North East England
Construction Innovation Ecosystem

February 2024

Black&White

Constructing Excellence North East

Hydrock

North East Local Enterprise Partnership

North of Tyne Combined Authority

OneVoice Driving Change

SCIUS Advisory

Ryder

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- Black & White Engineering
- Hydrock
- North East Local Enterprise Partnership
- North of Tyne Combined Authority
- One Voice
- Ryder Architecture
- Scius Advisory

The steering group met regularly to guide the project, review progress and recommend potential consultees whose perspectives would be important to hear. Interviews were conducted with the following subject matter experts. The authors are grateful for the time that everyone made for this project and for the wealth of valuable insights.

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Glossary

3D Modelling	Building Information Modelling (BIM) is a collaborative way of working, underpinned by the digital technologies which unlock more efficient methods of designing, creating and maintaining buildings and structures.
3D Printing	3D printing is a method of creating a three-dimensional object layer-by-layer using a computer-generated design (such as BIM). 3D printing is an additive process whereby layers of material are built up to create a 3D part or model.
AAGR	Average Annual Growth Rate
Advanced Manufacturing	Advanced manufacturing is the practice of using innovative technologies and methods to improve and enhance competitiveness within the manufacturing (construction) sectors.
AI	Artificial Intelligence
AR	Augmented Reality: AR, or Augmented Reality is the use of technology to superimpose a computer-generated image (such as BIM) on a user's view of the real world, thus providing a composite view.
ARR	Annual Recruitment Requirement
BIM	Building Information Modelling (BIM) is a very broad term that describes a process for creating and managing digital information throughout the lifetime of a built asset. The Building Information Model itself is a digital, 3-dimensional representation of a house or building. The model organises and manages information about the building for construction, operations, maintenance and decommissioning (building lifecycle) in a format that is accessible and useful by different stakeholders.
Blockchain	Blockchain is described as the decentralised, distributed and public digital ledger that is used to record transactions across many computers so that the record cannot be altered retroactively without the alteration of all subsequent blocks and the consensus of the network.

Building Energy Modelling - Performance Analysis	Building Energy Modelling – Performance Analysis utilises the Building Information Model in implementing an iterative process to continually assess how the building is performing from an efficiency aspect, determine what is driving that performance, and pinpoint what can be done to influence (improve) the building's energy efficiency.
Built Environment	The Built Environment is the human-made surroundings that provide the setting for human activity, ranging from buildings and parks or green space to neighbourhoods and cities. It can often include supporting infrastructure, such as water supply or energy networks.
CAD	Computer Aided Design/Drafting is the use of computer-based software to aid in the design and drafting processes. CAD software is used to create two-dimensional (2-D) drawings.
CITB	Construction Industry Training Board
Contech	Construction Technology
Digital Technology	Digital technology encompasses electronic devices, software systems, and resources that facilitate the creation, storage, and management of data.
Digital Twin	Digital Twin is the BIM digital facsimile of the building that accurately reflects the completed building. The digital twin can be used to simulate different aspects of a building, such as construction, operations or performance. It can also be combined with sensors and systems to allow owners to track building performance for planning maintenance, renovations, or retrofits.
ERDF	European Regional Development Fund
EPNE	Education Partnership North East
GHG	Greenhouse Gases
GIS	Geographic Information System (GIS) is a system that creates, manages, analyses, and maps all types of data. GIS connects data to a map, integrating location data (where things are) with all types of descriptive information (what things are like there).

Golden Thread of Information	The golden thread refers to both the information about a building that allows someone to understand a building and keep it safe and the information management tools to ensure the information is accurate, easily understandable, can be accessed by those who need it, and is up to date.
GPS	Global Positioning System (GPS) is a network of satellites and receiving devices used to determine the location of something on Earth.
GVA	Gross Value Added is the value of goods and services produced by an industry, sector, manufacturer, area or region in an economy. It is the total value of output produced, without including the intermediary costs that went into producing them.
HE / FE	Further education (FE) is additional education to that received at secondary school that is distinct from the higher education (HE) offered in universities and other academic institutions.
HICSA	Housing Innovation and Construction Skills Academy
IfATE	Institute for Apprenticeships and Technical Education
IoT	Internet of Things: the term IoT, or the “Internet of Things”, refers to a network of connected devices and the technology that facilitates communication between these devices and the cloud, as well as between the devices themselves.
KPI	Key Performance Indicators measure the factors that are critical for a business’s success.
LiDAR	Light Direction and Ranging (LiDAR) is remote-sensing technology for measuring relative distance. LiDAR is used to create accurate, 3D representations (digital models) of a given environment (such as buildings), also called a “point cloud”.
MMC	Modern Methods of Construction comprises a spectrum of approaches to construction which spans off-site, near site and on-site pre-manufacturing, process improvements and technology applications.

North East LEP	North East Local Enterprise Partnership
Net Zero	Net Zero means cutting greenhouse gas emissions to as close to zero as possible.
NGO	Non Government Organization
NICD	National Innovation Centre for Data
ONS	Office of National Statistics
R&D	Research and Development
R&M	Renovations and Maintenance
ROI	Return on Investment
RPA	Robotic Process Automation
SIC	Standard Industry Classifications
SME	Small and Medium Sized Enterprises
Testbed/Sandpit	Testbed, or sandpit is a is a platform for conducting rigorous, transparent, and replicable testing of scientific theories, computing tools and the use of new technologies.
VR	Virtual Reality: VR, or Virtual Reality is the digital creation of a simulated experience that employs pose-tracking and 3D near-eye displays to give the user an immersive feel of a virtual world.

Summary

Aims and Objectives

- Attract investment to the region.
- Create a collaborative, sustainable growth-focussed hub committed to greater integration of technology, innovation and education in the built environment.
- Maximise the potential of industry and education in the region to be resilient and thrive during a period of socio-economic volatility.
- Inspire and create enhanced education pathways which are relevant to the needs of industry and attractive to the workforce of tomorrow.
- Support connectivity outside the region and promote exports.
- Encourage adoption of innovative technologies, products and systems within regional construction organisations.

An evidence based research study on the North East England Construction Innovation Ecosystem, with input from more than 50 subject matter experts.

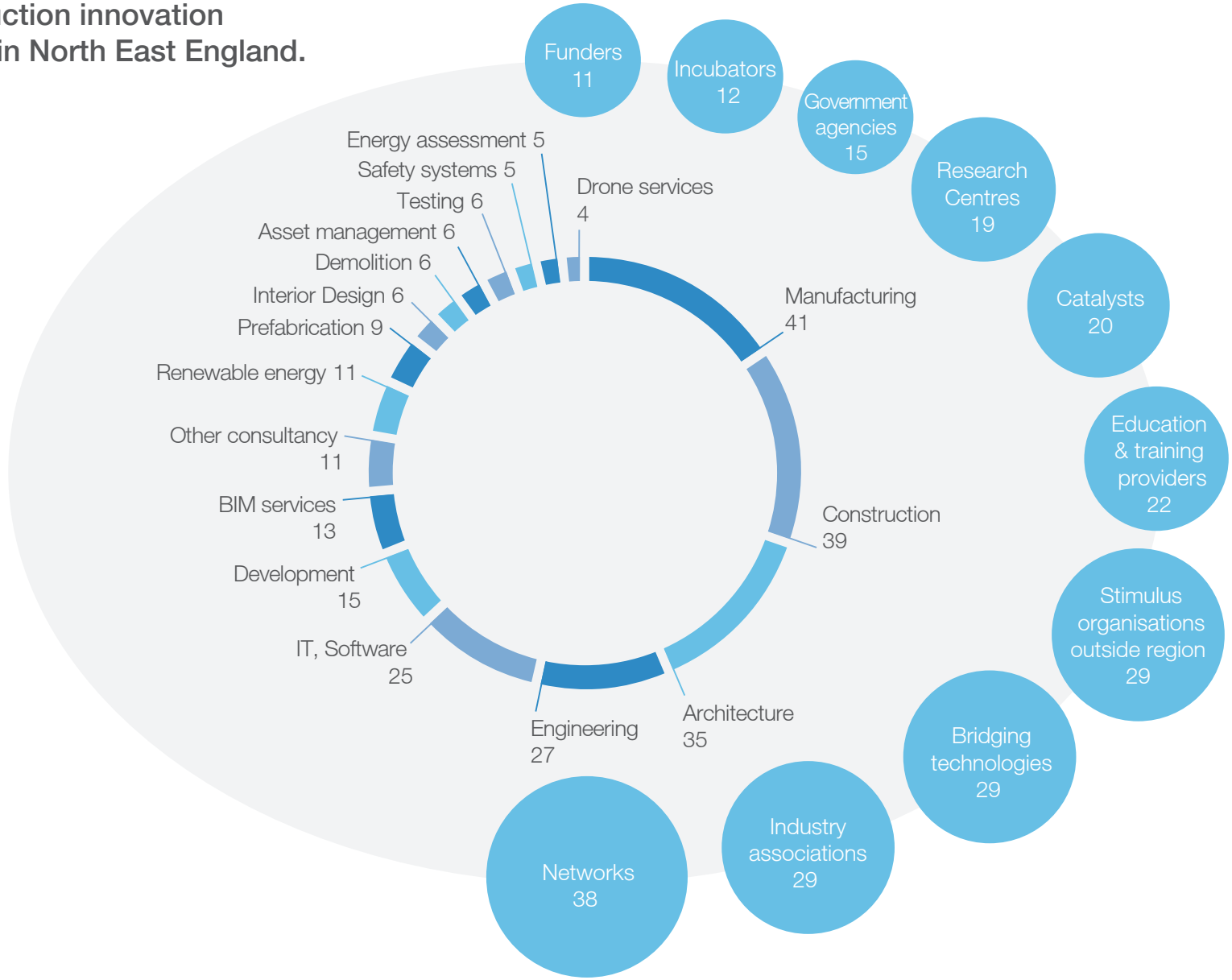
403
Organisations make up the North East England construction innovation ecosystem

264
Businesses are involved with construction innovation in North East England

£6.08bn
Turnover

20,768
Jobs

The construction innovation ecosystem in North East England.



Summary of Findings

Strengths and opportunities

- Early leadership in BIM has resulted in a robust digital construction cluster.
- Vibrant cluster of advanced materials technologies have application to construction.
- Collaboration and community.
- Presence of large companies with national and global reach.
- Local market is fiercely competitive, but this fosters creativity.
- Ample high quality research horsepower.
- Presence of innovative education programmes.
- Affordable rents and available space for start-ups – “a great place to live”.
- Available data and KPIs to benchmark innovation.
- Incubators are helping large and small companies collaborate on innovation.
- Innovative local construction education programmes gaining international attention.

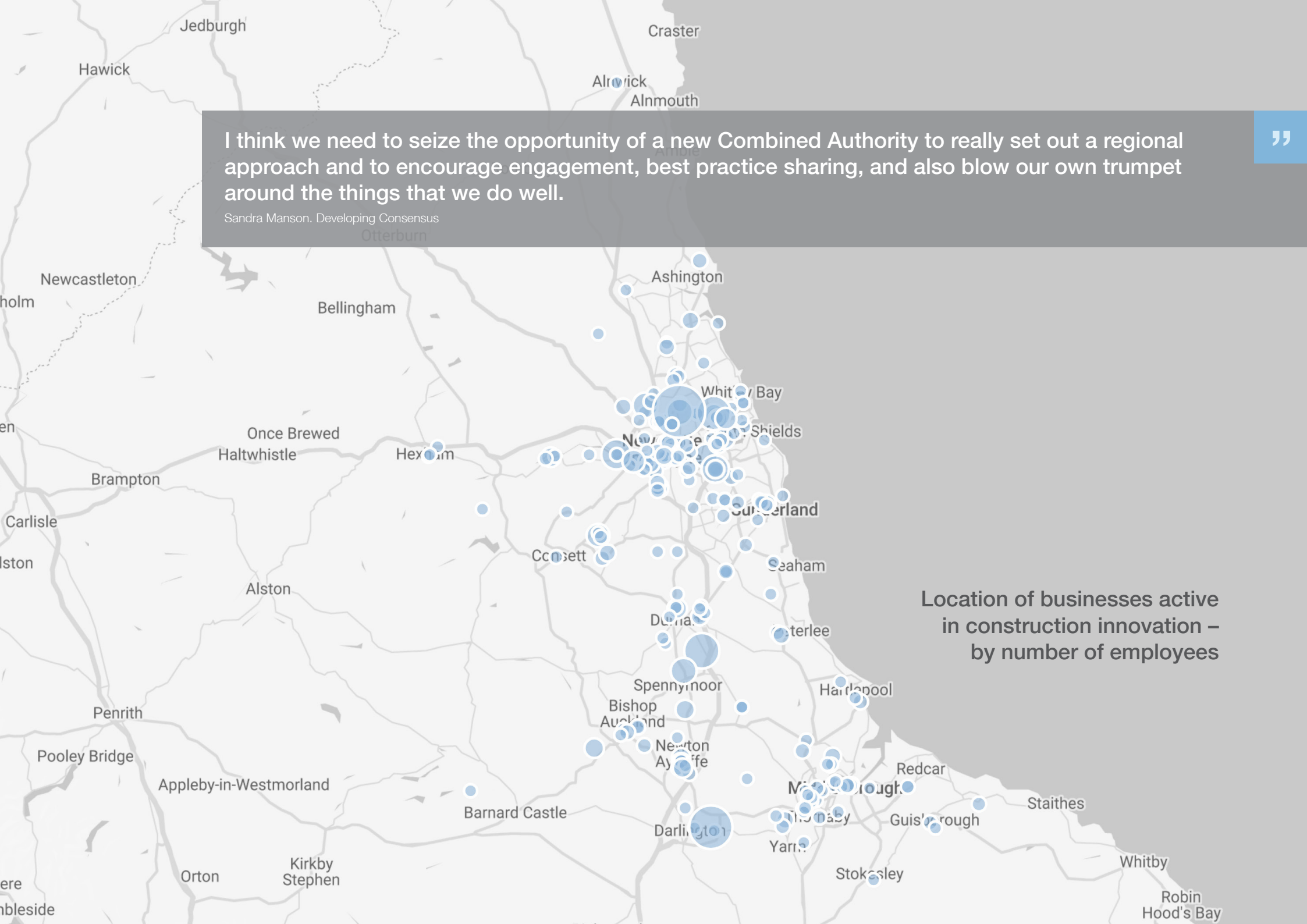
Gaps and challenges

- Slow to capitalise on early leadership in BIM.
- Industry short term-ism.
- Lack of regional industry data to track industry health and performance.
- Lagging in the shift to low carbon bio-based materials.
- Innovation is happening but knowledge is not being shared.
- Lack of construction-specific innovation funding and investment.
- Lack of incentives to innovate.
- Over complication of research support programmes.
- Regional “invisibility”.
- Inconsistent procurement processes.
- Regulatory challenges.
- Lots of talk, less action.
- Labour and IP “flight”.
- Lack of change management support.

Summary of Recommendations

- Prepare a construction technology cluster development strategy, pitch document and communication plan (with timelines) that builds on the region’s leadership in digital construction.
- Create a centralised innovation exchange.
- Nominate a construction innovation champion.
- Engage with and nurture the start-up community.
- Develop a dedicated construction innovation investment programme and funding plan (private and public sector).
- Undertake a long range education planning process.
- Create a regionally specific innovation KPI dashboard.
- Support and celebrate the strong community spirit in the region’s construction innovation space.
- Actively promote the region’s strengths in construction sector innovation both nationally and internationally.
- Showcase the region’s affordable available space to develop testbeds and “sandpits”.

