A Final Report
September 2025

The Greater Manchester Science & Innovation Audit – Refresh 2025

steer economic development

DMS RESEARCH & CONSULTING

INNOVATION GREATER MANCHESTER

GMCA GREATER MANCHESTER COMBINED AUTHORITY

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The Greater Manchester Science & Innovation Audit – Refresh 2025

Prepared by:

Steer Economic Development
5th floor, 61 Mosley St
Manchester
M2 3HZ

+44 113 389 6444

www.steer-ed.com

Prepared for:

Greater Manchester Combined Authority
Tootal Building
56 Oxford St
Manchester
M1 6EU

Client ref: GMCA1200

Our ref: 24844301

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1 Introduction

Purpose of this report

1.1 This Science and Innovation Audit (SIA) presents refreshed analysis of Greater Manchester's (GM) science, technology and innovation (ST&I) strengths and assets. It identifies the key capabilities that can drive accelerated growth in GM and deliver on the Greater Manchester Combined Authority's (GMCA) ambitions for 'good growth' which increases access to opportunity, improves living standards, reduces poverty, and improves health and wellbeing.

1.2 The original SIA for GM and Cheshire East in 2016 was a pivotal moment in GM's devolution journey. It set the foundation for much activity that public sector agencies, universities, and businesses have taken in the decade since to enhance the innovation ecosystem and drive innovation-led growth. This led to the establishment of Innovation Greater Manchester

1.3 The original SIA identified five key areas of strength on which to focus GM's efforts to accelerate innovation and productivity growth:

- Advanced Materials;
- Digital;
- Energy;
- Health Innovation; and
- Industrial Biotechnology.

1.4 These strengths have shaped the focus in GM's Local Industrial Strategy and Local Innovation Plan, with a consistent focus on the 'frontier sectors' of Sustainable Advanced Materials and Manufacturing; Health Innovation and Life Sciences; Digital and Creative; and Net Zero.

Drivers for the 'refresh'

1.5 Since 2016, Greater Manchester's innovation system has undergone substantial changes in scale and character. The original SIA identified clear strengths in Health Innovation and Advanced Materials, alongside emerging potential in Digital and Low Carbon sectors. What followed the SIA was a deliberate period of asset building, anchored by significant public and private investment in new research centres and translational facilities.

1.6 The development of nationally significant institutes and infrastructure has been matched by the growth of soft infrastructure including the establishment of Innovation Greater Manchester (IGM) as a coordinating body, the launch of the Innovation Accelerator in 2023, and the strengthening of civic-university-business partnerships (which includes Innovation Greater Manchester (IGM), Oxford Road Corridor Partnership, and CityLabs 2.0 and 4.0). The GM universities have also established a Civic University Agreement with GMCA and the 10 constituent local authorities to drive social and economic change in the city region.

1.7 The completion of the Henry Royce Institute Hub and the Graphene Engineering Innovation Centre (GEIC) between 2018 and 2020, respectively, elevated Greater Manchester's status as a national centre for materials science. In parallel, Health Innovation Manchester matured into a regional platform, bringing together NHS, academic, and civic institutions to accelerate health R&D. The arrival of global firms like QIAGEN, the launch of Salford's Energy House 2.0, and the recent expansion of the Pankhurst Institute into community-facing digital health innovation further signal the region's ability to align infrastructure with strategic sectors.

Objectives for the 'refresh'

1.8 Against this background, the objectives in commissioning the refresh can be summarised as follows:

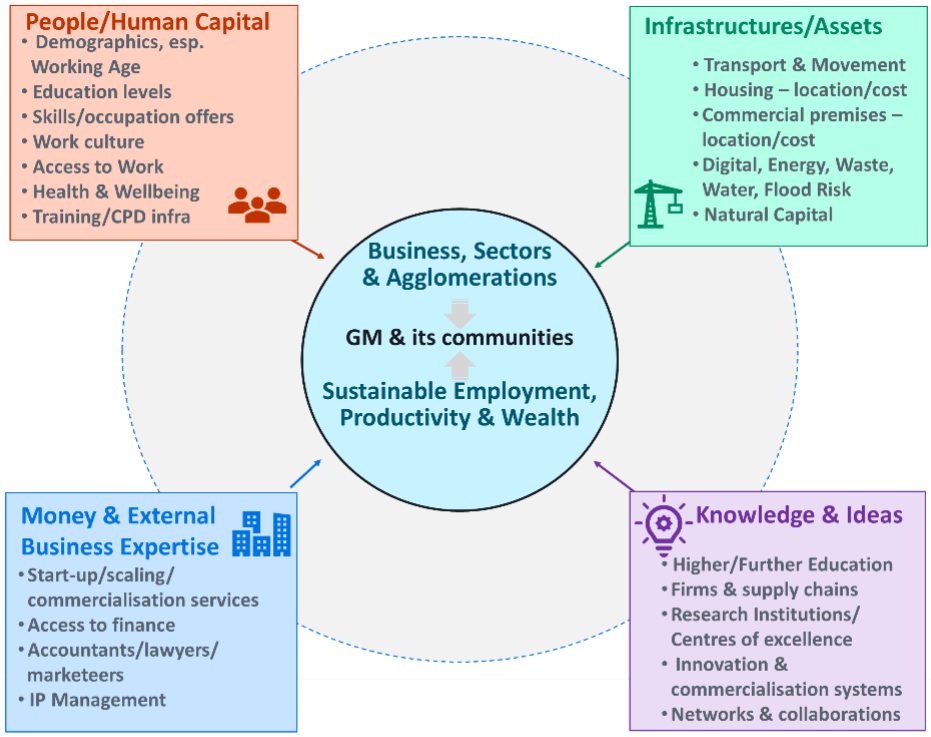
- Deliver an up-to-date assessment of the region's science, technology and innovation capabilities;
- Identify opportunities and challenges faced by the innovation ecosystem in Greater Manchester; and
- Take a wider approach than the original audit, particularly considering private sector strengths and inclusive innovation, which focuses on equitable benefits across all of society.

Additional thinking for the 'refresh'

1.9 This refreshed SIA builds on the original version, but uses a broader definition of innovation and its impacts. Whilst recognising that science and technology-based innovation remains fundamental to generating new ideas, products and services, this study takes a wider ecosystem view, more explicitly capturing innovation led by the private sector and innovation benefiting the public sector. A conceptual depiction of the economic ecosystem in Greater Manchester is given in the figure below.

1.10 Crucially, this also considers the wider benefits of innovation, beyond driving economic growth only. It considers the societal impacts innovation can have on people and communities– both through creating growth, but also through ensuring that benefit is shared equitably across all of society. It takes a more inclusive look at how innovation can address societal challenges and can help improve outcomes for underserved groups in domains such as health, wellbeing and access to opportunity.

Figure 1-1: Conceptual depiction of the economic ecosystem in GM



Source: Steer-ED, 2025

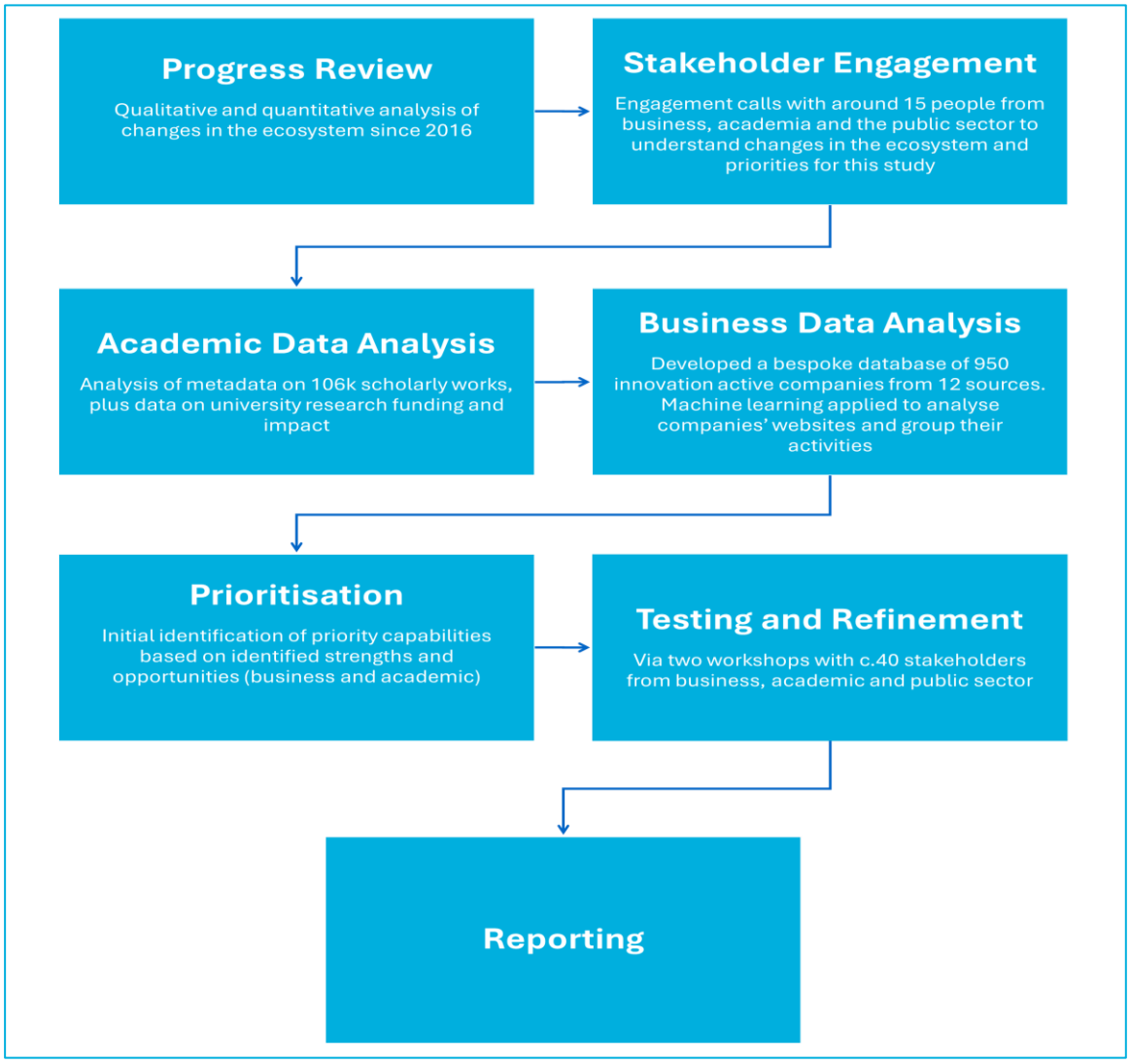
Work done

1.11 The study has deployed a mixed methods approach, combining:

- Analysis of socioeconomic data to understand progress since 2016;
- Extensive stakeholder engagement to sense check the study context, approach, and emerging findings; and
- Detailed analysis synthesising data from a range of sources on academic research and the business base to understand GM's strengths and opportunities.

1.12 The below diagram shows the stages of work undertaken. Key analytical approaches are described in more detail throughout the report.

Figure 1-2: Overview of the method for producing the 2025 SIA 'refresh'



Source: Steer-ED, 2025

Structure of this report

1.13 The below sets out the structure of the remaining chapters of this report and what each does:

- **Chapter 2: Progress since 2016** – headlines in terms of progress on key socioeconomic and innovation ecosystem indicators since the original SIA;
- **Chapter 3: GM's Innovation Ecosystem** – articulation of the current position of the ecosystem and how this has changed since 2016;
- **Chapter 4: GM's Academic Science & Innovation Capabilities** – detailed analysis of current strengths in academic research and science;
- **Chapter 5: Science & Innovation capabilities in GM's Industries** – detailed analysis of the business landscape in GM with a focus on innovation-active companies and their capabilities;
- **Chapter 6: GM's Primary Capabilities –** describes the process for arriving at a set of primary capabilities for GM, and the priorities that arise from this; and
- **Chapter 7: Recommendations** – based on the findings of this study.

2 Innovation in GM - progress since 2016

Overview

This Chapter provides headline analysis on progress against key socioeconomic and innovation ecosystem indicators since the original 2016's SIA. In particular, it focuses on:

- Output and productivity;
- Incomes and deprivation;
- Sectoral trends and the business base;
- Innovation and knowledge exchange; and
- Skills and education.

Introduction

2.1 By examining core indicators of economic performance such as Gross Value Added (GVA), employment rates, business activity, educational attainment, and investment trends, the material highlights the strengths and challenges shaping GM's innovation trajectory, and the role that science, technology and innovation plays in this.

Output and productivity

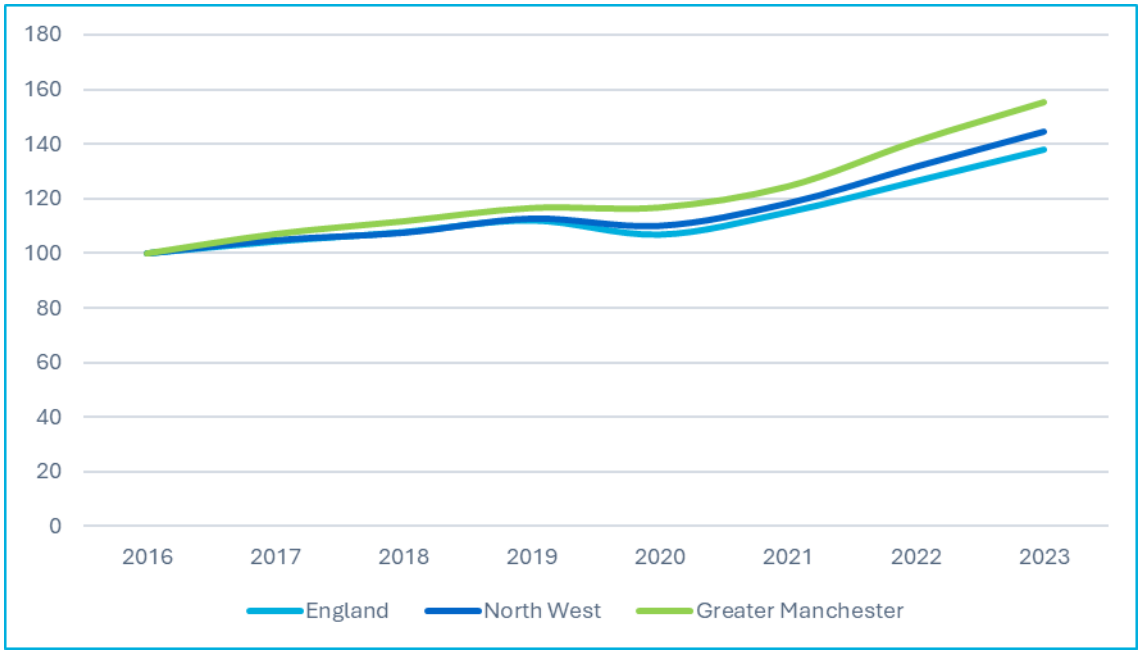
Gross Value Added (GVA)

2.2 With annual economic output of £100bn, GM is the second largest city region in the UK in terms of aggregate GVA, behind only London. Between 2016 and 2023, GM was the fastest growing city region in the UK, with output increasing by 55.2% in current prices, outpacing English growth of 38.1% over the same period. Growth in GVA since 2016 has also outpaced London, which recorded growth of 35.5% over the same period.

2.3 Much of the variation in performance was in the pre-Pandemic period (2016-19), during which time the GM economy grew by 16.6%, compared to 12.5% nationally. However GM has continued to outpace national growth levels - since 2020 output has increased by 32.9% compared to 29.2% across England.

2.4 There was also notable variation in performance during the COVID-19 Pandemic. Whilst national economic output fell by 4.6% between 2019 and 2020, and London's output fell by 7.7%, GM's economy grew slightly (by 0.2%), suggesting a higher degree of resilience in GM compared to other places. Post-Pandemic growth trajectories have been almost identical across the geographies analysed.

Figure 2-1: GVA growth (Index 2016=100) 2016-23

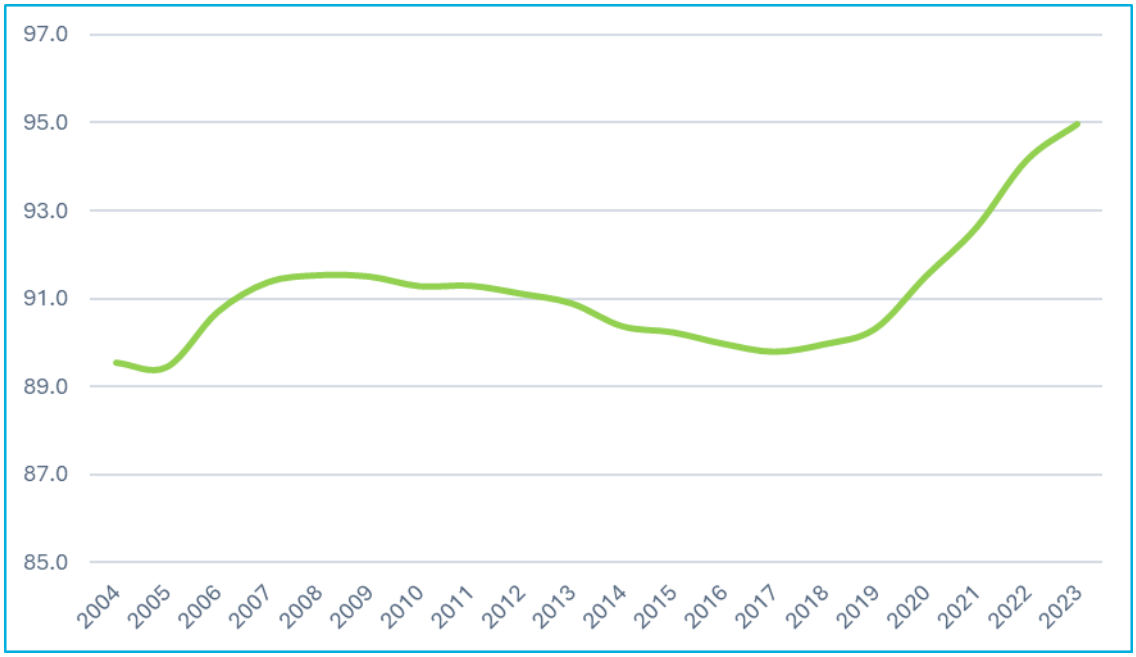


Source: Regional gross value added (balanced) by industry: all ITL regions. ONS. 2025

Productivity

2.5 Growth in productivity (measured as GVA per hour worked) has also been stronger in GM since 2016 than the UK as a whole. Between 2016 and 2023, productivity in GM increased by 32.2%, against a 24.9% increase nationally. There has been a particularly notable closing of the productivity gap between GM and the rest of the UK since 2019. In 2019, output per hour worked in GM was 90% of UK levels. By 2023, this had closed to 95%.

Figure 2-2: Productivity (as measured by output per hour worked) in Greater Manchester (UK=100)



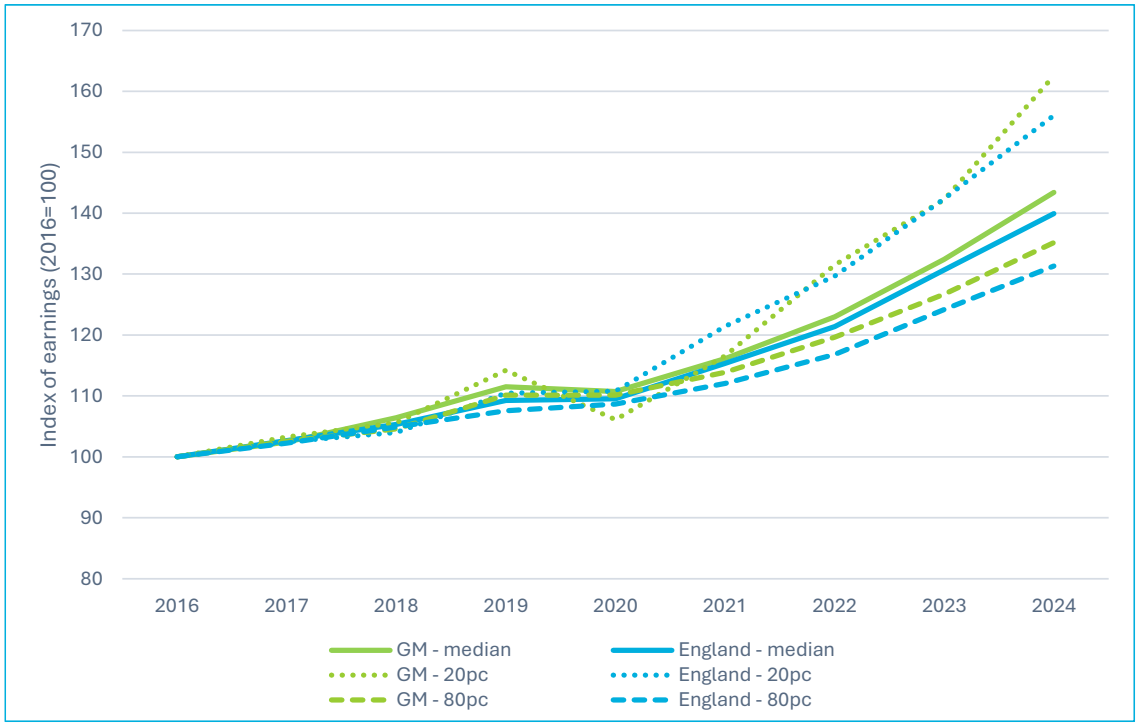
Source: Subregional productivity: labour productivity indices by UK ITL2 and ITL3 subregions. ONS. 2025

2.6 GM's strong productivity growth since 2016 is reflected in a 46.6% increase in GVA per head between 2016 and 2023, again outpacing GVA per head growth across the North West and England. Despite this, GVA per head in GM is below the average across England.

Incomes and deprivation

2.7 As growth and productivity have increased, so too have earnings. Median weekly pay has increased by 43% in GM between 2016 and 2024, slightly ahead of England's 40% increase. Encouragingly, earnings at the 20th percentile (i.e. the lowest 20% of earners), have increased more rapidly than median and upper earners, growing by 63% in GM. In all categories, earnings growth in GM has outpaced that across England.

Figure 2-3: Earnings at the 20th percentile, 80th percentile and median (Index 2016=100) 2016-23



Source: Annual Survey of Hours and Earnings, ONS 2024, Steer-ED analysis, 2025

2.8 Whilst this has helped to narrow the gap between lower earners and those higher up the income spectrum, GM still has significant levels of deprivation. Seven of its ten local authority districts have an above average proportion of lower super output areas (LSOAs) in the most deprived 10% nationally[1]. This is highest in Manchester, where 43% of LSOAs are in the most deprived 10% nationally, followed by Oldham, Salford and Rochdale at 30%.

Sectoral employment and industrial structure

2.9 Over 1.4 million people work in GM, an increase of 182,000 since 2016. Much of this growth has been concentrated in knowledge-intensive services.

[1] Indices of Multiple Deprivation, ONS, 2019

2.10 At the headline level, the Information and Communication sector (which encompasses a substantial amount of the digital economy) has grown by 58.5% - almost four times the growth rate across GM as a whole, and 3.5 times faster than the sector's growth rate nationally.

2.11 Professional, Scientific and Technical Services have also shown strong growth, with employment increasing by 36.1%, approximately 2.5 times faster than the GM economy and the national sector.

2.12 At the same time, total employment has decreased in manufacturing (-2.9%), retail (-5.4%) and transportation and storage (-6.8%). This suggests a realignment of the economy towards knowledge-intensive services since 2016.

Distinctive strengths in GM's employment base

2.13 Looking more closely at GM's industrial structure highlights key differences and specialisms compared to England as a whole. Compared to the national average, GM has significantly higher employment concentrations in specific sectors, as shown by location quotient (LQ) analysis. These include:

- Legal and accounting services (LQ = 2.2);
- Textile manufacturing (LQ = 2.2);
- Programming and broadcasting activities (LQ = 1.8); and
- Chemical manufacturing (LQ = 1.7).

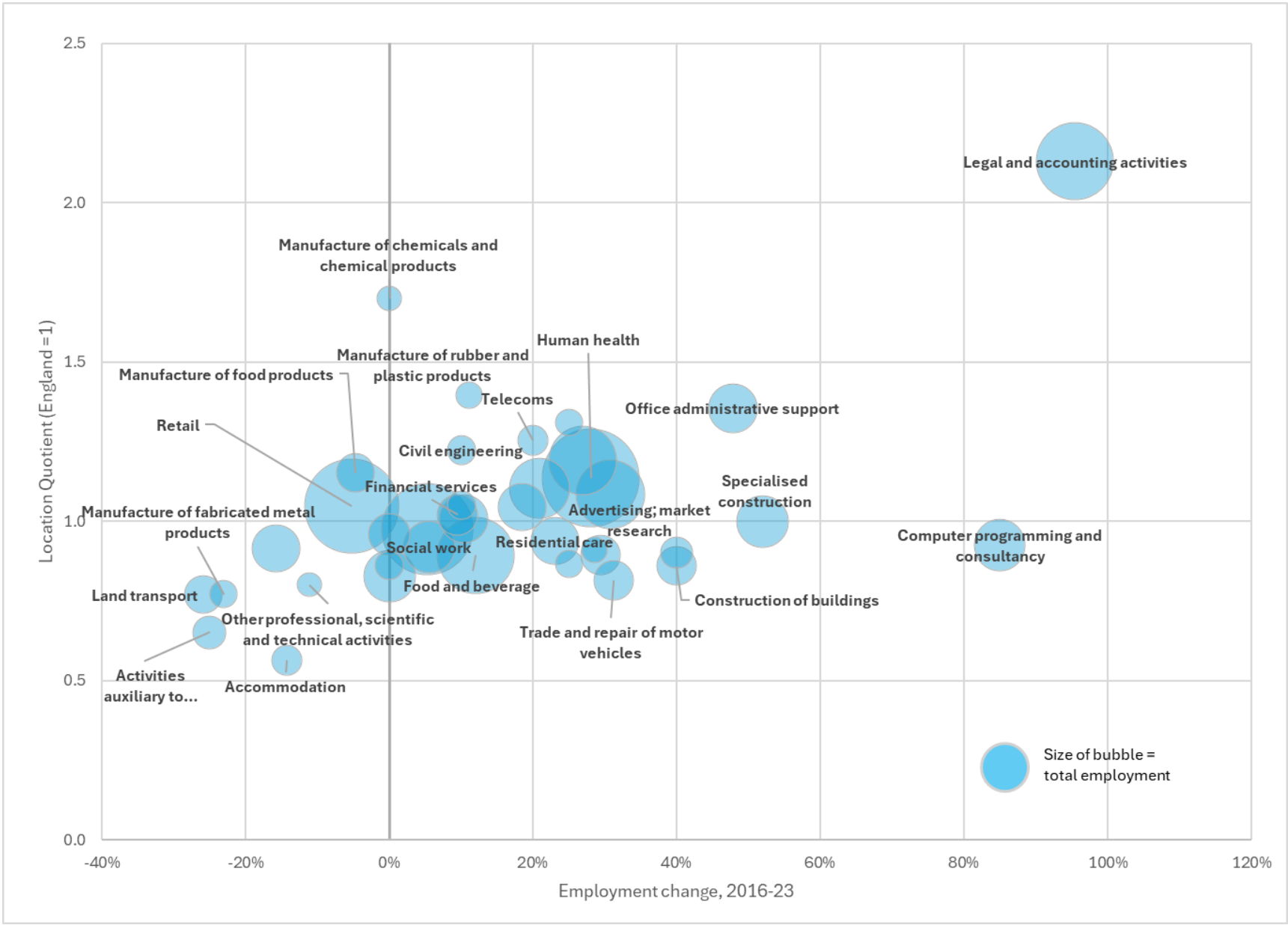
2.14 The fastest-growing sectors[2] include legal and accounting services, which almost doubled in size, with employment rising to 84,000 between 2016 and 2023. Computer programming and consultancy has also seen rapid growth, increasing by 85% to employ 37,000 people in 2023. Service industries make up the vast majority of growth sectors in GM, though specialised construction showed notable growth, increasing by 52%.

2.15 Conversely, a small number of industries have seen employment decline since 2016, including aspects of manufacturing such as metal fabrication (-23%) and food (-5%). Other notable declines are in land transport (-26%), accommodation (-14%) and retail (-5%).

2.16 The below chart shows the scale (bubble size), specialisms (location quotients, vertical axis), and employment growth (2016-23, horizontal axis) in sectors accounting for more than 0.5% of employment in GM.

[2] Analysis focuses on industries accounting for more than 0.5% of employment in GM.

Figure 2-4: Employment strengths by sector (only sectors of note highlighted)



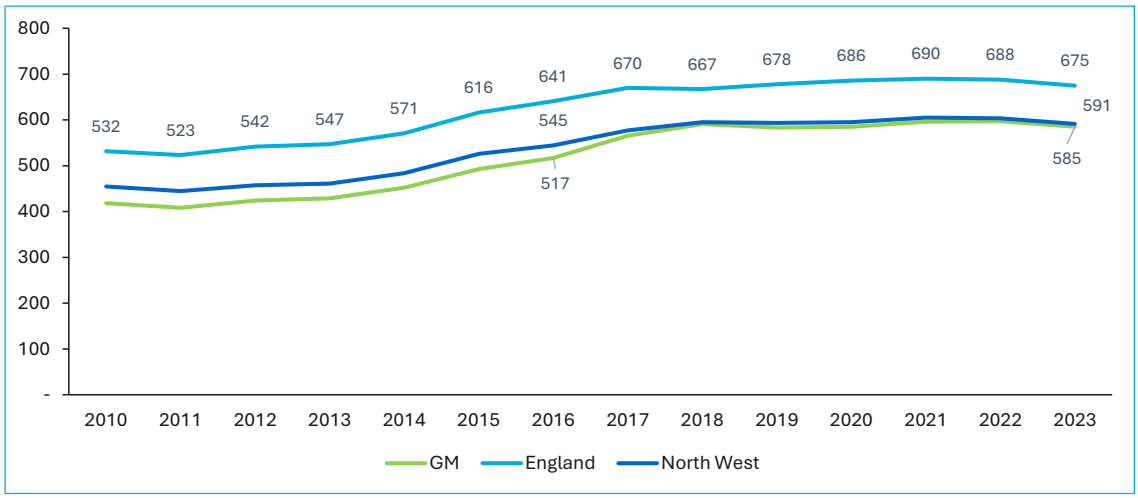
Source: Business Register & Employment Survey, 2023. Steer-ED analysis, 2025

Business base

2.17 As of 2023, there were 105,000 active businesses in Greater Manchester, reflecting a 15.1% increase since 2016 - double the growth rate of England as a whole. Despite this, GM continues to lag behind the North West and England overall in terms of businesses per 10,000 residents.

