *So I think for companies like us, the barriers are really seeing, where is it that AI will make a significant difference to us as a business. [D]*

- *I think we (Midlands) could and should have a big place on the application of AI, the practical application now that could be supply side or demand side. But what it means is solutions that take AI algorithms and create supply side business products and demand side adopt them [A]*
- *So you know if if I was looking at looking at policy, what I'd be looking at is how can we scale up the diffusion of the knowledge that we in skill we've got on the supply side across to the demand side because that's where the big prize is and that's the shortest path we trying to take.[E]*

6.5 Ethical Considerations

Environmental

Artificial intelligence has an environmental impact. Large language models stored on the cloud and able to be accessed on any smart device for prompting take up massive amounts of infrastructure in the form of supercomputers and server farms. These facilities consume vast amount of CO2 and have large carbon footprints. Dodge et al. (2022) created tools for measuring the environmental impact on AI and found high costs associated with the initial training as well as running costs to maintain the system. It was shown in cases where simpler models were replaced by LLMs that CO2 emission per task rose by a factor of 24. As such the use of AI should be value adding, its potential impact gauged and evaluated before implementation. In the case of business owners and the general population a more considered use of AI would be minimising the number of prompts entered into AI LMMs such as Chat-GPT and to explore an alternative that doesn't involve AI. There exists limited information to measure the environmental effects of AI on the planet as it is not a metric actively measured by the companies developing them.

- *Data centres require a lot of energy. With cloud systems and LLM proliferation sustainability will need to be considered [C]*

Equality and Discrimination

Significant concerns have been raised regarding discrimination as a result of AI use which must be considered when considering the growth of AI innovation in the Midlands. Systems that employ AI in hiring, policing and financial services have been shown to have bias leading to unfair treatment against marginalised groups. This is dependent on which data is used to train the algorithms and how the algorithms are coded. This is a well-researched area but lacking legislation and oversight.

- *Ethics within AI needs to be sorted quickly as the pace of evolution has increased considerably [B]*

7.0 Risks for AI deployment

7.1 Technological Risks

Technological Obsolescence

AI is a new and exciting area of development. However, as seen with previous technological innovations the landscape can change quickly and many ongoing projects will become outdated as new research is released and commercialised by competitors. Many start-ups prioritise rapid growth to avoid becoming technologically obsolete so they can then diversify their research and create stable revenue streams. This risk is difficult to avoid as many of the start-ups and spin outs are unlikely to survive long term, making large investments into singular businesses higher risk. It would be useful to create opportunities to redistribute the skilled talent from failed startups to others in the region.

These opportunities will be possible with funding and growth of existing AI startups and AI implementation within large companies. These could increase job stability for the skilled workers attracted to the AI sector making them more likely to stay in the Midlands and encourage risk taking which has been sighted as one of the key reasons some innovation hubs thrive while others do not.

Cyber-security Threat

High level Artificial Intelligence's that use complicated neural networks and deep-learning require large training sets. This data is often aggregated from multiple sources and can contain personal information of customers as well as valuable proprietary information like the understanding of a specific algorithm that underpins the entire companies value proposition. This makes data centres storing the information prime targets for cyber-attacks. The high likelihood of cyber-attacks and the high impact that this can cause, makes it a significant threat to training AI systems. Failure to effectively protect data often causes stakeholders to lose trust in the company, customers / clients may transfer their business to an alternate service that can better protect their information, and the company will struggle allowing other competitors to overtake them in their markets. Steps need to be taken to mitigate this risk. This involves having robust security protocols and ongoing staff training, meanwhile government and regulatory bodies can implement stricter guidelines on how data can be used as well as stored, conducting regular security audits to minimise the damage of cyber-attacks.

Figure 7.1 depicts a risk matrix that shows the major risks identified by this study for the Midlands when establishing an AI innovation Hub. The Y axis shows likelihood of an event occurring and X axis how severe that event would be. The greatest threats identified were for Cyber-security threats due to the commonality of such incidents as well as the massive damage to infrastructure they can cause. Investing in an AI innovation hub is creating an area with multiple targets for cyber-attacks to occur and can become a costly exercise to mitigate.