> I think we need to seize the opportunity of a new Combined Authority to really set out a regional approach and to encourage engagement, best practice sharing, and also blow our own trumpet around the things that we do well.
>
> Sandra Manson. Developing Consensus



Location of businesses active in construction innovation – by number of employees

Contents

1 Introduction

Introduction

1.1 Project Overview

Construction underpins every facet of the UK economy and society. An efficient and sustainable construction industry is fundamental to the future prosperity and resiliency of communities across the country, while providing large numbers of high-skilled, well-paid jobs.

The most widely used definition of innovation is from the **OECD Oslo Manual**[1], which defines innovation as, "a new or improved product or process (or combination thereof) that differs significantly from the unit's previous products or processes and that has been made available to potential users (product) or brought into use by the unit (process)".

A robust innovation ecosystem that facilitates access to and the transfer of information to key members of the construction industry supply chain is vital if the industry is to achieve its priorities of delivering affordable, quality housing and infrastructure in the quantity and at the speed required.

Generally, construction technology or "contech" refers to the collection of innovative tools, machinery, modifications, software, etc, used during the construction phase of a project that enables advancement in field construction methods, including semi-automated and automated construction equipment. This study takes a broader view and considers upstream planning and design-oriented technologies and approaches, the production and application of advanced, low carbon and sustainable products and materials, and novel processes, practices and delivery methods.

It also looks at the state of education and training in the region and the degree to which industry can access the skills necessary to implement new technologies and processes.

Nationally, the UK is poised to **invest more than £600 billion**[2] on infrastructure over the next decade, including at least £44 billion for housing. A recently agreed devolution deal that sees the creation of a new **North East Mayoral Combined Authority**[3] is expected to unlock £4.2 billion of investment in the region over the next 30 years. The deal is also expected to create 24,000 extra jobs, create 70,000 courses to give people the skills to get good jobs and leverage £5.0 billion of private sector investment. The devolution deal will grant new powers to the new mayor around housing and planning.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1.2 Study Aims and Objectives

This study has been commissioned by a North East England industry consortium that includes Black & White Engineering, North of Tyne Combined Authority, Hydrock, North East Local Enterprise Partnership, OneVoice and Ryder Architecture.

The purpose is to research the construction innovation ecosystem in the North East England region particularly in the fields of technology, products and education. It is the first to provide a snapshot of the current construction innovation landscape at a regional level in the UK. It covers the 12 Local Authority areas that make up Tees Valley and North East England (Figure 1).

Figure 1: The North East region of England (source: North East LEP[4])

The objectives of this study are to:

- Attract investment to the region.
- Create a collaborative, sustainable growth-focussed hub committed to greater integration of technology, innovation and education in the built environment.
- Maximise the potential of industry and education in the region to be resilient and thrive during a period of socio-economic volatility.
- Inspire and create enhanced education pathways which are relevant to the needs of industry and attractive to the workforce of tomorrow.
- Support connectivity outside the region and promote exports.
- Encourage adoption of innovative technologies, products and systems within regional construction organisations.

There are good reasons for taking a regional approach, and for starting in North East England. Construction is project-driven which results in a predominantly local focus. It can be impacted by local planning policies and the availability of regionally specific materials and skills. However, North East England has a track record for **proactively engaging in innovation**[5] with almost half (47%) of businesses (higher than the national average) actively involved in innovation projects, the introduction of a new or significantly improved products or processes, or participating in wider innovation such as new or improved forms of organisation, business practices or strategies. The construction industry is in a potentially strong position to build on other efforts underway to create clusters in high growth areas of digital technology and advanced manufacturing.

Innovation is the means by which you deliver higher quality services, experiences and outcomes, to your key customers. Some people try to use it as a competitive advantage, improvements to the way you deliver a product, exploring new ways of working, exploring new cultures within organisations to get the best out of people. Because it all comes down to the fact that people are the biggest factor.

Alistair McLeod, OneVoice

This study aligns with the UK Government's 2017 **Industrial Strategy White Paper**[6], which seeks to make the UK better at forming and growing clusters. Industry clusters are groups of firms, and related economic actors and institutions, that are located near one another and that draw productive advantage from their mutual proximity and connections. The clustering - of industry, skilled people, and institutions - leads to faster innovation and more rapid gains in productivity. Cluster analysis can help diagnose economic strengths and challenges and identify realistic ways to shape the region's economic future.

The approach follows the triple helix model of innovation, which identifies industry innovators, academia and those providing education and capacity building, and stimulus organisations (such as government agencies, research laboratories and not-for-profits) and evaluates the interactions between each group (Figure 2).

This report presents evidence-based research with input from more than 50 subject matter experts from industry, technology development, education, research, catalysts, and government. In addition to the findings contained herein, there are also lists in the Appendix of the companies, education providers and stimulus organisations that comprise the construction innovation ecosystem in North East England.

Figure 2: The triple helix model of innovation (source: Scius Advisory)

1.3 Complementary Work

This work complements and aligns with other efforts going on in the region to modernise and catalyse the construction industry.

- **OneVoice Construction Strategy**[7] aims to build a successful, sustainable and inclusive construction industry, equipped with the people and technology to deliver a carbon neutral built environment by 2050. Convened by Constructing Excellence North East, the OneVoice plan allows for a shift in focus as a result of the pandemic and changing attitudes in the industry. The overarching aim is ensuring that North East England is recognised as a beacon of best practice.
- **Net Zero North East England**[8] is a collaboration between local government, business, education, the public sector and civil society to drive a comprehensive regional approach to tackling the climate emergency. The objective is to establish and adopt clear and ambitious targets for the region that can be monitored and evaluated; align key regional strategies and programmes in support of the vision; develop and scale up a programme of activity that can generate resources and achieve national and international profile; and, offer the region as a 'test bed' for new approaches, attracting funding and placing the region at the forefront of the green economy.
- **The Just Transition Research Project**[9], led by the Energy Democracy Project for the North of Tyne Combined Authority, examines what a just transition means to workers, communities and businesses in the region and identify pathways for socially inclusive decarbonisation. The project aims to identify, engage and consult people working in high-carbon industries – starting with agriculture and construction - that will be most affected by the transition to a low-carbon economy. There will be specific focus on highlighting the opportunities and barriers facing workers in high-carbon industries moving into 'green' and low-carbon sectors.
- The **North East England Apprenticeship Ready Strategy**[10] is a 2022 research project overseen by the North East Local Enterprise Partnership that explored the scale of apprenticeship recruitment and retention and tested assumptions identified as a priority for employers and apprenticeship providers. The ambition was to provide a set of actionable priorities for increasing the number of young people starting and sustaining apprenticeships in the region.
- **The North East Evidence Hub**[11] brings together key data about the region and provides insights into the region's economy. Reports into emergent markets (such as cloud computing, robotics and immersive technologies), the transition to Net Zero and complementary high growth industries such as **digital technologies**[12] and **advanced manufacturing**[13] have had an important bearing on this study.

Research Methodology

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Research Methodology

Data was collected between January and July 2023 and involved identifying enterprises, stimulus organisations and training providers that were active in advancing innovation in construction in the region. Web based research was complemented by interviews with leaders from across the construction innovation ecosystem in the region and with those who have a good knowledge of the region or work in a related sector that could provide valuable insights.

Companies were identified from the **Companies House database of companies**[14] and classified by the 2007 Standard Industrial Classifications (SIC) set out in Table 1. This list of 860 enterprises was augmented by a comprehensive web search (using innovation and sustainability related keywords) and consultation with local industry leaders. For example, **XBIM** (a local BIM services provider) provided an infographic they had created previously of the digital construction ecosystem in the region that was extremely helpful.

To be included, companies had to have a physical presence in the region (branch or HQ) and be actively trading and filings had to be in good standing with Companies House (i.e. records were balanced, up to date, and no queries had been raised). They also had to have a functioning website. Where no data was available for turnover and the number of employees, industry averages were applied.

F – Construction

23.1 - Manufacture of glass and glass products

23.3 - Manufacture of clay building materials

23.5 - Manufacture of cement, lime and plaster

23.6 - Manufacture of articles of concrete, cement and plaster

23.7 - Cutting, shaping and finishing of stone

24 - Manufacture of basic metals

25.1 - Manufacture of structural metal products

25.5 - Forging, pressing, stamping and roll-forming of metal; powder metallurgy

26.51 - Manufacture of instruments and appliances for measuring, testing and navigation

28.99 - Manufacture of other special-purpose machinery not elsewhere classified

32.9 - Other manufacturing not elsewhere classified

71 - Architectural and engineering activities; technical testing and analysis

72.1 - Research and experimental development on natural sciences and engineering

74.9 - Other professional, scientific and technical activities not elsewhere classified

Table 1: 2007 Standard Industrial Classification (SIC) categories that were used to identify potential companies.

The technologies with which companies were involved were identified from a review of their website and, where possible, from interviews. Categories of technologies included:

- Design-oriented technologies
- Construction automation – supporting work through digitisation
- Industrialised and componentised construction advances
- Advanced materials and systems, sustainability and circularity

Stimulus organisations provide enabling policies, programmes and resources that are important for innovation adoption and proliferation. Many organisations provide more than stimulus activity. National professional institutions were included that included regionally specific information on their websites even though they may not have a physical presence.

Education and training providers included institutions, companies and not for profits that have a physical presence in the region. The focus was on Higher Education and Further Education (HE/FE) programmes that train new workers for entry into the construction industry. Particular attention was given to technical level qualifications, education pathways including apprenticeships, and related educational programmes at Bachelors and Masters level. Programmes were assessed for the degree to which they:

- Deliver technical content that includes innovative technologies and practices (such as BIM, MMC, etc)
- Use innovative teaching techniques to better meet the needs of employers and students – apprenticeships and workplace training, etc, or
- Target under represented groups (such as women, at-risk youth, recent immigrants), through novel outreach, organisational or other means

Industry associations and professional institutes that are based outside the region but offer continuing professional development online or through local events were also listed.

This study represents a first foray into construction innovation at the regional level in the UK. The comments from interviewees provide valuable perspectives and insights. However, the regional construction industry is made up of over 9,000 registered companies, the majority of which are small or micro businesses (see Section 3.1 Industry Characteristics). Inevitably, many are “flying below the radar” (e.g., do not have a functioning website) resulting in gaps in the research.

Technology adoption was evaluated based on descriptions posted to company websites. It was not possible to validate all of these statements. Similarly, it was not possible to allocate a weighting related to the amount of total revenue generated from or number of staff involved in innovative activities.

More details on the research methodology are provided in the Appendix.

3 Economic and Policy Context

Economic and Policy Context

3.1 Industry Characteristics

It is hard to overstate the importance of construction to the UK's national and regional economies. The construction sector is one of the largest in the North East region's economy – employing more than 95,000 workers[16] or about 7.5% of the region's 1.26 million strong labour force[17].

There are **9,750 registered construction businesses** in North East England[18]. However, the industry is primarily made up of small businesses – only **5,725 businesses** (58%) have more than one employee[19].

In 2021, construction generated **£2.3 billion in GVA** (5.5% of the regional total) which is an improvement of £318 million (13.7%) over the previous year[20]. In 2022, the industry delivered a total output of **£5.17 billion in new work** and a further £2.33 billion in renovations and maintenance (R&M)[21]. However, there are indications that the construction industry in North East England is stagnating (Figure 4). Main contract awards and detailed planning approvals in 2023 have **decreased on last year's levels**, and project starts remained flat against 2022 levels[22].

This is while North East England saw project starts advancing 19% during the three months to January 2023 but remaining 20% down on a year prior.

Figure 4: Construction industry output in North East region: 2004 – 2022 and forecast to 2027 (£ millions, constant 2019 prices) (Source CITB[23])

Current projections estimate that the volume of work will **grow slowly**[24] for the North East England construction sector at around 0.9% AAGR through to 2027, which is below the UK forecast of 1.5%. Infrastructure is the largest segment comprising 38% of total output followed by private new housing at 28% (Figure 5).

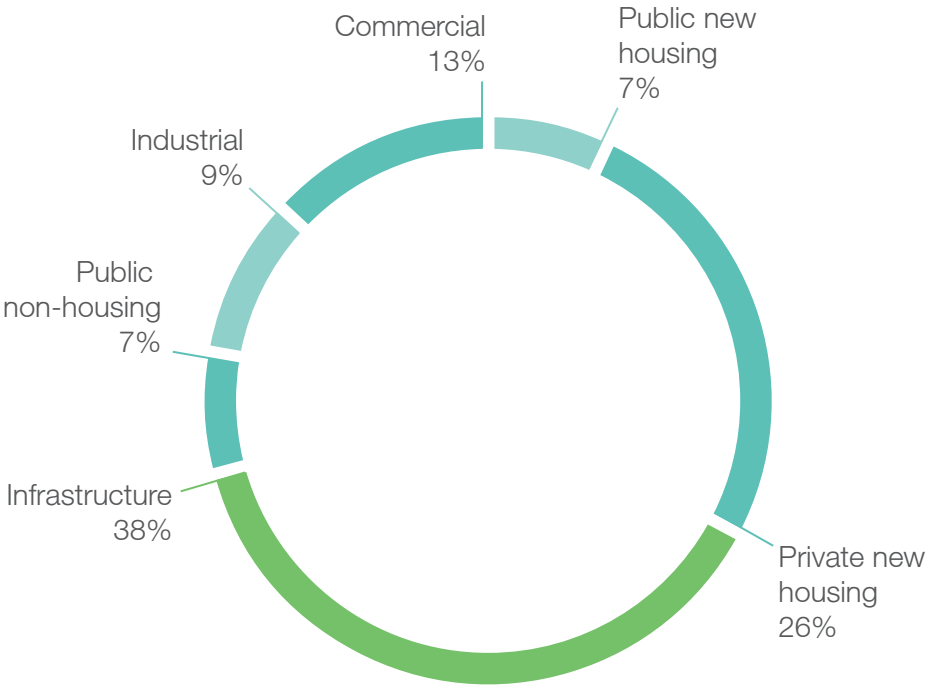


Figure 5: Construction industry structure in North East England, as of June 2023 (£ millions) (Source: ONS[25])

All Construction Output	2022 Annual (£m)	Jan to June 2023 (£m)
Public new housing	359	161
Private new housing	1341	738
Infrastructure	1,983	1,046
Public non-housing	375	250
Industrial	445	350
Commercial	668	528
All New Work	5,170	3,073

While the region covers a large area geographically, it is home to only 2.6 million people, which is less than 5% of the national population[26]. Economic activity is clustered within closely connected urban centres. Approximately 25% of construction businesses (2,460) and 25% of spend (approximately £1,420m in 2020) are in the Tees Valley[27] (Figure 6).