2.18 Since 2010, the number of active businesses in GM has steadily increased, with particularly strong growth between 2014 and 2018. Growth has since stabilised, with business numbers peaking at 107,250 in 2022, before a slight decline in 2023.

Figure 2-5: Businesses per 10,000 adults (16+)



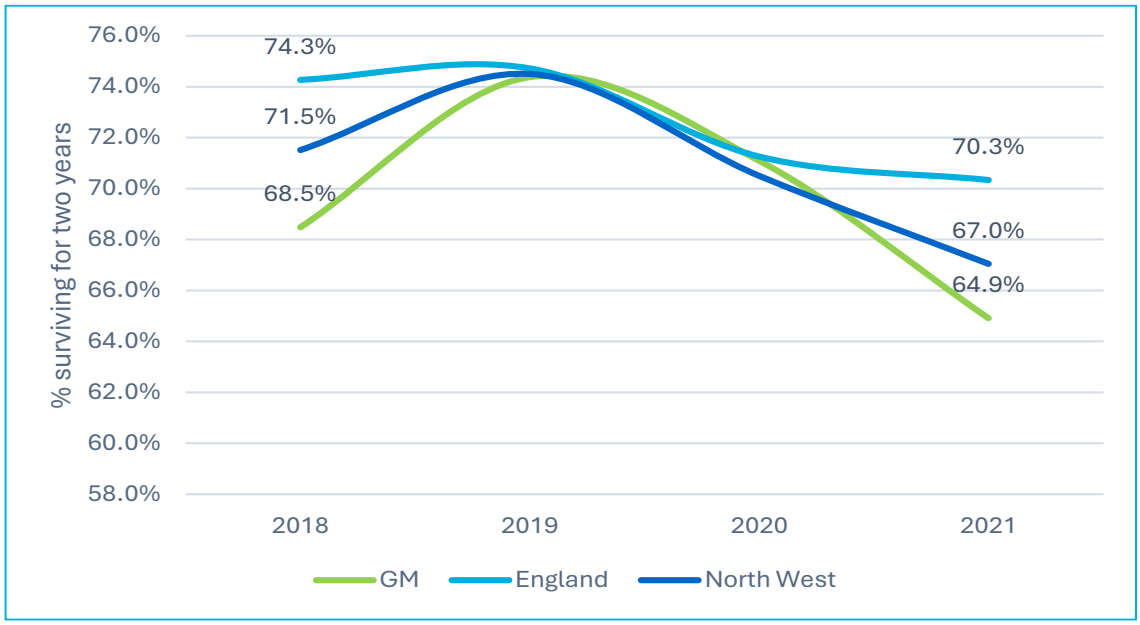
Source: Business Counts UK, ONS 2024, Steer-ED analysis, 2025

2.19 In 2023, there were 14,500 business births in GM, equivalent to 82 business births per working age people, higher than the start-up rates in England (80) and the North West (73). This reflects recent trends in the wider economy of growth in GM outpacing that of the country as a whole. Despite this, GM has a lower rate of active businesses per 10,000 adults than England as a whole (585 vs 675), though as with other indicators this gap has closed since 2016.

2.20 Rates of business survival have declined in recent years, and particularly since the Pandemic. Two-year business survival rates were similar across GM, the North West and England in 2019. However, from 2020 onwards, survival rates began to decline nationally and locally, likely due to economic disruptions caused by the Pandemic, rising costs, and shifting market conditions.

2.21 By 2023, the two-year survival rate had dropped to 64.9% in GM, falling below both the North West (67.0%) and England (70.3%). This decline highlights the growing challenges faced by start-ups and young businesses.

Figure 2-6: Business rate survivals at two years



Source: Business births, deaths and survival rates, ONS data, Steer-ED analysis, 2025

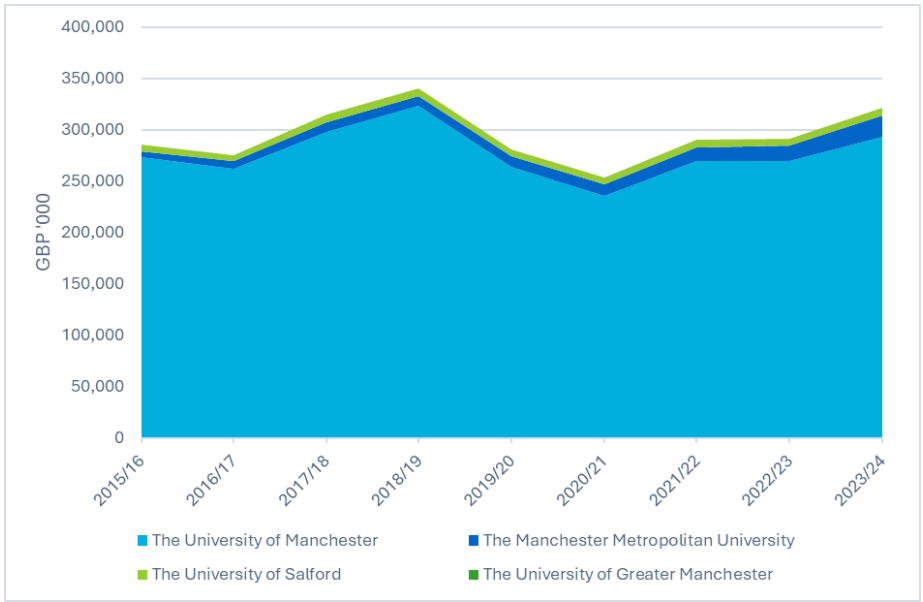
Innovation and Knowledge Exchange

Research grant and contracts funding

2.22 GM universities attracted £322m of research grant and contract funding in 2023/4 – an overall 12.6% increase on funding secured in 2015/16 (£285.9m). However, these figures are not adjusted for inflation. Funding has also fallen from a peak of £341.2m in 2018/19.

2.23 Whilst Manchester Metropolitan University has seen an increase in funding over the past decade, from £6m in 2015/16 to £20.2m in 2023/4, UoM remains the main driver of funding in this space accounting for 91% of research and contract funding in GM in 2023/4.

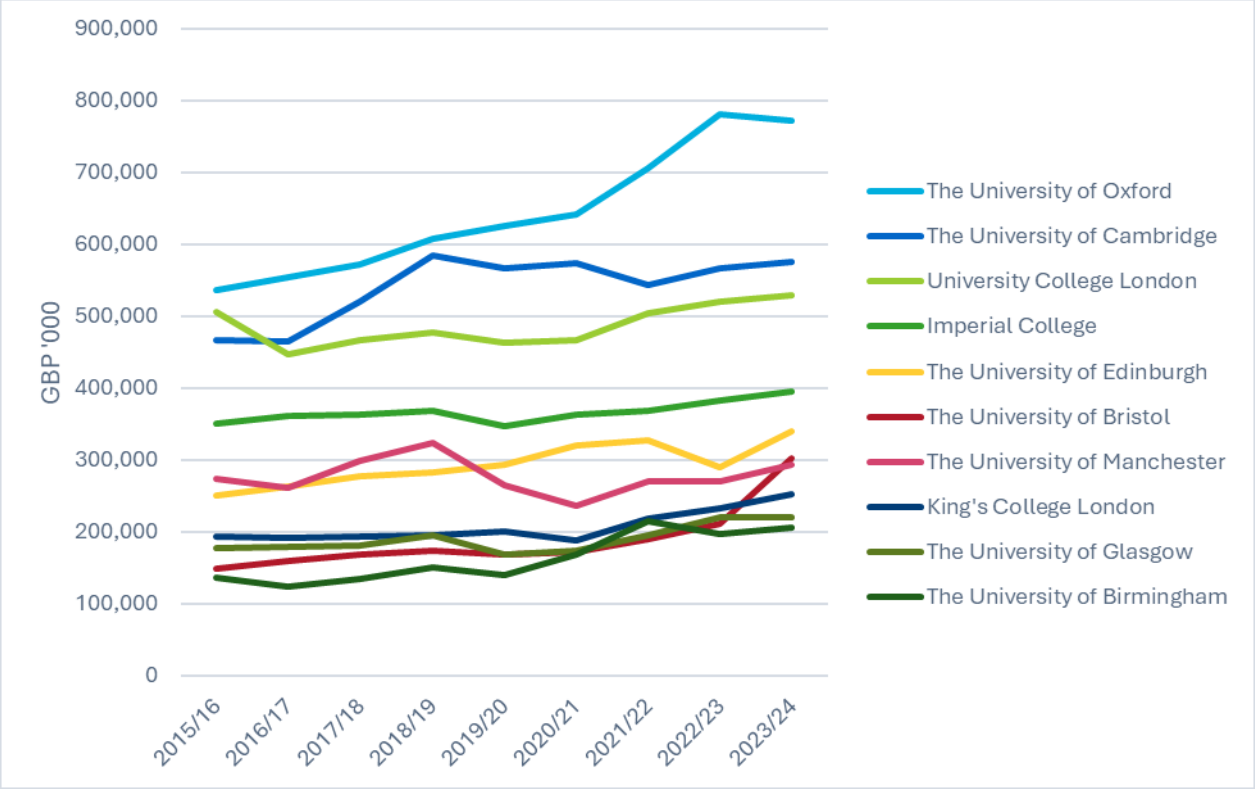
Figure 2-7: Total Research grants and contracts by GM HEI



Source: HESA, 2025

2.24 UoM has seen a notable decline in grant & contract funding since 2018/19 with the total amount funding secured falling from £323.2m to £293.5m. As a result, UoM has been overtaken by the University of Edinburgh and the University of Bristol in the value of grant and contract funding since 2020, pushing UoM to 7th place nationally .

Figure 2-8: Top 10 universities for research grants and contracts funding



Source: HESA, 2025

2.25 Looking in more detail at the sources of research and grant funding, £142.6m of this came from UK Research Councils in 2023/24 – an increase of 27.5% compared to 2016/17. The Engineering and Physical Sciences Research Council (EPSRC) is the biggest driver of this, increasing by 38.4% and accounting for 41.4% of Research Council funding to GM.

2.26 Whilst funding from UK public sector bodies has increased by 62.3% since 2016/17m, funding from UK industry, commerce and public corporations has fallen by 11.8%. Funding from non-UK sources has declined by 11.8% over the same period.

Table 2-1: Research grant and contracts funding to GM universities, by source (£m)

Source of funding	16/17	17/18	18/19	19/20	20/21	21/22	22/23	23/24	Change, 16/17-23/24
Biotechnology and Biological Sciences Research Council	16.2	15.7	12.4	11.9	7.1	6	11.8	15.4	-4.9%
Medical Research Council	20.6	15	13.9	9.7	7.7	9	16.9	18.4	-10.7%
Natural Environment Research Council	6	7.3	6.4	5.9	3.4	4.5	9	10.7	78.3%
Engineering and Physical Sciences Research Council	42.7	64.2	86.6	65.2	37.4	44	52.1	59.1	38.4%
Economic and Social Research Council	6.5	6.9	6.8	7	6.3	5.6	7.8	9.4	44.6%
Arts and Humanities Research Council	2.5	2.9	3.4	3.4	4.2	2.9	4.9	5.9	136.0%
Science and Technology Facilities Council	13.7	10.9	14.5	13.4	9.4	8.9	13.4	15.1	10.2%
UKRI Research England			5.9	0	2.9	4.4	1.6	0.7	-
Other Research Councils	3.6	4.3	4.4	5.1	27.3	38.8	6.5	7.9	119.4%
Total Research Councils	***111.8***	***127.1***	***154***	***121.6***	***105.8***	***124.1***	***123.9***	***142.6***	***27.5%***
UK-based charities	53.8	58.6	60.6	57.5	53.8	61.6	57.4	56.7	5.4%
UK central government bodies/local authorities, health and hospital authorities	37.7	41.1	48.6	37.5	39	44.9	49.1	61.2	62.3%
UK industry, commerce and public corporations	26.2	21.5	26.4	22	15.7	16.3	18	23.1	-11.8%
UK other sources	1.5	2.1	1.6	1.5	2.3	1.5	1.2	1.7	13.3%
Other non-UK sources	45	64.6	49.9	41	37.4	42.7	41.4	36.7	-18.4%
Total	**276**	**315**	**341.2**	**281.3**	**253.8**	**290.1**	**291.4**	**322**	**16.7%**

Source: DMS analysis of HESA Table 5 – Research grants and contracts – breakdown by source of income and HESA cost centre 2015/16 to 2023/24

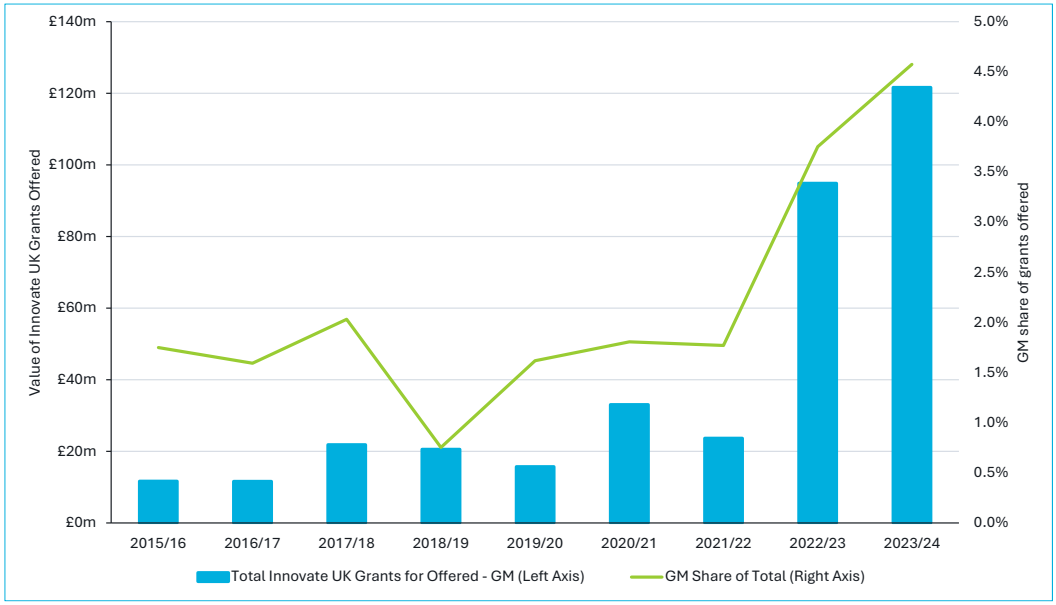
Innovate UK grants

2.27 GM has seen a substantial increase in Innovate UK (IUK) administered grant funding in terms of both value and the number of grants awarded since 2015/16. The fact that funding for GM's Innovation Accelerator is funnelled via IUK is an important factor in this.

2.28 The total number of grants awarded to GM organisations has fluctuated but has shown an overall upward trend, rising from 163 grants in 2015/16 to a peak of 316 in 2022/23. Similarly, the total value of IUK grants awarded to GM has grown significantly, increasing tenfold from £12m in 2015/16 to £121m in 2023/24. This growth represents a 3.3 percentage point increase in GM's share of total IUK funding, with 4.6% of all IUK grants now allocated to GM organisations.

2.29 Figure 2-9: Total value of IUK grants to GM shows a particularly sharp increase in funding in recent years. The value of grant awards values jumped from £24m in 2021/22 to £122m 2023/24. This suggests that, not only has GM been securing more grants, but the average value of each award has also increased, reflecting a stronger focus on high-impact innovation projects.

Figure 2-9: Total value of IUK grants to GM



Source: Innovate UK funded projects, UKRI data (2025), Steer-ED Analysis, 2025

2.30 Looking at the IUK funding streams driving funding in GM (

2.31 Figure 2-10: Innovate UK funding to GM by value, 2015/16 - 2023/24) shows that funding in recent years has largely been concentrated in a small number of high value projects and programmes. The three biggest factors are:

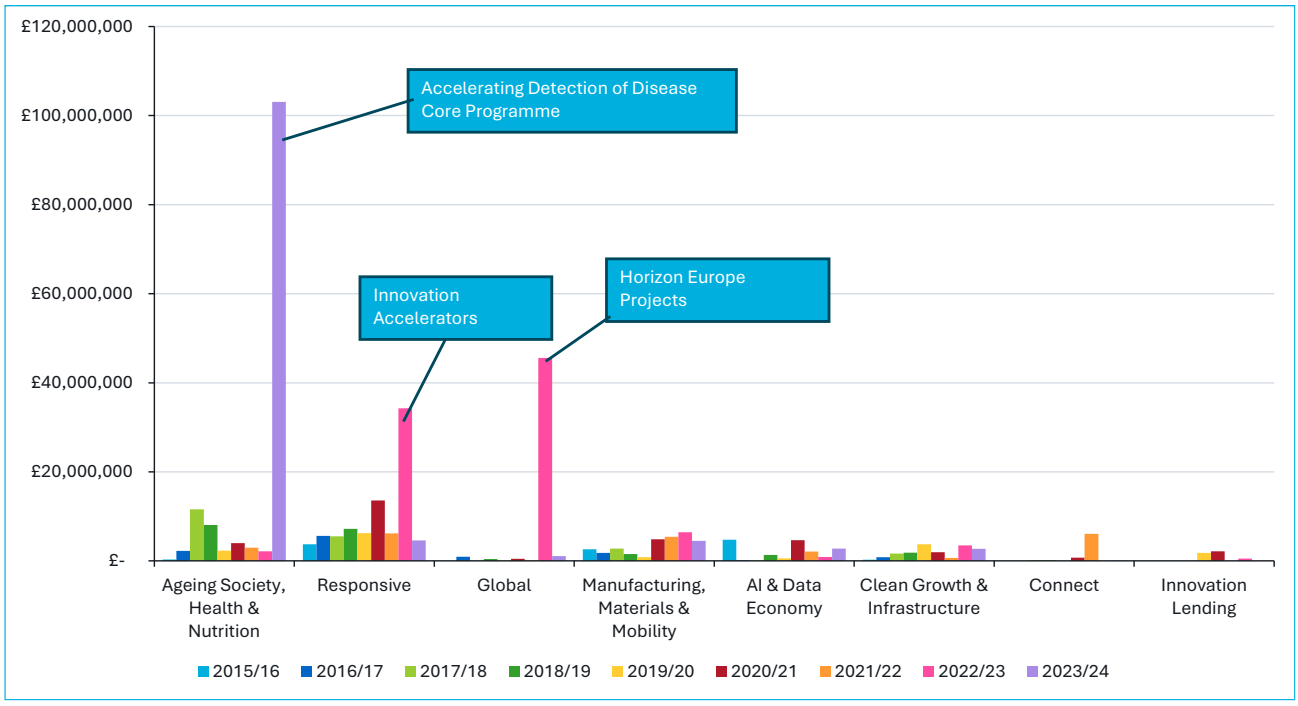
- £99m in 2023/24 for the Accelerating Detection of Disease / Our Future Health programme – the UK's largest health research programme.
- £46m for Horizon Europe in 2022/23 – guaranteeing funding for successful UK bids whilst the UK's post-Brexit association with the programme was agreed
- Innovation Accelerator has also been a key driver, supporting ten projects:
  - **Future Homes**, **University of Salford** - novel net-zero solutions for both new-build and existing homes
  - **Turing Innovation Catalyst**, **University of Manchester** - catalysing the AI ecosystem

- **Energy Accelerator for Non-Domestic Buildings, Energy Innovation Agency** - accelerating deployment of low-carbon innovations in commercial and public buildings
- **GM Advanced Diagnostics Accelerator, Health Innovation Manchester** - bridging research and clinical implementation to improve diagnostics and outcomes
- **Greater Manchester Electrochemical Hydrogen Cluster**, **Manchester Metropolitan University** – technical innovation in hydrogen energy and building SME capacity for its adoption
- **AR EdTech for Hydrogen**, **The Blair Project** - an immersive AR/AI-enabled edtech platform for scalable, inclusive hydrogen skills training
- **Centre of Expertise in Advanced Materials and Sustainability (CEAMS),** Rochdale Development Agency - establishing a major R&D and commercial facility to accelerate sustainable materials innovation
- **Centre for Digital Innovation, Manchester Metropolitan University** – driving industry-academic collaboration in AI, Cyber, Industrial Digitisation and Immersive Tech
- **DEVOTE**, **University of Manchester** - accelerating time-critical genomic diagnostics by enabling rapid genetic tests
- **MediaCity Immersive Technologies Innovation Hub, The Landing at MediaCityUK Ltd** - people-centred immersive tech hub to drive R&D in immersive applications

2.32 If these one-off sources of funding are removed and funding through these funding streams remained consistent with the average for previous years, GM would have received £20.6m in 2022/23 and 2023/24. This would still reflect a substantial increase on £11.6m in 2015/16, but would be some way below the peak of £32.4m in 2020/21.

2.33 Therefore, whilst welcome, the highly concentrated nature of these grants raises questions as to how far this reflects a persistent and sustained uptick in research-driven innovation in GM, or whether it is a short-term impact. Following on from the successful Innovation Accelerator Pilot Programme, the Local Innovation Partnership Fund, announced at the Spending Review 2025, will be introduced to continue locally focused place-based innovation activity, providing some assurance over sustained funding in this space.

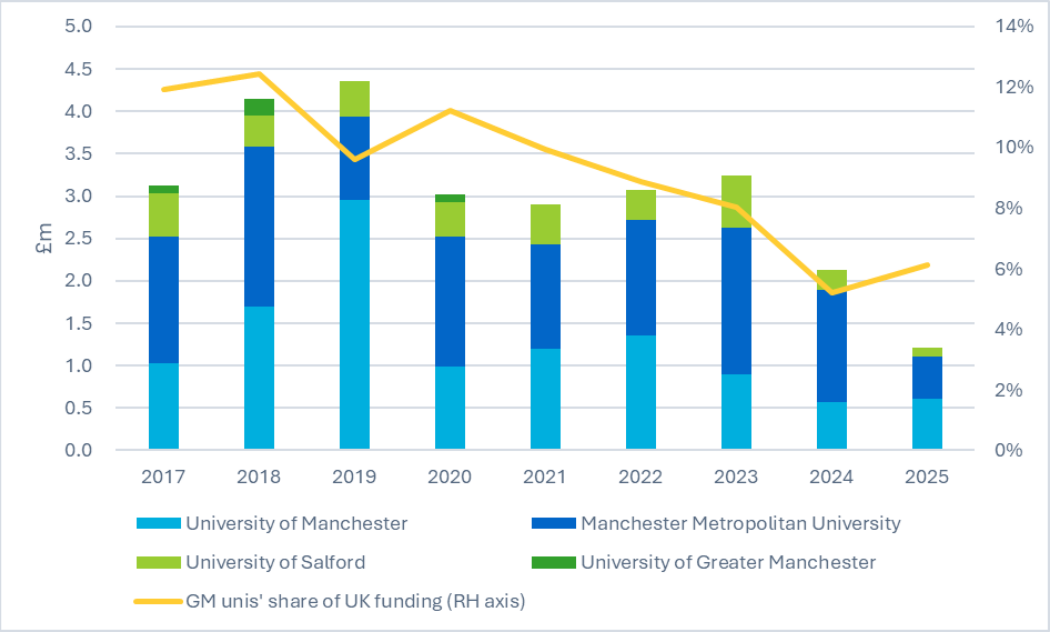
Figure 2-10: Innovate UK funding to GM by value, 2015/16 - 2023/24



Source: Innovate UK funded projects, UKRI data (2025), Steer-ED Analysis, 2025

2.34 Focusing specifically on Knowledge Transfer Partnership (KTP) funding from Innovate UK, GM's universities have accounted for 8.5 per cent of the UK's KTP funding since 2017: almost double GM's 4.3 per cent share of UK population. Although this share has decreased since 2018 (Figure 2-11), it remains well above GM's share of the population.

Figure 2-11: Innovate UK KTP award amounts by project start year

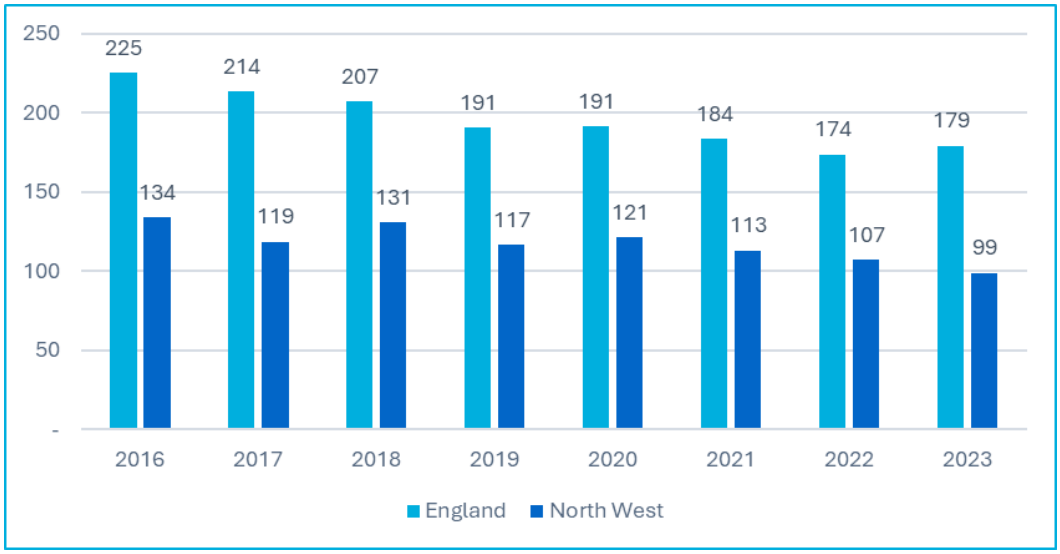


Source: Innovate UK funded projects, UKRI data (2025), DMS Analysis, 2025

Patents

2.35 England has outperformed the North West consistently in terms of patent filings. Between 2016 and 2023, England saw a gradual decline in patent activity, dropping from 225 patents per million people in 2016 to 179 in 2023. The North West followed a similar trend but with significantly lower figures, starting at 134 patents per million in 2016, falling to 99 in 2023. Unfortunately, patent data is not available at the GM level.

Figure 2-12: Number of patent applications per 1m people

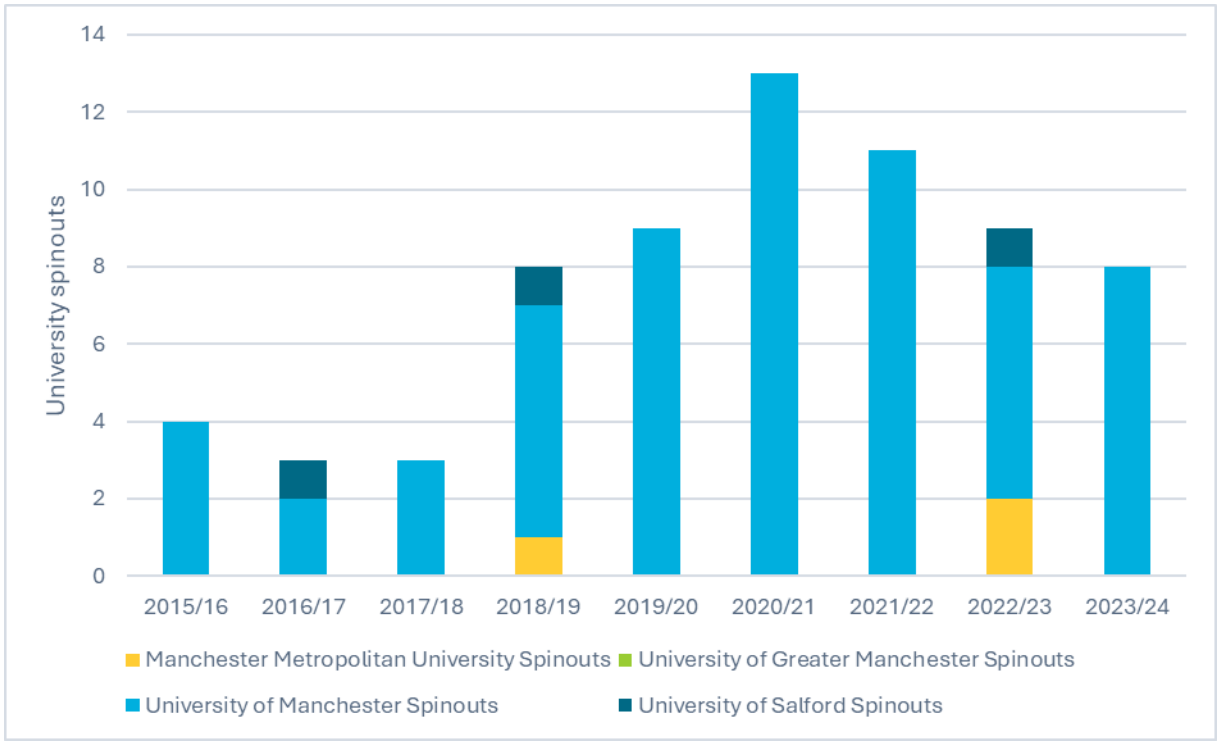


Source: UK Government IPO Data (2018-24), Steer-ED Analysis, 2025

University startups and spinouts

2.36 Figure 2-13 shows the University of Manchester is responsible for the vast majority of spinouts from GM universities, accounting for 62 of 68 spinouts since 2015/16. There has been an increase in spinouts in GM, from an average of 3.3 per year in 2015/16 to 2017/18, to an average of 9.7 per year in the years since. It has, however, dipped from a peak of 13 in 2020/21 to 8 in 2023/24.