Risk Matrix	Low	Medium	High
High	Minor Technical Failure	Regulatory Compliance Skill Gap	Cybersecurity Threats
Medium	Intellectual Property Theft	Funding Instability Economic Displacement Partnership Dependencies	Technology Obsolescence
Low		Community Resistance	Critical Infrastructure Failure

Figure 7.1: Risk matrix of AI innovation Hub implementation

7.2 Economic Risks

Economic Displacement

Encouraging AI businesses to grow within the Midlands could lead to job displacement in the region as the economy shifts. Furthermore, AI-related companies require a large number of highly skilled employees and therefore higher earning jobs. By setting up innovation hubs within the Midlands which has a relatively low household income compared to other areas of AI innovation such as London and Cambridge then the risk of pricing out the local population not involved in these industries increases, as property values rise and the service economy pivots to catering for higher income jobs. Therefore, training programs and support systems for displaced workers need to be robust and organisations should be transparent about the impacts certain technologies will have.

Funding Instability

Funding new technologies is costly often requiring large investments from both the public and private sector. Many tech companies currently operating within the AI space do not turn a profit and rely on constant rounds of investment. To mitigate the risk of funding paucity, diverse funding sources need to the established to develop a robust financial safety net. This may involve exploring more creative funding strategies as well as distributing investments in smaller amounts to a wider number of start-ups. With unsettled interest rate scenarios there is pressure on funded companies to cash out or make profits.

7.3 Social Risks

Community Resistance to Change

With the possibility of job displacement and requirements for additional skilling there may be community resistance to change. The risk can be reduced by actively engaging the community within regional AI development and economic growth through educational opportunities, apprenticeship training, entrepreneurship support. This could be taken a step further by making the local communities' as active stakeholders that can influence the direction of research and types of companies present in the space, through outreach and apprenticeship programs as well as surveying the community for research ideas in the R&D stage that they can then be a part of. This cements the regional AI innovation as part of the community instead of it being perceived as 'others' encroaching on the space.

Skill Gap

The skills gap in the Midlands workforce should be addressed by critical analysis into why the region is below the national average for high level qualifications and what can be done to not only meet the average but go beyond it. Furthermore, rapid AI developments also mean rapidly changing skills sets could be required as such a diverse range of educational opportunities need to be in place with support for retraining workers a priority.

7.4 Operational Risks

Minor Technical Failures

Day to day operations involving AI implementations will encounter frequent technical issues especially as AI companies develop more complex AI models and expand their systems. The reason for mitigating this minor risk is that if left unchecked it can allow much higher risk incidents like cyber-attacks to occur more easily because parts of the businesses and more broadly the innovation infrastructure stays vulnerable due to a lack of dedicated IT support.

Intellectual Property Theft

The theft of intellectual property is an important issue within AI, especially generative AI like chat-GPT, mid-journey and stable diffusion. It is now a topic of discussion, that some large language models in their pursuit of innovation disregard intellectual property laws and stole works to be used in training data, considering the potential gain in their model's effectiveness to be worth any fines issued to the company. The collaborative and open nature of research hubs while being a key reason for success increases the risk of IP theft. If this occurs it may put companies off locating themselves within the

region. While copyright laws are robust in the UK further steps could be taken to develop and maintain the collaborative nature of the innovation ecosystem and provide reassurance to potential start-ups.

Critical Infrastructure Failure

While extremely rare an incident of critical infrastructure failing could cause massive disruption to the innovation ecosystem and wider region depending on the level of dependency and inter-connectivity present. Power and internet outages could cost these companies large quantities of money in lost productivity and failures in data centres could destroy all valuable IP developed. Therefore, when building infrastructure for AI innovation, multiple fail-safes should be implemented to avoid such outcomes.