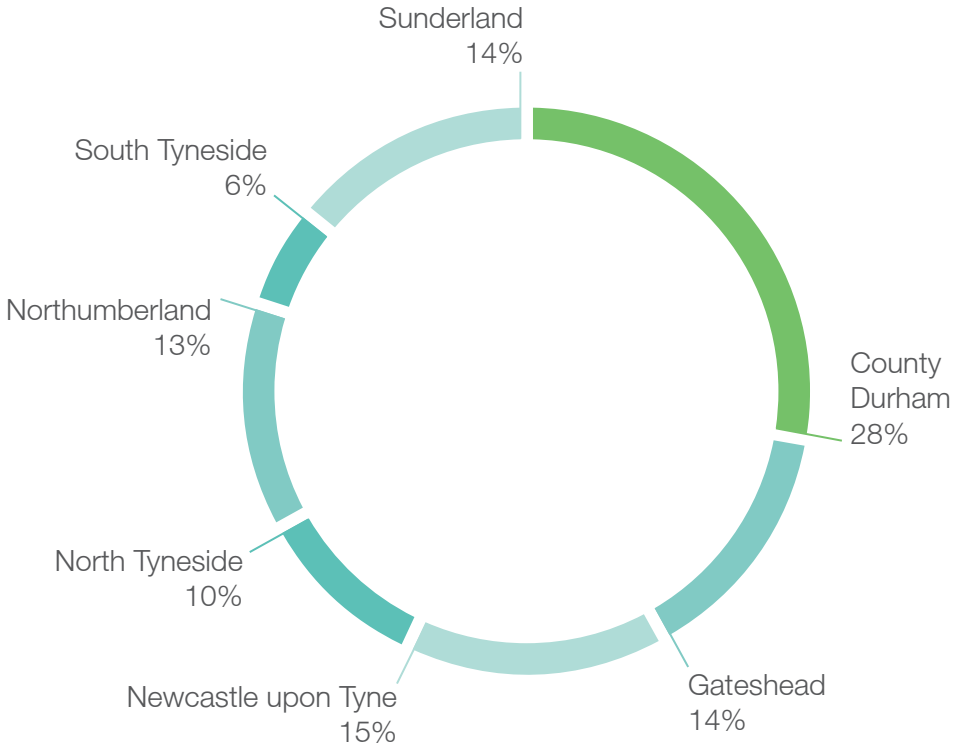


Figure 6: All Construction GVA in North East region - 2021 (£ m) (Source: **North East LEP**[28])

LA Area	All Construction GVA in North East region - 2021 (£m)
County Durham	640
Gateshead	335
Newcastle upon Tyne	338
North Tyneside	225
Northumberland	298
South Tyneside	145
Sunderland	333
Total	2,314

3

In terms of performance, productivity in the North East England construction sector is slightly lower than the national average (Figure 7).

Figure 7: Productivity North East region: Output per hour (Source: North East LEP[29])

The North East England construction sector is small by comparison to other regions in the UK, in terms of output (Figure 8), number of firms and number of workers (Figure 9). This should come as no surprise given that the North East has the smallest population of all regions in the UK. However, lack of size can translate into lack of visibility and presence when it comes to attracting funding and West Midlands support for innovation.

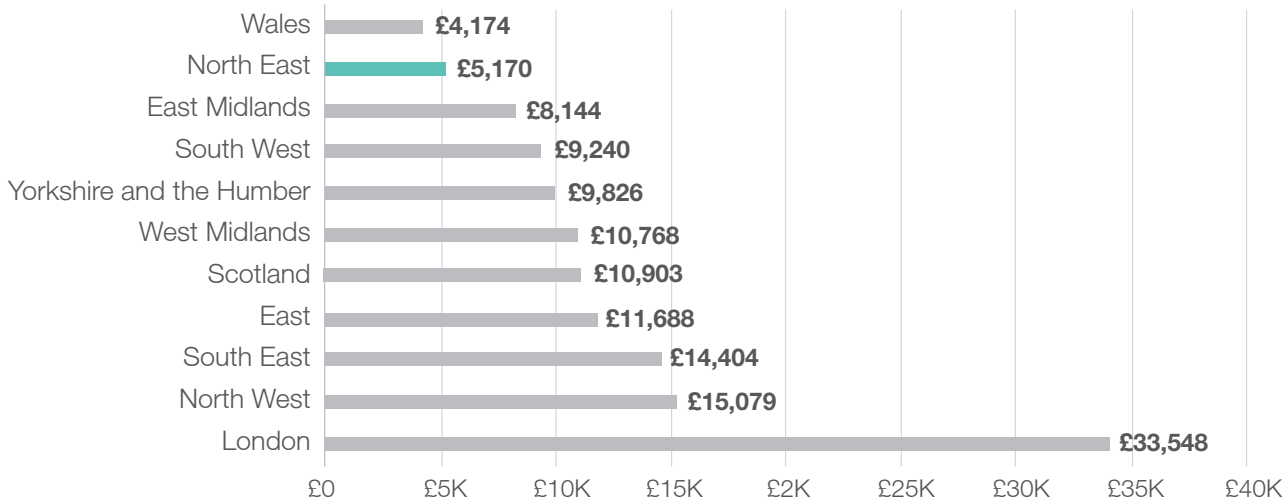


Figure 8: Construction output, value, non-seasonally adjusted, current prices, by region, £ million - all new work (2022) (Source ONS[30])

> **The North East often has to work very hard to showcase its innovation and leadership.**
>
> Peter Barker, Ryder Architecture

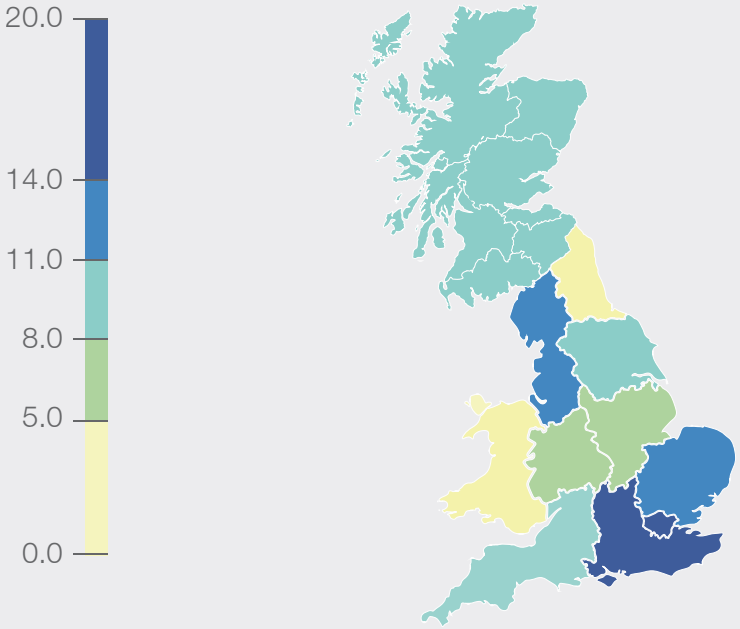
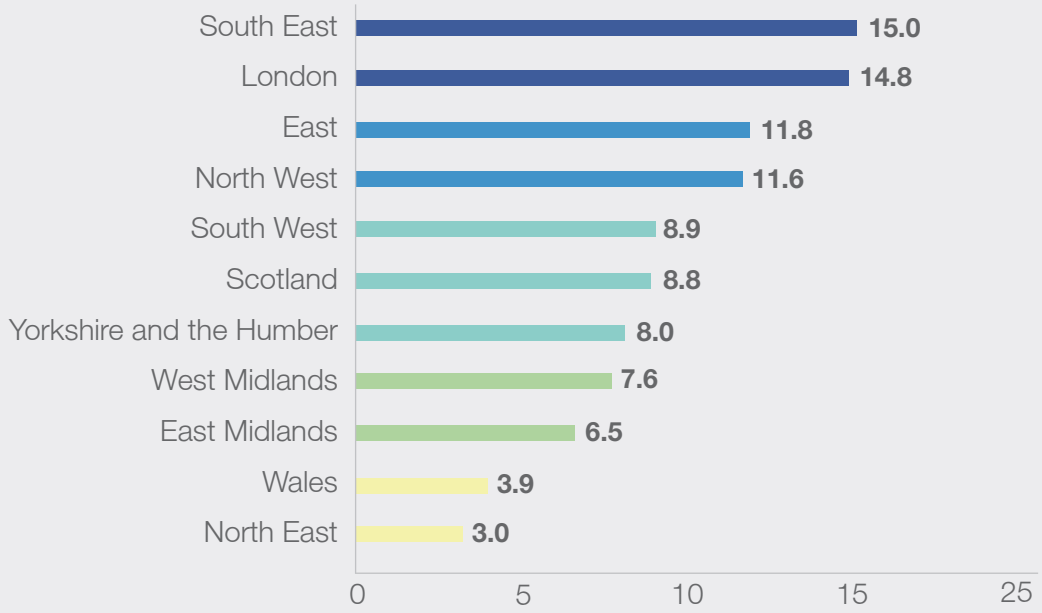


Figure 9: Proportion of total construction employees in Great Britain, by region of registration, as of Quarter 3 (July to Sept) 2021 (Source: ONS[31])



3.2 Trends and Drivers of Innovation

Nationally, the UK is poised to **invest more than £600 billion**[32] on infrastructure over the next decade, including at least £44 billion for housing. This could provide a significant boost to work volumes. Further, **a recently agreed devolution deal**[33] that sees the creation of a new North East Mayoral Combined Authority[34] is expected to unlock £4.2 billion of investment in the region over the next 30 years.

This includes:

1 £69m of investment in housing and regeneration, unlocking sites to bring forward new housing and commercial development.

2 An investment fund of £1.4bn, or £48m a year, to support inclusive economic growth and support our regeneration priorities.

3 An indicative budget of around £1.8bn, or £60m a year, for adult education and skills – to meet local skills priorities and improve opportunities for residents.

4 A £900m package of investment to transform our transport system, with £563m from the City Regional Sustainable Transport Fund, on top of funding already announced for our buses and metro system.

Between 2023 and 2027, the fastest sector rate of growth is expected for private housing, commercial, industrial, and non-housing repair and maintenance. A raft of policies at the national and regional level are also expected to create opportunities arising from factors such as building safety upgrades, achieving net zero emissions targets, and measures to address climate adaptation and resilience (discussed further in Section 3.3 Emerging Policies and Regulations).

The construction industry is facing profound regulatory, technical, demographic, macroeconomic and consumer changes. The megatrends are retrofit, digital, modern methods of construction, and building safety and the requirement for a “golden thread of information” as part of the Building Safety Act, all of which are around advancements in construction and different ways of doing things.

While technological developments will shape the practice of construction, and profoundly change the nature of construction work, the following trends and drivers will impact profitability in the short term and create challenges for the industry in the long term. They are forcing all businesses involved in construction to adapt and innovate or risk being left behind.

Trends and drivers of innovation

Macro-economic disruptions	EU-Exit – impacts on labour and supply chains continue to be felt. The UK's exit from the European Union has created uncertainty for the construction industry, with potential impacts on trade, labour supply, and funding for infrastructure projects. COVID 19 – drop in labour force during the pandemic has largely been recovered, productivity in the construction industry in 2020-2021 was as low as during the 2008/9 recession.
Government stimulus	Industrial policy and spending (US: Inflation Reduction Act, EU: Green Deal Industrial Plan, UK: fragmented policies and spending commitments). The UK is poised to **invest more than £600 billion**[35] on infrastructure over the next decade, including at least £44 billion for housing. The new **North East Mayoral Combined Authority**[36] is expected to unlock £4.2 billion of investment in the region over the next 30 years. North East England will host the national **Digital Launchpad**[37] – one of eight regional innovation clusters across the UK that are being backed by a share of a £75 million investment.
Market dynamics	Housing supply shortage. Office occupancy (working patterns). Online retail is emptying out town centres. Adoption of electrified mobility and increasingly inter-connected nature of power management between buildings and transportation.

Trends and drivers of innovation

Market dynamics	Inflation: construction is economically sensitive to rising costs of raw materials, labour, fuel and energy – particularly for firms operating under fixed price contracts signed before the inflation spike in 2021-2022. Project payment delays exacerbate the problem.
Supply chains	Shift to prefabrication, offsite construction and MMC. "Near-shoring" and "re-shoring" where supply chains are shifting from global to local in the face of rising shipping costs, tariffs and post-BREXIT red tape. The interconnected nature of construction supply chains leaves firms vulnerable. Two **local construction firms failed recently**[38].
Energy costs and security	Diversified generation, distribution and storage. Ukraine-Russia war.
Climate resilience	IPCC targets and net zero commitments are getting closer. Mitigation (decarbonisation: operational, embodied, biodiversity gain). Adaptation (built environment – retrofitting and re-use, natural environment – infrastructure protection and resilience).
Building safety	Repercussions from the Grenfell tragedy and subsequent enquiry Focus on construction materials, digital golden thread (BIM, digital twins, data) and regulations to ensure that what is specified is fit for purpose and gets built.

Trends and drivers of innovation

Labour force	The construction sector relies on a labour-intensive business model, which is becoming unsustainable due to the impact of demographic change. This shortage is driven by factors such as an aging workforce (the number of hours worked by workers 50 years and over has increase substantially, while for younger workers there is little growth), limited training opportunities, and competition for skilled workers from other industries. Recruiting workers will be a major task and means construction employers will need to refresh the way they recruit. Concerns that employing fully skilled workers is unlikely to meet the expected shortfall because the workers simply aren't available. Decline in apprenticeships prior to March 2020.
Infrastructure	Electricity grid constraints. Gas and hydrogen networks, water networks, heat networks. Cloud computing and data centres.

The North East England construction economy is very competitive. Local firms must be creative and agile to survive and be ahead of the curve if they are to compete in other regions. The fact that the region can be a tough place to do business is, ironically, a major spur for innovation.

3

The North East is quite a competitive environment to work in. It's a small economy and it's very relationship orientated. So, if you can do something innovative in the North East you will likely succeed anywhere you go. I think that this catalyses a lot of innovation. Local firms have to be cutting edge or they are going to get taken down. I think because of this, the North East has an incredible opportunity.

George Mokhtar, Turner & Townsend

I think in the North East we are quite creative in how we make schemes deliverable because there tends to be less funding available.

Ed Besford, Bowmer + Kirkland

3.3 Emerging Policies and Regulations

There are important national and local policies and regulations aimed at improving efficiency and safety, and decarbonisation. These are putting pressure on the industry to integrate new ideas, technologies, and specifications into their projects.

Efficiency

The Construction Sector Deal[39] aims to accelerate the shift in construction towards manufacturing and digital processes and a value outcome approach. The Construction Sector Deal's targets are:

- **Lower Costs:** 33% reduction in the initial cost of construction and the whole life cost of built assets
- **Faster Delivery:** 50% reduction in the overall time, from inception to completion, for new build and refurbished assets
- **Lower Emissions:** 50% reduction in greenhouse gas emissions in the built environment
- **Improvement in Exports:** 50% reduction in the trade gap between total exports and total imports for construction products and materials

The 2011 **UK Government Construction Strategy**[40] requiring all centrally-procured public projects the 'Government to use fully collaborative 3D BIM (with all project and asset information, documentation and data being electronic) as a minimum by April 2016. Today, construction companies need to be able to deliver projects in accordance with the **UK BIM Framework**[41] which aligns to international industry standards.

In 2022, the UK government established a £10 billion **Offsite Construction Framework**[42] agreement available for use by local governments, healthcare, education, police, fire and rescue, housing associations and charities. The Affordable Homes Programme 2021-2026 has made adoption of MMC a condition of its strategic partnership grant programme.

Safety

The **Building Safety Act 2022**[43] puts in place new and enhanced regulatory regimes for building safety and construction products. It is designed to provide greater safety, quality, transparency of the building process and accountability of the professionals involved.