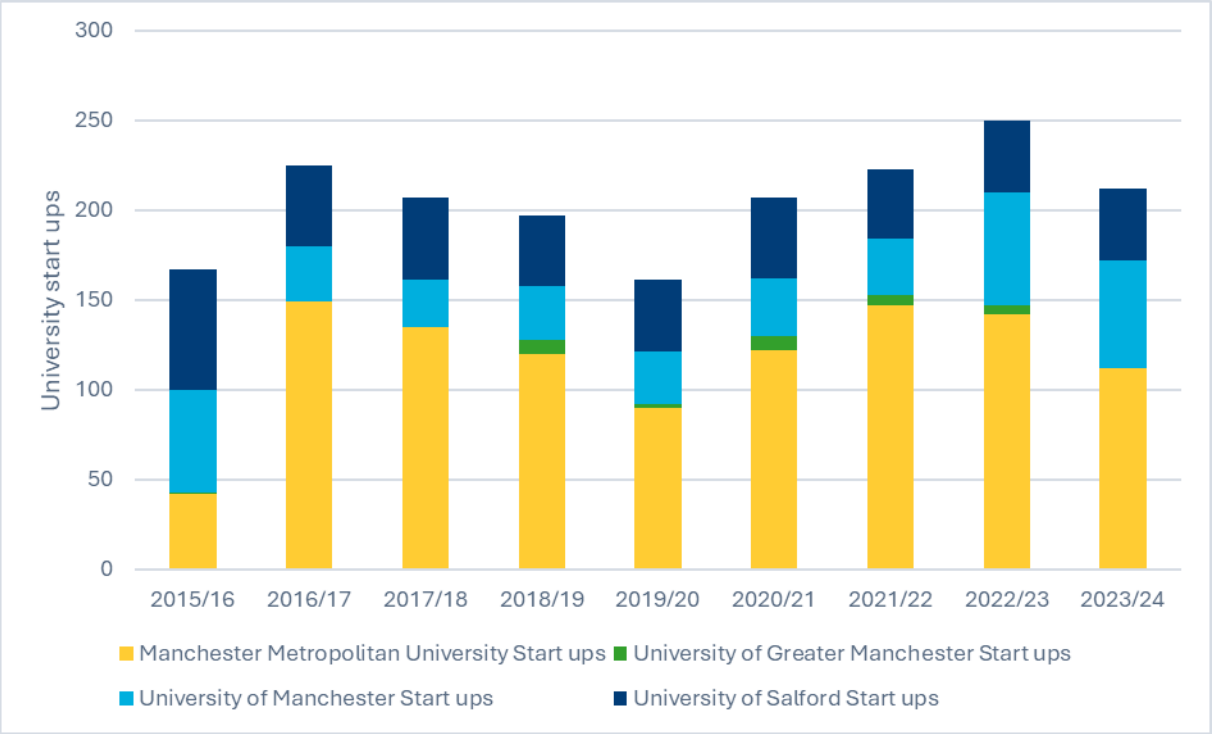
Figure 2-13: Spinouts from GM Universities in 2015/16 to 2023/24



Source: HESA data on start-ups and spinouts, Steer-ED analysis, 2025

2.37 The distribution of startups[3] across GM HEIs is more even but is dominated by Manchester Metropolitan University, from which 1,059 startups have emerged since 2015/16 and over 500 since 2020/21. University of Salford has produced 401, and University of Manchester 359 since 2015/16.

Figure 2-14: Startups from GM universities, 2015/16 - 2023/24

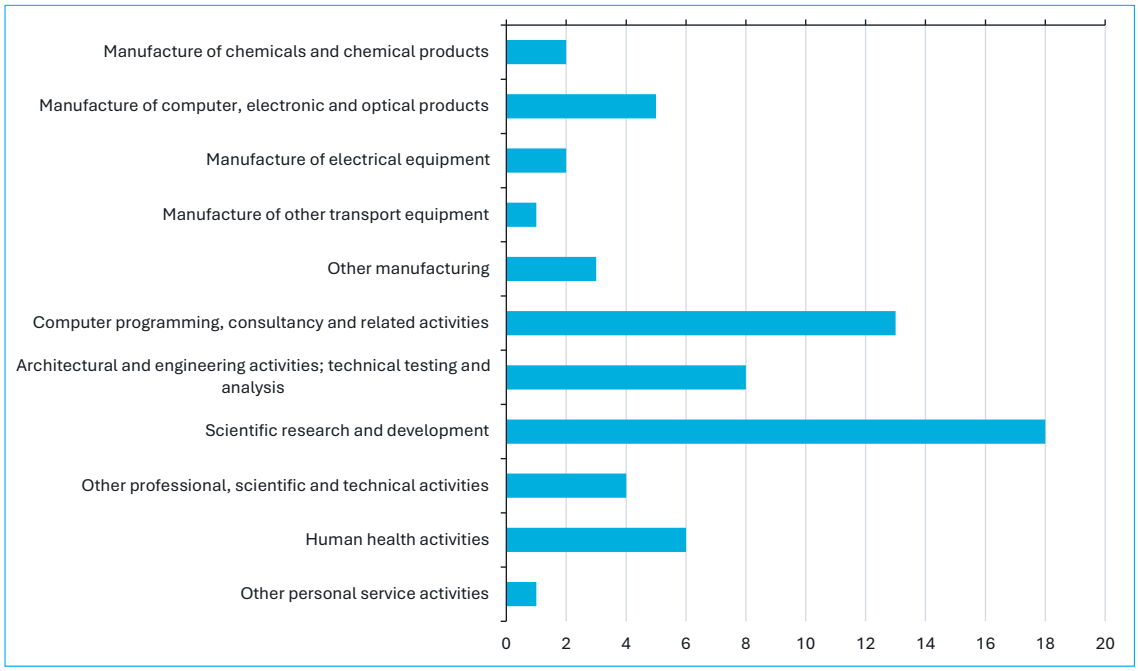


Source: HESA data on startups and spinouts, Steer-ED analysis, 2025

2.38 Looking at the activities of spin outs from GM's universities since 2015/16 shows that 13 (20%) are manufacturers – and seven of these are focused on computer, electronic or electrical products. A further 13 are engaged in computer programming, and six are health spin outs. The biggest category, however, is for the 18 spin outs working in scientific R&D.

[3] Startups in this context means businesses started by active of recent HE staff or by active or recent students who have received formal business/enterprise support from the HEI.

Figure 2-15: GM spin outs by SIC code



Source: Steer-ED analysis of HESA Spinouts Register, using Moody's FAME database, 2025

2.39 Spinouts from GM universities with more than 20 employees are shown below in (Table 2-2) below. Notably, only one of these was founded after 2016, emphasising that growing from start up to significant scale is usually a gradual process. All GM spinouts employing more than 20 people are in either professional, scientific and technical activities or research and development industries.

Table 2-2: GM spinouts with 20+ employees

Company name	Foundation year	SIC Code description	Employees
NORTHWEST EHEALTH LIMITED	2016	Other professional, scientific and technical activities	106
F2G LIMITED	2001	Research and experimental development on biotechnology	72
GENTRONIX LIMITED	1999	Other professional, scientific and technical activities	64
VERSARIEN PLC	2014	Engineering design activities for industrial process and production	64
REACTA BIOTECH LIMITED	2015	Research and experimental development on biotechnology	55
C4X DISCOVERY LIMITED	2008	Other research and experimental development on natural sciences and engineering	47
NANOCO TECHNOLOGIES LIMITED	2003	Other research and experimental development on natural sciences and engineering	46
GENEDRIVE PLC	2007	Research and experimental development on biotechnology	43
IMORPHICS LIMITED	2002	Other information technology and computer service activities	30

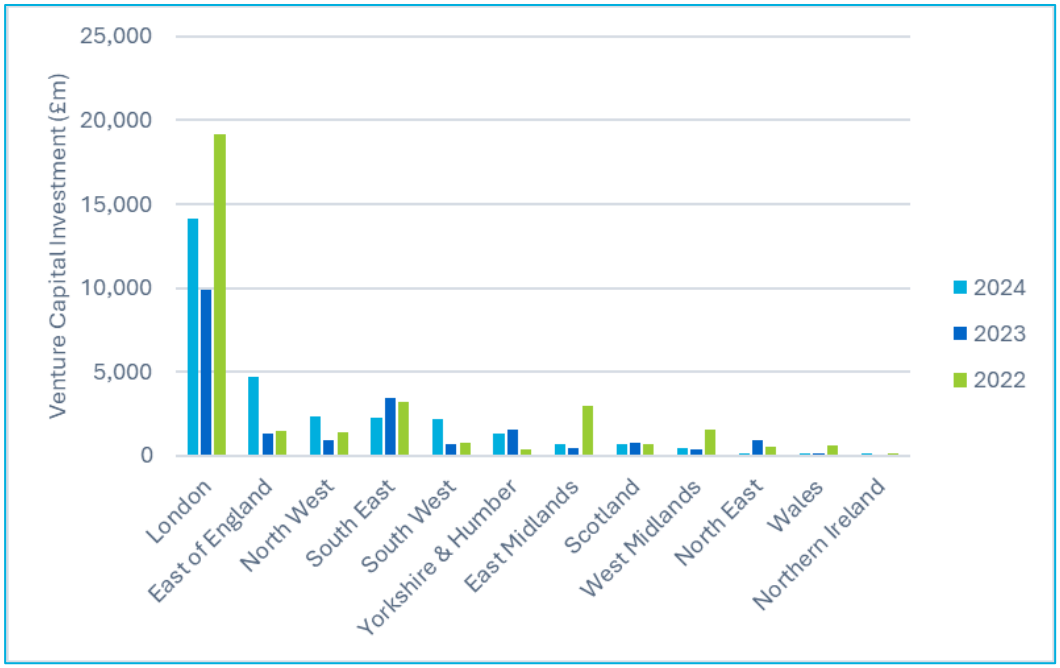
PHAGENESIS LIMITED	2007	Other research and experimental development on natural sciences and engineering	26
GRAPHENE INNOVATIONS MANCHESTER LIMITED	2021	Other research and experimental development on natural sciences and engineering	21

Source: Steer-ED analysis of HESA Spinouts Register, using Moody's FAME database, 2025

Venture capital (VC) and private equity investments

2.40 City region level data on investment trends is limited, but data from the British Venture Capital Association shows that the North West is the third most attractive region for venture capital (VC) investment outside of London and the East of England in 2024. The North West overtook South East England in 2024. Over the three-year period between 2022-4, almost £4.6bn was invested in 331 companies in the North West. This is up from £2.6 billion invested in 210 companies headquartered in the region from 2017-19.

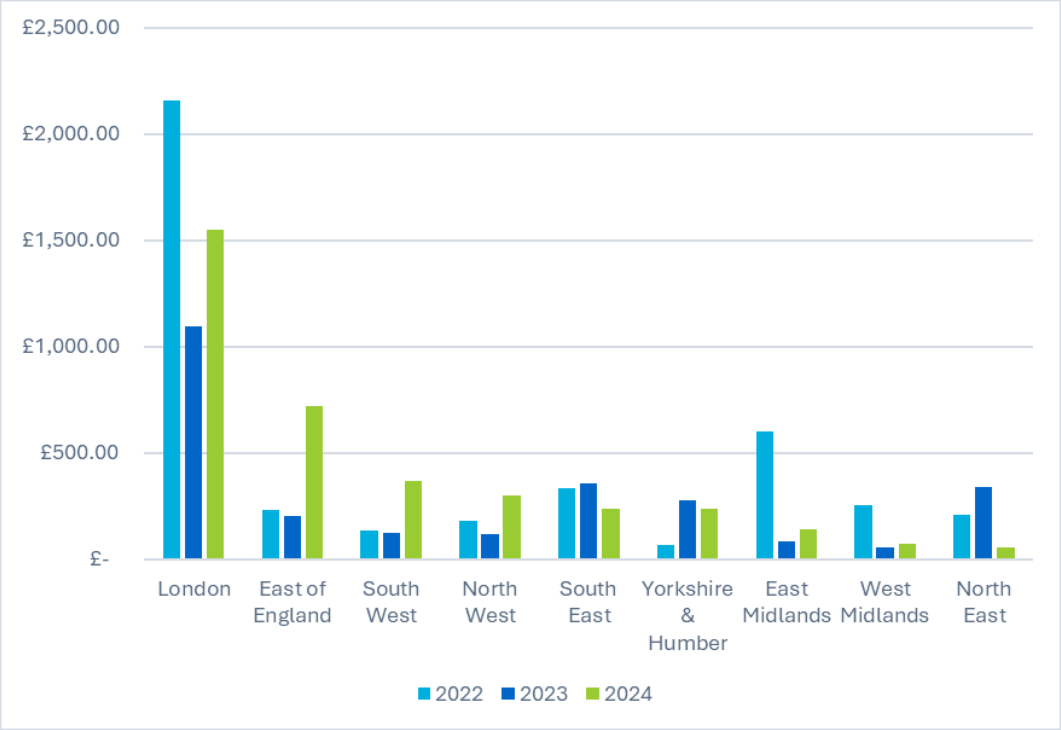
Figure 2-16: Venture capital investment by region



Source: Report on Investment, British Venture Capital Association, 2024

2.41 The North West region attracted 8% of all VC investment in the UK in 2024, double the share of funding attracted in 2022 and 2023 but similar to the 9% averaged in 2017-19. The North West attracted £302 of VC investment per head in 2024, ranking it fourth out of English regions. This is however less than half the £719 attracted to the East of England, and around 20% of the £1,551 investment per head in London.

Figure 2-17: Venture capital investment per head by region



Source: Report on Investment, British Venture Capital Association, 2024

2.42 KPMG's mid-market private equity[4] review also highlights that the North West is the most active market outside London and the South East in 2024, with activity reaching its highest level in three years. The North West accounts for around 11% of activity in this market.

Skills and education

Qualification levels

2.43 In 2023, educational attainment levels in GM were broadly in line with regional and national trends, as reflected in RQF qualification data. The proportion of the population with no qualifications in GM stood at 7.3%, significantly higher than 6.2% in England, but a little higher than the North West average of 6.7%.

2.44 In terms of higher-level qualifications, 46.2% of GM's population had achieved Level 4 or above, nearly matching the England average of 46.7% and outperforming the North West at 44.4%. Intermediate qualification levels (Levels 2 and 3) accounted for 20.4% and 19.9%, respectively, in GM, closely mirroring regional and national distributions.

[4] UK mid-market private equity review, KPMG, 2024

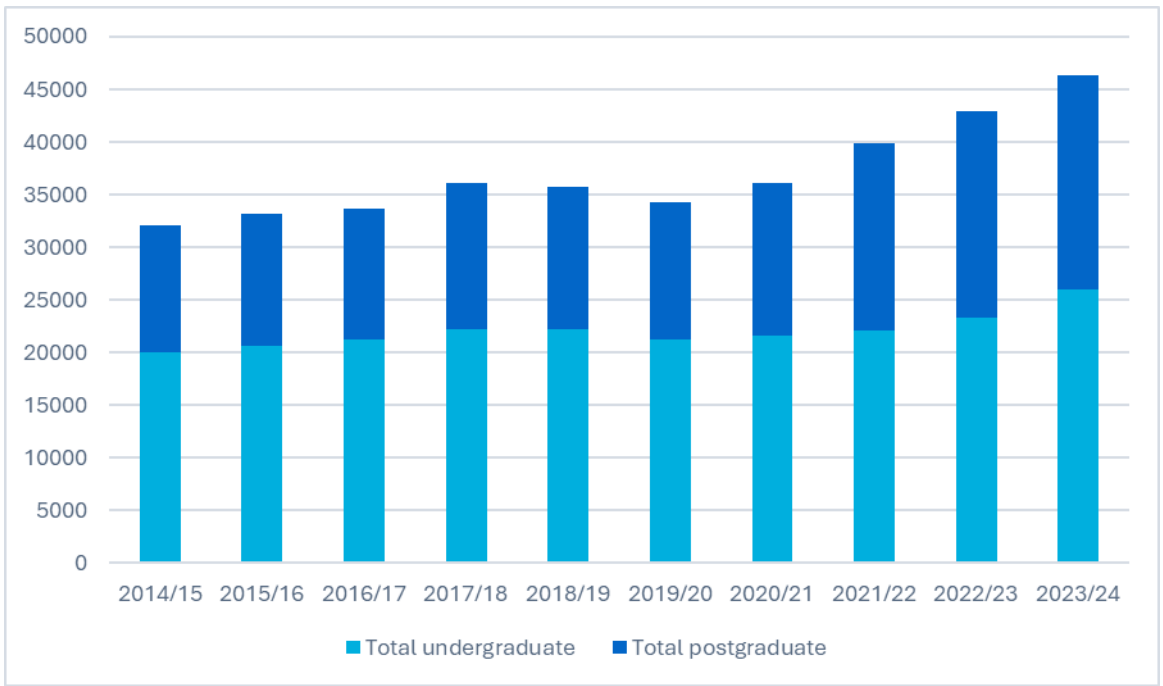
Figure 2-18: RQF levels in GM and England in 2023

Source: Annual Population Survey (APS), 2024, ONS Data, Steer-ED analysis, 2025

Graduate and Student Numbers

2.45 Graduate numbers from Greater Manchester universities have shown steady growth over the past decade. In 2023/24, a total of 46,285 students graduated, comprising 25,975 undergraduates and 20,310 postgraduates. This represents a 39% increase in total graduates compared to 2015/16, when the combined figure was 33,325. The rise has been driven by growth in both undergraduate and particularly postgraduate qualifications, the latter having increased by 62% since 2015/16.

Figure 2-19: Graduates from GM universities



Source: HE qualifiers by HE provider (2024), Steer-ED Analysis, 2025

2.46 In 2023/24, the five GM universities (the Royal Northern College of Music, University of Manchester, Manchester Metropolitan University, University of Greater Manchester, and University of Salford) educated 125,395 students, again marking a continued rise in student numbers over recent years. This represents an increase from 116,000 in 2020/21, reflecting an 8% increase in student numbers in GM – outpacing a national increase of 6.7% over this period.

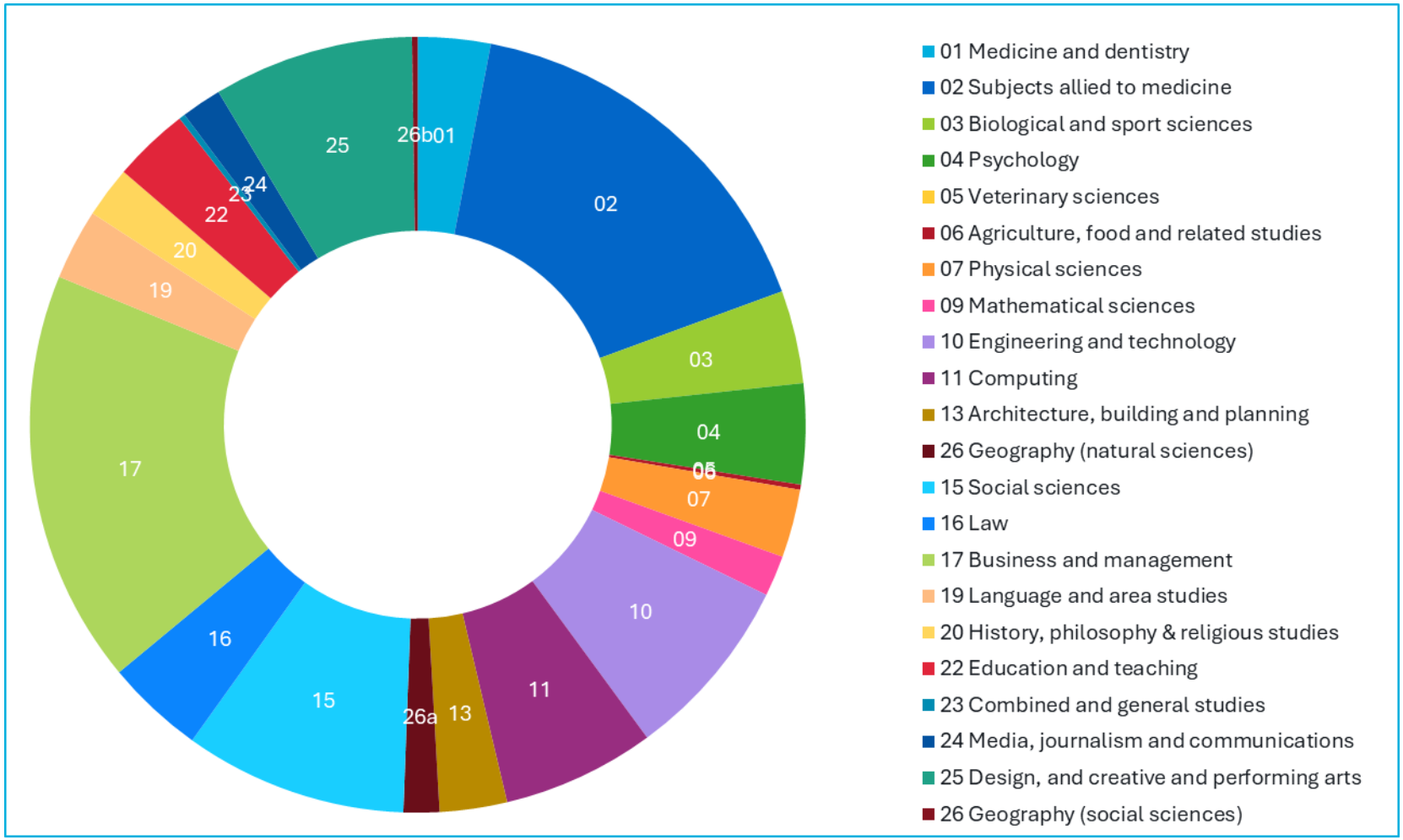
2.47 A significant proportion of these students are enrolled in STEM (Science, Technology, Engineering, and Mathematics) courses, with 63,445 students studying in these fields in 2023/24. The number of STEM students in GM has increased by 13.2% since 2020/21 with these subjects now accounting for more than half of students (50.5%). This is a higher share of students than seen across England, where 44.8% study STEM subjects.

Impact Case Study: Digital Innovation for Tackling Health Inequalities: Using social media to improve access, equity, and outcomes

The University of Salford is pioneering digital health models that address inequalities in long-term condition management. Through co-designed platforms like the Kidney Information Network (KIN) and the Greater Manchester MS Information Network (GMMSIN), Salford researchers have created award-winning, peer-supported digital services that empower patients and reduce pressure on the NHS.

These platforms are reshaping how underserved populations engage with health advice and emotional support. This has been so effective that Salford has formed a Community Interest Company (CIC) to ensure KIN's long-term social impact. This work is now influencing national policy and workforce development across the region.

Figure 2-20: Number of students by subject at GM universities



Source: HE student enrolments by HE provider and subject of study (2024), Steer-ED Analysis, 2025

Key findings

- GM's economy has overall outperformed national averages on many key metrics of growth since 2016;
- This has fed through into higher levels of employment, higher earnings and reduced disparity in pay;
- Much of the growth has been concentrated in knowledge intensive service sectors, particularly digital industries, legal and accounting;
- GM has seen a marked increase in innovation funding via Innovate UK, but much of this is via one-off channels presenting risks to its sustainability;
- Overall research grant and contract funding for GM's universities has been broadly flat in nominal terms with UoM's position declining relative to other leading institutions; and
- The number of graduates from and students at GM's higher education institutions has continued to increase more rapidly than the nation overall. There has been particularly strong growth in STEM subjects, providing a strong talent pipeline to support the City Region's ambitions for science and innovation led growth.
- Overall, GM's performance on key economic and innovation indicators shows signs of strong progress over the past decade and there is evidence of alignment between GM's innovation policy priorities and areas of growth or existing strength.

3 GM's innovation ecosystem

Overview

This Chapter outlines the evolution, structure, and current status of the innovation ecosystem in GM. It describes in qualitative terms the development of innovation assets, programmes, and governance frameworks that have emerged or evolved since 2016, and considers how infrastructure has been mobilised to support GM place-based innovation.

Changing institutional context

3.1 The institutional context in Greater Manchester has changed greatly since the original SIA in 2016. The first election of a directly elected mayor for GM took place in May 2017 and the city region's devolution journey has continued at pace since.

3.2 The priorities set out in **the 2016 audit** have nonetheless remained influential throughout. The five priorities identified in 2016 have remained relatively consistent through the major strategy developments that followed, though as depicted below at Figure 3-1, Industrial Biotechnology has been increasingly considered as part of Health Innovation & Life Sciences.

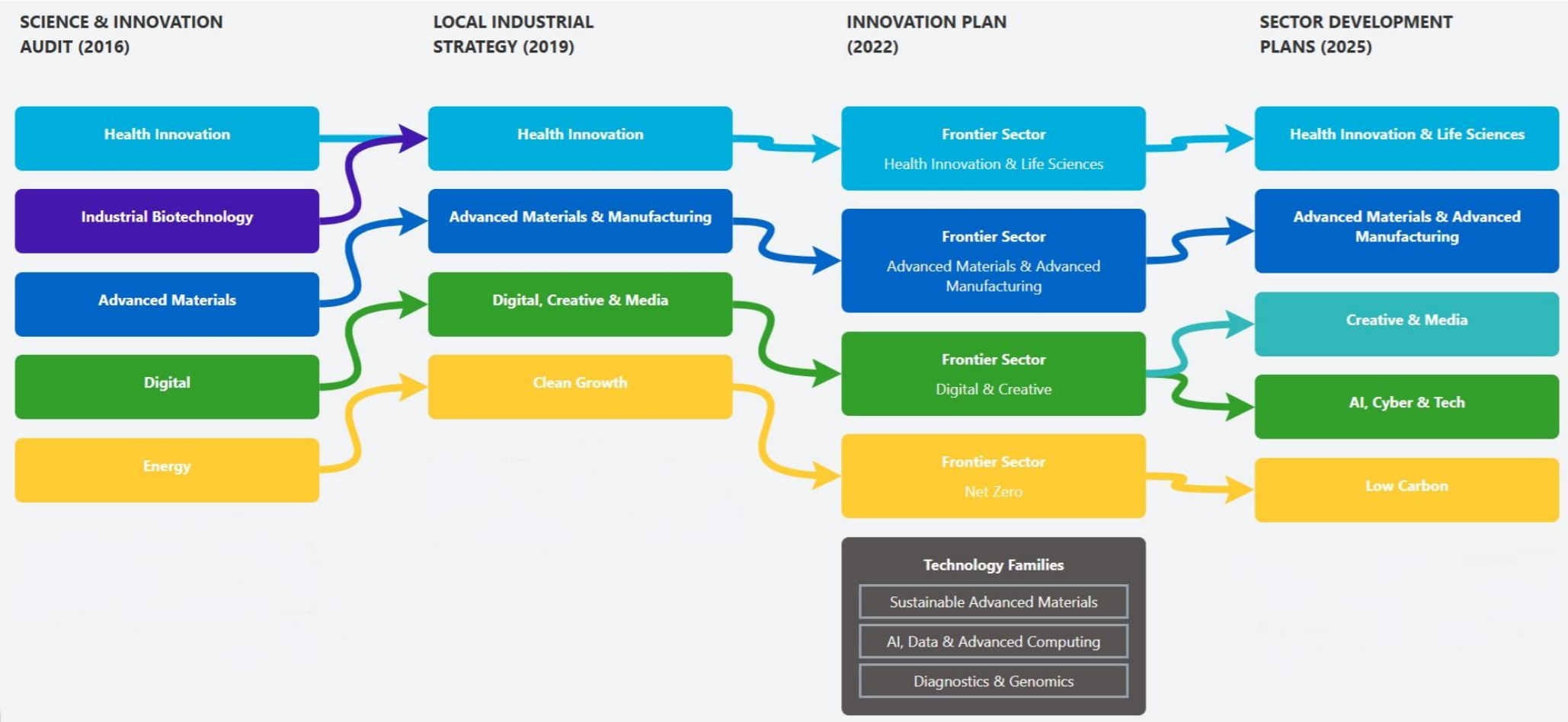
3.3 The Independent Prosperity Review (2019) confirmed the strengths identified in the SIA and provided the basis for the Local Industrial Strategy (2019) which refined these priorities and introduced four Frontier Sectors. The Innovation Plan (2022) retained these frontier sectors alongside three technology families (Sustainable Advanced Manufacturing, AI, Data & Advanced Computing and Diagnostics & Genomics) which operate across frontier sectors to coordinate and advance GM's innovation ecosystem.

3.4 As of 2025 GM now has Sector Development Plans in place for five sectors. These provide clear line of sight to the 2016 SIA whilst reflecting the continual evolution of technological, market and policy trends.

3.5 Over this period, further devolution of powers and funding streams has continued to flow to GM. This has included greater local influence over innovation with the establishment of Innovation Greater Manchester and the subsequent investment via the Innovation Accelerator. As one of three Innovation Accelerator pilot areas, GM has had access to £33m via the fund (later supplemented with an additional £10m) to support 10 projects to boost innovation collaboration in the region.

3.6 The pace of devolution continues, with GM becoming the first area alongside in the UK to receive an Integrated Settlement in April 2025, giving it yet greater control over spending. The 2025 Comprehensive Spending Review earmarked at least £30m over 4 years for GM through a Local Innovation Partnerships Fund from 2026, with the potential to bid for further funding aligned to local priorities and cross-boundary opportunities.

Figure 3-1: Evolution of GM's innovation cluster priorities



Source: Steer-ED, 2025

Core innovation physical infrastructure

3.7 Greater Manchester's innovation infrastructure now spans a diverse set of facilities across health, materials, digital, and energy. Some, like the Henry Royce Institute and GEIC, are national-and international-class assets. Others, including CityLabs 2.0, MediaCity Immersive Hubs, and the Secure Data Environment, are more tailored to the needs of indigenous GM businesses but are integral to the GM ecosystem and act as both an enabler to growth of businesses within GM and an attractor of investment.

3.8 These physical assets are not evenly distributed and tend to be concentrated within identifiable clusters. The Oxford Road Corridor, for example, combines university departments, NHS trusts, and business-facing facilities into a highly productive corridor of translational health and materials research. Salford's MediaCity and Innovation Triangle focus more on digital and immersive technologies. Plans continue to progress to further expand the physical infrastructure and employment space offer. For example, Atom Valley, the most significant industrial development site in the North West, is emerging as a focal point for advanced manufacturing and sustainable materials innovation. The GM Investment Zone, focused on Advanced Materials & Manufacturing brings £160m of funding over 10 years and a substantial opportunity to generate increased revenue for the City Region.