Regulatory Compliance

The law has lagged behind AI innovation. Sudden changes in regulation as it aims to catch up with developments will cause disruption to innovation through non-compliance in areas such as data protection and international standards (when collaborating across borders). This can be mitigated by the Midlands region taking a lead in AI regulatory compliance to assist smaller startups in the early stages of the innovation journey, help them to focus on research and commercialisation.

Partnership Dependencies

The Porter's diamond model showed that the success of an innovation ecosystem is highly correlated with the level of inter connectivity between stakeholders. Failure to foster partnerships between academic institutions, larger companies, and startups will lead to misalignments between them and region's growth goals. Hence there needs to be clear channels of communication between stakeholders, and the Midlands Engine can act as a mediator between all stakeholders helping to facilitate networking events and workshops to encourage collaboration.

8.0 Conclusion

8.1 Summary of Key Findings

Current State of AI in the Midlands

Artificial intelligence is a broad topic that touches on many areas. The technology is already in use across the Midlands in a diverse range of industries and highlight the transformative role of AI on the regions key economic sectors. The study shows a high level of AI integration in manufacturing, healthcare and automobiles. Within manufacturing, AI has been used for the optimisation and securing of supply chains while in healthcare, it has potential as a diagnostics tool. This highlights the adaptability of the AI technologies and suggests a large amount of untapped potential within the Midlands.

Economic and Social Impact

The integration of AI technologies has already begun and with the advent of LLMs has been adopted at a fast pace. As more advanced forms of generative AI are becoming accessible to a wider population, this is set to reshape the economic landscape significantly. While the potential of sustainable economic growth exists, there are risks associated with job displacement within traditional industries combined with local businesses beginning to cater for the influx of higher income workers. The dual impact requires strategies to manage the development and mitigate any negative impacts through co-operation between government and businesses. In addition, the shift in demographics caused by AI could have an influence on daily living conditions and urban development for the wider region.

Geographical Concentrations

Birmingham emerged as a critical centre for AI innovation and a possible hub for the region with its robust infrastructure and close proximity to academic, financial and government institutions. With the potential for expansion, other opportunities exist to disseminate innovation across the Midlands ensuring a more equal distribution of the benefits offered. A choice needs to be made whether to setup a centralised innovation centre in one region or to spread out investment across the region, each have option has its associated risk and benefits.

8.2 Major Recommendations

1. **Enhancing AI Literacy and Education within the Midlands**
   To develop the Midlands as a UK hub (enterprise area) for AI innovation then all stakeholders within the Midlands will need an increased understanding of artificial intelligence. For businesses this will mean knowing what forms of AI make the most sense to be integrated into their operations and for other stakeholders allows them to utilise the technology themselves driving innovation as well as dispel possible resistance to adoption. This enhancement could be in the form of standard university courses, but also other mechanisms for training and application.

2. **Infrastructure Investment for the growth of AI capability**
   The Midlands requires to improve its digital connectivity and infrastructure related to this. The growth of AI is also reliant on digital infrastructure. As AI technology is embedded into the operations and service offerings of businesses then further infrastructure developments will be required to grow the AI driven economy. The research in this report has also identified that a good digital infrastructure will be useful for startups and to attract companies from outside the Midlands and internationally.

3. **Change of HMRC SIC codes to represent AI companies.**
   When researching this report, it was evident that it is extremely difficult to identify AI companies or AI related companies from Companies House and other business datasets. It is recommended that the government / HMRC setup a separate SIC code for companies working within the AI domain who identify as AI or AI related companies.

4. **Ethical and Sustainable AI Development**
   Implementing Ethical and sustainable policies is extremely important as the use of AI increases within new products and service offerings. Ethicality has wider implications for EDI and hence it is important for the Midlands to lead on embedding ethical policies within the use of AI. Sustainability considerations from the aspects of energy, circularity, and carbon emissions will need to be considered as the Midlands grows its AI based economy.