Emerging Policies and Regulations

Climate and the environment

The UK **Net Zero Carbon Buildings Standard**[44] aims to establish performance targets that align with science based trajectories needed to achieve net zero by 2050 and a 78% reduction by 2035 in the UK, i.e. what is known to be required to stand a reasonable chance of mitigating global warming to 1.5°C.

Starting in November 2023, a national **Biodiversity Net Gain**[45] mandate will require a minimum 10% uplift in the overall biodiversity value of a development site as part of planning.

Part Z[46] is an industry led campaign to incorporate an embodied carbon focused amendment into existing Building Regulations. Government consultation is expected to continue through 2023 with further announcements in 2024.

The UK Manufacturing Sector **Net Zero Road Map**[47] aims to reduce GHG emissions by 65% by 2035 over 2018 levels and to achieve net zero by 2050. Currently, about 90% of emissions from the manufacturing and construction industry come from manufacturing activity.

The **Home Upgrade Grant scheme and the Social Housing Decarbonisation Fund**[48] (collectively worth £1.4 billion) provides dedicated funding to local authorities and social housing providers to subsidise energy efficient retrofits for social housing.

The Construction Innovation Ecosystem 4

4

The Construction Innovation Ecosystem

The organisations that are considered important for advancing construction innovation in the region were classified into three categories: enterprises, stimulus organisations and education and training providers.

1 Enterprises: companies that are active in the development, design, and construction of buildings (asset managers, developers, architects, engineers, builders, and related professions). It also includes manufacturers of building products, technology providers (such as software developers), advanced manufacturing (companies involved with prefabricated and industrialised construction systems, 3D printing, etc.), clean and green technology firms (such as companies involved with energy efficiency and renewables), and those companies that may be in "bridge" industries that could serve a modernised and expanded construction industry in the future (such as advanced materials, defence, energy, off-shore, automotive, etc).

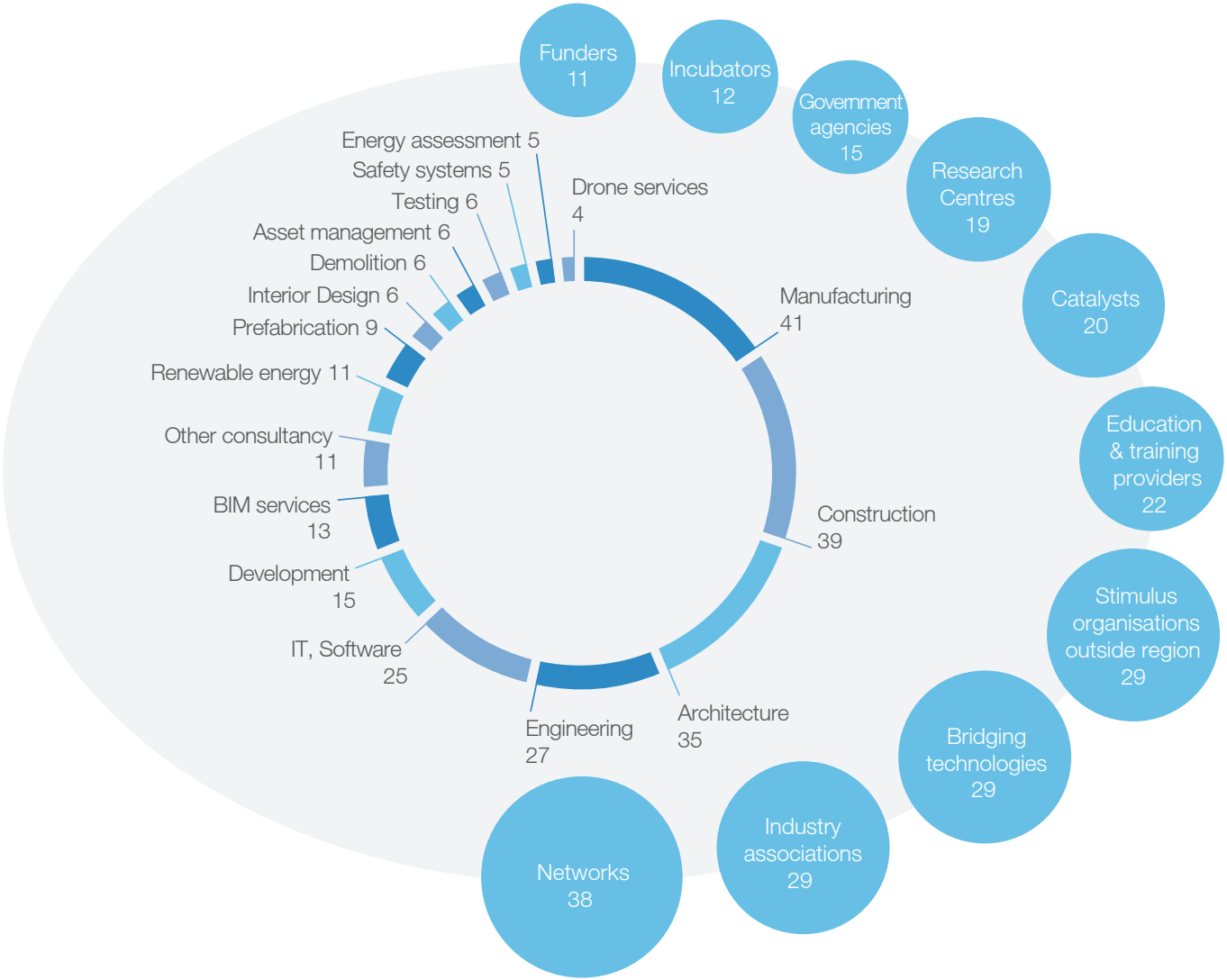
2 Stimulus: stimulus organisations provide enabling policies, programmes and resources that are important for innovation adoption and proliferation. They include:

- Research groups, laboratories and Centres of Excellence.
- Incubators that provide technical, business and operational support (such as advice, affordable office space, access to equipment, etc.) to grow new ventures and technology development.
- Catalysts (organisations, and initiatives) that drive the adoption of specific technologies and practices (such as modular building, renewable energy, advanced materials, etc.)
- Networks and meet up groups.
- Associations and Professional Institutes.
- Investors, funders and those that provide access to capital.
- Governments and agencies with a mandate to foster innovation, encourage economic development, promote clean, green and diverse employment.

3 Education: education and training providers included institutions, companies and not for profits that that train new workers for entry into the construction industry. Industry associations and professional institutes that are based outside the region but offer continuing professional development programmes are also included.

403 organisations (including groups, and major activities) have been identified as important for supporting construction innovation in North East England (Figure 9). There are 293 enterprises, of which 264 are directly involved with construction and the built environment and a further 29 that potentially offer "bridging" technologies. These companies are mostly clustered in the major urban centres (Figure 10). There are 88 stimulus organisations or activities of which 29 are not physically located in the region though still retain an important virtual presence. There are 22 organisations that are involved with education and training.

Figure 10: Summary of organisations that comprise the North East England construction innovation ecosystem (circle or segment size denotes the number of organisations in each category).



> I think utilising an innovation ecosystem can be really helpful from what I've seen in different sectors.
>
> Researcher, Newcastle

> The construction sector is critical to enabling regional economic growth. A sector in its own right, employing people in a variety of careers and professions, it also cuts across our economy, facilitating growth and development of other sectors and services.
>
> Helen Golightly, North East LEP

> I think there is an ingenuity in the region, in that some of the smaller North East businesses can be nimble in working together to try something different.
>
> Peter Barker, Ryder Architecture

4

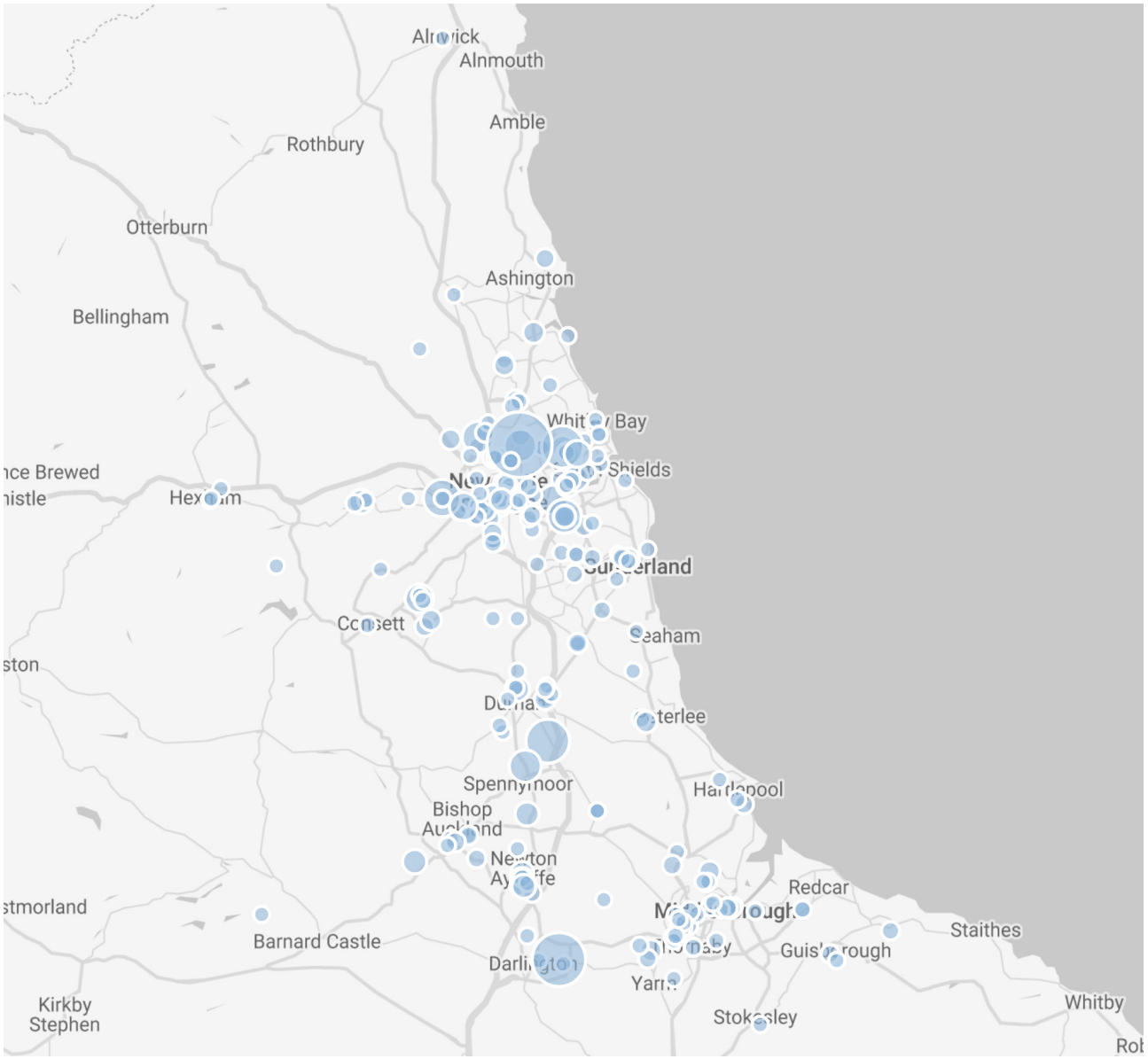


Figure 11: Location of companies by number of employees

4.1 Innovative Businesses

The 265 enterprises that are directly involved in construction innovation work in all major facets of the industry and serve all markets from housing to infrastructure (Figure 11). Together, they generate an estimated £6.08 billion in turnover (Table 3). The largest categories are manufacturing and construction which together make up 30% of the total number of firms.

Figure 12: Number of enterprises active in construction innovation.

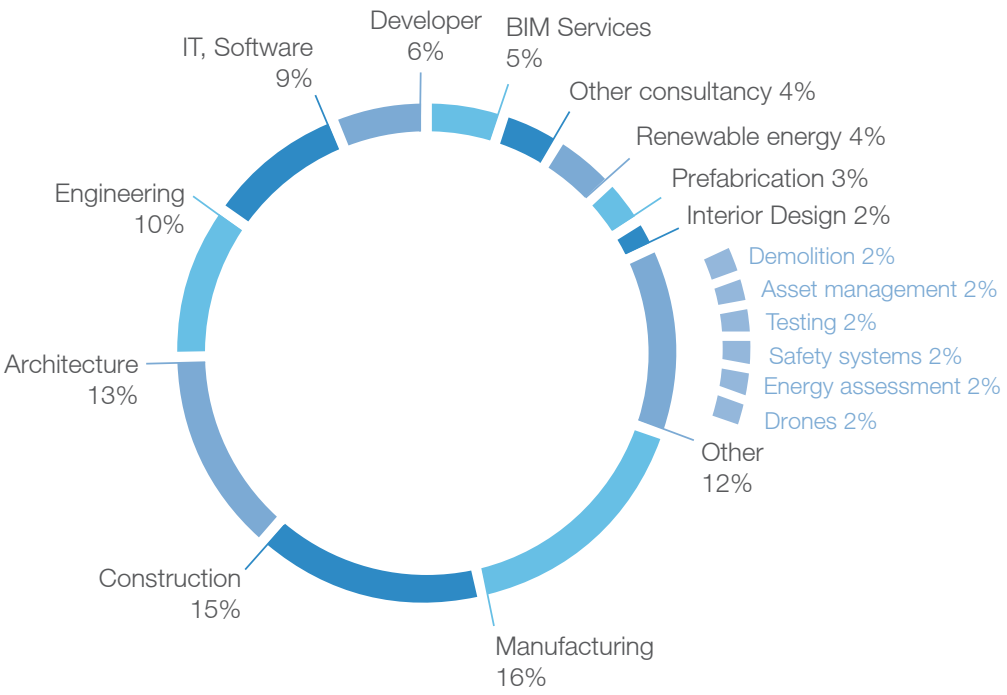


Table 3: Categories of enterprises by number, turnover and labour force

Categories	Number of Enterprises	Estimated turnover generated in NE	Estimated workforce in NE
Manufacturer	41	941,864,060	4,429
Construction	39	2,431,237,455	6,831
Architecture	35	125,318,688	826
Engineering	27	334,080,189	2,617
IT, Software	25	136,990,291	1,080
Development	15	1,179,230,677	1,683
BIM services	13	7,249,492	57
Other consultancy	11	42,443,134	294
Renewable energy	11	30,406,428	218
Prefabrication	9	65,149,375	324
Interior Design	6	1,383,258	15
Demolition	6	127,016,433	553
Asset management	6	489,790,000	1,004
Testing	6	64,735,769	340
Safety systems	5	97,196,667	465
Energy assessment	5	985,450	25
Drone services	4	643,822	8

Esh Group[49] is the largest company involved in innovation (in terms of turnover) that is headquartered in the region. However, most companies are small, with 40% generating less than £2 million per year (Table 4).