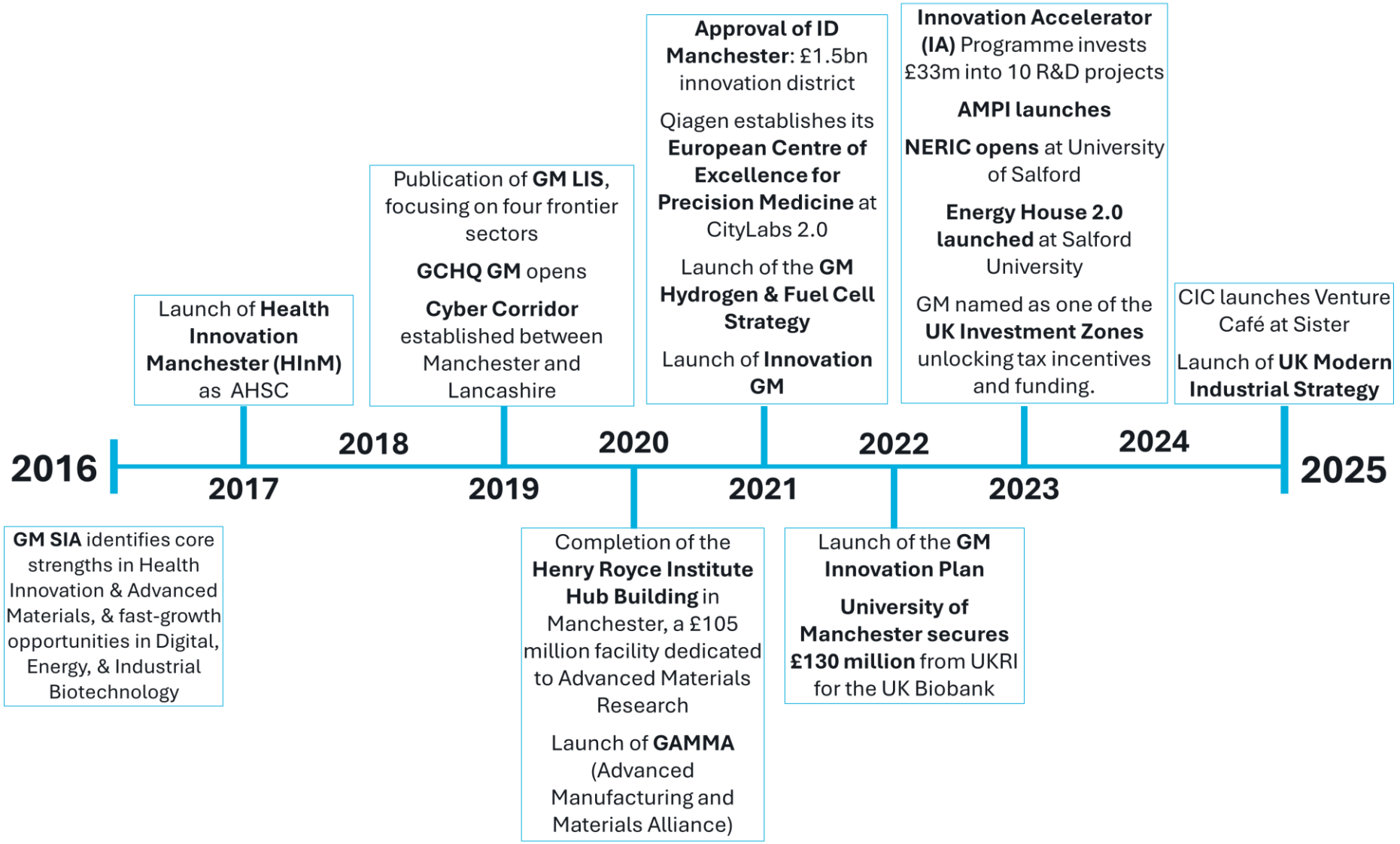
3.9 This spatial distribution reflects deliberate planning. The 2019 GM LIS prioritised the spatial coordination of innovation assets with growth locations supported by transport hubs, and this has begun to materialise through strategically focused investments and zoning strategies.

Soft infrastructure and strategic coordination

3.10 The introduction of the Innovation GM Partnership (IGMP) in 2021 marked an inflection point in ecosystem governance. IGMP works to create a stronger, greener and more inclusive innovation ecosystem in GM, through a triple helix that combines businesses, universities, and local government to drive up productivity through collaboration, research and innovation. It seeks to establish Greater Manchester as an internationally recognised and leading innovation ecosystem with clusters of innovation-led businesses and globally significant research & development & innovation assets, centred on GM's frontier sectors. Chaired by business leaders and supported by GMCA and local universities, the IGM board has provided system-level coordination in GM's innovation support landscape.

3.11 In addition to programme coordination, soft infrastructure has grown to include a number of targeted translational and policy vehicles. Examples include University of Manchester's Unit M, specifically created to enhance how UoM works with the region's innovation economy. The Energy Innovation Agency and the Innovation Ecosystem Navigation Service delivered by the Growth Hub, also support the creation, translation and commercialisation of ideas whilst the Hub also provides specialist support for innovative businesses through a range of programmes, workshops, mentoring and one to one support. Along with Knowledge Transfer Partnerships between GMCA and local HEIs to improve the use of AI and information sharing across public sector partners, these platforms bridge across institutions and draw on academic research and data to enable real-world application.

Figure 3-2: Changes in Greater Manchester's innovation ecosystem between 2016 and 2025 (non-exhaustive)



Source: Steer-ED, 2025

Ecosystem architecture and anchoring organisations

3.12 The architecture of the GM innovation system increasingly reflects the "triple helix" model, with universities, businesses, and government (including health and civic society partners) co-producing strategy and delivery. This approach has partially enabled and will further enable the region to move beyond project-based collaboration towards longer-term ecosystem building.

3.13 Several anchor institutions now underpin the innovation economy. The University of Manchester continues to play a central role through its research performance and also via strategic commercial ventures such as Sister (formerly known as ID Manchester). Similarly, the University of Salford has positioned itself as a national leader in built environment innovation through Energy House 2.0, as has Manchester Metropolitan University through the Fuel Cell Innovation Centre.

3.14 GM continues to develop partnerships beyond its borders to grow the scale and visibility of its ecosystem nationally and internationally. The £4.8m Research England investment in the Cambridge x Manchester Innovation Partnership is a key example and will include activity to strengthen the innovation ecosystem.

3.15 On the business side, large firms including Arm, Thales, and QIAGEN act as anchors in their given sectors, as do the myriad local and national health institutions within GM. The investment ecosystem has also continued to evolve, with Northern Gritstone reflecting a landmark shift in providing a major fund with a primary northern focus.

Impact Case Study: The Centre of Expertise in Advanced Materials and Sustainability

The Centre of Expertise in Advanced Materials and Sustainability (CEAMS) is a collaborative initiative aimed at supporting businesses to develop and commercialise sustainable materials and innovative ideas. CEAMS acts as a bridge between academic research, commercial exploitation and scale-up in the field of advanced sustainable materials.

The consortium consists of Rochdale Development Agency (RDA), The University of Manchester, Centre for Process Innovation (CPI), The Henry Royce Institute, National Composites Centre (NCC), National Physical Laboratory (NPL) and the Manufacturing Technology Centre (MTC).

Funded via the Greater Manchester Innovation Accelerator programme, this nationally significant initiative helps companies overcome problems, invent new processes, adopt new materials and re-use existing materials drawing on the internationally leading R&D capabilities of the project partners. Over 104 industry engagements have been delivered over the two-year programme, resulting in 45 collaborative R&D projects which have generated £5.75m of industry co-investment.

Beneficiaries of CEAMS support include Dekiln, a company focused on reducing the carbon footprint of the ceramics industry. As a result of their collaboration with the CEAMS project, they have developed a sustainable bio-based alternative to ceramic tiles, alongside a minimum viable product that enabled them to secure their first round of funding at £693,000.

CEAMS highlights how access to both state-of-the-art R&D facilities and advanced materials expertise is enabling business across Greater Manchester to contribute to the local economy through the development of sustainable materials.

Gaps and constraints

3.16 Despite considerable progress outlined above, the ecosystem still faces a number of structural and operational challenges. The first relates to physical space: despite investment, there remains substantial unmet demand for lab and scale-up space near anchor institutions, particularly in central Manchester and around university campuses. This limits the growth potential of high-value businesses emerging from the academic base, with plans such as Atom Valley aiming to address this gap.

3.17 Second, the support landscape is fragmented. While Innovation GM is a central focus for in simplifying the system and coordinating activity, and interventions such as the Innovation Ecosystem Navigation Service are working to address this, businesses still report difficulties in navigating programmes, funding routes, and institutional boundaries. This is particularly acute for SMEs and newer entrants to the innovation space.

3.18 Third, Greater Manchester lacks a critical mass of R&D-intensive anchor firms headquartered in the region. While global companies are present, most have relatively small R&D footprints compared to those in the South East or international comparators. Whilst this avoids dependency on a single large anchor, it also limits opportunities for knowledge spillovers and supply chain development.

3.19 Finally, many of the funding mechanisms that underpin innovation activity, from translational hubs to accelerator pilots, are short-term or dependent on central government cycles. Other funding sources such as equity and venture capital remain relatively underdeveloped for a city region the size of GM. This does not encourage stability and inhibits long-term investment by both public and private actors.

Key findings

- GM's innovation ecosystem has progressed significantly since 2016, with substantial new assets and a more structured, coherent and strategically aligned set of shared priorities. This trajectory reflects deliberate investment in hard and soft infrastructure, clearer alignment with national and regional priorities, and stronger collaborative working;
- A new generation of physical assets, such as Salford's Energy House 2.0 and the emerging Atom Valley programme, demonstrates GM's growing ability to align infrastructure with policy goals, including Net Zero and inclusive growth; and
- Despite this progress, several challenges do still persist. These include a shortage of specialist grow-on space near universities and innovation clusters; underrepresentation of R&D-intensive private sector anchor firms; and a lack of long-term revenue certainty for translational assets and programmes.

4 GM's academic science & innovation capabilities

Overview

This Chapter provides analysis of GM's current science and innovation strengths and capabilities. It includes analysis of:

- Research Excellence Framework;
- Research Funding;
- Scholarly works; and
- Startups and spinouts.

Research Excellence Framework 2021

4.1 The Research Excellence Framework 2021 highlighted many areas of strength in Greater Manchester's HEIs (Figure 4-1).

4.2 The figure below normalises for varying numbers of submitting institutions per Unit of Assessment (UoA) by showing a percentile ranking for each of GM's HEIs per UoA for Research Power[5] (100 = the highest scoring submitting institution for that UoA).

4.3 In the science and technology research areas, there were particularly strong Research Power results for University of Manchester in:

- Engineering (second out of 89 in UK);
- Chemistry (third out of 41);
- Biological Sciences (fourth out of 44);
- Psychology, Psychiatry and Neuroscience (seventh out of 93); and
- Allied Health Professions, Dentistry, Nursing and Pharmacy (seventh out of 91).

4.4 More widely, GM universities were among the top institutions for Research Power in:

- Business and Management Studies (UoM: third out of 108);
- Sociology (UoM: third out of 37);
- Education (MMU: ninth out of 83);
- Sport and Exercise Science, Leisure and Tourism (MMU: sixth out of 61);
- English Language and Literature (MMU: eighth out of 92); and
- Art and Design: History, Practice and Theory (MMU: second out of 86).

5 Following the Times Higher Education methodology: Grade Point Average (GPA) is calculated by multiplying the per cent of 4* research by 4, the per cent of 3* research by 3, the per cent of 2* research by 2 and the per cent of 1* research by 1 (using the 'Overall' quality metric); those figures are added together and then divided by 100 to give a score between 0 and 4. Research Power is calculated by multiplying the institution's GPA by the total number of full-time equivalent staff submitted for that Unit of Assessment (UoA), reflecting the view that excellence is, to some extent, a function of scale as well as quality.

Figure 4-1 Research Power percentiles per Unit of Assessment in REF 2021, for GM HEIs (100 = top in UK)

Source: DMS analysis of **REF 2021 results**

4.5 Taken collectively, **the REF 2021 results were an encouraging endorsement of the excellence of research being undertaken at Greater Manchester's universities,** particularly in the Life Sciences and Materials/Engineering areas.

4.6 Focusing on the STEM UoAs in which UoM performed particularly well in terms of Research Power (Engineering, Chemistry and Biological Sciences), the titles of the impact case studies submitted by UoM for REF 2021 provide a flavour of the varied areas in which the university's research is having impacts at local, national or global levels (Table 4-1:).

Table 4-1: Titles of impact case studies submitted by UoM for REF 2021 in Biological Sciences, Chemistry and Engineering

Biological Sciences
A new international lighting standard that meets our biological needs
Commercial development and patient benefit of Adoptive Cell Therapy (ACT) for cancer

Defining global antifungal azole resistance in Aspergillus – enhancing diagnostics and driving drug discovery
Improved infection awareness, prevention and treatment in hard-to-reach groups
Improving treatment and prevention of cervical cancer in Kenya
Re-animating school biology lessons through teaching with living flies
The miRBase microRNA database – driving the development of commercial microRNA research tools, diagnostics and therapeutics
Transforming the management of people with inherited eye diseases: A paradigm for the implementation of genomic medicine
Chemistry
C4X Discovery: Generating market-leading drug candidates from cutting-edge technology
DOSY and Pure Shift NMR: From changed practice in the chemical, pharmaceutical and scientific instrument industries to a multimillion pound new food ingredient
Driving the industrial biotechnology revolution: Cheaper and more sustainable chemical manufacturing through enzyme discovery, engineering and scale-up
New paradigms for 3D materials analysis using polyatomic projectiles: Changing capacity and industrial practice
Engineering
Empowering local climate change action and shaping local authority policy through their adoption of carbon budgets
Financial and environmental benefits through the development and transfer of control and monitoring technology in the process industries
Improved designs of high voltage overhead lines increases transmission capacity, providing environmental and financial benefits
Increasing productivity in the process industries through the use of artificial intelligence and machine learning for the optimisation of distillation operations
Increasing renewable energy and reducing customer bills: Using managed connections and flexible demand response controls in the electricity network to support decarbonisation with the minimum infrastructure investment
Manchester's independent graphite research for the Office for Nuclear Regulation has been instrumental in improving the safety, security and reliability of the UK's nuclear industry.
New industrial electromagnetic sensor systems improve safety processes and optimise capabilities in the UK's energy, rail and manufacturing sectors
Providing the scientific foundations to grow a sustainable, low-carbon UK bioenergy sector
Reducing climate change caused by shipping and aviation
Reducing usage of fossil-oil-based insulating liquids in power transformers to deliver environmental, safety, and financial benefits
Robotic and mechatronic manufacturing of 3D shell-shaped textile products to deliver medical and structural textile reinforcements
System-scale design of water resource systems improves water security and resilience

Source: REF 2021 Impact Case Study Database

Research funding

4.7 Looking at the cumulative externally-funded research grants and contracts obtained by GM's universities over the period 2016/17–2023/24 (the HESA data by cost centre shows that **the best-funded areas have been Biosciences (£406 million), Clinical Medicine (£380 million), Physics (£219 million), Mineral, Metallurgy & Materials Engineering (£213 million), and**

Chemistry (£205 million). Collectively, these five areas accounted for 60 per cent of total external research funding for GM's academic departments over the period (including non-STEM areas).

4.8 However, it is striking that funding for **Clinical Medicine has, on average, shown a significant reduction since 2015/16**. This has been a major driver in the overall reduction in GM universities' share of total research funding noted in Chapter 2.

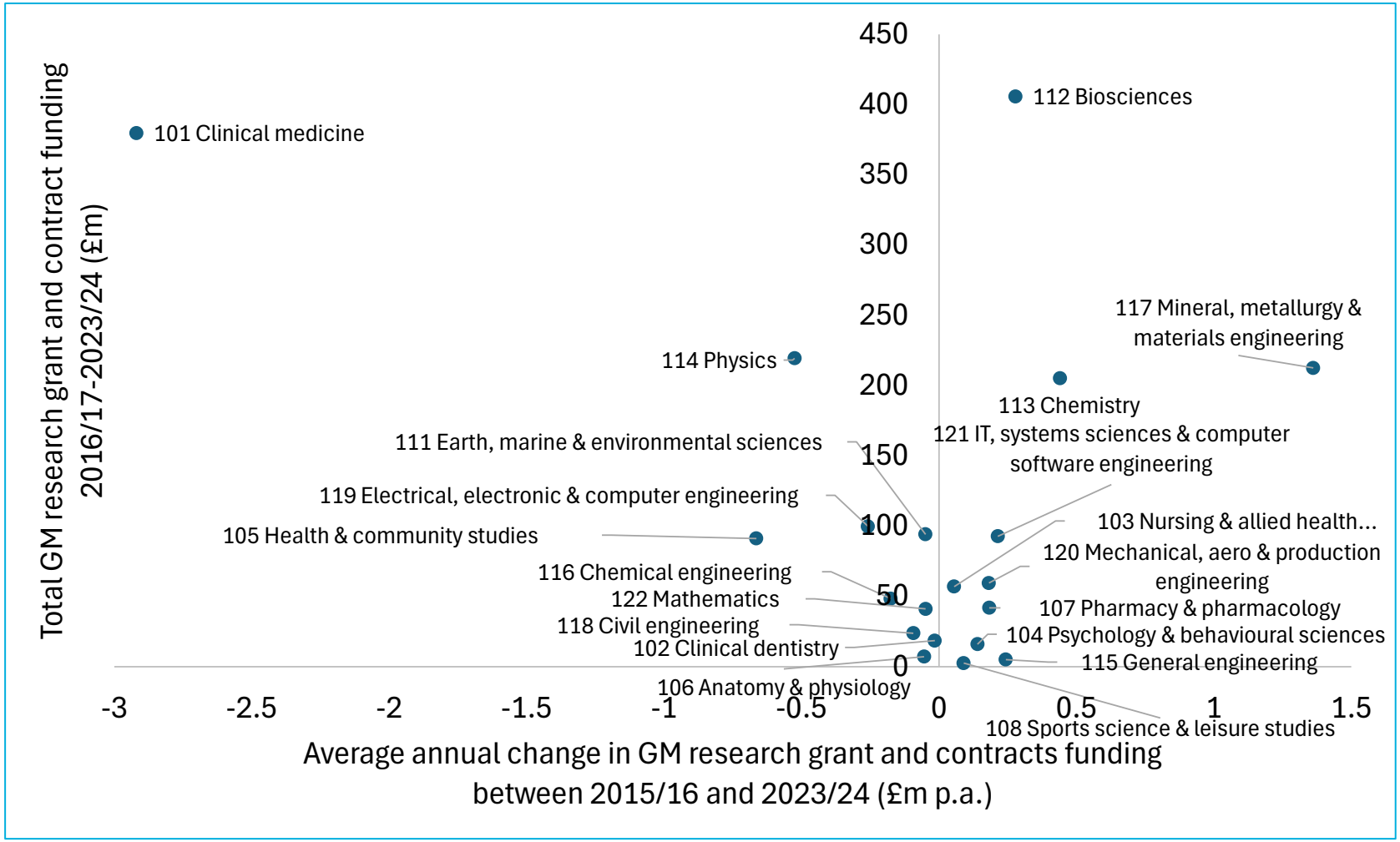
4.9 Furthermore, GM universities (in practice, UoM) accounted for just 2.1 per cent of Clinical Medicine research grants and contracts for UK HE providers over 2016/17–2023/24 (cf GM's 4.3 per cent share of UK population). However, **Greater Manchester is punching above its weight in its share of research funding for several other STEM areas** with Mineral, Metallurgy & Materials Engineering (22.5 per cent of UK funding) and Chemistry (10.4 per cent) being particularly notable, as well as the smaller areas of Health and Community Studies (18.3 per cent) and Clinical Dentistry (12.4 per cent)

Impact Case Study: Advanced Manufacturing: Pushing the Boundaries of 3D Printing

Through **PrintCity**, Manchester Metropolitan University has established an award-winning Digital Manufacturing facility, with over £3 million invested in state-of-the-art 3D printing and digital scanning equipment. PrintCity's expertise covers the entire digital workflow — from design, simulation, manufacture, and post-processing to metrology and industrial digitalisation.

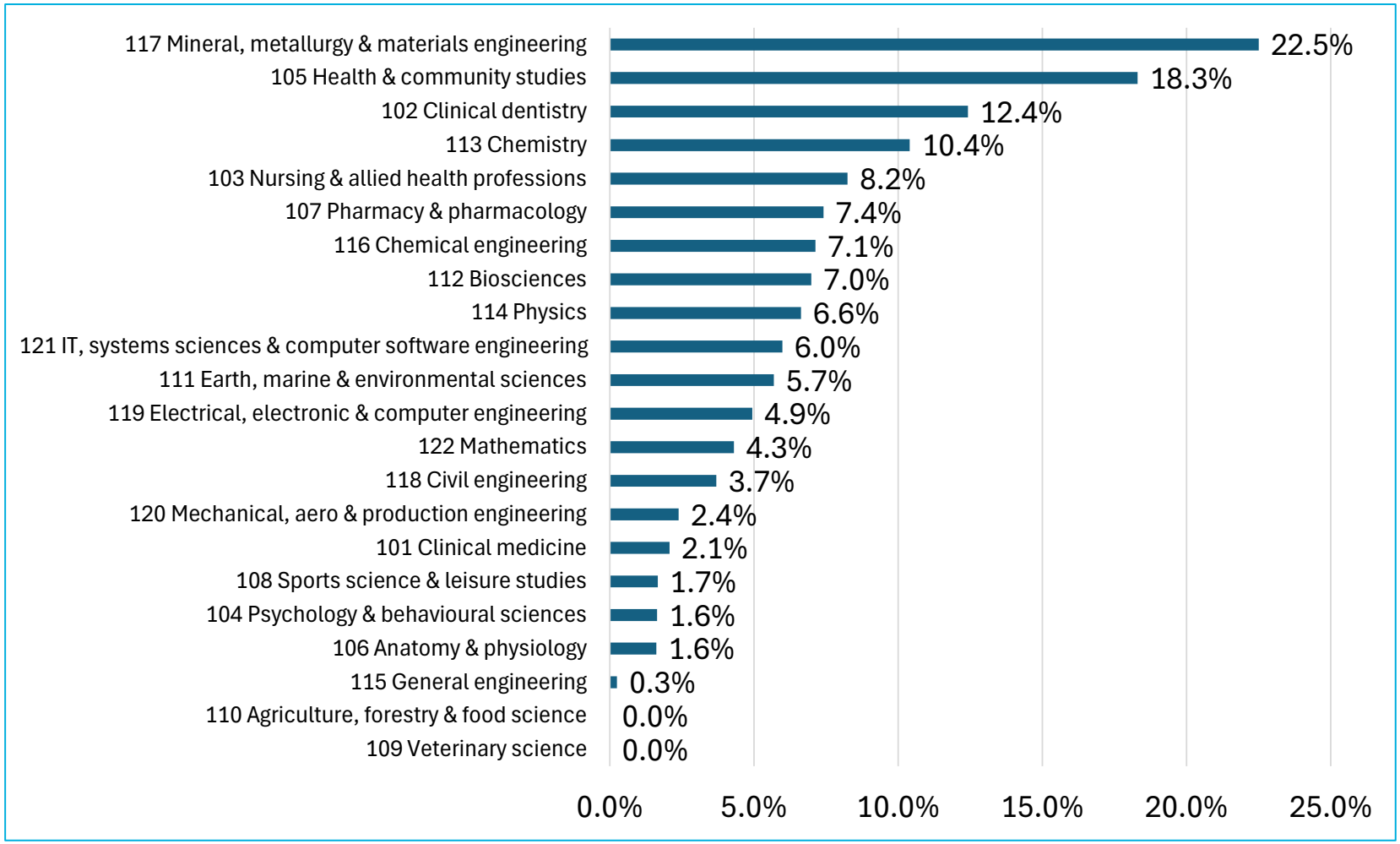
As one of the most well-equipped polymer 3D printing facilities in the UK, PrintCity has supported **over 200 businesses across Greater Manchester**, helping them integrate advanced additive manufacturing techniques into their product development and production processes. By providing expert guidance and hands-on access to next-generation digital fabrication tools, the facility has driven transformative innovation across multiple industries. These interventions have led to companies adopting the technology in-house, expanding their workforce, streamlining operations, and — in many cases — improving productivity and measurable carbon footprint savings.

Figure 4-2: Size and growth of GM universities' research grant & contracts funding, per STEM cost centre



Source: DMS analysis of HESA Table 5 – Research grants and contracts – breakdown by source of income and HESA cost centre 2015/16 to 2023/24

Figure 4-3: GM universities' share of UK HE providers' research grant and contract funding 2016/17–2023/24, per STEM cost centre



Source: DMS analysis of **HESA Table 5 – Research grants and contracts – breakdown by source of income and HESA cost centre 2015/16 to 2023/24**

Scholarly works analysis

Overview

4.10 A further perspective on academic strengths is provided by considering the scholarly works published by authors at GM's universities. Using the OpenAlex API[6], the study team has extracted metadata on 106k works involving authors at GM universities, which were published from January 2017 onwards. These were further filtered to 53k works in which GM universities accounted for at least 25 per cent of the authors[7], and which have abstract texts available in the metadata.

4.11 The chart below visualises these works, with the bubble size being proportionate to the citation count, and the colour denoting the field of the 'primary topic' assigned to the work by OpenAlex. Natural Language Processing (NLP) techniques have been applied to the abstract texts for this visualisation[8]: Similar works are close together; very different works are far apart.

Impact Case Study: Unit M

In October 2024, the University of Manchester launched Unit M, its dedicated innovation arm. Unit M's mission is to unlock the full innovation impact of the University by making the institution's world-class research, innovation assets and talent more accessible to all, and by developing new capabilities to help solve the real-world challenges of businesses, policymakers, and residents.

Projects focused on driving growth for GM and the UK include:

- **Materials** – supporting the development of a national centre for sustainable materials and manufacturing innovation in north-east Manchester through the Sustainable Materials & Manufacturing Centre (SMMC) initiative.
- **Artificial Intelligence (AI)** – building the region's AI cluster through the Turing Innovation Catalyst which has supported 38 PhD-led ventures towards commercialisation, supported more than 50 AI-first start ups to scale, and provided skills courses for over 9,000 women and underrepresented communities.
- **Health innovation** – pushing the frontiers of health technology innovation through advanced computational modelling and simulation for new drugs and medical devices by supporting the development of the UK Centre of Excellence for Insilco Regulatory Science & Innovation.
- **Biotechnology** – bringing together the north-west's industrial biotechnology community to accelerate knowledge exchange and skills development through the Industrial Biotechnology Innovation Catalyst (IBIC)

Unit M builds on the University's already sector leading innovation activity. The most up to date results from the Higher Education Statistics (HESA) agency recognises the University of Manchester as the fourth-highest ranked university for spinout creation, driving innovation and impact for the region and beyond. Over the past four years, the University has driven a 47% growth in industry research income, almost doubling the sector average and is ranked 5th nationally for industry research income and 2nd for contract research income with SMEs. The University remains a sector leader in Innovate UK's Knowledge Transfer Partnerships with 75% of the collaborating businesses based in the north-west.

[6] This indexes over 240 million scholarly works, adding about 50,000 daily. Metadata includes authors, authors' institutions, publication dates, work titles, abstracts and citations.

[7] Some works involve scores of authors. This filtering excludes, for example, a highly cited paper on which just one of 100 authors was from a GM university.

[8] Sentence embedding was used to represents the abstract texts as numerical vectors; dimension reduction was then used to reduce these vectors to two dimensions for presentation.

Figure 4-4 Visualisation of 53k scholarly works published since 2017, for which GM universities accounted for at least 25 per cent of the authors, and for which abstracts are available

Source: DMS analysis of **OpenAlex API data**

4.12 From this the study team notes, in particular:

- The diversity of works in the field of Medicine research (orange);
- The considerable overlaps between Medicine and Psychology (light green), and between Medicine and Biochemistry, Genetics & Molecular Biology (dark blue); and
- The 'weight' of outputs in the fields of: Psychology; Medicine; Biochemistry, Genetics & Molecular Biology; Chemistry (light blue); Materials Science (dark green); and Engineering (brown).

Highly cited works

4.13 Filtering further, to the 4.4k STEM works for which GM universities accounted for at least 50 per cent of the authors, and that are in the top 10 per cent cited works in their area (in each year), Figure 4-5 visualises these highly cited works. As before, NLP analysis of the abstracts' text has been used to visualise the research, with bubble size being proportionate to the citation count.

4.14 Here, k-means clustering has been applied to identify groupings of similar research (each colour is a grouping). The broad areas – in some cases spanning multiple groupings identified by the k-means algorithm – have been determined through manual examination of works' titles in each grouping, and are labelled in the chart below[9].

4.15 In this highly-cited sub-set of STEM works, **Materials and Life Science-related research areas dominate**, although there is also a **substantial representation for Digital** research (AI, AI apps, immersive tech, cyber, blockchain, wireless networks and computing).

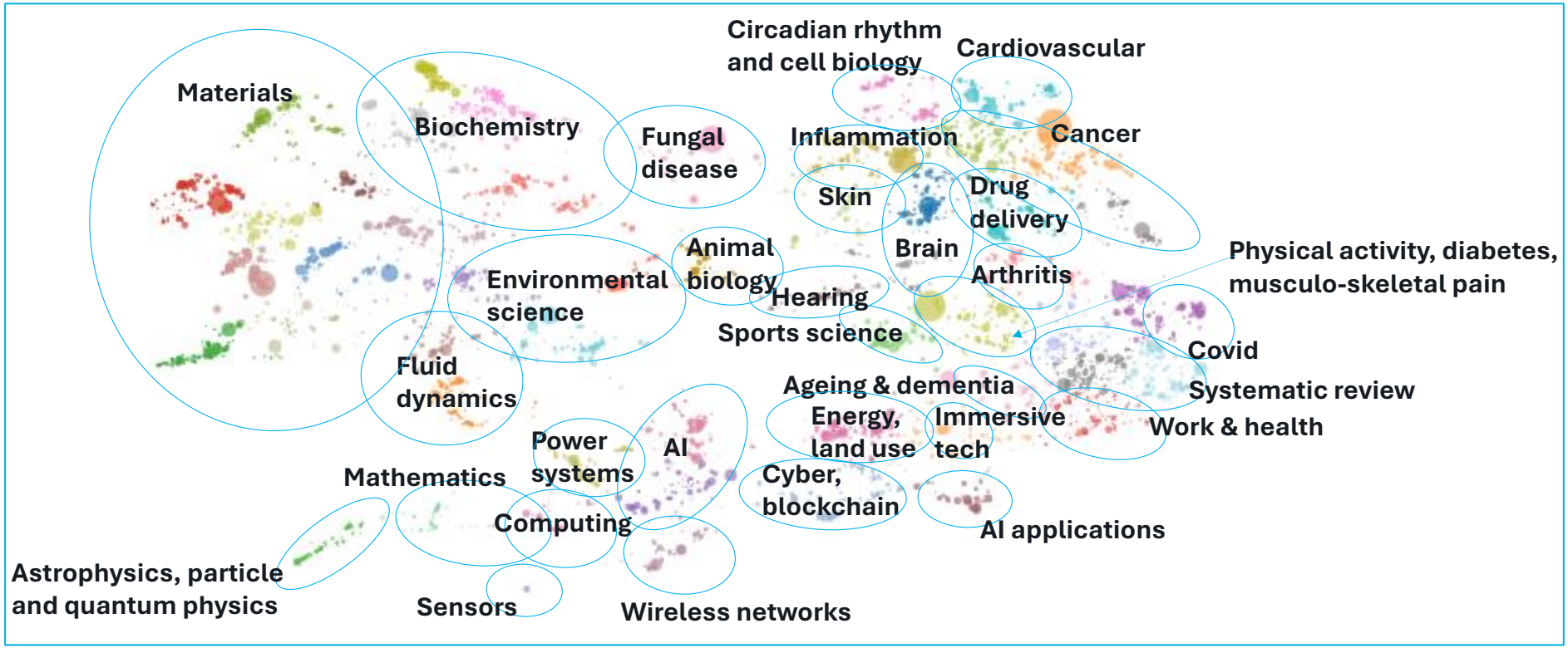
Impact Case Study: The Advanced Manufacturing and Materials Innovation Centre (AMMIC)

The Manchester Metropolitan University is pioneering an interdisciplinary approach to drive innovation in advanced manufacturing and materials, combined with innovation capacity development for SMEs in Greater Manchester.