5. **Venture Capital and government support**
   For the growth of the AI sector and primarily startups within this sector, it will be useful for the Midlands to setup a funding / venture ecosystem (see Figure 8.1). The respondent sin this research discussed the lack of venture funding in the Midlands and the impact it has on the growth of technology companies when compared to other regions on the UK and primarily Silicon Valley in the USA.

To create an AI innovation ecosystem in the Midlands pre-existing industry / speciality needs to be developed. Initial government investment is key as well as identifying large well-established businesses in the region that can act as a backbone for smaller start-ups. From this a strong cultural and economic identity can be formed that will influence the common goals for the ecosystem to work towards. The process is adapted from the funnel method for outlining innovation, (Davis et al. 2023).

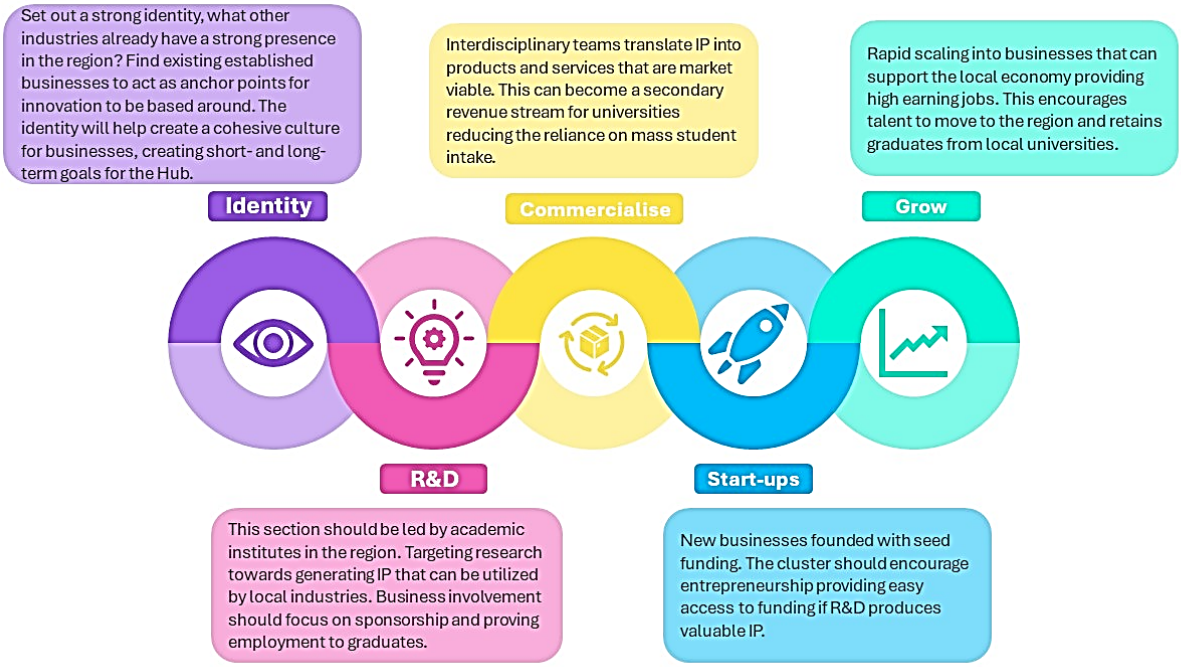


Fig 8.1: Developing an innovation ecosystem

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MIDLANDS ENGINE

Trent Bridge House
Fox Road
West Bridgford
Nottingham
NG2 6BJ

info@midlandsengine.org

@MidsEngine
midlands-engine
midlandsengine.org

The Midlands Engine is a coalition of local authorities, local enterprise partnerships, universities and businesses across the region, actively working with government to build a collective identity, to enable us to present the Midlands as a competitive and compelling offer that is attractive at home and overseas.

Our mailing address is: Midlands Engine, Trent Bridge House, Fox Road, West Bridgford, Nottingham, NG2 6BJ