	< £2m	£2m - £5m	£5m - £10m	£10 - £50m	>£50m
Turnover	105	36	24	74	25

Table 4: Number of enterprises by turnover

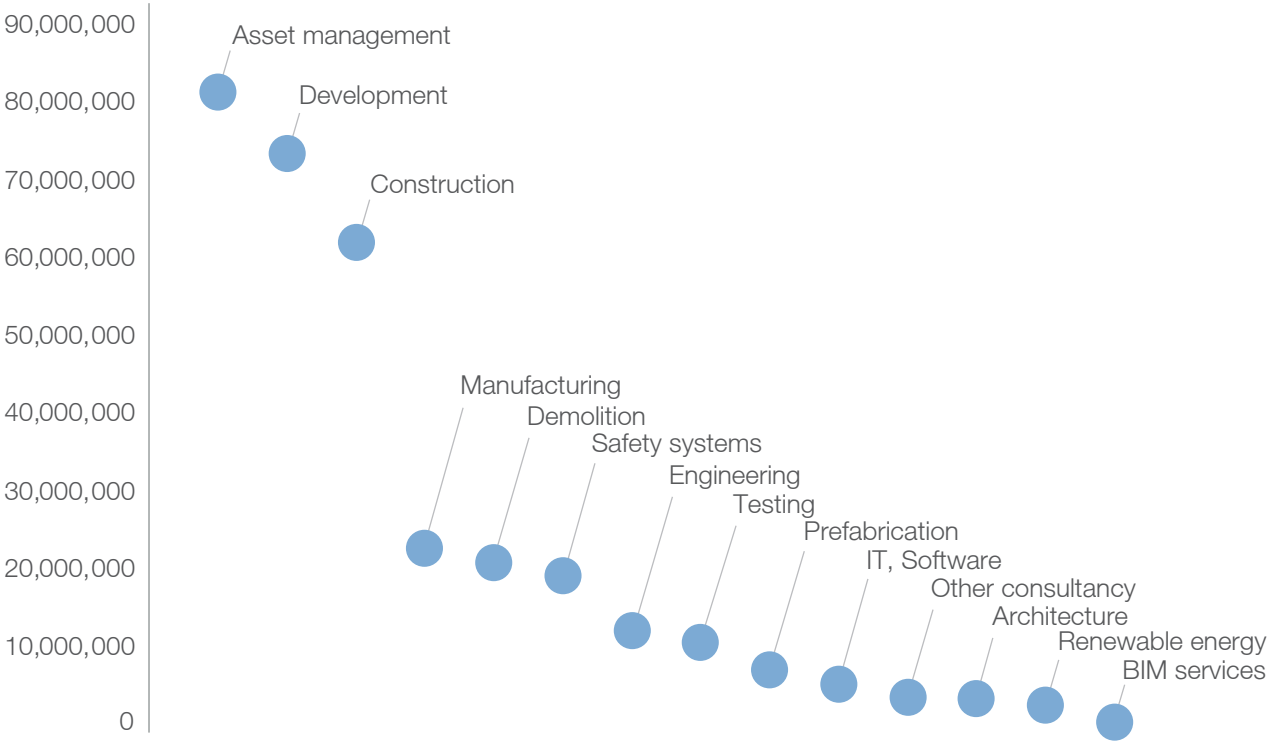


Figure 13: Average turnover per company (categories that on average generate less than £1m were omitted for legibility)

Collectively, 39 construction companies turned over £2.43 billion in 2022 (the largest sector, and 38% of total). However, in terms of average turnover per company, the most significant category is asset management driven primarily by **Grainger plc**[50] and **Northumbria Healthcare Facilities Management**[51]. Although architecture makes up a large number of companies, they are generally small businesses with average annual turnover per company around £3 million. Figure 13 presents the average turnover per company for each industry category.

Collectively, the enterprises involved in construction innovation in North East England support a labour force of an estimated 20,775 people. The 39 construction companies active in innovation employ 33% of the total workforce, followed by manufacturing at 21%. The largest employers are **Equans**[52], Magnet[53], **Northumbria Healthcare Facilities Management**[54], **Esh Group**[55] and **Karbon Homes**[56].

Most businesses that are active in innovation are small. Almost two thirds (63%) have less than 50 staff and 34% have less than 10 (Table 5). However, while the asset management category is small in number, it includes two large organisations (Figure 14).

	<10	10 to 50	50 to 100	100 - 500	> 500
Employees	91	75	35	56	6

Table 5: Number of enterprises by workforce

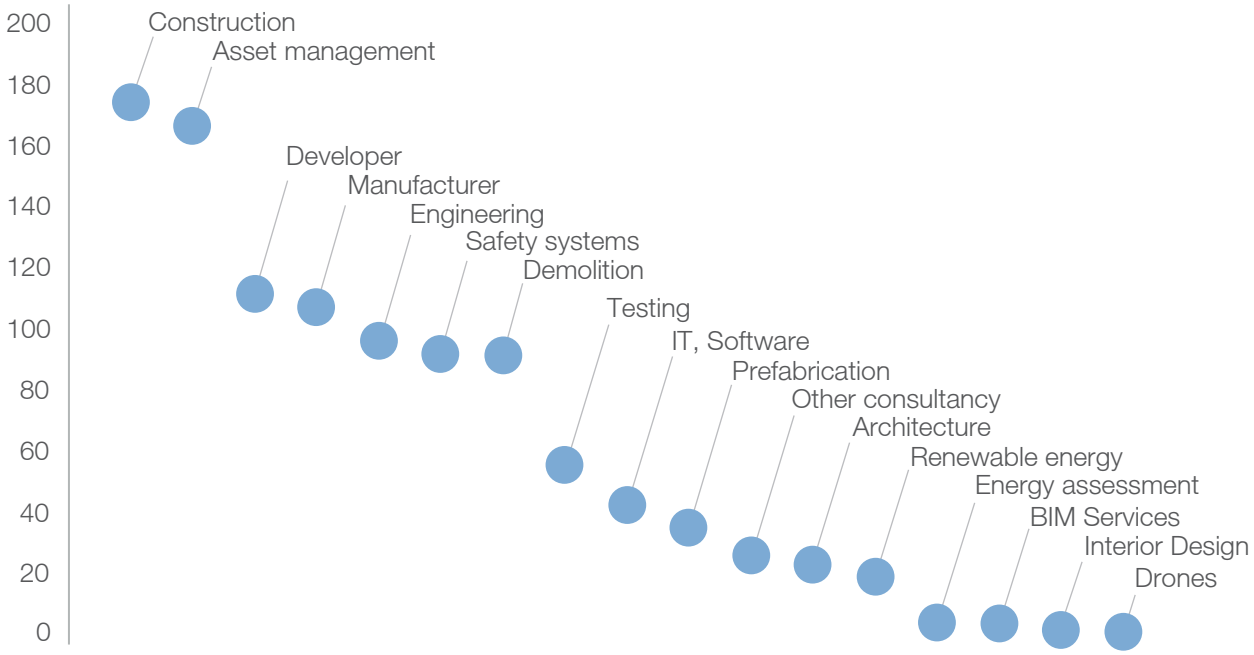


Figure 14: Estimated average number of employees per company by industry category

The presence of large companies is important for innovation proliferation. Large companies tend to have the market presence and financial capacity to adopt new technologies and processes. Several large multinationals have a presence in the region that could not only scale up local innovations, but also bring in new ideas from elsewhere.

The ten largest global companies (in terms of size of global workforce) that have a presence in North East England are:

- Siemens
- WSP
- Akzo Nobel
- BAM Construct
- Balfour Beatty
- Equans
- AECOM
- Arcadis
- Mott MacDonald
- Arup

> Although we are based in the North East, we do a lot of global projects, so we may have ten offices around the world contributing to major projects. We would not have 120 people here in Newcastle if we were just working on North East projects.
>
> Tomás Neeson, Cundall

> There are several large engineering consultancies that have an office in the region who can feed off the innovation happening elsewhere in their organisation and bring it to the region, and vice versa. There are also some contractors who are just very good at what they do and are quietly implementing innovation and efficiencies without any fanfare.
>
> Peter Barker, Ryder Architecture

In terms of trade outside North East England, 83 companies (31%) have out of region locations. 41 companies (15%) have at least one office outside the UK, however only 19 of these are headquartered in the region. The regions where most companies are present are North America, Europe, and Australia (Table 6).

Global presence of enterprises	Number
National	83
North America	29
Europe	26
Australia and New Zealand	25
China, Japan, Philippines	21
Central and South America	19
India	17
Africa	14
Middle East	11

Table 6: National and international presence of enterprises

> We are seeing big steps forward in the use of automation and cloud hosted services to share data and are getting much more into proper BIM, rather than just drawing in 3D.
>
> Tomás Neeson, Cundall

4.1.1 Technology Development and Adoption

Nationally, Figure 15 presents the number of companies that mention construction technologies on their websites, or in interviews (key words: BIM, Digital Twin, Smart sensors, 3D printing, prefabrication, etc.). Many companies are active in more than one technology. The degree to which they are active is difficult to judge. Nevertheless, the most frequently mentioned technologies related to digital tools such as BIM, various types of design and construction software, digital twins and prefabrication.

The region has developed a cluster of expertise in BIM and digital technology. 40% of the companies are active in BIM – more than any other technology. There are also several large software companies that are operating at a global level, that are born and bred in the region (such as the **NBS**[57], **Causeway**[58] and **Viewpoint**[59]).

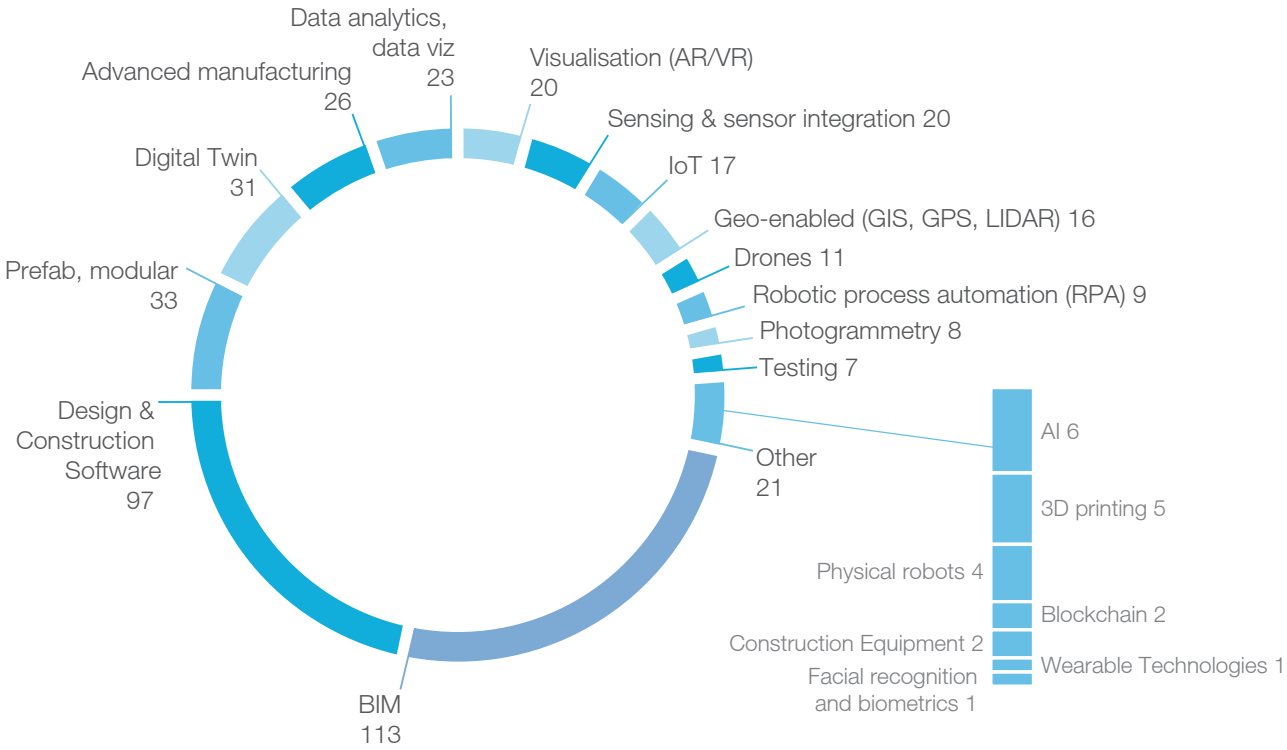


Figure 15: Companies active with construction technology

> The Newcastle area is developing a specialism in digital construction. It's got regional headquarters for lots of contractors, so that's where the digital expertise is located as well as boots on the ground.
>
> Andy Ward, XBIM

> I think that the landscape's changed in the last few years. Technology is increasingly seen less as a cost and more as an investment.
>
> Andy Ward, XBIM

> I think a lot of companies have adopted digital practice. In recent years, we've seen a revolution, in design, manufacturing and construction towards a BIM workflow.
>
> Dr. Stephen Hamil, NBS

> I've just done a full concept design all in Midjourney and ChatGPT and the client didn't know the difference. Doing it this way saved on fees, allowing us to spend more money on delivering the final 20% polished aspects to the design.
>
> Steven Charlton, i/o atelier

Testament to the region's early leadership in digital is the fact that North East England has hosted some very successful digital technology conferences. **Thinking Digital**[60] is a major two-day annual event attracting international speakers although it is not construction specific. Up until 2019, a major BIM conference – the **BIM Show Live**[61] – was held in Newcastle. This two-day event brought together global construction professionals from all aspects of the built environment. It is important for the region to use events such as this to maintain visibility as a leader in the digital construction space.

It is worth noting that there is a lack of regional industry-level data available on the construction industry's performance. Data is critical to managing change. Key Performance indicators (KPIs) are measurable values that demonstrate the general health of the industry and provide a basis from which to work collaboratively to lift industry performance overall, and therefore can serve as innovation benchmarks. In addition to government statistics, **CITB**[62] gathers employment data and **Constructing Excellence**[63] tracks KPIs at a national scale. Given the unique characteristics of the region, these data sources, complemented by regular industry surveys, could be aggregated into a KPI dashboard to establish KPIs for the region that can be aggregated on a dashboard as a way to help pinpoint issues and highlight success.

> We should be looking at digital twins to change behaviours, and influence the way people live, and so on. I think it's a wonderful tool for bringing communities together to talk about issues and solve them by developing scenarios. This would let consumers and communities drive change.
>
> Educator, Alison Watson, Class of Your Own

4.1.2 Construction Technology Development

This study captures both technology users (in innovative applications and thereby driving the industry forward) and technology developers. Figure 16 illustrates the 117 organisations (companies, research centres, etc.) that are involved in developing technology that can be directly applied to construction (software, advanced materials and manufacturing, etc.). However, it was not possible to determine the degree to which IP was being formally categorised and patent protection sought. It should be noted that there are likely many more engineering and construction firms that are developing proprietary technologies for business or process optimisation.