AMMIC is a 5 year Investment Zone project, designed to translate research capabilities in manufacturing, materials and innovation development into business innovation and growth. Providing in depth funded PhDs, Knowledge Transfer Partnership development, and a unique innovation capacity development programme for SMEs, AMMIC is addressing the manufacturing sector's need for digital innovation transformation, as well as creating new avenues for academic research, driven by business challenges.

[9] The 'Systematic review' grouping is an outlier, in that the NLP vectorisation appears to have been dominated by the *methods* mentioned in the works' abstracts, rather than the *topic* areas.

Figure 4-5 Visualisation of 4.4k scholarly works published since 2017, for which GM universities accounted for at least 50 per cent of the authors, and which are in the top 10 per cent citation percentile



Source: DMS analysis of OpenAlex API data

Specific topic areas of strength

4.16 To obtain a still more granular view of GM's academic strengths, the study team examined the specific topics in which GM universities rank highly versus other UK universities, in terms of *very* highly cited works (in the top *1 per cent* citation percentile for their area and year).

4.17 Metadata was extracted from OpenAlex on 260k STEM scholarly works published since 2017 that involved authors from UK institutions. Using the 'topics' assigned to each work by OpenAlex, the study team calculated a count of these very highly cited works per UK university and per topic. From this, a percentile ranking per topic across UK universities was derived for each of the four GM universities. A percentile ranking of 100 indicates that the university was in the top 1 per cent of those UK universities that had non-zero work counts for that topic; in practice this almost always means that the university was the top-ranked institution, as very few of the 2,932 topics had more than 100 UK universities with a non-zero works count.

4.18 This analysis reveals **many topics in which UoM was the top-ranking UK university**. Those topics in which UoM had 50 or more very highly cited works, and where UoM was the top-ranked UK university, are shown in Table 4-2: . Various Materials and Life Sciences topics dominate here, with graphene research and applications heading the list.

Table 4-2: Topics in which UoM has 50 or more very highly cited works (top 1 per cent citation percentile), and in which UoM was the top-ranked UK university (Colour key: Life Sciences, Materials, Other)

Topic	UoM very highly cited works	UoM percentile ranking
Graphene research and applications	204	100
Radio Astronomy Observations and Technology	151	100
Antifungal resistance and susceptibility	110	100
Additive Manufacturing and 3D Printing Technologies	100	100
Lung Cancer Treatments and Mutations	91	100
Bone Tissue Engineering Materials	84	100
Fungal Infections and Studies	80	100
Graphene and Nanomaterials Applications	76	100
Lung Cancer Research Studies	71	100
Enzyme Catalysis and Immobilization	68	100
Psoriasis: Treatment and Pathogenesis	66	100
Advanced Radiotherapy Techniques	66	100
Hydrogen embrittlement and corrosion behaviours in metals	60	100
Corrosion Behaviour and Inhibition	59	100
Lanthanide and Transition Metal Complexes	57	100
Catalytic C-H Functionalization Methods	57	100
Aluminium Alloy Microstructure Properties	56	100
Magnetism in coordination complexes	56	100
Dental materials and restorations	53	100
Welding Techniques and Residual Stresses	53	100
Wound Healing and Treatments	52	100
Radioactive element chemistry and processing	50	100
Pharmacogenetics and Drug Metabolism	50	100

Source: DMS analysis of **OpenAlex API data**

4.19 The numbers of very highly cited works are considerably lower for the less research-intensive universities[10]. However, there are still important specific areas of strength in Manchester Metropolitan University and University of Salford revealed by this analysis.

4.20 Focusing on topics in which Manchester Metropolitan University has 20 or more of these very highly cited works, Table 4-3: highlights Manchester Metropolitan University strengths in electrochemistry and certain Life Sciences, Digital and Environmental disciplines.

Table 4-3: Topics in which Manchester Metropolitan University has 20 or more very highly cited works (top 1 per cent citation percentile). (Colour key: Life Sciences, Materials, Other. Bold highlights topics in which Manchester Metropolitan University is in the top 5 per cent of UK universities)

Topic	MMU very highly cited works	MMU percentile ranking
Electrochemical sensors and biosensors	**42**	**99**
IoT and Edge/Fog Computing	**34**	**98**
Electrochemical Analysis and Applications	34	94
Sports injuries and prevention	33	89
Environmental Education and Sustainability	32	93
Sports Performance and Training	32	90
Ecology and Vegetation Dynamics Studies	32	73
Blockchain Technology Applications and Security	26	86
Diabetic Foot Ulcer Assessment and Management	**25**	**99**
Musculoskeletal pain and rehabilitation	25	85
Virtual Reality Applications and Impacts	**24**	**99**
Network Security and Intrusion Detection	**24**	**99**
Species Distribution and Climate Change	24	71
Muscle metabolism and nutrition	**23**	**96**
Nutrition and Health in Aging	21	79
Wildlife Ecology and Conservation	21	68
COVID-19 diagnosis using AI	20	94
Land Use and Ecosystem Services	20	73
Electrocatalysts for Energy Conversion	20	72

Source: DMS analysis of **OpenAlex API data**

4.21 Considering topics in which UoS has 15 or more very highly cited works, Table 4-4: reveals UoS's strengths in sports and nanofluid flow.

[10] Results for University of Bolton (now University of Greater Manchester) are not included here, as there were no topics in which the university had more than 8 very highly cited works.

Table 4-4: Topics in which UoS has 15 or more very highly cited works (top 1 per cent citation percentile) (Colour key: Life Sciences, Materials, Other. Bold highlights topics in which UoS is in the top 5 per cent of UK universities)

Topic	UoS very highly cited works	UoS percentile ranking
Sports injuries and prevention	**55**	**96**
Sports Performance and Training	**45**	**95**
Nanofluid Flow and Heat Transfer	**41**	**100**
Environmental DNA in Biodiversity Studies	21	87
Species Distribution and Climate Change	21	69
Urban Green Space and Health	19	81
Identification and Quantification in Food	**18**	**95**
Fluid Dynamics and Turbulent Flows	18	89
Bat Biology and Ecology Studies	18	87
Lower Extremity Biomechanics and Pathologies	**17**	**100**
Heat Transfer Mechanisms	**17**	**100**
Muscle activation and electromyography studies	17	90
Urban Heat Island Mitigation	17	85
Building Energy and Comfort Optimization	16	80
Wildlife Ecology and Conservation	15	61
Plant and animal studies	15	58

Source: DMS analysis of OpenAlex API data

Collaborations

4.22 Analysis of co-authorships of scholarly works involving authors from GM universities confirms the very collaborative and international nature of modern research. Table 4-5: shows the percentage of works involving authors from non-UK institutions and the top five co-authoring countries per field of research (using the field of the 'primary topic' assigned to each work by OpenAlex).

4.23 The share of works involving authors from non-UK institutions ranges from 18 per cent in Arts & Humanities to 82 per cent for Physics & Astronomy. The **United States and China dominate as the non-UK countries most frequently co-authoring works with authors from GM universities**, with United States institutions being the most frequent international collaborators in most Life Sciences fields and Chinese institutions being the most frequent co-authors in most Physical Sciences.

Table 4-5: International co-authorships on works involving authors from GM universities, since 2017

Field	Total works	% with co-author from a non-UK institution	Top 5 co-authoring countries, and % of works co-authored
Physics and Astronomy	5,713	82.1	US: 49%, DE: 41%, IT: 33%, FR: 31%, ES: 27%
Chemical Engineering	291	73.5	CN: 20%, FR: 9%, US: 8%, ES: 6%, AU: 6%
Earth and Planetary Sciences	2,057	73.0	US: 25%, DE: 15%, FR: 11%, CN: 11%, IT: 8%

Field	Total works	% with co-author from a non-UK institution	Top 5 co-authoring countries, and % of works co-authored
Energy	606	71.1	CN: 22%, US: 12%, DE: 6%, ES: 6%, PK: 5%
Dentistry	654	69.3	SA: 14%, US: 11%, CN: 7%, BR: 6%, JO: 6%
Environmental Science	4,387	67.0	US: 17%, DE: 10%, CN: 10%, AU: 7%, ES: 6%
Agricultural and Biological Sciences	1,351	65.6	US: 18%, DE: 9%, CN: 8%, FR: 8%, ES: 8%
Immunology and Microbiology	1,386	64.0	US: 28%, DE: 14%, FR: 10%, AU: 8%, CA: 8%
Nursing	349	63.6	US: 19%, IT: 12%, FR: 11%, DE: 8%, DK: 8%
Materials Science	4,313	63.5	CN: 19%, US: 10%, DE: 6%, ES: 5%, FR: 4%
Engineering	13,084	62.7	CN: 21%, US: 8%, IN: 4%, AU: 4%, DE: 4%
Computer Science	4,996	62.6	CN: 15%, US: 12%, DE: 6%, SA: 6%, IN: 5%
Decision Sciences	1,209	61.1	US: 15%, CN: 14%, DE: 8%, NL: 7%, AU: 6%
Biochemistry, Genetics and Molecular Biology	6,542	61.1	US: 24%, DE: 13%, FR: 9%, AU: 9%, IT: 8%
Neuroscience	2,592	59.0	US: 21%, DE: 11%, AU: 9%, ES: 8%, IT: 6%
Chemistry	2,193	58.1	US: 16%, CN: 10%, DE: 8%, ES: 5%, FR: 5%
Medicine	24,799	56.7	US: 22%, AU: 11%, DE: 10%, IT: 9%, NL: 8%
Business, Management and Accounting	2,717	56.1	US: 12%, CN: 7%, AU: 5%, DE: 5%, FR: 4%
Pharmacology, Toxicology and Pharmaceutics	261	54.8	US: 16%, DE: 6%, EG: 5%, AU: 4%, SE: 4%
Economics, Econometrics and Finance	2,321	53.4	US: 17%, CN: 10%, FR: 4%, DE: 4%, IT: 4%
Veterinary	93	51.6	US: 13%, BR: 9%, DE: 8%, IT: 5%, CH: 5%
Mathematics	1,246	51.5	US: 14%, DE: 6%, CA: 5%, CN: 4%, IT: 4%
Psychology	4,721	38.7	US: 11%, AU: 7%, CA: 4%, NL: 4%, DE: 4%
Health Professions	3,666	36.4	US: 9%, AU: 7%, NL: 4%, CA: 4%, DE: 3%
Social Sciences	10,855	35.1	US: 8%, AU: 5%, DE: 4%, IE: 3%, NL: 3%
Arts and Humanities	2,513	18.6	US: 5%, AU: 3%, FR: 2%, IE: 2%, DE: 1%

Source: DMS analysis of OpenAlex API data. AU: Australia; BR: Brazil; CA: Canada; CH: Switzerland; CN: China; DE: Germany; DK: Denmark; EG: Egypt; ES: Spain; FR: France; IE: Ireland; IN: India; IT: Italy; JO: Jordan; NL: Netherlands; PK: Pakistan; SA: Saudi Arabia; SE: Sweden; US: United States

4.24 However, domestic links remain very strong, and the **top co-authoring institutions are UK-based**. As shown in Table 4-6:, colleagues from 'Golden Triangle' (Oxford-Cambridge-London) universities and the University of Liverpool are the most frequent co-authors on works involving GM universities.

Table 4-6: Top 10 co-authoring institutions (of 19k), for works involving authors from GM universities

Institution	Co-authored works	Mean citations per work
University College London	3,367	38.3
University of Oxford	3,258	38.3
University of Liverpool	2,799	27.2
University of Cambridge	2,731	51.3
Imperial College London	2,384	47.5
King's College London	2,040	38.7
University of Leeds	2,012	24.8
University of Birmingham	1,896	35.8
University of Bristol	1,859	35.3
University of Sheffield	1,852	28.2

Source: DMS analysis of OpenAlex API data

4.25 In terms of *companies* collaborating on scholarly works, the most frequent industrial co-authors on works involving GM universities are Life Sciences and Energy companies, as shown in Table 4-7.

Table 4-7: Top 10 co-authoring companies (of 1.8k), for works involving authors from GM universities

Institution	Co-authored works	Mean citations per work
AstraZeneca (Sweden)	127	36.5
Janssen (United States)	91	33.3
Oxford BioMedica (United Kingdom)	86	61.2
National Grid (United Kingdom)	74	14.4
GlaxoSmithKline (United States)	70	38.7
Sellafield (United Kingdom)	60	11.5
Waters (United Kingdom)	53	21.8
Johnson Matthey (United Kingdom)	48	22.1
Monasterium Laboratory Skin & Hair Research Solutions (Germany)	45	20.2
Janssen (Belgium)	41	24.2

Source: DMS analysis of OpenAlex API data

Key findings

- REF 2021 results were an encouraging endorsement of the excellence of research being undertaken at Greater Manchester's universities, particularly in the Life Sciences and Materials/Engineering areas;

- In terms of externally-funded research grants and contracts obtained by GM's universities over the period 2016/17–2023/24, the best-funded areas have been Biosciences (£406 million), Clinical Medicine (£380 million), Physics (£219 million), Mineral, Metallurgy & Materials Engineering (£213 million), and Chemistry (£205 million);
- Greater Manchester punches above its weight in its share of research funding for Mineral, Metallurgy & Materials Engineering (22.5 per cent of UK funding) and Chemistry (10.4 per cent) in particular;
- However, funding for Clinical Medicine has, on average, shown a significant reduction since 2015/16. This has been a major driver in the overall reduction in GM universities' share of total research funding; and
- For the highly-cited sub-set of STEM scholarly works, Materials and Life Science-related research areas dominate, although there is also a substantial representation for Digital research (AI, AI apps, immersive tech, cyber, blockchain, wireless networks and computing).

5 Science and innovation capabilities in GM's industries

Overview

This Chapter presents detailed analysis of the business landscape in GM with a focus on innovation-active companies and their capabilities. It includes analysis of:

- Growth and location quotients by SIC code;
- Mapping of innovation-active companies using machine learning techniques;
- Mapping academic research to company groupings; and
- Knowledge Transfer Partnerships.

Growth and location quotient analysis by SIC code

5.1 One perspective on GM's capabilities is available through the use of traditional SIC code analysis: looking at the industries in which GM has a comparative advantage (in terms of higher-than-average concentration of employment, as measured by Location Quotient[11]), and those which are growing most rapidly.

5.2 Table 5-1: shows Greater Manchester's '**high point industries**' (defined for these purposes as those 4-digit SIC industries which account for at least 0.25 per cent of employment in GM and which have a LQ vs. England of at least 1.2); and Table 5-2: shows GM's **high growth industries** (taken to be the 4-digit SICs with at least 0.25 per cent of GM's employment and with employment growth of at least 30 per cent since 2016).

Table 5-1: High point industries in Greater Manchester

Industry	GM employment (2023)	% share of GM employment (2023)	LQ vs. England
6920 : Accounting bookkeeping and auditing activities; tax consultancy	63,000	4.27%	2.70
6512 : Non-life insurance	7,000	0.47%	2.58
8122 : Other building and industrial cleaning activities	4,000	0.27%	2.55
5223 : Service activities incidental to air transportation	6,000	0.41%	2.39
8220 : Activities of call centres	6,000	0.41%	2.34

[11] Location Quotient (LQ) divides an industry's share of employment in a given area (e.g. Greater Manchester) by its share at national level (e.g. England). A LQ above 1.0 indicates that the area has 'above average' concentration of employment in that industry.

Industry	GM employment (2023)	% share of GM employment (2023)	LQ vs. England
4651 : Wholesale of computers computer peripheral equipment and software	4,500	0.30%	2.33
4791 : Retail sale via mail order houses or via Internet	16,000	1.08%	2.27
4642 : Wholesale of clothing and footwear	4,500	0.30	2.27
6020 : Television programming and broadcasting activities	4,000	0.27	2.25
7911 : Travel agency activities	5,000	0.34	1.95
1071 : Manufacture of bread; manufacture of fresh pastry goods and cakes	7,000	0.47	1.94
2229 : Manufacture of other plastic products	4,000	0.27	1.78
5110 : Passenger air transport	6,000	0.41	1.64
5221 : Service activities incidental to land transportation	6,000	0.41	1.53
4299 : Construction of other civil engineering projects n.e.c.	8,000	0.54	1.52
4639 : Non-specialised wholesale of food beverages and tobacco	6,000	0.41	1.51
4690 : Non-specialised wholesale trade	6,000	0.41	1.47
8110 : Combined facilities support activities	12,000	0.81	1.46
6629 : Other activities auxiliary to insurance and pension funding	4,000	0.27	1.44
6832 : Management of real estate on a fee or contract basis	8,000	0.54	1.37
9312 : Activities of sport clubs	11,000	0.75	1.36
6910 : Legal activities	23,000	1.56	1.35
4669 : Wholesale of other machinery and equipment	7,000	0.47	1.34
4110 : Development of building projects	8,000	0.54	1.29
8610 : Hospital activities	96,000	6.50	1.26
7810 : Activities of employment placement agencies	14,000	0.95	1.24
4773 : Dispensing chemist in specialised stores	5,000	0.34	1.21

Source: DMS analysis of Business Register and Employment Survey

Table 5-2: High growth industries in Greater Manchester

Industry	GM employment (2023)	% share of GM employment (2023)	% growth 2016–23
6920 : Accounting bookkeeping and auditing activities; tax consultancy	63,000	4.27	186
4639 : Non-specialised wholesale of food beverages and tobacco	6,000	0.41	167
8122 : Other building and industrial cleaning activities	4,000	0.27	167
4651 : Wholesale of computers computer peripheral equipment and software	4,500	0.30	157
8412 : Regulation of the activities of providing health care education cultural services and other social services excluding social security	6,000	0.41	140
8790 : Other residential care activities	11,000	0.75	120
6202 : Computer consultancy activities	21,000	1.42	110
4322 : Plumbing heat and air-conditioning installation	8,000	0.54	100
4690 : Non-specialised wholesale trade	6,000	0.41	100

Industry	GM employment (2023)	% share of GM employment (2023)	% growth 2016–23
4511 : Sale of cars and light motor vehicles	9,000	0.61	80
4110 : Development of building projects	8,000	0.54	78
5911 : Motion picture video and television programme production activities	4,000	0.27	78
8299 : Other business support service activities n.e.c.	19,000	1.29	73
6209 : Other information technology and computer service activities	6,000	0.41	71
4321 : Electrical installation	10,000	0.68	67
6201 : Computer programming activities	10,000	0.68	67
2229 : Manufacture of other plastic products	4,000	0.27	60
9312 : Activities of sport clubs	11,000	0.75	57
7810 : Activities of employment placement agencies	14,000	0.95	56
9311 : Operation of sports facilities	6,000	0.41	50
6512 : Non-life insurance	7,000	0.47	40
9602 : Hairdressing and other beauty treatment	7,000	0.47	40
8610 : Hospital activities	96,000	6.50	39
7010 : Activities of head offices	18,000	1.22	38
6832 : Management of real estate on a fee or contract basis	8,000	0.54	33
5221 : Service activities incidental to land transportation	6,000	0.41	33
6020 : Television programming and broadcasting activities	4,000	0.27	33
8423 : Justice and judicial activities	4,000	0.27	33

Source: DMS analysis of Business Register and Employment Survey. Industries which are also high point industries (with LQ of 1.2+) are highlighted in bold.

5.3 Some caution needs to be used in interpreting this data, as BRES employment estimates can be quite 'noisy' at such granular levels. However, some key points relevant to innovation and technology can be noted[12]:

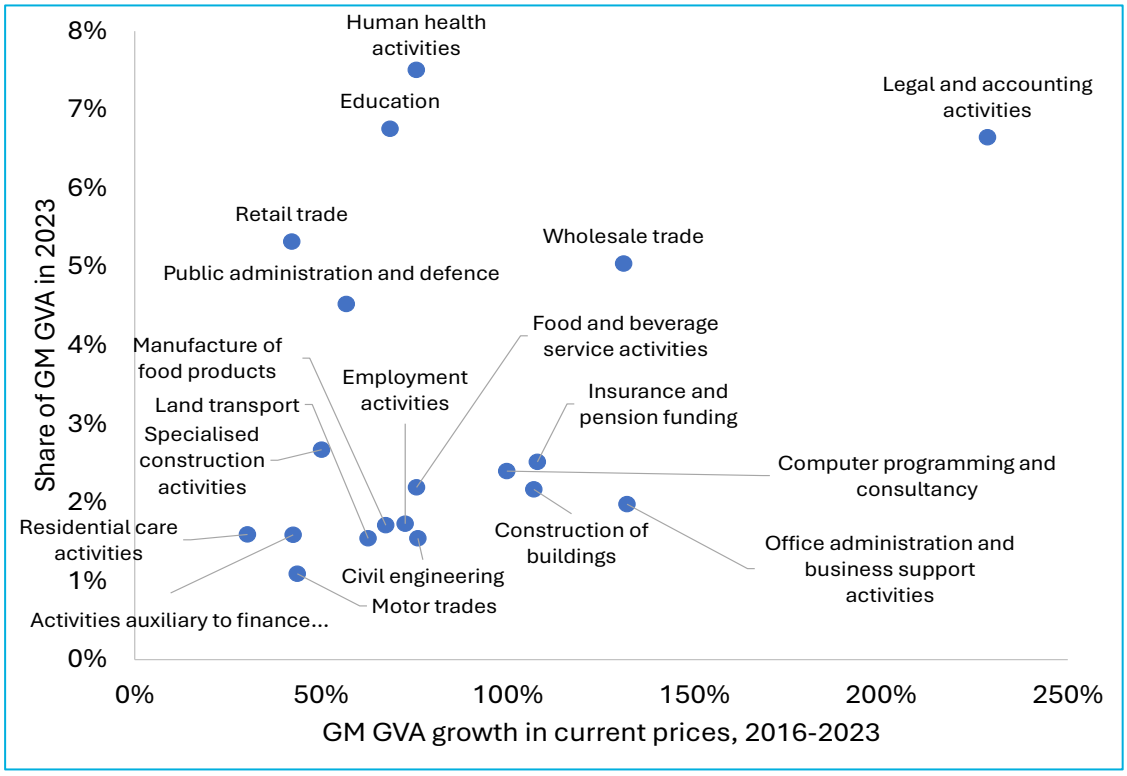
- **Financial services** stand out as having been particularly strong for GM in terms of both growth and relative concentration of employment (including 6920 : Accounting, bookkeeping and auditing activities; tax consultancy; 6512 : Non-life insurance; 6629 : Other activities auxiliary to insurance and pension funding);
- **The legal sector** (6910 : Legal activities) is also notable for being a large industry with a high LQ for GM;
- **E-commerce** activity is intrinsic to many industries (including but not exclusively retail and wholesale), but the high LQ for SIC 4791 (Retail sale via mail order houses or via Internet) is a flag that e-commerce is particularly important for GM;
- **Creative industries** feature on these lists, with 8,000 employment in 2023 between SICs 6020 (Television programming and broadcasting activities) and 5911 (Motion picture, video and television programme production activities);

[12] Some of the higher industry concentrations can be explained by certain professions preferring major cities. For example, the LQ of 1.35 for 'Legal activities' in GM is similar to that in Leeds City Region (1.30). However, in general the high GM LQs highlighted here are still high compared with other urban areas. For example, the LQ of 2.70 for 'Accounting bookkeeping and auditing activities; tax consultancy' in GM is far higher than that industry's LQ of 0.67 in Leeds City Region.

- GM's **digital sectors** do not yet have particularly high LQs, but they do feature prominently in the list of high growth industries, with 37,000 employment across 6202: Computer consultancy activities (up 110 per cent since 2016), 6209: Other information technology and computer service activities (up 71 per cent), and 6201: Computer programming activities (up 67 per cent);
- Considering the types of innovation relevant to these industries, relatively few of them are likely to be actively pursuing traditional 'scientific R&D' for their products and services. While there is clearly a role for this in 8610: Hospital activities and 2229: Manufacture of other plastic products, the **value creation in most of GM's strongest industries is not being driven by scientific advances in the areas in which GM's universities are especially strong: Life Sciences and Materials**; and
- **Digital innovation** is relevant to many, if not all, of these industries: whether it is a slicker user interface for an e-commerce retailer, the use of machine learning to improve the quality and efficiency of service delivery for lawyers and accountants, the implementation of Internet of Things approaches for a manufacturer's factory automation, and/or the use of generative AI coding tools to assist software programmers. The extent to which GM's industries successfully exploit digital technology is likely to be a key determinant of future growth.

5.4 Turning to Gross Value Added (GVA), data for GM are only available at a less detailed level: down to 2-digit SIC. Figure 5-1: shows those 2-digit industries that account for at least 1 per cent of GM's total GVA and that had growth in GVA[13] of at least 30 per cent between 2016 and 2023.

Figure 5-1: Greater Manchester's 2-digit SIC industries with high GVA share (1 per cent+) and high GVA growth since 2016 (30 per cent+)



[13] Growth in *current price* GVA is used here. Inflation was about 26 per cent over this same period (as measured by the GDP deflator). So a growth in current price GVA in excess of 26 per cent represents a real-terms increase in GVA.

Source: DMS analysis of **ONS Regional gross value added (balanced) by industry: All ITL regions**

- Legal & accounting activities stand out as having both a large share of GM's total GVA (6.7 per cent) and particularly rapid growth in GVA over that period (+228 per cent, compared with 26 per cent general inflation);
- Other industries which more than doubled GVA over that period were Office administration and business support services (+132 per cent), Wholesale trade (+131 per cent), Insurance and pension funding (+108 per cent), Construction of buildings (+107 per cent) and Computer programming and consultancy (+100 per cent); and
- As observed with the employment data, traditional scientific R&D may have a role in helping to grow some of these industries (e.g. Human health activities, Manufacture of food products, Specialised construction activities). However, the innovation in many of the strongest sectors (e.g. Legal & accounting activities, Wholesale trade, Retail trade, Insurance & pension funding) is more likely to be around **digital transformation** and/or **innovative approaches towards business models, sales and marketing** etc.

Mapping innovation-active companies

5.5 To obtain a further perspective on innovation in GM's private sector companies, the study team developed a sample of 944 innovation-active companies with operations in GM, and applied machine learning techniques to analyse the texts scraped from their websites, identifying groupings of companies with relatively similar activities, as judged by the vocabularies used on their websites.

5.6 The sample of innovation-active companies with operations in GM was developed from 12 separate sources (see Annex A), including searching for R&D terms in electronically-filed company accounts. Only companies with 10 or more employees were included. The study team developed an automated tool to check that the given URL for each entity (sourced from FAME and The Data City) was for the correct company, and that the company has operations in GM.

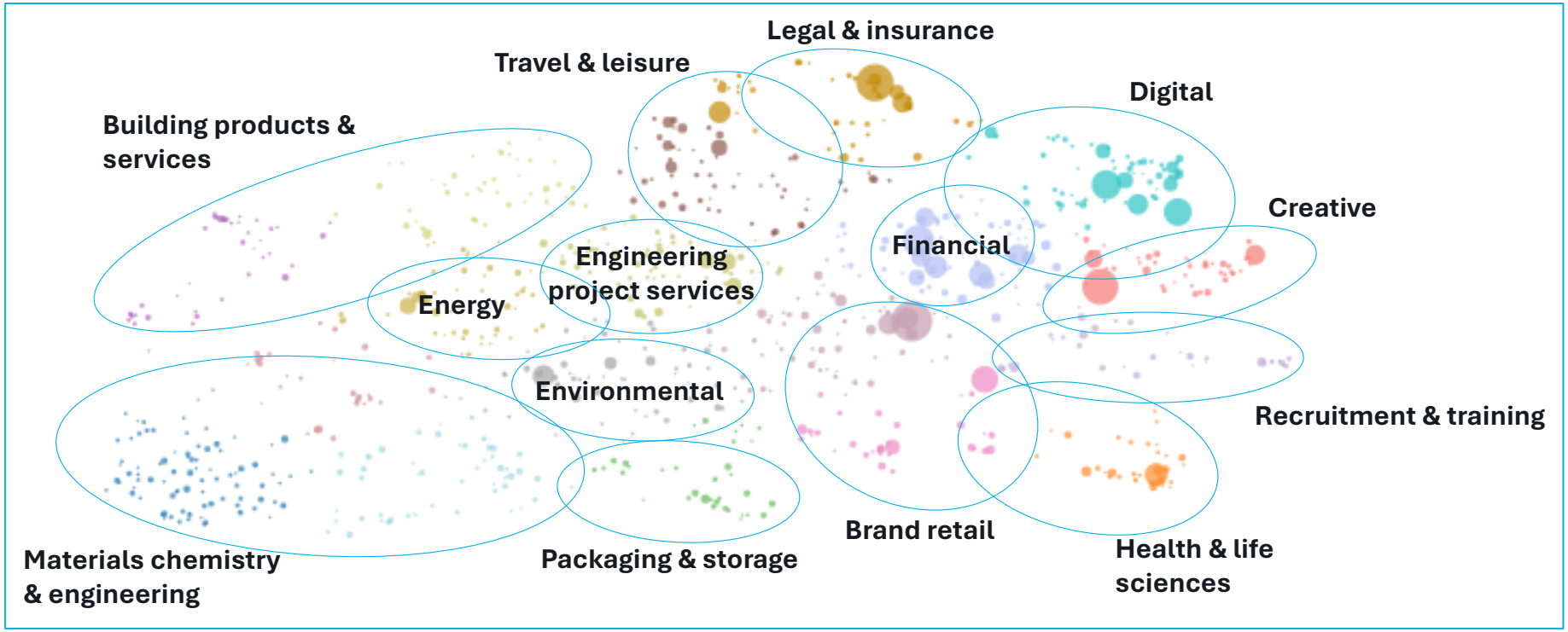
5.7 There is no robust public domain data on the employment per company in specific geographic areas. So, for the larger companies (with 100+ employees), the study team undertook manual searches on LinkedIn, to find the number of LinkedIn members in the 'Manchester Area' at each company. This was used as a proxy for indicative employment in GM for these companies.

5.8 Having built the database, the study team then scraped a sample of pages from each company's website. As with the scholarly work analysis described above, NLP techniques were used to visualise the distribution of these companies, and k-means clustering was used to assign each company to a grouping based on their website texts[14]. A manual examination of the companies was then used to label the groupings (in some cases combining multiple groupings).

5.9 The resulting distribution of innovation-active companies is illustrated in the chart below. Bubble size is proportionate to indicative employment in GM for each company; colours are for the groupings assigned by the k-means algorithm.

[14] Text from the web-scraping was cleaned, then vectorised as a 'bag of words' for each company. Dimension reduction was then used to reduce these vectors to two dimensions for presentation. K-means clustering was applied to assign a grouping to each company; the optimum number of groupings was determined using silhouette score analysis.

Figure 5-2: Visualisation of a sample of 944 innovation-active companies in Greater Manchester [1]



Source: DMS analysis of text scraped from company websites

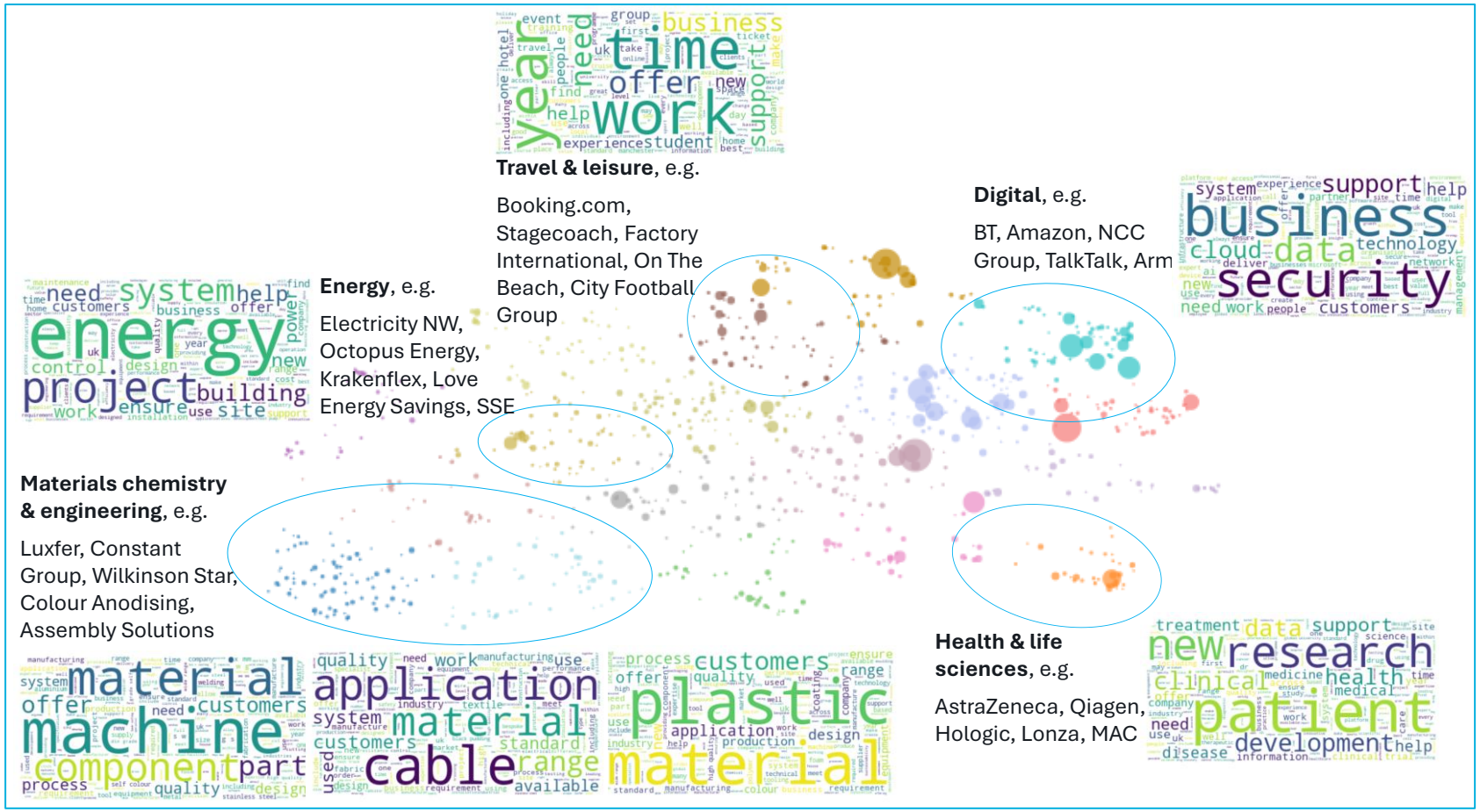
5.10 The following charts, overleaf, provide examples of companies in each area, and wordclouds for each of the groupings identified by the k-means clustering. Various limitations of this approach should be noted:

- The 944 companies included here are only a sample. The study approach sought to avoid systematic bias in developing the sample, but there will undoubtedly be many other innovative-active companies in GM. Also, the sample did not include public sector bodies such as GCHQ or the NHS, nor micro-businesses with fewer than 10 employees;
- The GM employment information (for the bubble size) is only indicative – using a proxy from LinkedIn for the largest companies, and total employment for those with fewer than 100 employees; and
- The automated website text analysis and k-means clustering cannot perfectly represent companies' activities. For a few companies, the groupings assigned – based on an automated analysis of the 'bag of words' taken from a sample of pages on their websites – are not the groupings the study team would have manually assigned them.

5.11 In general, however, the approach used here has been reasonably effective in grouping together companies with closely-related activities, and in giving a sense of the distribution, and potential agglomeration, of economic activity in GM's innovation-active firms. In particular, the study team notes the following:

- The groupings for Digital, Financial, Legal & Insurance and Creative appear to be particularly substantial – including a number of large organisations (each with several hundred people in GM), as well as many small and medium enterprises;
- 'Brand Retail' emerges as an innovative sector of significance. GM-based companies like JD Sports, N Brown, Boohoo and THG are highly innovative and have built up substantial numbers of high value jobs in the region. Digital innovation and data analysis are at the heart of this; and
- While Health & Life Sciences and Materials Chemistry & Engineering do feature as significant groupings, the bulk of GM employment in this sample of innovation-active private sector companies is in areas in which GM's especially strong academic areas (Materials and Life Sciences) are less obviously relevant. There would appear to be an opportunity to grow and/or attract more companies of scale in these areas, to build critical mass and help ensure that GM universities' particular academic strengths are leveraged more in fostering economic growth for the region.

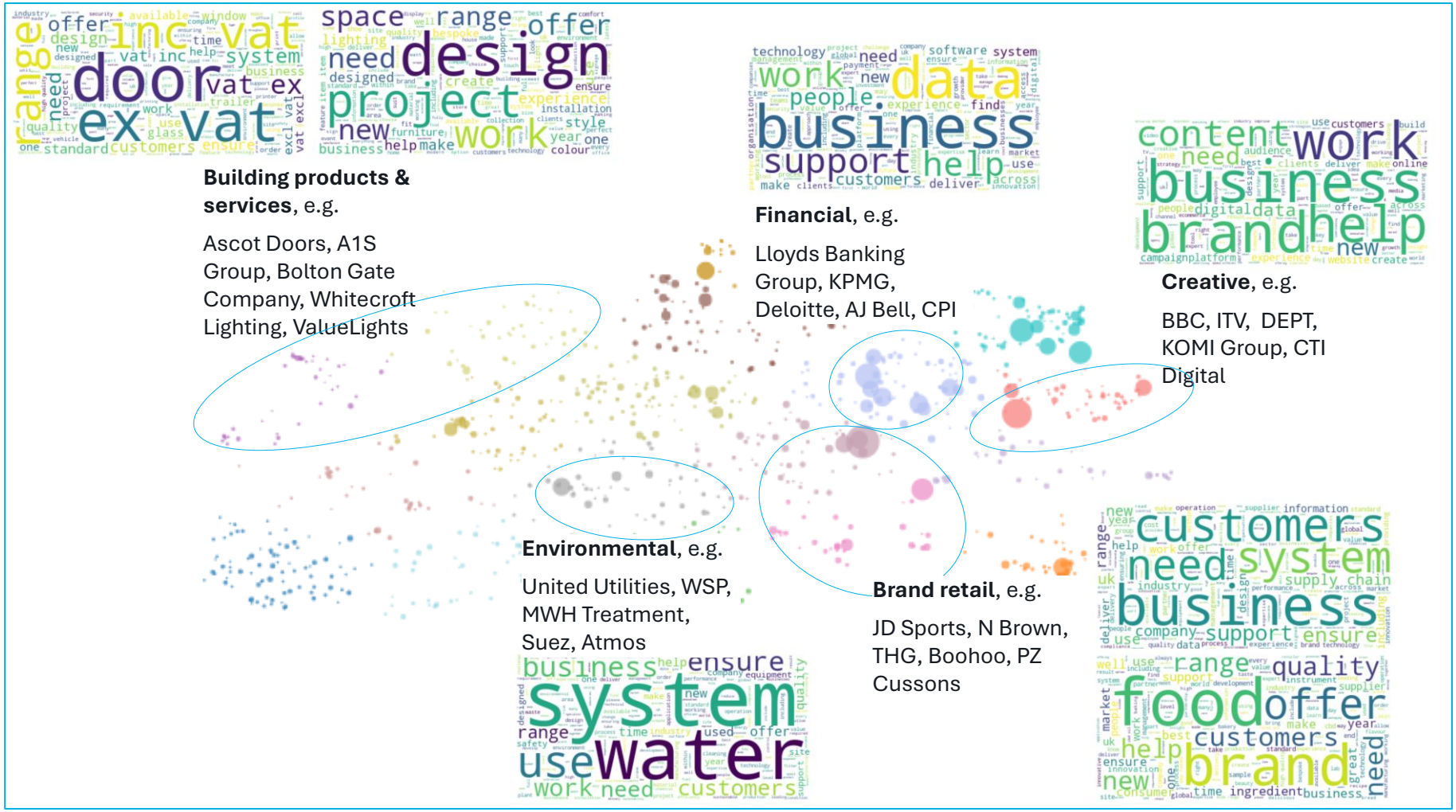
Figure 5-3: Visualisation of a sample of 944 innovation-active companies in Greater Manchester [2]



Source: DMS analysis of text scraped from company websites[15]

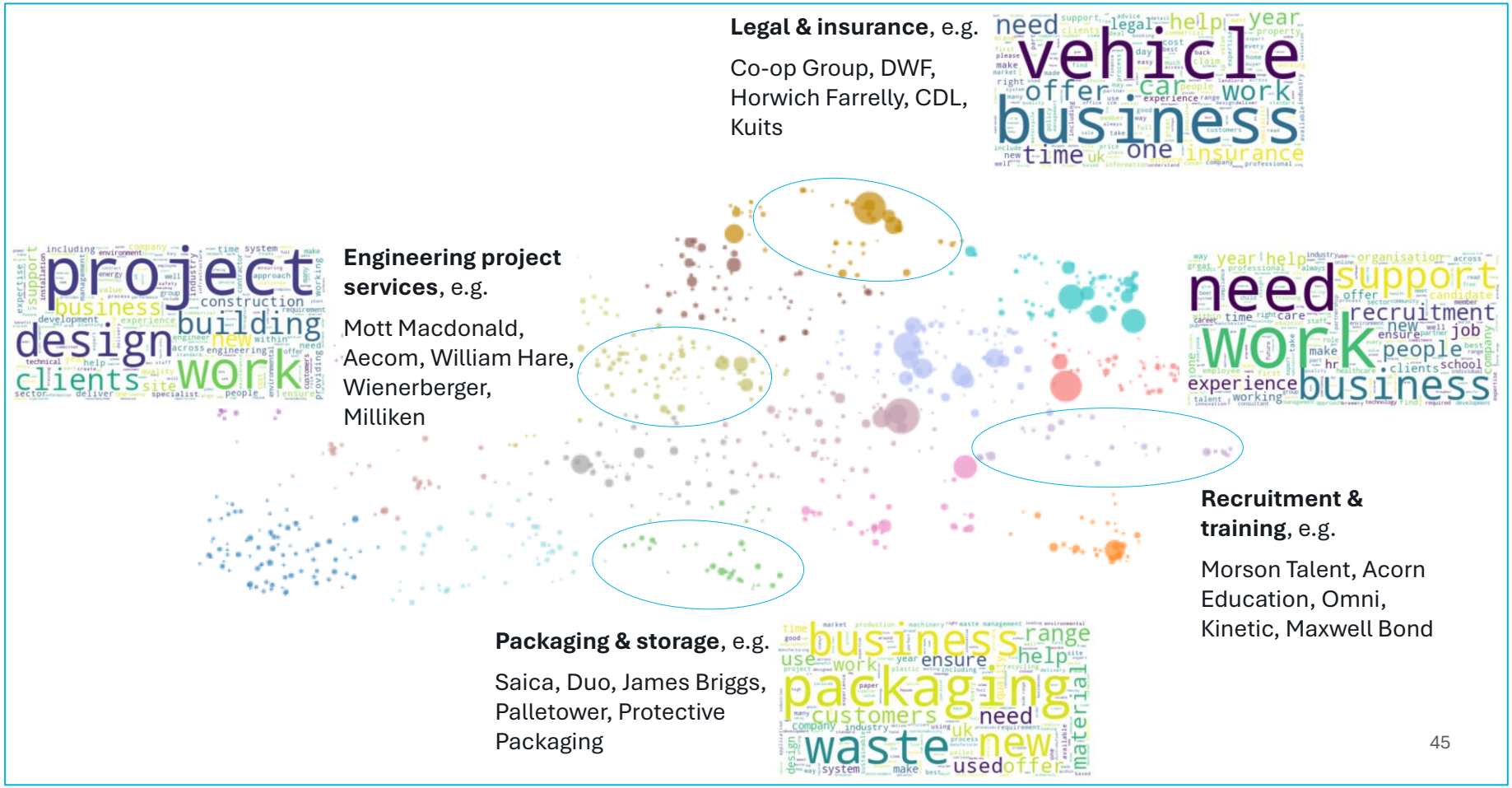
[15] In the Health & Life Sciences grouping, AstraZeneca has been included. Although it does not currently have a physical presence in Greater Manchester, it retains a major manufacturing site at nearby Macclesfield, and there are c. 1,100 LinkedIn members based in the 'Manchester Area' who work at AstraZeneca.

Figure 5-4: Visualisation of a sample of 944 innovation-active companies in Greater Manchester [3]



Source: DMS analysis of text scraped from company websites

Figure 5-5: Visualisation of a sample of 944 innovation-active companies in Greater Manchester [4]



Source: DMS analysis of text scraped from company website

Mapping academic research to company groupings

5.12 Comparing text information about GM universities' research with text from company websites gives some *broad* indication of the short-term relevance of sub-regional HE research for different sectors: by effectively measuring the extent to which they are 'speaking the same language'.

5.13 Figure 5-6 presents a matrix of 'cosine similarities[16]' between the 53k abstract texts from GM universities' outputs in 26 research fields and the website texts from 944 companies in the 14 groupings discussed above. Key points to note include the following:

- The pattern of textual similarities is **broadly in line with what would be expected**. For example, the various Life Sciences research fields have their strongest similarities with the Health & Life Sciences company grouping, and the Materials, Chemistry and Chemical Engineering research fields are most similar to the Materials Chemistry & Engineering and Environmental company groupings;
- The **relevance of GM's strong Materials Science research field is not perhaps as clear** for the companies in this sample as might be expected – even for the Materials Chemistry & Engineering grouping; and
- This analysis provides a vital reminder that it is **not just STEM disciplines that have relevance to GM's industry base**. In particular, note the relatively high similarities for the Business, Management & Accounting and Economics, Econometrics & Finance research areas with the Financial and Brand Retail company groupings

5.14 Figure 5-7 provides an equivalent matrix using the 243 impact case studies[17] submitted by GM universities for 34 Units of Assessment in REF 2021 as source text to represent academic research.

Impact Case Study: An integrated human-centred approach to deliver and leverage technological innovation success for SMEs

Digitalisation is transforming our economy at pace, but digital and technological advances alone are no guarantee of innovation success for enterprises. Research from Salford Business School shows that digital innovations only reach their full potential when adaptive leadership embeds our very human values within the organisation's culture of innovation and change.

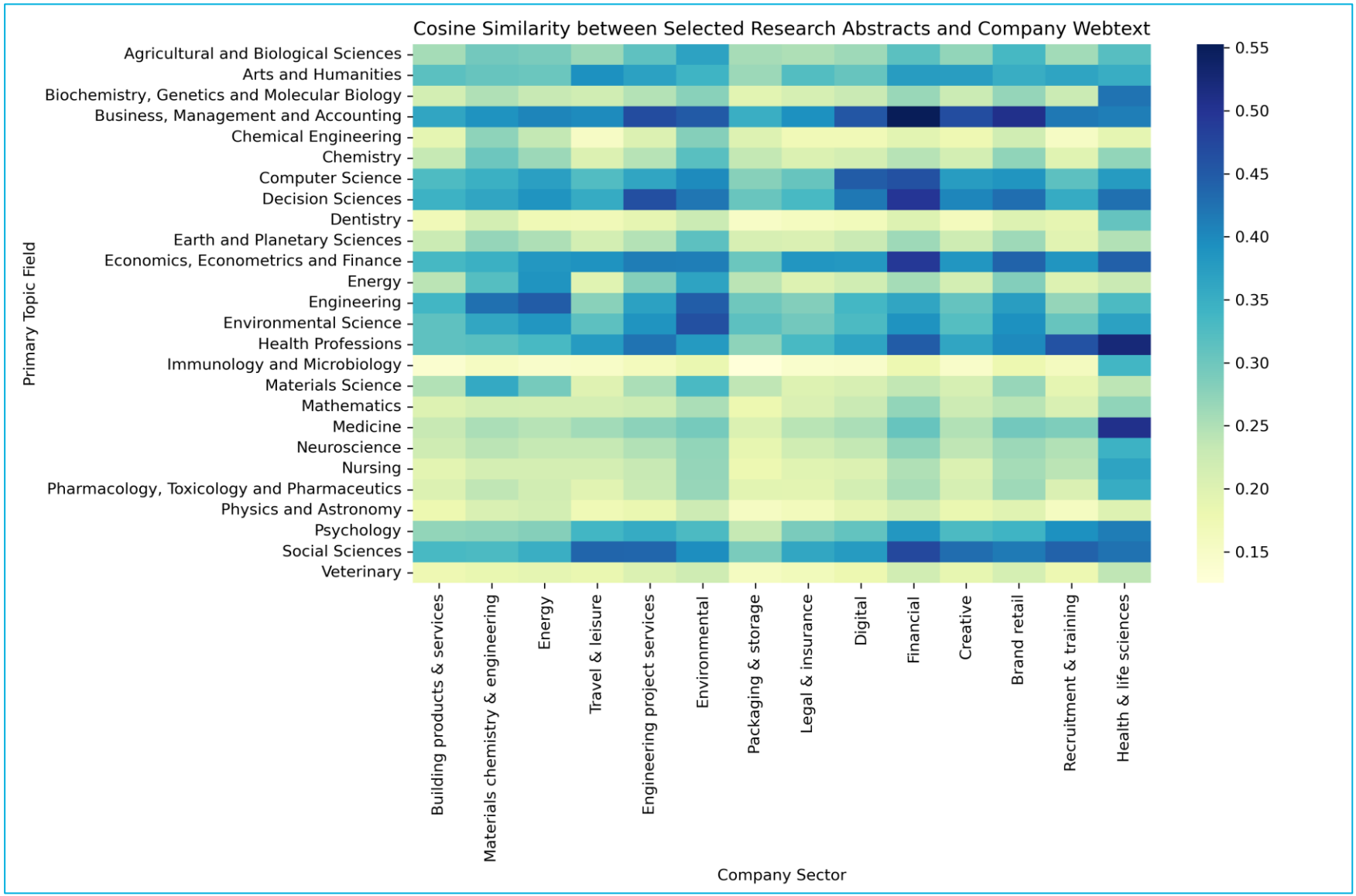
Of more than 1100 small and medium enterprises (SMEs) involved in the study, 96% confirmed that this integrated approach has benefited their organisation, enhancing efficiency and innovation and increasing productivity. Social science developed a human-centred sociotechnical framework of innovation to support others wanting to adopt and apply this approach.

Salford Business School's participative and engaged research demonstrates that innovation is about empowering people to develop new technologies. These insights have driven several initiatives to make digital innovation transformative for SMEs, including the development of the Know Digital platform and immersive technology hubs. The impacts of these initiatives are long lasting with significant social and economic benefits.

[16] This approach represents the text for each research area and the text for each company grouping as multi-dimensional vectors. Cosine similarity then measures the similarity between two vectors by calculating the cosine of the angle between them. It ranges from -1 to 1, where 1 means the vectors are identical in direction, 0 means they are orthogonal (unrelated), and -1 means they are opposite.

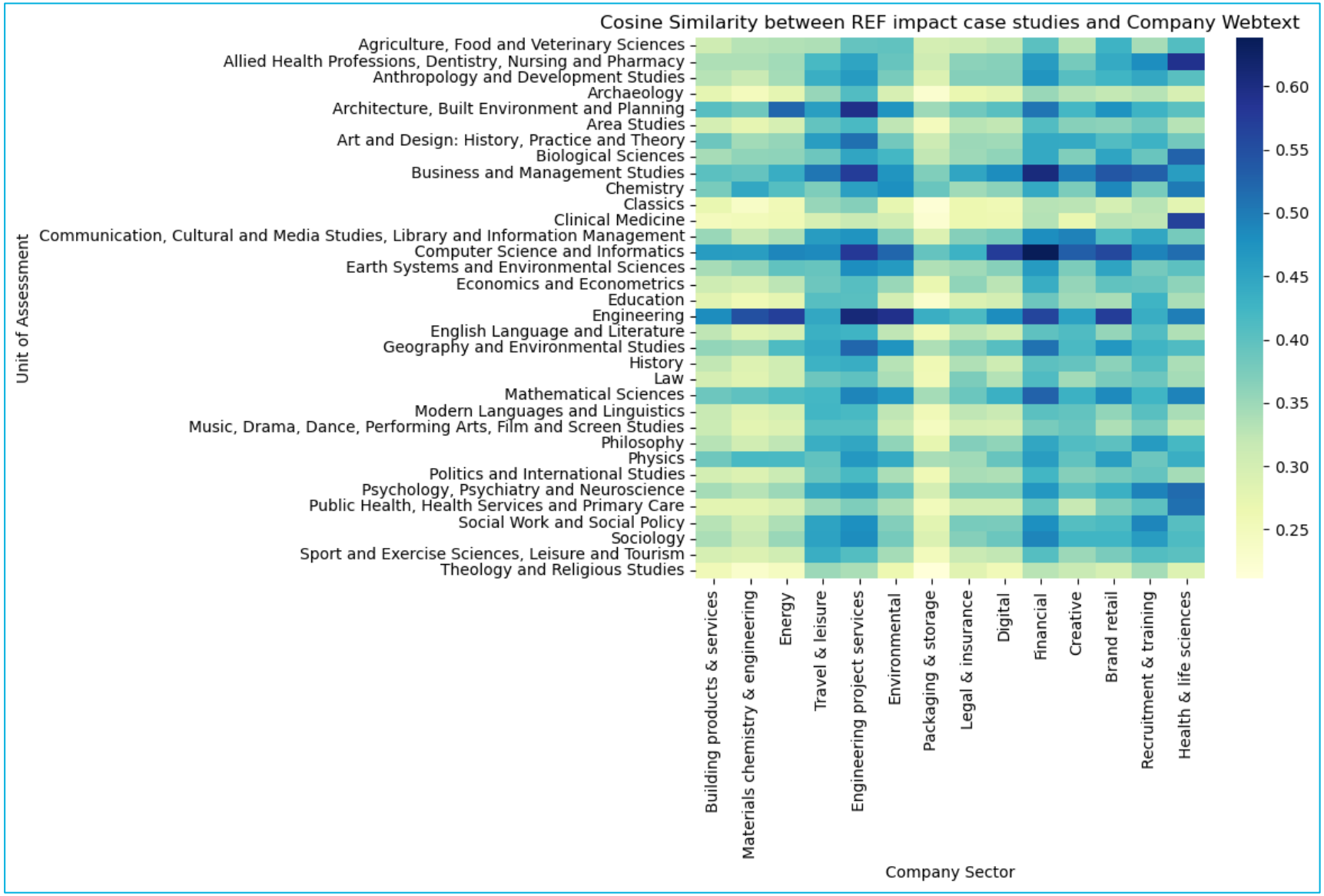
[17] It should be noted that sample sizes are much smaller for this matrix, ranging from 1 case study for Theology and Religious Studies to 23 case studies for Allied Health Professions, Dentistry, Nursing and Pharmacy.

Figure 5-6: Similarity matrix for GM academic research since 2017 by research field (rows) and groupings of innovation-active companies in GM (columns)



Source: DMS analysis of text from 53k research abstracts (from OpenAlex) and 944 company websites

Figure 5-7: Similarity matrix for GM's REF 2021 impact case studies by Unit of Assessment (rows) and groupings of innovation-active companies in GM (columns)



Source: DMS analysis of text from 243 REF 2021 impact case studies for GM universities and 944 company websites

5.15 Here, the study team notes that:

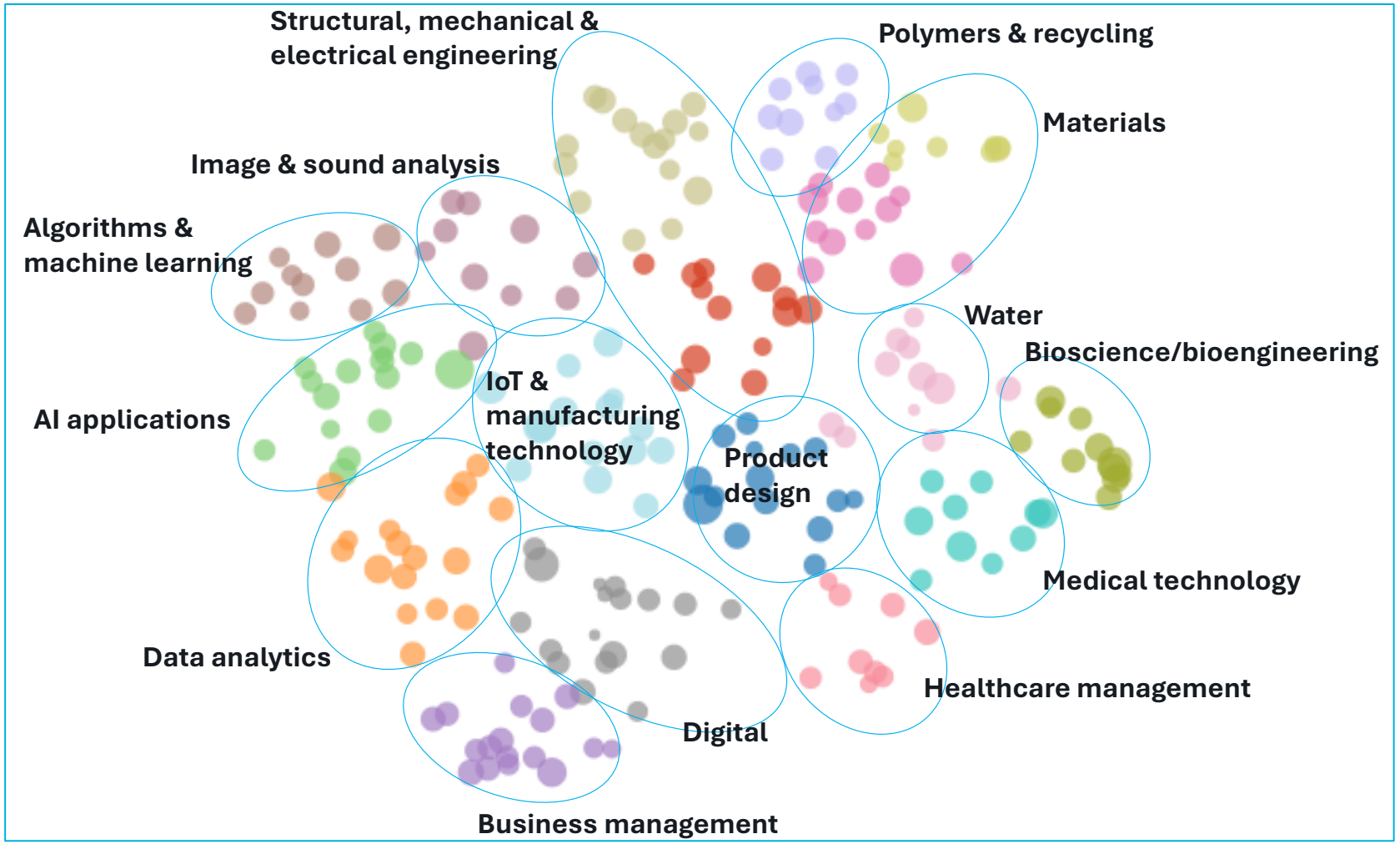
- This provides a pattern of similarities that is broadly aligned with that generated using abstract texts, depicted at Figure 5-6;
- There are generally higher levels of similarity using the impact case studies than when using the research output abstracts: this is to be expected given that the case studies are describing the impacts of the research for real-world industries/communities. In particular, Maths and Physics have noticeably higher levels of similarity, as their case studies are using much less technical language than that in their scholarly works; and
- The Units of Assessment with the broadest 'relevance' across the company groupings (as measured by the textual similarity analysis) are Computer Science & Informatics, Engineering and Business & Management Studies.

Knowledge Transfer Partnerships

5.16 Some insight into the areas in which industry and academia are working together is given by analysis of Knowledge Transfer Partnerships (KTPs), which are innovation collaborations involving a business, a UK university or research institution, and a recent graduate. Filtering the list of funded Innovate UK projects to KTPs involving one of the GM universities and/or a business located in Greater Manchester reveals that there have been 221 such projects to date since the start of 2017.

5.17 The chart below again uses NLP techniques and k-means clustering to visualise these 221 KTP projects, grouped by broad topic area as inferred from their project descriptions. As would be expected, the projects are all focused on applying academic partners' expertise to real-world business problems. They span a wide variety of areas, from structural engineering to business management to bioscience.

Figure 5-8: Visualisation of Greater Manchester Knowledge Transfer Partnership projects since 2017



Source: DMS analysis of Innovate UK projects data. Bubble size is proportional to award amount per project. Colour denotes the grouping allocated to each project by the k-means clustering algorithm. Groupings have been manually labelled based on inspection of the projects within each.