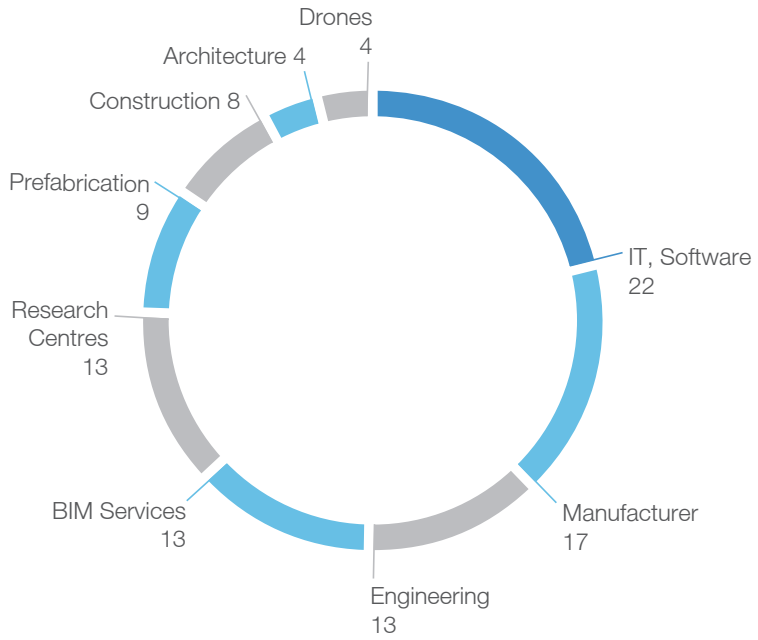


Figure 16: Number of organisations active in technology development

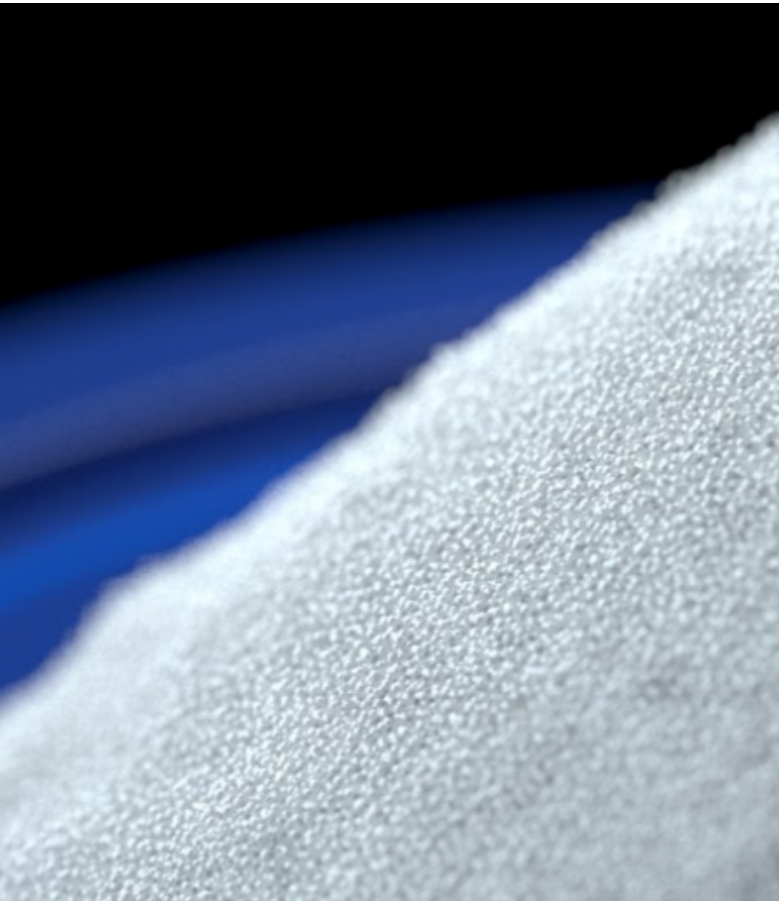
> Tech companies don't understand the world of construction, and hence they find it difficult to create products and services that will fulfill a need in that sector.
>
> David Dunn, Dynamo North East

> I think that there's a huge opportunity to use a lot more technology. And, for example, in things like visualisation, and being able to create rapid prototyping using digital twins and being able to turn those into reality.
>
> Dominic Endicott, Northstar Ventures

> We have always been seen as a really innovative area around digital construction, but I think the industry generally is catching up. I do think we've got some really innovative organisations who are always looking to push the boundaries.
>
> Kate Lloyd, Institution of Civil Engineers

4.1.3 Sustainability

Figure 17 shows the number of companies that mention technologies or practices associated with sustainability (key words: sustainability, energy, renewables, advanced materials, recycling, deconstruction, retrofits, etc). The most frequently mentioned were related to energy efficiency and renewables, sustainable materials management, zero waste and practices that promote a circular economy.



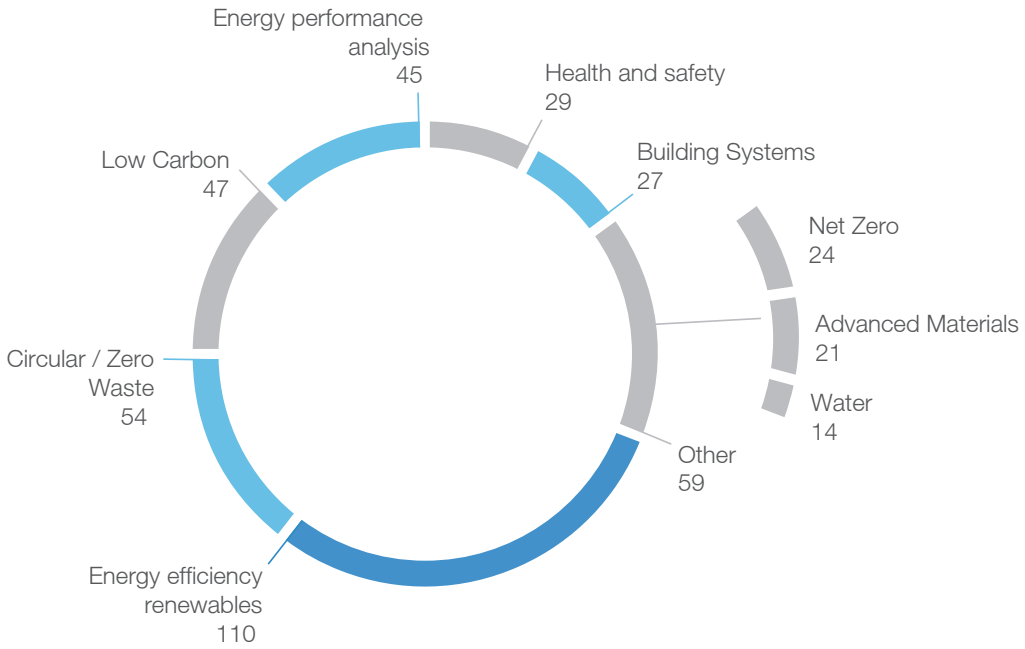


Figure 17: Companies active with sustainability

Selling bricks is core to what we do. However, we are now looking at the market to see who is innovating and who is doing different things. As well as pushing the traditional models, we are investigating different materials that make bricks more carbon efficient – potentially net carbon negative.

We are also looking at airbricks that open and close, so they still keep out damp and condensation, but they also prevent heat from escaping the property. They will save about 15/16% on heating bills and will add 2-4 EPC points to the house. So, they are ideal for a retrofit application. In particular, owners and managers of large housing stocks, such as housing associations etc, who need to improve EPC ratings.

Andrew Pickersgill, W. McGoverns & Co.

4.1.4 Advanced Materials

There are six companies (three of which are early-stage ventures) that are developing products using advanced materials such as low carbon aggregates, graphene and aerogel technology – which is a highly efficient, non-combustible insulation product, which has direct application to buildings. This particularly timely given the requirements of the new **Building Safety Act**[64].

Companies developing advanced materials for construction applications:

- Dragonfly Insulation
- First Graphene
- Graphene Composites
- IBSL Group
- Low Carbon Materials
- Thermulon

Table 7 is a "heat map" that summarises activity in both technology and sustainability by industry category. It suggests that engineering companies are the most active in the use of both technology and in sustainability practices, followed by construction firms. Many architecture firms promote the use of BIM and the use of digital technology on their websites.

Construction companies are also active in the use of digital technologies and are also the most involved in energy efficiency, energy modelling and renewables (solar panels, wind, etc). There are several firms that do business in the off-shore energy field.

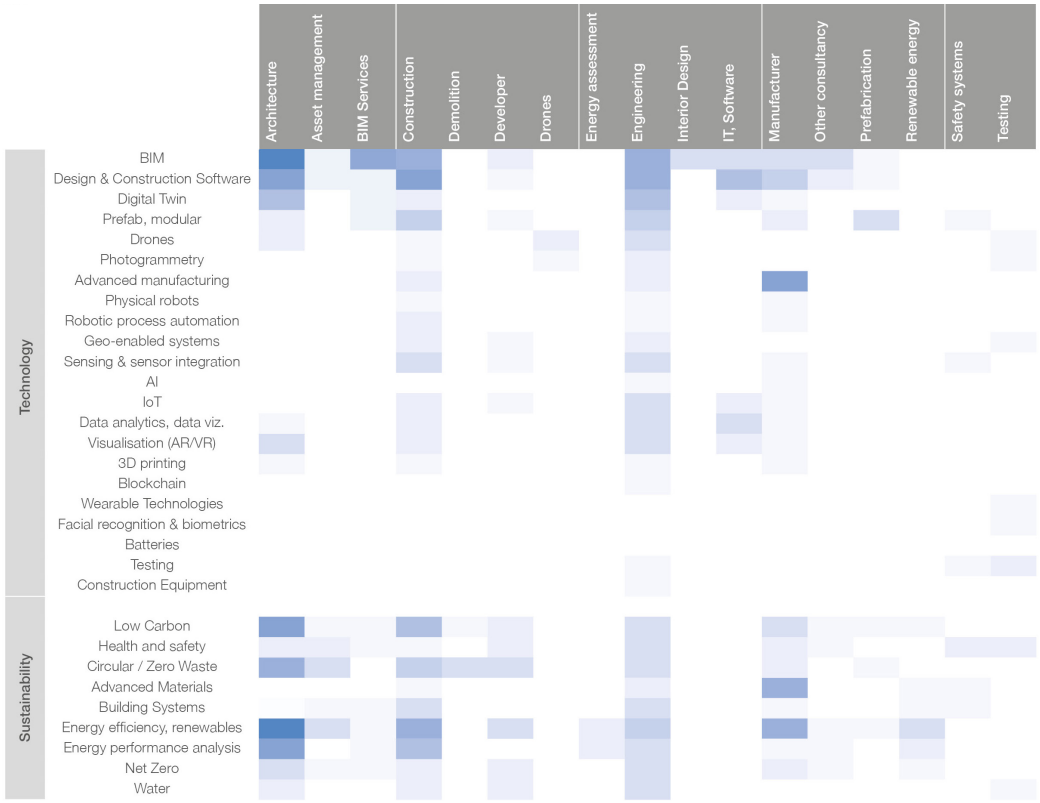


Table 7: Technology and sustainability heat map

4.1.5 Enabling Sectors and Bridging Innovations

The region is strong in a number of high-value sectors that offer opportunities for collaboration, some of which have been identified for their strong potential for growth, others for the potential to influence the construction supply chain (both upstream and downstream). These include digital technologies, non-construction engineering and manufacturing (e.g. steelmaking, mechanical components, etc), off highway automotive, renewable energy, and mining and quarrying. The construction industry can leverage regional capabilities in engineering, marine and sub-sea technologies, which have been at the heart of its transition to become a global hub for energy and environmental technologies and a leading focus for growth in the renewables sector, with the capabilities to make a significant contribution to the global challenge of decarbonisation.

Twenty nine companies were identified that may be in “bridge” industries that could serve a modernised and expanded construction industry in the future.

> I think innovations in other sectors have potential to influence the adoption of new products in the built environment in the region.
>
> Peter Barker, Ryder Architecture

4.1.5.1 Digital Technologies

In 2022 there were 2,515 enterprises in the **digital tech sector**[65] across North East England, providing jobs to 27,000 people. These businesses are involved in digital media, gaming, immersive tech, cyber security, artificial intelligence, and developing solutions for specific industries such as finance, healthcare and education. The region has recently been selected to host the national **Digital Launchpad**[66] – one of eight regional innovation clusters across the UK that are being backed by a share of a £75 million investment.

> In digital we are competing quite well now. Some great companies are springing out. In the city centre, Newcastle is starting to get that vibrancy that you see in Manchester and Leeds. There is a bit of momentum centred around the tech and life sciences sectors. That is helping with retention of graduates and spin off companies. There are a lot of start-ups. There is a support network and funding, which has helped. The councils and organisations like Dynamo and Sunderland Software City have done really well in terms of pushing that agenda. Construction needs that kind of spotlight.
>
> Alistair McLeod, Gray Fox Consulting

> There are some innovative modular house builders in the region which is down to the North East's strengths in manufacturing.
>
> Mike Pitts, UKRI

4.1.5.2 Non-Construction Engineering and Manufacturing

The region has a long history in engineering and manufacturing and there are several companies that do not primarily cater to the local construction sector, but whose products, technologies, and approaches either feed into the supply chain indirectly (such as steelmakers, manufacturers of valves, filters, heat exchangers, etc), or could serve a modern, industrialised construction industry in the future (electro-mechanical systems, batteries, etc). A subset of the manufacturing sector is dedicated to the development of new materials such as graphene and aerogels, that have applications in insulation, renewable energy, etc.

4.1.5.3 Off-highway Automotive

The **automotive sector in North East England** has a turnover of £11 billion per annum. The region produces 30% of all UK passenger vehicles, which includes 20% of all battery electric vehicles across Europe and 350,000 engines per year[67]. With the push for electric and autonomous vehicles, this sector is poised to **attract significant investment**[68]. Of relevance to the construction sector, the region is home to three of the UK's top five off-highway manufacturers – **Komatsu**[69], **Hitachi**[70] and **Caterpillar**[71] – which produce 10% of all UK non-highway vehicles.

There are also several engineering firms that work on military vehicles and equipment. It offers the potential for significant support to a modernising construction sector not only in the form of "connected", efficient equipment but also access to a globally competitive supply chain. There are also 21 local R&D centres and a strong business support network led by the **North East Automotive Alliance**[72] .

> We have some companies with very niche specialisms around AI in defence in the region. I would guess that no one is using AI for construction.
>
> Jenny Hartley, Invest Newcastle

> There is more foreign direct investment into the North East than any other region in the UK outside of London, including wind, batteries, renewable energies etc.
>
> Chris Chennell, Hydrock

4.1.5.4 Off-shore Renewable Energy

There has been significant investment in offshore renewable energy (and renewable energy in general) in the region resulting in a burgeoning cluster of companies that have developed specialised construction skills for extreme environments (ranging from specialised paints and coatings to robotics). Tees Valley is the location **a national Net Zero Launchpad**[73] with the initial focus of offshore wind, hydrogen production, distribution and usage, and carbon capture, usage and storage within the net zero theme.