5.18 Table 5-3: below summarises the trends in certain project types over the years, having searched for selected lists of relevant text strings within the project descriptions. It is notable that the proportion of **projects involving AI has increased** from 11% for projects starting in 2017-2019 to 19% in 2023-2025, while the proportion of **projects related to health and life sciences topics has reduced** from 16% in 2017-2019 to just 9% so far in 2023-2025 (after peaking at 21% in the Pandemic years of 2020-2022).

Table 5-3: Proportion of Greater Manchester KTPs including selected terms[18] in project descriptions, by period in which the projects started

Period	Total projects	AI-related	Data-related	Materials-related	Health and life sciences related
2017-2019	95	11%	12%	13%	16%
2020-2022	73	15%	12%	14%	21%
2023-2025 (so far)	53	19%	11%	11%	9%
Total	**221**	**14%**	**12%**	**13%**	**16%**

Source: DMS analysis of Innovate UK projects data

Key Findings

- Analysis of industries with high location quotients and/or high growth since 2016 highlights the importance for GM of financial services, legal services, e-commerce, creative industries and digital in particular.
- The value creation in most of GM's strongest industries is *not* being driven by scientific advances in the areas in which GM's universities are especially strong: Life Sciences and Materials. But digital innovation is relevant to many, if not all, of these industries.
- Mapping a sample of innovation-active companies with GM operations reveals particularly substantive groupings for Digital, Financial, Legal & Insurance, Creative and Brand Retail. While Health & Life Sciences and Materials Chemistry & Engineering do feature as significant groupings, there would appear to be an opportunity to grow and/or attract more companies of scale in these areas, to build critical mass and help ensure that GM universities' particular academic strengths are leveraged more in fostering economic growth for the region.
- Analysis of Knowledge Transfer Partnerships in GM reveals strong growth in the proportion of projects involving AI: increased from 11% for projects starting in 2017-2019 to 19% in 2023-2025.

[18] AI-related text strings: "artificial intelligence", "machine learning", " AI ", " ML ", "deep learning". Data-related text strings: "data". Materials-related text strings: "material", "composite", "polymer", "plastic", "graphene", "foam". Health & life sciences related text strings: "bio", "health", "medic", "patient", "bacteria", "cancer", "disease", "drug", "neuro", "cardio", "pharma", "microb", "wound", "infection", "physio".

6 GM's primary capabilities

Overview

This Chapter sets out the seven Primary Capabilities identified through this study. It details the approach to identifying the science and technology capabilities that are most critical to GM's future growth and prosperity, before describing in turn the dimensions of each of these capabilities.

Approach to identifying Primary Capabilities

6.1 Following the analyses conducted in the course of this study and described in preceding chapters, work was undertaken to identify the science and technology capabilities that are most critical to the region's future prosperity. In this context, a capability is an area of particularly strong science and innovation performance or capacity in the GM research or industrial bases.

6.2 In order to identify primary 'capabilities' for GM, potential areas of strength were analysed against two criteria.

6.3 The two criteria used for assessment were as follows:

- **Criterion 1:** There is outstanding knowledge capability in GM universities & a realistic prospect of this being translated into superior economic growth (new or additional) in GM's private sector; **OR**
- **Criterion 2:** Existing strong sectors and/or high growth sectors in GM have strong demand for the knowledge capability area in view, irrespective of GM's universities' comparative advantage.

6.4 Analysis against these criteria was conducted, drawing on the research and analysis set out in Chapters 2 to 5, as well as insights from stakeholder consultations, a review of GMCA's strategies (including Sector Development Plans, the GM Innovation Plan and Local Industrial Strategy), material from other key partners (including the universities, the Growth Company and GM's inward investment agency, MIDAS), and relevant national documents, such as the recently published Modern Industrial Strategy (MIS) and associated Sector Plans.

6.5 Outstanding knowledge capabilities were identified through evidence of particularly strong research performance based on a combination of factors such as:

- Strong performance in the REF;
- Evidence of scale or high degree of specialism (e.g. scale or share of research funding); and
- High impact of research outputs (e.g. highly cited works in relevant topics).

6.6 Our assessment of industry demand was informed by consideration of the capabilities required in sectors with:

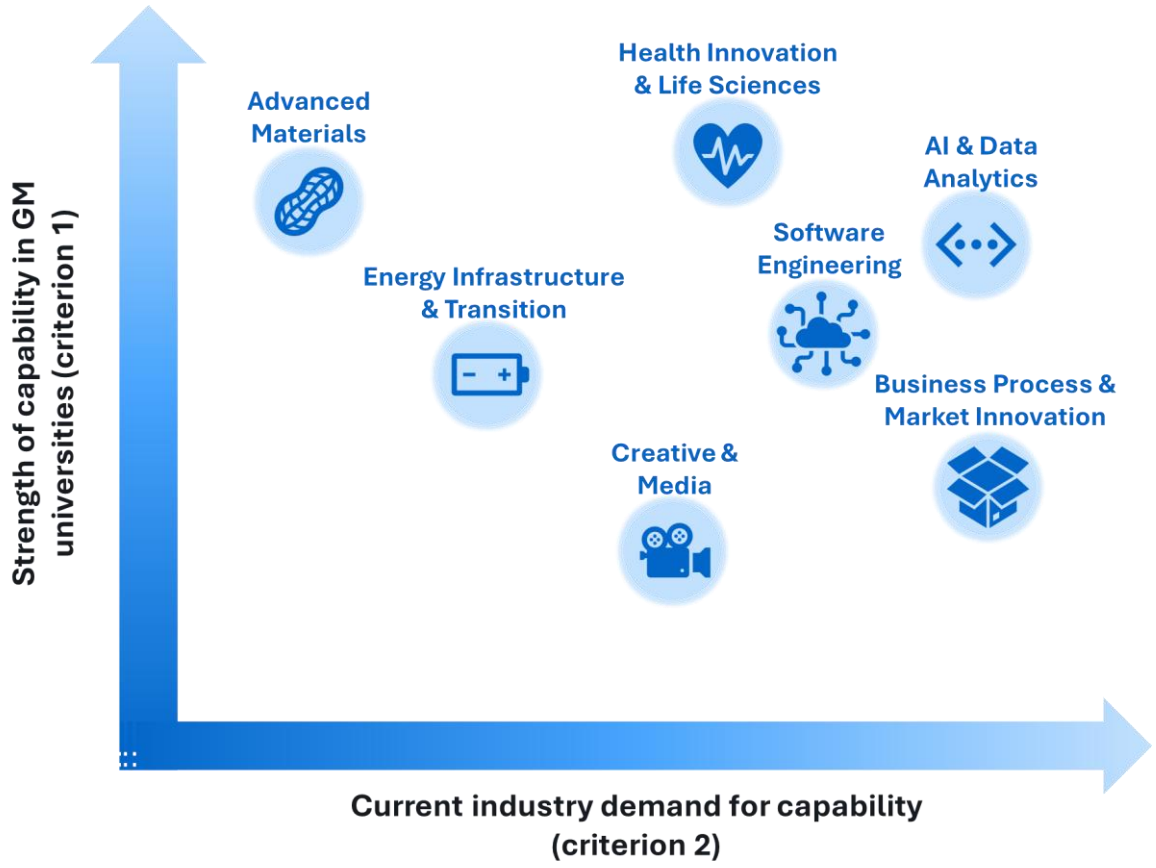
- Existing strengths in GM's business base (scale of employment, or concentration of employment in a given industry);
- Evidence of high growth since 2016; and
- An anchor firm, asset or strategic opportunity around which future growth could coalesce.

6.7 Consideration was also given to the extent to which capabilities aligned with wider city regional and national strategic priorities.

The primary capabilities

6.8 Applying these criteria, seven Primary Capabilities were identified for GM. The graphic below depicts the extent to which each identified capability meets with the two criteria described above.

Figure 6-1: Depiction of GM Primary Capabilities

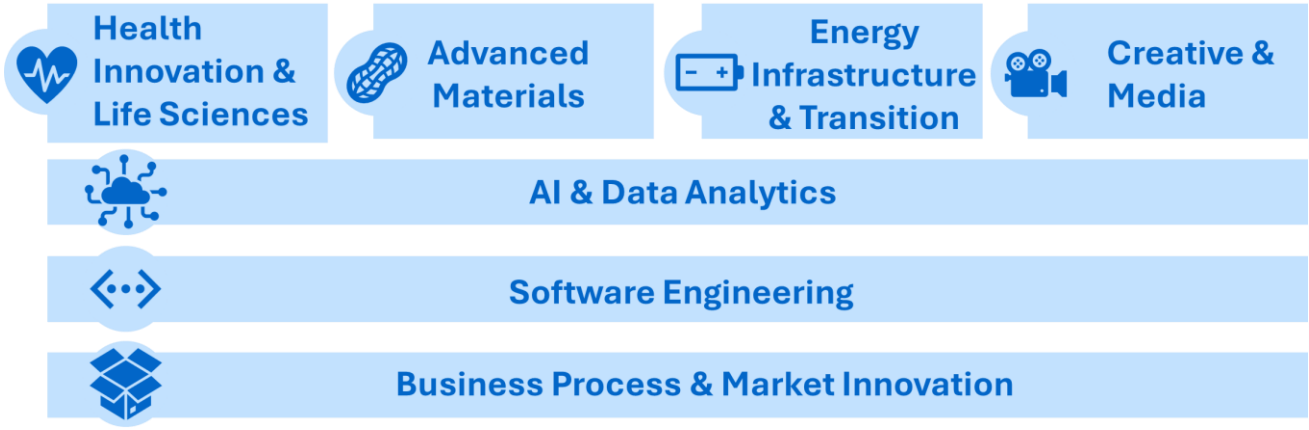


Source: Steer-ED, 2025

6.9 It is important to note that these capabilities are not mutually exclusive, with strong linkages between them and reinforcing strengths. Many share common knowledge assets and institutions, and in some instances the greatest opportunity to drive growth sits at the intersection of these strengths. For example, Advanced Materials will play a key role in innovation in Health and Life Sciences and also has strong connection to AI and Data Analytics. Similarly, Business Process and Market Innovation is a driver of innovation across Creative Industries – and indeed other industries.

6.10 With this in mind, the primary capabilities reflect a mix of 'vertical' capabilities and 'cross-cutting' ones , which have application across the width of GM's ecosystem.

Figure 6-2: Vertical and cross cutting capabilities



Source: Steer-ED, 2025

6.11 Each of the seven capabilities is described in the fiches below. Each is written to a consistent format comprising the following elements:

- **Why is this a Primary Capability?** – a short summary of why this capability is important to GM;
- **Key science and innovation assets** – providing a (non-exhaustive) listing of the key institutions, assets and research strengths which underpin the capability, with a fuller list of assets included in Annex B;
- **Examples of private sector and industry strengths** – providing (again, non-exhaustively) a summary of strengths aligned to this capability in GM's business base, drawing on existing strategies and policy intents, such as the draft Sector Development Plans, GM's Innovation Plan and the national Modern Industrial Strategy; and
- **Policy alignment and future opportunities –** setting out how the capability aligns to GM's existing priorities for delivering inclusive innovation and growth, and alignment to national priorities as defined in the Modern Industrial Strategy and the associated sector plans.

Health Innovation and Life Sciences

Why is this a Primary Capability?

GM's strengths in this space are underpinned by exceptional research capability, making it a Primary Capability based on Criterion 1.

Despite a fall in clinical medicine funding coming to GM in recent years, this capability includes the two biggest research funding streams coming to GM's universities, namely Biosciences (£406 million) and Clinical Medicine (£380 million). Scholarly works analysis identifies a broad range of Health and Life Sciences research strengths, with UoM ranked in the top percentile for many topics including lung cancer research, advanced radiotherapy, wound healing and treatment, and pharmacogenetics. Manchester Metropolitan University and University of Salford are also ranked in the top 10% nationally in areas such as sports injuries and prevention, sports performance and training, musculoskeletal topics, and using AI to diagnose COVID-19.

GM's private sector in Health Innovation and Life Sciences does not yet match the strength of its research base, hence the inclusion of this capability based on Criterion 1 rather than Criterion 2. There are however undoubted strengths in the business base, and clear opportunities for further future growth, covered in more detail below.

Key science and innovation assets

The below table highlights key research assets and knowledge resources which enable GM's health innovation and life sciences capabilities.

Table 6-1: Key Health Innovation and Life Sciences assets (table content is non-exhaustive)

Asset	Location	Description
Christabel Pankhurst Institute	University of Manchester	Innovation facility combining academic strengths in AI, digital health and Advanced Materials to support R&D in innovative technology-based health and care solutions.
The Christie Hospital	Withington, Manchester	Largest single site cancer centre in Europe, includes the Paterson cancer research centre and Proton Beam Therapy Centre
Manchester Cancer Research Centre	Didsbury, Manchester	Partnership between UoM, Cancer Research UK and The Christie NHS Foundation Trust, taking an integrated approach to improving patient diagnosis and care
UK Biobank	Manchester Science Park	Biomedical research resource storing health/genomic data from 500,000 volunteers
GM Care Record	GM-wide	Digital resource on GM's 2.8m residents used for integrating care, planning commissioning and informing research

The capability is also supported by sector support bodies such as Health Innovation Manchester (HInM), a partnership body combining NHS, local government, industry, and research and academia. As well as managing the GM Care Record describe above, HInM brings together senior expertise to drive collaboration across the ecosystem. It also manages the Health Innovation Manchester Accelerator, an incubator for major health-technology solutions. Sector bodies such as BioNow also support sector businesses in the North West.

Examples of private sector and industry strengths

The health sector is the single largest employment sector in GM and employment increased by 23.5% to 205,000 between 2016 and 2023. Within this, almost 100,000 people are employed in GM hospitals.

The examples below (non-exhaustive) give a flavour of GM's private sector specialisms in this capability:

- Diagnostics and therapies, including:
  - QIAGEN's Centre of Excellence for Diagnostics;
  - Hologic manufacturing diagnostic and medical instrument solutions;

  - Pharmacogenetics-testing company Genedrive;
  - Apis Assays Ltd (a spinout JV between QIAGEN and the City Council) – designing and manufacturing innovative drug-linked biomarker assays;
  - Waters Corporation's Centre of Excellence for Mass Spectrometry, on the Cheshire/GM border; and
  - Phagenesis and QV Bioelectronics, both deploying electrotherapy to improve care outcomes.
- Personalised medicine, including:
  - Aligning private sector strengths with leading public institutions such as the UK Biobank and the Manchester Centre for Genomic Medicine integrating genomics into care pathways;
- Clinical research, including
  - companies working to conduct clinical trials at scale, including MAC Clinical Research and North West E-Health;
- Utilising GM's Care Record, technology, institutions and access to high quality, high volume healthcare data to improve research, service planning and commissioning to improve economic and social outcomes.
  - This includes a partnership with global medicines company Eli Lilly to conduct a five year real-world evidence study on approaches to weight loss, and diabetes/obesity prevention.
  - Iqvia's investment in the Medicines Evaluation Unit at Wythenshawe, strengthening GM's offer on real-world evidence and clinical trials.

Policy alignment and future opportunities

Health Innovation and Life Sciences is a longstanding priority for GM. Health Innovation was identified as a strength in the 2016 SIA. It was subsequently prioritised in the Local Industrial Strategy and its strategic importance was recognised in the 2019 Prosperity Review. The sector was identified in the 2022 Innovation Plan, and is now one of GM's Frontier Sectors, with a Sector Development Plan in place to support growth. This recognises the value this capability plays in driving inclusive innovation, and ensuring that world-leading research and commercialisation translates into improved health outcomes and quality of life for GM's residents.

Life Sciences is one of the IS-8 priority sectors identified in the UK Government's national Modern Industrial Strategy. The accompanying UK's Life Sciences Sector Plan recognises specifically the role that GM will play in delivering this, highlighting strengths in Genomics, Diagnostics and Health Data. GM is positioned ideally to capitalise on the Plan's actions to:

- Invest £600m, alongside the Wellcome Trust, to create a Health Data Research Service, unifying genomic, diagnostic and clinical data at population scale;
- Attract global Life Sciences firms to the UK via the £520m Life Sciences Innovative Manufacturing Fund; and
- Partner with leading life sciences firms and high potential companies to attract, scale and retain innovative companies in the UK.

Good health outcomes are a key societal goal for both the UK and for GM, with relatively poor population health outcomes linked to poverty and economic inactivity. Outcomes can be improved through strengthening health systems, ensuring equitable access to healthcare and addressing the social determinants of poor health early, where possible in childhood. Inclusive innovation involving local government, NHS Trusts, universities, businesses and communities can create joined-up solutions focused on health systems as well as housing, skills development and employment. These approaches are vital to improving economic performance, enabling more people to participate fully in society and to lead fulfilling, rewarding lives.

The ageing population further increases demand for health services and necessitates innovation in treatments, diagnosis and prevention. GM has pioneered the devolution of health and social care, with the 2016 devolution deal being the first to offer specific powers to a city region in this space, and frontloading transformation funding.

GM's Patient Care record is a key resource which brings together health and care information into a single dataset covering 99.95% of GM patients. This is not only improving patient care but is also an invaluable research tool which enables large-scale analyses of population health challenges in a diverse population.

Aligned to the above, the Integrated Settlement provides opportunities for GM to leverage its strengths in this space and drive greater collaboration and innovation on health and life sciences. Using the mix of academic and commercial research excellence, world-leading patient data and collaborative institutions, GM can attract further investment to drive growth and improve societal outcomes.

Advanced Materials

Why is this a Primary Capability?

GM has a world-leading research base in Advanced Materials which, under Criterion 1 above, justifies the inclusion of this as a Primary Capability. GM's research ranks in the top percentile in a range of topics including:

- Graphene;
- Nanomaterials;
- Additive manufacturing; and
- 3D printing.

Reflecting these strengths, GM overperforms significantly on attracting research funding in this domain. This includes attracting 22.5% of Materials Engineering funding and 10.4% of Chemistry. UoM's materials research is highly cited globally, reflecting the City Region's world-leading strengths in this capability.

Whilst this research excellence has not. as yet, translated into high levels of private sector growth, there is a substantial cluster of activity in GM and a steady stream of startups and scale ups with growth potential.

To exploit this growth potential, the Graphene, Advanced Materials and Manufacturing Alliance (GAMMA) has been formed to lead the creation of an Advanced Materials supercluster in the City Region. Major development sites have been allocated to accommodate this growth, including Atom Valley in the North East of the City Region – a site which is both a part of GM's designated Investment Zone and one of its six Growth Locations.

Key science and innovation assets

Reflecting its research strengths as above, GM significantly overperforms on attracting research grant and contract funding. This includes attracting 22.5% of UK universities' Materials Engineering funding and 10.4% of Chemistry funding. UoM's materials research is highly cited globally, with GM home to genuinely world-class research assets in Advanced Materials, including the National Graphene Institute and the Graphene Engineering Innovation Centre which provide spaces for R&D, industry collaboration and support for Advanced Materials start- and scale-ups.

In addition, the Henry Royce Institute, opened in 2020, is based in Manchester and coordinates 700 academic, technical and research staff across the UK to develop solutions to materials challenges, and to accelerate associated commercialisation.

Table 6-2: Key Advanced Materials assets (table content is non-exhaustive)

Asset	Location	Description
National Graphene Institute	Booth Street East, Manchester	A flagship £61 m facility housing cleanrooms and labs for academic-industry R&D into graphene and 2D materials. Includes 1,500m^2 ISO-class 5–6 cleanroom complex
Graphene Engineering Innovation Centre (GEIC)	Sackville Street, Manchester	Industry-led pilot and scale-up centre for graphene applications in energy, coatings, electronics, building products etc.
Henry Royce Institute	Oxford Rd, Manchester	The UK's national Advanced Materials hub for multi-scale materials research and industry collaboration, includes the Defence Materials Centre of Excellence
Advanced Materials and Digitalisation Innovation Centre	Manchester Metropolitan University	Leading research in Advanced Materials, nanotechnology and low carbon fuels
National Physical Laboratory	University of Manchester	Strategic research partnership to accelerate commercialisation of Advanced Materials

Greater Manchester Investment Zone	Salford Crescent, Sister (Oxford Road), Atom Valley (Rochdale)	GM's Investment Zone focuses on its advanced manufacturing and materials sector with the potential to create 32,000 jobs)

Examples of private sector and industry strengths

GM's diverse strengths in this capability involve a mix of home-grown and multinational firms, with a width of specialisms including, but not limited to:

- Firms working to realise the high growth potential of graphene and wider nano-materials, located in the GEIC including:
  - Vector Homes: sustainable, affordable, smart homes;
  - Concretene: enhancing strength and durability in construction;
  - AEH Innovative Hydrogel: growing crops without soil; and
  - Graphene Innovation Manchester: accelerating research and commercialisation of graphene in a breadth of industrial sectors.
- Materials engineering companies such as:
  - Luxfer MEL, which has both R&D and manufacturing operations in GM producing high performance components for use in Automotive, Aerospace, Energy, and Health applications.

Advanced materials are also increasingly finding uses within areas of advanced manufacturing including digital and electronics, and additive manufacturing. For example, Hyde Precision Components delivers safety-critical components to the defence and commercial sectors. There is therefore potential for further adoption, substitution, and innovation in Advanced Materials in industries which are already strong in GM, such as textiles, chemicals and rubber and plastic products.

GM's Advanced Materials capabilities also align and integrate strongly with the City Region's strengths in Health Innovation and Life Sciences, detailed elsewhere in this Chapter.

Policy alignment and future opportunities

Advanced Materials is well-established as a priority in Greater Manchester, and was recognised as such in the 2016 SIA. It was identified subsequently as a 'Frontier Sector' in the 2019 Local Industrial Strategy, which informed the development of the Advanced Materials and Advanced Manufacturing Sector Development Plan. The establishment of GAMMA and the focus of GM's Investment Zone reinforces the City Region's commitment to driving growth and capacity in this capability.

Advanced Materials have applications across a range of industries, most prominently in advanced manufacturing industries using technologies such coating processes and advanced technical textiles. There are also applications in areas of Life Sciences, and major opportunities for materials innovation to contribute to Net Zero ambitions through decarbonising construction materials. An increasing focus on Defence as a national priority is also likely to drive demand for products using Advanced Materials.

These opportunities are recognised in the inclusion of Advanced Manufacturing as one of the IS-8 priorities in the Modern Industrial Strategy. The associated national Sector Plan recognises GM's Advanced Materials strengths as part of a wider North West cluster and emphasises the growth opportunity from Advanced Materials in diverse sectors including Life Sciences, Defence, Digital, and Clean Energy.

Energy Infrastructure and transition

Why is this a Primary Capability?

The analysis of highly cited scholarly works identifies the leading research which GM institutions are producing to address the challenges in the Energy arena, including research in Engineering and Environmental Science.

REF Impact Case Studies highlight GM's research power and influence in areas such as:

- Electrical power systems (managed connections and flexible demand response controls; overhead line design improvements, etc);
- Nuclear technologies (graphite research to improve safety, security and reliability in the UK nuclear industry); and
- Industrial decarbonisation (reducing climate impacts of shipping and aviation; reducing usage of fossil-oil-based insulating liquids in power transformers).

GM's universities are also producing highly cited works in topics such as urban heat island mitigation. Similarly, the Greater Manchester Electrochemical Hydrogen Cluster (GMEHC) is accelerating the development and adoption of electrochemical (green) hydrogen technologies by fostering collaboration between academic institutions, government and industry.

GM's private sector strengths in this space include innovative firms involved in the generation, distribution and storage of sustainable energy, as well as engineering firms enabling the decarbonisation of industry to support the transition to Net Zero. As such, this Capability is included on the strength of the research base (Criterion 1), as well as strengths in industry with significant potential for future growth (Criterion 2).

Key science and innovation assets

The table below highlights key assets and knowledge resources in GM which underpin its strengths in energy infrastructure and transition.

Table 6-3: Key Energy Transition assets (table content is non-exhaustive)

Asset	Location	Description
Energy House 2.0	Frederick Road Campus, University of Salford, Salford	Dual-chamber lab simulating weather extremes to test building energy performance and net-zero technologies
Trafford Low Carbon Energy Park	Carrington, Trafford, SW Manchester	Large-scale clean-energy hub with battery storage (680 MW), liquid air and hydrogen production
Dalton Nuclear Institute	University of Manchester	Experience and equipment to research the full nuclear fuel cycle
Centre for Processes, Resilient Infrastructure and Sustainable Built Environment	University of Salford	Focus on enhancing the built environment and infrastructure through digital technology and innovation
Tyndall Centre for Climate Change Research	University of Manchester	Research into options for mitigating climate change including energy systems, emissions pathways and energy storage
Energy Innovation Agency	Oxford Road Corridor	Collaboration between GM stakeholders to accelerate the introduction of energy-related innovations

Examples of private sector and industry strengths

GM is home to major companies who are critical to developing, maintaining, and using the energy infrastructure required for the Net Zero transition. Non-exhaustive examples include:

- Energy and Infrastructure suppliers such as:

  - SSE, Octopus Energy and its subsidiary Krakenflex (using AI and a cloud-based platforms to control distributed energy assets matching supply and demand);
  - Electricity North West, the distribution network operator; and
  - Rolls Royce's Small Modular Reactor headquarters, based in central Manchester, which is developing the next generation of nuclear energy generation facilities (which can be deployed more flexibly and at smaller scale than existing models).
- The Trafford Low Carbon Energy Park, which hosts innovation demonstrators on hydrogen, batteries, and liquid air storage; and
- Major global consultancies with strong presences in the City Region, such as Jacobs, Mott MacDonald and AECOM, together with a thriving community of smaller boutique consultancies such as Sustineri and Carbon Profile specialising in low carbon, energy transition, and environmental sustainability.

GM is part of a wider cluster of energy-related activity across the North West, with which this capability can integrate and create synergy. This wider cluster includes, by way of example:

- Hydrogen, where the Hynet project in Cheshire is decarbonising one of the UK's highest emitting industrial clusters;
- Nuclear, in Cumbria (home to the UK's most developed nuclear cluster), and at Springfields in Lancashire which hosts the UK's only nuclear fuel processing plant; and
- Tidal energy generation in Merseyside and North Wales.

Policy alignment and future opportunities

The transition to Net Zero is a key driver of inclusive innovation, with the decarbonisation of energy systems being a major challenge for society. The transition also has the potential to drive sustainable economic growth, and power the move to a decarbonised economy, whilst retaining and growing employment across the skills spectrum.

Low Carbon is one of GM's Frontier Sectors, reflecting analysis that shows GM has the largest low carbon sector outside of London[19]. This built on the strength identified in the 2016 SIA around Energy and Low Carbon and the opportunity for inclusive innovation to address the transition to a just Net Zero economy.

The imperative for action in this space remains as strong, if not stronger, today. The transition to Net Zero is a priority for GMCA and its constituent LAs, who declared a climate emergency in 2019 and a biodiversity emergency in 2021.

The GM Five Year Environment Plan has an ambition to ensure that all in GM have a healthy, low carbon, nature-rich environment in which to live well, prosper, and grow. GM's Low Carbon Sector Development Plan sets out how low carbon innovation and technological leadership can contribute to this, attracting investment and developing sector-specific decarbonisation approaches.

The Modern Industrial Strategy's sector plan aligns strongly with GM's ambitions in this arena, promoting technologies such as hydrogen, nuclear, and wind, and recognising the importance of developing robust supply and skills pipelines to ensure the energy transition supports inclusive innovation and growth.

[19] Greater Manchester's Green Economy Sector Mapping Study, Green Economy, 2022

Creative & Media

Why is this a Primary Capability?

GM's private sector strengths are the primary driver of this capability and as such this is included on the basis of Criterion 2.

The City Region is home to Europe's largest purpose-built digital hub, Media City UK, which sits at the heart of one of the biggest Creative and Media clusters in Europe. Underpinned by major organisations, including the BBC and ITV, the capability spans a breadth of specialisms, with innovation driven by freelancers, startups, SMEs, and global brands. This has driven strong growth in the sector since 2016, including in TV and Broadcasting, which has been among the highest growth industries and now employs 8,000 people in GM.

GM universities provide almost 4,000 graduates a year in Media, Design, Creative and Performing Arts subjects. This talent pool feeds a significant and growing industry, described below. The city's world renowned music scenes encompasses acts and venues at all scales, and also includes the Royal Northern College of Music (RNCM) and the Halle Orchestra.

There is undoubted academic strength across all of GM's universities in this space:

- Manchester Metropolitan University is among the top ranked universities for Virtual Reality applications and impacts in citation analysis for this study;
- University of Salford hosts the Creative Tech Labs and has strengths in immersive technologies; and
- The University of Manchester ranked in the top three nationally in Drama, Dance, Performing Arts, Film and Screen Studies in REF 2021.
- The RNCM produced almost 350 graduates in creative and performing arts in 2024.

Key science and innovation assets

The assets exemplified below support innovation in this capability area:

Table 6-4: Key creative & media assets (table content is non-exhaustive)

Asset	Location	Description
MediaCityUK	Salford Quays	Major creative hub for TV, radio, digital and post-production workflows
Creative Technology Research Centre	University of Salford	Workspace and R&D facilities for AI/VR in media and creative industries
Exchange Startup Accelerators	Manchester office tech spaces	Accelerators for creative, digital and cyber SMEs offered by Growth Hub
MediaCity Immersive Technologies Innovation Hub	Salford	Driving applied innovation, connecting cutting edge assets to industry
School of Digital Arts (SODA)	Manchester Metropolitan University	£35m investment into workspace, research and teaching facilities to drive innovation across all forms of creative content
The Royal Northern College of Music	Oxford Road Corridor	Highly rated conservatoire with a focus on innovative approaches to research and teaching

Examples of private sector and industry strengths

Whilst MediaCity is the focal point of GM's Creative and Media activities, this capability comprises freelancers and companies at all scales, driving strong growth across the City Region. Examples of activity in this space include:

- Content Creation, including:

  - TV and broadcasting - as noted above, national broadcasters BBC & ITV are core anchors of the ecosystem which comprises companies at all scales and independents such as Revolution Productions and Title Role Productions;
  - Music and Performing Arts – which continue to grow through new additions to a rich and vibrant live performance offer including Factory International, Aviva Studios and CoOp Live; and
  - Marketing, branding and design – including digital agencies such as KOMI Group, (operating over 80 brands including some of the biggest in the world), web developers (such as CTI Digital) and design agencies like Magnetic North.
- Immersive Technology, including:
  - Games developers, such as Cloud Imperium Games and Team17
  - Technology providers and developers, such as Virtalis, dock10, and Recode XR.

Policy alignment and future opportunities

GM has long recognised its strengths in this space, aligning Creative Industries with the digital sector (recognised as a 'Frontier Sector' by GMCA). The 2022 Innovation Plan continued this, highlighting strengths in digital arts and creative content as part of the AI, Digital and Advanced Computing workstream. This reflects the strong alignment between this capability as defined here, and other capabilities in this study – particularly AI and Data Analytics, Software Engineering, and Business Process & Market Innovation.

The MIS similarly notes this alignment, and also identifies Creative Industries as a priority sector in its own right. It aims to grow this through interventions which:

- Accelerate innovation-led growth;
- Increase access to growth finance for creative start-ups and scale-ups;
- Build a resilient workforce; and
- Increase trade and inward investment.

The specific priority areas highlighted in the Creative Industries Sector Plan align strongly with GM's strengths identified in this study – particularly film and TV, video games, music and performing arts, and advertising and market research.

AI & Data Analytics

Why is this a Primary Capability?

This capability encapsulates broad strengths within GM's research institutions with a strong and growing private sector. As such it is included on the basis of strength on both criteria

Scholarly works analysis for this study identifies research strengths in substantial clusters of highly cited works in AI and AI applications. Furthermore, analysis of Knowledge Transfer Partnerships in Greater Manchester has revealed that the proportion of KTP projects involving AI has increased markedly since 2016.

There are also substantial research strengths in cybersecurity, where both University of Manchester and Manchester Metropolitan University display strong capabilities in areas such as network security and intrusion detection; and in wireless networks. These strengths are reflected in a strong and growing private sector, which includes major global firms such as Arm and Thales, and an array of startups and disruptors applying AI to a range of disciplines. GM is also a core part of the North West Cyber Corridor, encompassing institutions such as the National Cyber Security Centre and GCHQ.

Key science and innovation assets

The assets which underpin GM's strengths in this capability, frequently extending beyond its borders and into Lancashire and Cheshire, include:

Table 6-5: Key AI & Data Analytics assets (table content is non-exhaustive)

Asset	Location	Description
Arm Centre of Excellence	University of Manchester	Collaborative research projects and studentships in areas such as processor technology, machine learning and automated reasoning
Turing Innovation Catalyst Manchester (TIC)	Sister	Supports AI, R&D, startup acceleration, upskilling and enterprise development
Hartree Centre	Sci-Tech Daresbury	UK supercomputing hub focused on industrial HPC, data analytics, and AI applications
Centre for Digital Innovation	Manchester Metropolitan University	Fosters collaboration between industries and sectors with a focus on AI, cyber, industrial digitisation and immersive technologies.
North of England Robotics Innovation Centre	University of Salford	Focus areas include intelligent infrastructure, automation and health tech
GCHQ / National Cyber Security Centre	Manchester	Focuses on identifying and disrupting threats to the UK

Examples of private sector and industry strengths

The private sector within GM includes national and international tech firms who are deploying AI and data analytics in the City Region, such as BT, Amazon, and Arm (who have a deep partnership with OpenAI to deploy AI across all facets of the business). Arm's presence in GM includes the development of system hardware, developer tools, and automotive GPU.

GM is also home to specialist and startup firms who are driving the adoption and application of AI and analytics across industries including:

- Matillion, started in Manchester, now global in deploying AI to process data across industries;
- PeakAI working in sectors such as manufacturing and retail to manage inventory;
- Mindtrace providing defect detection to manufacturers;
- Mobysoft deploying predictive AI for managing social housing; and

- Digital and Defence companies, such as Thales, whose facility in Cheadle specialises in sonar systems for Defence and a centre of excellence for software design.

GM is a core part of the North West Cyber corridor, with national agencies such as GCHQ and the National Cyber Security Centre key parts of this ecosystem. There is increasingly strong alignment between cybersecurity and AI, with companies deploying AI as part of cybersecurity solutions and an emerging focus on security within AI applications. Companies in this space in GM include:

- Thales –a global tech firm with a substantial presence in GM, including a centre of excellence for software design including work on AI and cybersecurity;
- NCC Group – global cyber and software resilience business operating across sectors and technologies; and
- BeyondTrust – providing enterprise grade systems enabling secure report technical support.

AI and data analytics are also being deployed in specialist areas covered elsewhere in this report including Health Innovation, Fintech and e-commerce, and as such is a key cross-cutting capability for the GM economy.

Policy alignment and future opportunities

AI has emerged as a key technology imperative across all sectors in recent years. As it has moved into the mainstream, the practical application of AI is reshaping activity across the economy radically. The same is true of data analytics, where the ability to collect, store and analyse large-scale datasets has increased significantly since 2016.

GMCA and its partners have recognised the rapid evolution of digital industries locally and globally since the 2016 SIA. Whilst the original SIA identified GM's strengths in big data, the internet of things and digital's role in media, these have continued to develop in the years since. 2022's Innovation Plan focused on AI, Digital and Advanced Computing as a strength and this in turn informed a Sector Development Plan focused on Digital, Cyber and AI.

The pervasiveness of AI across industries – not just in predominantly digital sectors, but across the whole economy – emphasises the importance of ensuring that AI innovation and adoption is harnessed in a way which delivers equitable and sustainable growth for GM residents. This includes ensuring that AI tools focus on addressing societal challenges in areas such as health research and access to opportunity.

AI and Cyber are highlighted as 'Frontier Industries' within the Modern Industrial Strategy's 'Digital and Technologies' sector. Furthermore, the Modern Industrial Strategy explicitly recognises GM's strengths in AI and Cyber, highlighting the North West Cyber Corridor and its 300 cybersecurity companies, and an AI cluster of 250 companies.

Software Engineering

Why is this a Primary Capability?

Strengths in software engineering underpin, pervasively, much of the innovation in GM, and across all sectors, including those beyond traditional models of science-based research and development. With software engineering enabling new approaches and new business models across a wider range of industries, exploiting digital technology is likely to be a key determinant of future growth in most (if not all) industries. As such, this capability is driven by Criterion 2.

The information and communications sector has been among the fastest growing sector in GM between 2016 and 2023, driven by industries with software engineering at their hearts, including:

- Computer consultancy (growth of 110%);
- Computer programming (+67%); and
- Other IT/computing services (+71%).

However, GM's universities still play a key role in GM's providing a software engineering talent pool which drives innovation and business growth across industries. This includes around 3,000 computing graduates each year, along with 1,000 in mathematics and 3,500 in engineering and technology. Engagement carried out in the course of this study highlighted that qualifiers in these subjects (not just "pure" computer science graduates) are vital to driving digital adoption and innovation in the GM business base.

This cross-cutting capability area shares many assets with the AI and Analytics capability outlined above.

Examples of private sector and industry strengths

Growth of software engineering in GM includes software-intensive digital companies whose primary function is the development and deployment of software solutions. This includes companies such as:

- Cisco – a global technology company with an innovation centre (Mi-IDEA) focused on tech start ups;
- Codethink – a provider of software engineering and consultancy across industries including Finance, Automotive and Life Sciences;
- Interact – a digital company focused on developing intranet platform software; and
- Apadmi – a high growth mobile app developer and digital consultancy serving industries such as Retail, Finance and Utilities globally.

Software-related innovation is driving growth across all industries, including in many of the other capabilities highlighted in this report. Sectors with substantial in-house software engineering capabilities include:

- e-commerce (e.g. THG, Boohoo, AO.com, JD Sports, Booking.com);
- financial & professional services (e.g. BNY, KPMG, Deloitte, AJ Bell, Interactive Investor);
- digital (e.g. Arm, BT, TalkTalk, BeyondTrust, NCC Group); and
- the public sector (e.g. DWP Digital, HMRC, DfE, and GCHQ/NCSC).

Analysing the 50 largest hubs for software engineering in Europe, Sequoia ranks Manchester as the seventh largest in Europe, with a similar share of software engineering talent to Stockholm (6th) and Copenhagen (8th).

Policy alignment and future opportunities

The 2019 Local Industrial Strategy acknowledged the role that strengths in software engineering played in driving growth in a range of industries including Retail, Leisure and Financial services. These alignments remain valid – software engineering remains vital to these industries and, with the rise of AI, there continues to be strong demand for software development skills in industries across GM.

The MIS demonstrates the UK Government's commitment to developing software skills, recognising the vital role it will play in delivering many of its sector plans – most prominently the Digital and Technology Sector Plan, though to a lesser extent it features in the Professional and Business Services Plan (via the adoption of digital and AI technologies), the Advanced Manufacturing Sector Plan (through digitisation and automation) and Clean Energy (by automating energy systems). The MIS also included £187m for investment in digital skills for young people linked to the IS-8.

Business Process & Market Innovation

This priority recognises that a key route to innovation-driven inclusive growth is through the adoption of new business models, processes, and technologies to disrupt sectors' existing ways of doing things (Criterion 2). Within GM, this includes companies who have deployed new technologies to change the way of providing services to consumers in retail and e-commerce, and in the adoption of technology in professional services to drive efficiency, productivity and value in areas such as Financial Services, Accountancy and Legal Services.

Whilst such innovation can be driven by academic research and scientific R&D, it is at least as often driven by combinations of ideas, skills, and entrepreneurialism. The private sector drives innovation in business models and processes, and this can occur across all sectors. In GM, this has manifested most prominently in areas such as e-commerce, leisure and professional services with GM home to a host of disruptors in this space.

Key science and innovation assets

Academic strength to support innovation-driven growth in this space is particularly supported by the GM universities' business schools. UoM ranks in the top three nationally for research power in Business and Management Studies.

Assets and institutions which support this capability include:

Table 6-6: Key Business Process & Market Innovation assets (table content is non-exhaustive following feedback)

Asset	Location	Description
Pro-Manchester	GM-wide	Industry body which supports business development and collaboration across GM
Centre for Digital Innovation (CDI)	Manchester Metropolitan University	R&D and consulting support across AI, cybersecurity, industry 4.0, immersive tech
GM Chamber of Commerce	GM-wide	The UK's largest chamber of commerce providing a range of support and networking opportunities
GM Business Growth Hub – Innovation Navigator	GM-wide	Provides advisory and funding support to SMEs for R&D, sustainability, AI/tech adoption

Examples of private sector and industry strengths

Research for this study has highlighted specific areas where this is evident as a strength in GM:

- Retail and Ecommerce, e.g.
  - AO.com developed a vertically integrated e-commerce and logistics model powered by data analytics and automation to streamline white goods delivery;
  - JD Sports merging online and in-store offers through multichannel technology and deploying real time inventory to move goods;
  - The Hut Group built a proprietary e-commerce platform (Ingenuity) enabling end-to-end digital brand building and fulfilment, in the beauty and wellness sector; and
  - Boohoo adopted a data driven model and rapid design to shelf model to provide fashion via an online only model.
- Leisure, e.g.
  - booking.com innovating in frictionless online travel booking deploying sophisticated analytics; and
  - On the Beach developed a dynamic packaging platform and digital-only customer service model to simplify beach holiday booking and reduce consumer costs.
- Financial & Professional Services, e.g.
  - AJ Bell developing cloud-native investment platforms providing investors with greater autonomy and flexibility; and

  - Traditional Financial Services firms such as Co-Op and Lloyds developing integrated, multichannel services for their products.
- Legal and Accounting industries have been the fastest growing sectors in GM and provide opportunities for further adoption of technology and AI to drive further growth.

Policy alignment and future opportunities

This capability manifests across many vertical sectors, many of which (such as e-commerce and finance and professional services) are not explicit local priorities. Both the GM Local Industrial Strategy (2019) and the Innovation Plan (2022) have not specifically prioritised the Financial and Professional Services sector as a focal point for innovation itself, but do recognise the scale and strength of the sector and the key role it plays as an enabler of growth and innovation. Similarly, the strength of GM's e-commerce sector is recognised in these plans and also forms part of the digital frontier sector, reflecting its scale and opportunity.

Nationally, the MIS reflects this priority by setting an ambition for increased tech adoption and effective use of data across the UK economy. At a sector level, the 2025 Comprehensive Spending Review committed over £150m to programmes which aim to increase the adoption of technology, innovation and AI in Professional and Business Services (PBS). The PBS Sector Plan identifies GM's strengths in Legal Services and Lawtech in particular, as well as strengths in Accountancy, Management Consultancy, and Real Estate.

Key findings

The key findings flowing from this chapter are:

- GM has some exceptional capabilities which align its research strength and private sector specialisms. This presents opportunities for accelerated innovation-driven growth in the seven identified primary capabilities:
  - Health Innovation & Life Sciences
  - Advanced Materials
  - Energy Infrastructure & Transition
  - Creative & Media
  - AI & Data Analytics
  - Software Engineering
  - Business Process & Market Innovation
- Capabilities are a mix of cross-cutting themes and more traditional sectors. Many of the most substantial opportunities are at the intersection of these capabilities; and
- There is strong alignment between these capabilities and local and national policy priorities, suggesting they are well placed to support GM's wider ambitions for equitable, inclusive growth and a decarbonised economy.

7 Recommendations

7.1 Based on the data analyses and qualitative engagement undertaken throughout the course of this study, the following recommendations are made:

Recommendation 1: From audit to plan to action

7.2 The 2016 SIA laid the evidential foundation for Greater Manchester's innovation and cluster strategies over the following decade. This 'refreshed' SIA should similarly serve as the basis for future focus across the GM ecosystem. To achieve this, the study's findings and identified Primary Capabilities should be widely disseminated and embedded, providing an objective framework for prioritisation by partners. As new innovation strategies and sector/cluster plans emerge, they should be guided by this evidence base and contribute to its ongoing refinement—ensuring GM's understanding of its innovation ecosystem remains accurate and up to date.

Recommendation 2: Live/regular monitoring of the ecosystem

7.3 This study has developed a method for identifying and understanding innovation-active firms in GM. Building on this, consideration should be given to establishing a more regular and coordinated approach to gathering intelligence on these sorts of firms. Organisations such as the Growth Company, universities, MIDAS, GMCA, and Pro-Manchester hold valuable insights here. A shared dataset of innovation-active firms could support annual reporting (e.g. to the Innovation Greater Manchester Board) and enable targeted deep dives into specific themes, emerging new capabilities, or policy areas. While this would require resources, the benefits of a more dynamic and inclusive understanding of innovation-led growth are significant.

Recommendation 3: A Broader Strategic View of 'Innovation'

7.4 This 'refresh' has identified the role that innovation can play in achieving objectives for GMCA and partners around both economic growth *and* equitable and sustainable societal outcomes, providing an increased focus on inclusive innovation. Whilst this link is increasingly recognised, it is important to continue to strengthen this so that GMCA and partners (i) have a shared and unified view of the need for balance between growth per se and the need to equitably distribute the gains across all of society, and (ii) think beyond natural science and technology based innovation strengths to an approach that incorporates perspectives from social sciences and public health.

Recommendation 4: Developing, attracting and retaining skills

7.5 Across all the Primary Capabilities, there is a consistent need to develop and retain high-level skills, and build the pathways that support them. This includes both technical expertise and broader entrepreneurial competencies. GM's universities and Further Education institutions play a critical role in preparing an employment-ready workforce. These partners should continue to align the skills pipeline with areas of growth and opportunity—helping retain talent in GM and attracting high-value inward investment.

Recommendation 5: Agility in responding to opportunity

7.6 The Primary Capabilities identified in this refresh include both sector-specific and cross-cutting opportunities, many of which have evolved since the 2016 SIA. GM's partners must remain

agile, ready to identify and act on emerging innovation opportunities. Importantly, much innovation occurs outside the formal public policy and academic spheres - market-driven innovation is equally vital. While not all firms require engagement with the formal support ecosystem, many could benefit from it. Implementing Recommendations 2 (monitoring) and 9 (visibility) will help GMCA and partners identify these opportunities and raise awareness of available support.

Recommendation 6: Functional innovation geographies

7.7 Innovation is increasingly open and globally connected, making it less geographically bounded. While GM's innovation partners are place-centred, they must also be outward-looking—actively seeking knowledge, expertise, and opportunities wherever they exist and bringing them back to the City Region. This 'outside-in' approach should become a defining feature of how GM builds its innovation ecosystem.

Recommendation 7: Targeting interventions at need and opportunity

7.8 Some capabilities will require more intensive support to align research strengths with commercial opportunities. For example, GM's world-class research in Advanced Materials and Health Innovation is not yet matched by a critical mass of industry activity in the City Region. Coordinated action across public, private, and academic sectors is needed to better translate research excellence into commercial impact.

Recommendation 8: Knowledge Transfer and Diffusion

7.9 substantial expertise in the primary capabilities is held in institutions at all scales. However, this study identified a clear appetite from large anchors in the private and academic sectors to collaborate more closely with SMEs in the city region. Priority should be given to developing mechanisms which support the transfer of knowledge from large entities with national and global reach to local firms with the ability to adapt and grow.

Recommendation 9: Increasing Ecosystem Visibility

7.10 There is a clear appetite among GM's public and private partners to raise the profile of the City Region's innovation ecosystem—locally, nationally, and internationally. A formal launch event for this refreshed SIA could serve as a starting point, followed by a programme of networking events, innovation festivals, and other activities. These would promote GM's innovation offer, and enable learning from other leading regions.

A Company database sources

A.1 The table below lists the 12 sources used in developing the sample of 944 innovation-active companies with operations in Greater Manchester.

Table A-1: Sources for the sample of innovation-active companies with operations in Greater Manchester

ID	Description	Companies added at each stage	Companies remaining after filtering/checking
Source1	Companies with registered addresses in GM, mentioning R&D terms in electronically filed accounts, with 10+ employees [CH]	443	232
Source2	Companies with trading address in GM (but not registered address) with 10+ employees [TDC], mentioning R&D terms in electronically filed accounts [CH]	339	228
Source3	Companies with registered address or primary trading address in GM, reporting at least £1k R&D expenditure [FAME]	182	75
Source4	Companies with registered or trading address in GM, in SIC72 (scientific R&D), with 10+ employees [TDC]	79	36
Source5	University spin-out companies with registered or trading address in GM, with 10+ employees [TDC]	11	4
Source6	Companies participating in or associated with Horizon 2020 and Horizon Europe projects (giving GM address) [EC]	51	15
Source7	Companies (non-academic, non-PSO) with Address LEP = GM in database of Innovate UK funded projects [IUK]	362	93
Source8	Companies currently recruiting in GM for jobs related to 'science' or 'software' [Adzuna]	21	18
Source9	Companies engaging with publicly-funded innovation programmes, in GMCA 'innovative firms' workbook (2021) [GMCA]	336	97
Source10	Life sciences companies with sites in GM from the Office of Life Sciences [OLS]	40	8
Source11	Materials and advanced manufacturing companies in GM from Optimat study (Focused Database) [Optimat]	330	89
Source12	Companies mentioned in sector development plans	86	49
	Totals	**2,280**	**944**

Source: DMS analysis. Abbreviations for sources: CH = Companies House; TDC = The Data City; OLS = Office of Life Sciences; GMCA = Greater Manchester Combined Authority; EC = European Commission; IUK = Innovate UK

A.2 Companies were added sequentially as each source was used (adding in companies that were not already in the database), giving a total of 2,280 companies. This was reduced to 944 after removing companies that are no longer active, removing companies with < 10 employees, and applying an automated web-scraping check that the website address (from FAME/TDC) is for the correct company and that the company has operations in GM.

B List of science & innovation assets in the primary capabilities

Health & Life Sciences		
Asset	**Location**	**Description**
University of Manchester	Manchester	Facilities include • Christabel Pankhurst Institute Digital Health Innovation Facility • Manchester Cancer Research Centre • National Institute for Health Research Biomedical Research Centre
Manchester Metropolitan University	Manchester	Facilities include • Centre for Mental Health, Nursing & Midwifery • Centre for Life-based Design • Centre for Physiological Sciences • Institute of Sport
University of Salford	Salford	Facilities include • Biomedical Research & Innovation Centre • Centre for Applied Health Research • Centre for Human Movement & Rehabilitation • Salford Institute for Dementia & Ageing
Manchester Academic Health Science Centre	University of Manchester/NHS Trusts	Integrates academia and NHS for translational research and training
The Christie Hospital	Withington, Manchester	Largest single site cancer centre in Europe, includes the Paterson cancer research centre and Proton Beam Therapy Centre
Health Innovation Manchester	GM-wide	Partnership body combining NHS, local government, industry, and research and academia
Wolfson Molecular Imaging Centre	The Christie Hospital, Manchester	Advanced PET/MRI imaging for oncology and neuroscience R&D
Citylabs & Citylabs 4.0	Oxford Road Corridor	Bruntwood SciTech life-science campus hosting startups, labs, med-tech firms
UK Biobank	Manchester Science Park	Biomedical research resource storing health/genomic data from 500,000 volunteers
Alderley Park Bioscience Campus	Alderley Park, Cheshire (near GM)	Hosts 200+ life-science companies in pharmaceuticals and diagnostics

GM Advanced Diagnostics Accelerator & DEVOTE	Across NHS/University sites	Piloting AI/genomic diagnostics and rapid testing technologies
Health Innovation Manchester Accelerator	GM-wide	Incubator for major health-technology solutions
Manchester Institute of Biotechnology	UoM and partners	Runs the Industrial Biotechnology Innovation Catalyst
Manchester Centre for Genomic Medicine	St Mary's Hospital, Manchester	Integrating the latest genomic technologies across the NHS
Sister	Former UMIST Campus	Major new innovation district for central Manchester, one sector focus of the district will be health innovation and life sciences
GM Care Record	GM-wide	Digital resource on GM's 2.8m residents used for integrating care and informing research
Manchester Institute of Health & Performance (MIHP)	Adjacent to Etihad Campus and East Manchester leisure Centre	Healthcare facility offering modern diagnostic technology, sports medicine and education
Aquatics GB Performance Centre, Manchester	Manchester Aquatics Centre	Facility offering sports science and sports medicine services to member athletes
Advanced Materials		
National Graphene Institute	Booth Street East, University of Manchester	A flagship £61 m facility housing cleanrooms and labs for academic-industry R&D into graphene and 2D materials. Includes 1,500 m^2 ISO-class 5–6 cleanroom complex
Graphene Engineering Innovation Centre (GEIC)	Sackville Street, University of Manchester	Industry-led pilot and scale-up centre for graphene applications in energy, coatings, electronics, etc.
Henry Royce Institute	Royce Hub, Oxford Rd, University of Manchester	The UK's national advanced materials hub for multi-scale materials research and industry collaboration, includes the Defence Materials Centre of Excellence
Manchester Centre for Mesoscience & Nanotechnology	University of Manchester	Interdisciplinary nanotech and cleanroom facility, pivotal in graphene discovery
International Centre for Advanced Materials (BP-ICAM)	University of Manchester	Partnership between BP, UoM, and other leading universities to provide capabilities in structural materials, corrosion, separations, surfaces, deposits, imaging, modelling and self-healing materials
North West Composites Centre	University of Manchester	Driving innovation in the manufacture, design and testing of advanced composites.

Advanced Materials and Digitalisation Innovation Centre	Manchester Metropolitan University	Leading research in advanced materials, nanotechnology and low carbon fuels
Greater Manchester Investment Zone	Salford Crescent, Sister (Oxford Road Corridor), Atom Valley (Rochdale)	GM's Investment Zone focuses on its advanced manufacturing and materials sector with the potential to create 32,000 jobs)
National Physical Laboratory	University of Manchester	Strategic research partnership to accelerate commercialisation of advanced materials
Sustainable Materials and Manufacturing Centre	Atom Valley, Rochdale	Centre to support the development and commercialisation of smart machinery, advanced sustainable materials and Made Smarter technologies (Construction start Autumn 2025)
Advanced Materials and Manufacturing Innovation Centre	Manchester Metropolitan University	research centre with the aim of supporting businesses in the advanced materials and manufacturing sectors through offering access to university expertise and facilities
Advanced Machinery Productivity Institute	Atom Valley, Rochdale	Industry-defined initiative to stimulate and support rapid growth of the UK's machinery manufacturing sector.
MIX Manchester	Adjacent to Manchester International Airport	Science, innovation and manufacturing campus
Energy Infrastructure and Transition		
Energy House 2.0	Frederick Road Campus, University of Salford, Salford	Dual-chamber lab simulating weather extremes to test building energy performance and net-zero technologies
Salford Energy House (original)	University of Salford	Early research facility (since 2011) for assessing domestic retrofit and energy innovations
Manchester Fuel Cell Innovation Centre	Manchester Metropolitan University	Hub for SME development of hydrogen fuel cells, electrolysers, advanced materials and prototyping
Trafford Low Carbon Energy Park	Carrington, Trafford, SW Manchester	Large-scale clean-energy hub with battery storage (680 MW), liquid air and hydrogen production
Dalton Nuclear Institute	University of Manchester	Experience and equipment to research the full nuclear fuel cycle
Energy Innovation Agency	GM-wide	Partnership including GMCA, the Growth Company, SSE and the Universities to support decarbonisation of GM's energy systems, buildings and processes through innovation.

Green Economy	Growth Company / GM-wide	Support service helping businesses to decarbonise and supporting growth of green technology and services businesses
Centre for Processes, Resilient Infrastructure and Sustainable Built Environment	University of Salford	Focus on enhancing the built environment and infrastructure through digital technology and innovation
Tyndall Centre for Climate Change Research	University of Manchester	Research into options for mitigating climate change including energy systems, emissions pathways and energy storage
Manchester Environmental Research Institute	University of Manchester	Connecting expertise from natural sciences, health, ecosystem, water and energy to explore complex environmental challenges.
Creative & Media		
MediaCityUK	Salford Quays	Major creative hub for TV, radio, digital and post-production workflows
Creative Technology Research Centre	University of Salford	Workspace and R&D facilities for AI/VR in media and creative industries
Exchange Startup Accelerators	Manchester office tech spaces	Accelerators for creative, digital and cyber SMEs offered by Growth Hub
MediaCity Immersive Technologies Innovation Hub	Salford	Driving applied innovation, connecting cutting edge assets to industry
School of Digital Arts (SODA)	Manchester Metropolitan University	£35m investment into workspace, research and teaching facilities to drive innovation across all forms of creative content
AI, Data Analytics & Software Engineering		
Arm Centre of Excellence	University of Manchester	Collaborative research projects and studentships in areas such as processor technology, machine learning and automated reasoning
Turing Innovation Catalyst Manchester (TIC)	Sister	Supports AI, R&D, startup acceleration, upskilling and enterprise development
Hartree Centre	Sci-Tech Daresbury, Cheshire	UK supercomputing hub focused on industrial HPC, data analytics, and AI applications
The Virtual Engineering Centre (VEC)	Sci-Tech Daresbury	Works closely with the Hartree Centre on virtualisation and in-silico design and modelling (e.g. for the automotive sector)
Daresbury Laboratory	Sci-Tech Daresbury	Hosts STFC facilities including Hartree, engineering centres & virtual engineering R&D labs

Centre for Digital Innovation	Manchester Metropolitan University	Fosters collaboration between industries and sectors with a focus on AI, cyber, industrial digitisation and immersive technologies.
Manchester Digital	GM-wide	Industry body for tech and digital business
North of England Robotics Innovation Centre	University of Salford	Focus areas include intelligent infrastructure, automation and health tech
GCHQ / National Cyber Security Centre	Manchester	Focuses on identifying and disrupting threats to the UK
Greater Manchester Digital Security Hub (DISH)	Manchester	Collaboration between business, academia and government to develop real world solutions for cyber resilience and digital security
Made Smarter	GM-wide	Supporting GM manufacturers to utilise and embed digital technologies
Centre for Digital Trust and Society	University of Manchester	Focuses on barriers to and enablers of trust in digital technologies, with the scope including (but not limited to) cybersecurity
Centre of Intelligence of Things	University of Greater Manchester	Provides a platform for research that leverages AI technologies to enhance the capabilities and intelligence of IoT, Big data, and robotic systems.
Home of Skills and Technology (HOST)	MediaCity, Salford	Offers workspace, training, support and networking as well as innovation labs in data, cyber and immersive technologies.
Business Process & Market Innovation		
GM Business Growth Hub – Innovation Navigator	GM-wide	Provides advisory and funding support to SMEs for R&D, sustainability, AI/tech adoption
Centre for Digital Innovation (CDI)	Manchester Metropolitan University	R&D and consulting support across AI, cybersecurity, industry 4.0, immersive tech
Pro-Manchester	GM-wide	Industry body which supports business development and collaboration across GM
GM Chamber of Commerce	GM-wide	The UK's largest chamber of commerce providing a range of support and networking opportunities

C List of consultees

First Name	Surname	Organisation
Tom	Addisson	GMCA
Tahir	Ali	Energy Innovation Agency
Lisa	Ashby-Dowling	Innovate UK
James	Baker	Graphene Engineering Innovation Centre
Louise	Bates	University of Manchester
James	Bedford	STFC
Justin	Bentham	Growth Company
Ben	Bridgewater	Health Innovation Manchester
Julia	Buckler	QIAGEN
Simone	Buitendijk	University of Salford
Barry	Clare	North West E-Health
Lisa	Dale-Clough	GMCA
Geoff	Davison	BioNow
Alex	Frangi	Christabel Pankhurst Institute
Katie	Gallagher	Manchester Digital
Yvonne	Grady	Growth Company
Rupert	Greenhalgh	Growth Company
James	Hadley	Northern Gritstone
Catherine	Headley	Innovation Factory
Jack	James	GMCA
Ania	Jolly	Henry Royce Institute
Richard	Jones	University of Manchester
Matthew	Kershaw	GMCA
David	Knowles	Henry Royce Institute
David	Levene	Innovation Greater Manchester
Neil	McClymont	Electricity North West Limited
Jacob	Morris Davies	GMCA

Jacob	Morris-Davies	GMCA
Geraint	North	ARM
Mandy	Parkinson	University of Salford
Sam	Robertson	GMCA
Sam	Robertson	GMCA
Steve	Rothberg	Manchester Metropolitan University
Alex	Roy	Unit M
Marta	Sama	Manchester Metropolitan University
Russ	Shaw	Genedrive
Jennie	Shorley	Manchester Metropolitan University
Caroline	Stanton	University of Manchester
Chris	Taylor	University of Manchester
Andrew	Tolan	MIDAS
Adrian	Toland	GMCA
Mark	Wigglesworth	Alderley Lighthouse Labs
Andrea	Winders	MIDAS
Rachel	Woolley	University of Salford
Tom	Worthington	National Energy System Operator (NESO)

Control Information

Prepared by

Steer
5th floor, 61 Mosley St
Manchester
M2 3HZ
+44 113 389 6444
www.steer-ed.com

Prepared for

Greater Manchester Combined Authority
Tootal Building
56 Oxford St
Manchester
M1 6EU

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Author/originator

James Hopton
Simon Pringle
David Mack Smith

Reviewer/approver

Simon Pringle

Other contributors

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