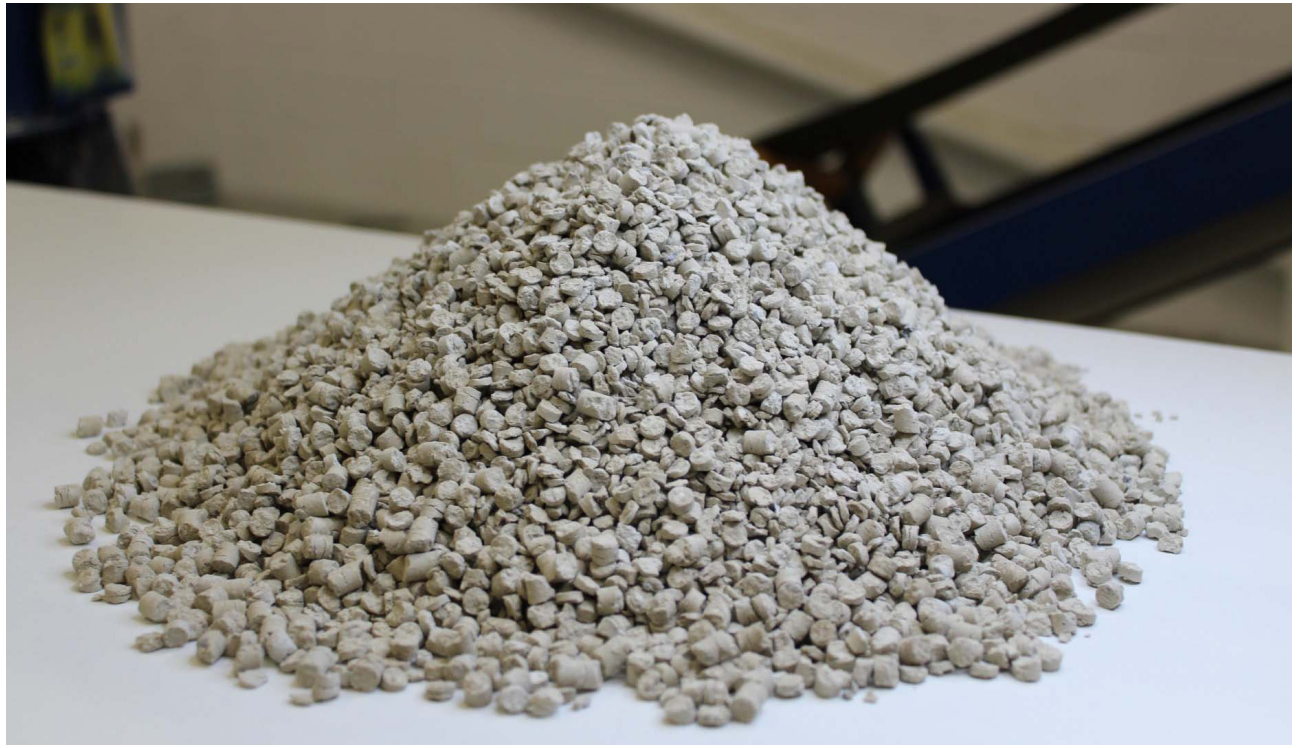
The national **Offshore Renewable Energy Centre**[74] (ORE Catapult), the UK's leading technology innovation and research centre for offshore renewable energy, is based in Blyth. The local offshore sector also has sophisticated prefabrication capabilities that initially serviced oil and gas rigs that could be oriented towards mainstem construction.

4.1.5.5 Mining and Quarrying

North East England's mining and industrial heritage has shaped the region's identity and has a potentially important role to play in the future of construction. **The British Geological Survey**[75] identifies numerous local sand, gravel, roadstone, crushed rock and aggregates businesses (both onshore and marine extraction). There are also quarries producing clay for brickmaking, sandstone and limestone and fluorspar.

These companies can support the shift to low carbon materials and the circular economy. For example, the **Aycliffe East Quarry**[76] receives construction and demolition waste and produces recycled aggregates. Geological, materials science and geotechnical expertise from the mining and quarrying sectors is increasingly being sought in construction.

> Recently, we've started working with stone quarries helping them develop innovative applications for their products. One of our team in the North East is involved with a quarry company that is looking at using stone for structural applications.
>
> Engineer, Newcastle



> Recently we used ground reinforcing polymers to prevent a sports complex from sinking into a mine below. It was designed in the North East and saved a lot of grouting and a lot of money.
>
> Tomás Neeson, Cundall

4.2 Stimulus

88 stimulus organisations, groups and major activities were identified as playing a role in advancing construction innovation in the region (Figure 18). Of these, 59 have a physical location in North East England.

Many associations and professional institutes are national, but either have a local volunteer group or a dedicated regional page on their website. Several organisations are involved in more than one activity. For example, 11 dedicated research centres were identified, but a further eight organisations also conduct research as part of multiple stimulus activities.

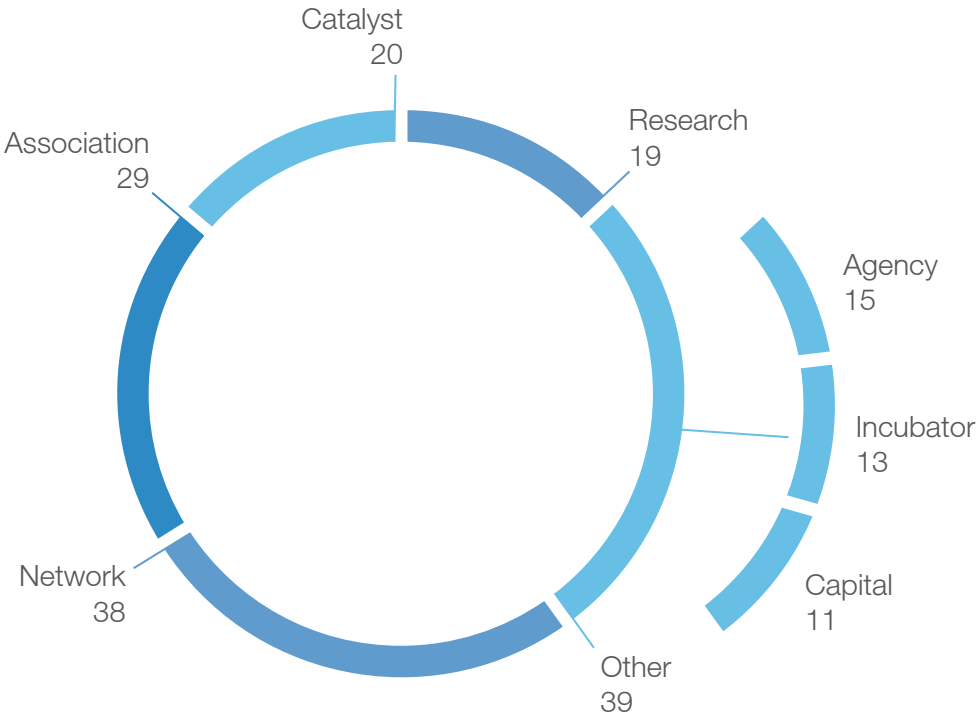


Figure 18: Number and distribution of stimulus activities and initiatives (organisations may be active in more than one)

Although several incubators and catalysts are technology agnostic and support any early development or high-growth ventures, Table 8 (next page) summarises the stimulus support for construction innovation in terms of applicable technology and sustainability areas, where these are noted.

The two organisations that are dedicated to construction innovation are **OneVoice**[77] an initiative of Constructing Excellence North East, and the **International Centre for Connected Construction** (IC3)[78], which is run out of Northumbria University.

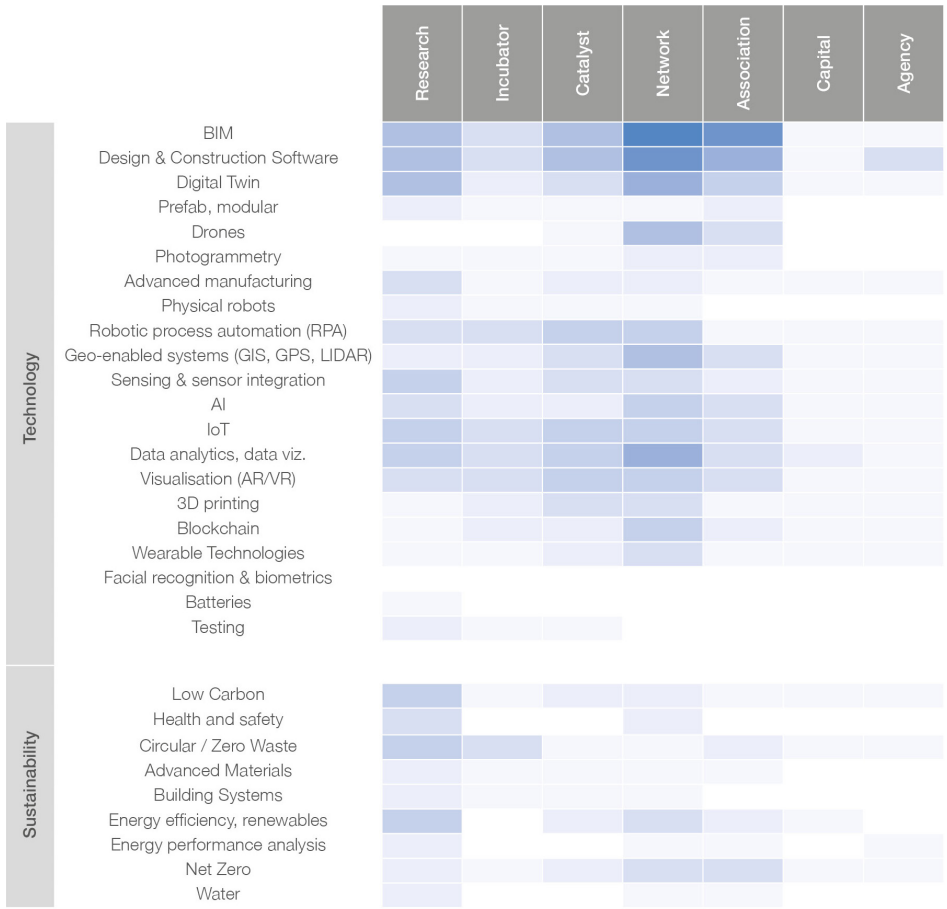


Table 8: Heat map illustrating the technology and sustainability focus of stimulus organisations.

4.2.1 Networks and Forums

26% of the stimulus organisations are networks which foster a high degree of connectivity and collaboration. Most of these networks are not primarily dedicated to construction innovation, which leads to confusion and hinders any networks from building critical mass. For example, many are professional associations whose primary mandate is to represent members' professional interests and do not have a physical presence in the region. The key local networks dedicated to advancing construction innovation largely focus on digital technologies (Table 9).

Network Organisation	Mandate / Focus
BIMStore (a business that administers an online BIM community)	BIM
Constructing Excellence in the North East / One Voice	Innovation – People, Net Zero, Digital
IC3: The International Centre for Connected Construction	Innovation – digital and MMC
NIMA (formerly the UK BIM Alliance)	BIM
Women in BIM	BIM

Table 9: Network organisations primarily focussed on advancing construction innovation (see Appendix A3. Stimulus Organisations for weblinks).

> Compared to construction, the pharmaceutical industry has a very clear innovation pipeline. There's a well-defined process. You have access to large corporations that have substantial innovation team who know how to take things forward. They know the exact uplift that the proposed innovation will bring and can very quickly tell you what the business model is.
>
> Sam Cryer, Thermulon

> I would like to see more openness and collaboration in the industry, sharing knowledge and ideas. A willingness within industry to take on and explore innovation and innovative possibilities.
>
> Thora Arnardottir, Hub for Biotechnology in the Built Environment

> As a construction innovation start-up, it doesn't make as much sense to be in London from a financial perspective. Rents are higher, there's less space.
>
> Andrew Brennan, ViewPoint

Overall, there is a profusion of networks, associations and catalysts all vying to foster innovation. However, while so many could cause confusion and dilute audiences (so none are able to scale), there are none specifically dedicated to supporting start-ups, such as angel investor forums, or pitch sessions to large established businesses. In fact, there is a lack of willingness and openness among construction businesses to helping technology developers through sharing data, etc. for fear of exposing competitive advantages.

The region's leaders have, however, proven effective at proactively establishing forums and taskforces for discussion about topical issues. For example, **Developing Consensus**[79] is a group of business leaders from across the real estate development and construction sectors that is currently developing a plan for how the construction industry's interests will be served under the new **North East Combined Authority**[80].

For industry practitioners, most networking opportunities are either "talking shops" or profession-specific events hosted by institutions. There appears to be insufficient platforms for meaningful exchange of information on key innovation topics.

Those that exist tend to be discipline-specific, and not bringing the different voices of the industry together effectively. Many have some but not all of the information sought by users, which may dilute the value and diminish users' motivations to access the information.

Constructing Excellence[81] used to run an exhibition for innovation so ideas could be picked up and introduced as part of their annual conference. There are several incubators, catalysts and networks that provide opportunities for pitch sessions where start-ups can engage with industry and funders, but none are construction specific.

Further, there is no centralised, innovation management platform or online community for the construction industry which collects information on local innovation success stories, curates best practice lessons from elsewhere, serves as a data repository and coordinates innovation-related events.

Apart from the **North East and Yorkshire Net Zero Hub**[82] and Net Zero North East[83] (which are primarily government focussed), there were no industry networks dedicated to sustainability. The **UK Green Building Council**[84] does not have a regional presence and there is no local Passive House group.

> We could do with an industry body for architectural, engineering and construction sector that looks at information and data in the same way that RIBA looks at design.
>
> George Mokhtar, Turner & Townsend

4.2.2 Research and Centres of Excellence

North East England is home to highly rated research universities. **Durham University**[85], **Newcastle University**[86], **Northumbria University**[87] and **Teesside University**[88] all undertake research in the area of architecture, urban design, construction, engineering and a wide range of topics relevant to the built environment.

In addition to the 19 laboratories, research groups and Centres of Excellence operated by stimulus organisations there are also 10 companies and three education providers with laboratory and testing facilities. **The Centre for Process innovation (CPI)**[89] is a hybrid – part government funded, part company. Most relevant to construction is in their formulation capability, such as the use of two materials to make a product such as a composite or whatever it may be. Also related is their electronics specialism, with regards to photovoltaics and other technologies.

You want to go to the shining examples from around the world and develop case studies about what they did and how it worked, to debunk all the common misconceptions (like you can't get insurance for a wood frame building) – there are so many questions that are probably completely and utterly false but are easy enough to assume that they're correct.

John Seager, Broad Oak Asset Management

I would like to see more openness and collaboration in the industry, sharing knowledge and ideas. A willingness within industry to take on and explore innovation and innovative possibilities.

Thora Arnardottir, Hub for Biotechnology in the Built Environment

There's a lot of testing of newer technologies on actual physical properties here. I'm not aware of anywhere else in England where they're going to that level of detail.

Graham Kelly, BIM Academy

The National Innovation Centre for Ageing (NICA) is doing some interesting research on how we can retrofit to enable people to stay in their houses for longer, and how we can design properties to adapt as people age.

John Haynes, Equans

Lots of good people are trying to do good things, however it is fragmented. There is no leadership to bring together the (support) organisation to make them more effective. As an industry we need to raise awareness of what's available in regard to innovation.

Graham Kelly, BIM Academy

We should encourage the building and testing of innovation here in the region as an example for the rest of the world. Ideally, we should become a centre of innovation for global construction – to become the world standard in BIM.

Charlie Hoult, Opencast

The Centre for Process Innovation (CPI) is really good – especially for early-stage ventures to get projects done and effectively free of charge to the company. CPI works all over the country, but they are based in the North East. They work with massive companies and early age start-ups.

Advanced materials developer, Sunderland

We need to raise awareness and encourage collaboration between organisations. It is important to not only bring different sectors of the industry – the consultants, general contractors, designers, products and innovators etc – together, but we've also got to include the legal side, the insurers and the certification bodies because, if we don't all come together, we're never going to get there.

Catriona Lingwood, Constructing Excellence North East

You've got to develop a decent database of companies who are interested in learning, in listening and exchanging ideas. Most of the bodies have got their standard database of people who have paid a subscription, but they haven't refined it to find out who is interested in what.

Tom Harrison, IC3

We see much more of the innovation happening on some of our other projects around the world and other parts of the country. For example, we see the use of timber in buildings much more widely in other parts of the UK and certainly on the continent. When we talk to universities about that, the only reason is because they can't get insurance on timber buildings. Some of that can hold people back.

Tomás Neeson, Cundall

A key area where innovation is needed is in retrofit. How do we deal with the investment required, and the level of intervention and the disruption that is required. The construction industry is having to think of innovative ways of delivering that sort of retrofit. It needs to be on a very tight programme or else you're going to have residents and businesses uprooted for months at a time.

Michelle Percy, Newcastle City Council - NCLeus project

As a construction innovation start-up, it doesn't make as much sense to be in London from a finance perspective. Rents are higher, there's less space. But most of the investment firms are in London, Cambridge, Oxford. Being in that triangle for easy in-person meetings makes a big difference. You can get a lot of traction with investors in the early stages if they can come to your space and see what you're doing.

Sam Cryer, Thermulon

The North East is definitely innovative, but are we getting these innovations to market quick enough? Probably not.

John Seager, Broadoak Asset Management

We find that a lot of the focus now is on Smart Cities, and we work a lot with companies working across a wide range of technologies. To bring the sector together we create forums so that the different subsectors can come together. This allows companies that are classed as Tier 2 in the supply chain to have access to some of the larger projects.

Jayne Pickersgill, DBT

You need to find a way to financially incentivise people to stay in the North East – to build their businesses and not leave the region. That is a local government issue, but you need to create investment funds so that these firms can make a profit.

Steven Charlton, i/o atelier

There have been some successful partnerships between industry and academia, but projects tend to develop through personal relationships rather than an organised platform for ideas exchange.

However, access to funding for this type of research project can be over complicated.

> We've had some very successful knowledge transfer partnerships with universities in the region, where there's a very industry focused person within the university, who can work with a business to fund research to solve a specific problem or exploit an opportunity.
>
> There needs to be more clarity and simplicity, for companies with an innovative idea to nurture that idea, in partnership with academia. I think a lot of research opportunities are stifled by unnecessary complexity, and a lot of research in the universities is still very theoretical.
>
> Peter Barker, Ryder Architecture

Further, the **International Centre for Connected Construction** (IC3)[90] was specifically established as a research catalyst to convene engagement between industry and academia around construction technology and MMC, though it is under resourced.

Although the region is home to the Hub for **Biotechnology in the Built Environment**[91], the adoption of biobased materials (notably timber) into local projects is slow. This is unfortunate because Arup estimates that a shift from current supply chains and methods to regionally grown and processed biobased construction could **generate up to £1.9 billion**[92], with the gross value added to the economy having the potential to reach £14.8 billion. Even a partial shift would have a profound economic impact on the region.

The **Materials Processing Institute**[93], which primarily serves the mining and metallurgy sectors, may offer a novel line of research support as the construction industry increasingly focusses on the environmental impacts of materials, and circularity. MPI's research, development and innovation is focussed on developments in advanced materials, achieving industrial decarbonisation through a low carbon and hydrogen future, deploying new digital technologies, and reducing waste through a circular economy.

Northumbria University's Construction, Technology, Process and Management Research Group[94] engages internationally leading academics and researchers to examine contemporary and emerging industry challenges. Emphasis is placed on delivering conjoined evidence-based solutions – from theoretical concepts and methodologies, through to the delivery of innovative approaches to improve sector performance. Their core expertise covers four interdisciplinary research themes: Construction, Technology, Process and Management. These interrelated themes directly align to industry challenges at micro, meso and macro levels – ranging from small scale solutions and regional challenges, through to global strategic issues affecting sector performance.

> What we're trying to find out is who's got challenges in their business? Are there some solutions out there that we can connect more people to? Does a university have a good idea for innovation for research, but they want some practical input?
>
> Tom Harrison, IC3

> If you look at the headline numbers in terms of R&D expenditure in the region, the North East region accounts for 1.6% of total private R&D spending within the UK, but, with 4% of the population. So, we're definitely underweight in terms of business R&D spending in the region. Some of that is a function of where head offices are and how investments are counted.
>
> Mark Stamper, North of Tyne Combined Authority

4.2.3 Incubators and Catalysts

The region is well served by catalyst organisations and programmes and has centralised support for key high-growth sectors into strategic innovation centres, such as the Newcastle Helix. However, construction has yet to be directly included in this effort. Several have a national reach (such as the **Centre for Process Innovation**[95] and the **ORE Catapult**[96]) and can offer valuable incubation services and business growth support for construction innovations.

Incubators and Catalysts (See Appendix A3. Stimulus Organisations for weblinks)

- Centre for Process innovation (CPI)
- Digital Catapult - North East Tees Valley region
- Durham City Incubator
- Durham University Venture Lab
- Dynamo North East
- Ignite North East
- Innovation Super Network
- Invest Newcastle
- National Innovation Centre for Data (NICD)
- Newcastle Gateshead Initiative
- Newcastle Helix
- North East Business and Innovation Centre
- ORE Catapult
- RTC North
- Sunderland Software City

There are several incubator spaces and technology parks that provide flexible office space for start-ups, such as **NetPark**[97] in Durham and **Innovation Central**[98] in Darlington. However, there are no dedicated "sandpits" for large-scale product development and early stage manufacturing outside of research labs. While several incubators also run programmes that offer change management support for companies as they transform, again, they are not tuned to the project driven culture of the construction industry.

It is important to note that rents for space that is suitable for start-ups are **cheaper**[98] in North East England than most other places and there is more space available.

4.2.4 Funding Capital and Investment

There are 11 organisations in the region that can provide access to funding programmes, capital and investment. Government plays a very important role in providing funding for a range of business growth, but these funds ebb and flow. The region has been successful in raising external funds for other sectors (e.g. the **Newcastle Helix**[100]) and attract major R&D centres to the region (such as the **Faraday Institute for Battery Power**[101] and the **ORE Catapult**[102]).

There have been some notable construction technology-related mergers and acquisitions. In 2020, the NBS **joined the Byggfakta Group**[103], a leading Scandinavia-based data and software provider to the global construction industry. Then, in 2021, Specified By (a Newcastle-based building products information platform) was **acquired by Causeway Technologies** – a construction tech company based in Gloucestershire – which then opened an office in Middlesborough, bringing 100 new jobs[104].

Things may be changing with the devolution deal. The **North of Tyne Combined Authority**[105] runs a number of investment programmes aimed at regional development.

Close to £20 million has been invested to support technology development (improvement of wireless and fibre connectivity. There is also a **£10 million programme**[106] to support the growth of the tech businesses themselves. The Authority is involved with housing and infrastructure work as well: for example, through the **brownfield housing fund**[107] where they remediate development land.

There are also numerous programmes running at any time that fund companies to collaborate and scale up. Of relevance to construction, Innovate **UK's Made Smarter**[108] programme provides grants to SMEs in the tech sector and advanced manufacturing sector to work together to improve advanced manufacturing and **Bridge AI**[109] is looking at where artificial intelligence could be applied in sectors that are not making strong use of it yet. Yet, construction does not appear on the Innovate UK's **KTN opportunities page**[110], even though it lists several sources of funding that would be applicable (circular materials, longevity of concrete structures, etc).

Some organisations provide small amounts of seed capital and / or other services such as access to lab space and business coaching (such as Ignite, NETPark, Proto). Most are not direct sources of funds but instead help companies access funding from others. Other than the big banks, **Northstar Ventures**[111] is the only local early-stage investor with industry knowledge. **FW Capital**[112] provides flexible financing and property development loans to support growth and expansion and also manages the **North East Commercial Property Investment Fund**[113] which provides loans of up to £7 million for speculative developments for new or refurbished commercial projects.

All that said, there has historically been a lack of funding both in terms of government financial support to bring innovations in to the marketplace and to encourage the upskilling of skilled labour. There is also a lack of confidence among industry leaders that these types of funding for supporting long term, sustained growth on timelines are appropriate to construction. Venture investment appears to be biased towards London and Manchester.

> There's lots of activity that we fund that is sector agnostic to some extent, such as around digital adoption support. There's absolutely no reason why a construction company couldn't engage with those programmes. We've all sorts of innovation grants, programmes that provide capital and revenue grants to support innovation projects. Again, there's no reason why construction companies wouldn't be eligible for that. However, there is nothing deliberately badged as a construction innovation programme.
>
> Mark Stamper, North of Tyne Combined Authority

Construction timelines and returns are different from other sectors and projects can take many years. The fact that the **Centre for Digital Built Britain**[114] was only provided a five-year operating mandate illustrates the disconnect between government schedules and industry realities – it can take much longer than five years to take a project from start to finish.

Leaving the EU has meant that the funding landscape has changed. The **European Regional Development Fund** (ERDF)[115] business and innovation support programmes, which have been important for several North East technology start-ups (such as **Thermulon**[116]), have all but finished. Implementation of the new **UK Shared Prosperity Fund**[117] (UKSPF) is intended to be managed through local governments, but the details are still being worked out.

> In terms of an investment approach, we want the asks and aspirations of the development community in front of the politicians and the public sector as they develop their strategy. In that regard, the engagement so far with the business community in the development of that emerging strategy is welcomed. Developing Consensus will continue to work collaboratively to ensure that the members' key issues are front and centre to effect real change through the Devolution deal for the wider benefit of all in the North East and wider region.
>
> Sandra Manson, Developing Consensus

4.2.5 Commercialisation Pathways

There are support systems in place across the region for the development and commercialisation of technologies. For example, **Sunderland Software City**[117] runs innovation challenges that connects large companies with smaller ones to collaborate on innovative solutions. There may be a lack of awareness of these initiatives and there also be a lack of fit with how construction innovation works because industry leaders generally feel that that there are challenges in bringing new ideas to market quickly.

Overall, there is lack of sufficient capital, government funding that works for the construction sector – what funding exists is tailored to industries and technologies that deliver faster ROI. It is very difficult to secure funding for projects that are incorporating innovative products and processes because project procurement and financing is based on very traditional methods. Generally, there is a lack of funding both in terms of government financial support to bring innovations in to the marketplace and to encourage the upskilling of skilled labour. There is also a lack of timely scale-up, commercialisation support.

> The challenge is that the North East does not necessarily have its fingertips on the scale of investment that some of the other regions do – particularly around infrastructure.
>
> George Mokhtar, Turner & Townsend

> I don't think we have access to the scale of investment that enables some of the innovation that we are driving to realise at a scale that gets a return.
>
> George Mokhtar, Turner & Townsend

> Generally, most of the funding has gone to London and the major centres.
>
> Mark Seberry, Hydrock

> "There are constraints with regulations that are holding back the industry from being innovative and limiting the use of innovative products.
>
> Thora Arnardottir, Hub for Biotechnology in the Built Environment

> The construction industry seems to take longer to adopt new innovations and that it's difficult for start-ups to break into the space. Maybe because there isn't much of a willingness to change and adapt. Some of these start-ups are trying to work with big companies but they are not being well utilised or adequately resourced. We have found that start-ups getting involved in the construction sector will likely go down a more difficult path than most other sectors.
>
> Marek Tokarski, Durham University

> The value of change is not clear – it needs to be monetised. There is a l ack of advice being given on the advantages of solutions, there needs to be greater effort educating/consulting with non-technical leadership and project decision makers.
>
> Chris Chennell, Hydrock

When the government BIM mandate came out, the North East really picked up on that and was brilliant. We're really good at getting ahead of the curve, then local universities got into it, BIM Academy was formed and there were spin out companies like XBIM, that really accelerated technology development. I have a feeling that we've just stagnated a bit in last 10 years.

Alistair McLeod, OneVoice

We share knowledge between local authorities which allows us to share experience and lessons learned, creating a network within our specific organisations. We work with universities on innovations such as waste wood for gasification process (green hydrogen) to fuel our energy centres. We recently applied for bio energy grants for with carbon storage from government.

Mohsen Kohannejad, South Tyneside Council

There is a lack of consistency in market demand for MMC and modularisation. Starting and stopping production based upon short-term market demand is not efficient.

Mark Seberry, Hydrock

I think that some of the procurement routes and the frameworks in the North East don't particularly help. The words are there – you must innovate, you must do all these things – but the incentives are not. It is all driven to the lowest price.

Tomás Neeson, Cundall

In the North East, project decision-making has always been driven by cost. So historically, we have always had to have the most cost-effective solution. Whereas for some of our national projects in other areas, budget hasn't always been the primary constraint.

Ed Besford, Bowmer + Kirkland

Legislation holds the industry back - it is not keeping up with the latest in technology or performance.

Rob Charlton, Space Group

If construction is anything like mining or waste management, the issues are really around compliance and enforcement – there are so many regulatory gaps and at the same time onerous compliance requirements that don't make sense.

Engineer, Newcastle

In the North East of England, the profit levels are not huge, because the values aren't that great. Developments are marginal unless they're led on a commercial basis. So, if you are contemplating an emerging technology, you find that the cost goes up whether or not it's really more expensive – just because of the uncertainty.

John Seager, Broadoak Asset Management

4.2.6 Innovation Incentives

The construction industry is risk averse, and innovation "safety nets" need to be established to manage the risks associated with attempting something new in a construction project. These can take the form of government backed guarantees, insurance policies, etc. Introducing new technological advances to the mainstream is often prevented by the current supply chain. Areas for future opportunities could lie within aiming to break down those barriers – possibly through funding to foot the bill whilst these technologies are inefficient during their inception – the recuperation of initial start-up costs for construction projects can take longer than for other schemes.

It is also important to establish clear costs and benefits of innovation because there are risks and costs of doing nothing. The risks that projects and buildings are likely to face in the future will be different. Many innovations aim to mitigate the risks associated with rapid decarbonisation (e.g. energy cost, failures of inefficient equipment and building envelope). To forgo these investments will expose buildings to the physical risks of inadequate resilience, and the market risk of early obsolesce. There is a lack of adequate life-cycle based risk evaluation frameworks that could create a better market environment for investments in innovation.

> The energy efficiency provisions in the building regulations mean that the construction industry is being made to improve in terms of insulation properties, but that's out of necessity. It is not driving innovation.
>
> John Seager, Broadoak Asset Management

> I think there's always tension between delivering innovation and meeting the immediate priorities of employers. We constantly strive to keep our curriculum up to date and relevant, but the drive for innovation and change must come from industry, based on real demand for new knowledge and skills.
>
> Steve Logan, Gateshead College

4.2.7 Governments and agencies

Governments have important roles to play not just in setting policy and administering regulations (see Section 3.3 Emerging Policies and Regulations). Although this project did not include a detailed review of building regulations, policies and standards and the degree to which they support or hinder innovation, it was clear from interviews that there are many regulations that are inconsistent with encouraging the adoption of innovative products and practices.

Governments have tremendous purchasing power and can drive change in how construction projects are delivered. Nationally, there has been focussed investment on helping construction become more innovation friendly. It was made possible by the commitment from the UK government to change the way it procured buildings.

Recognising that about 30% of construction in the UK is for public buildings, the **Transforming Construction programme**[119] was set with £170 million up to help the sector modify the way it works nationally, and in particular:

- to focus on value rather than cost.
- do outcome driven procurement and take out steps that add cost without adding value, which implied taking a more process driven approach like manufacturing. Adopting a platform approach where you're building a set of components and standardising layouts so things like floor heights and door sizes are standardised.
- require net zero operations on new builds, while reducing embodied carbon, embedding renewable technologies on a building level.

This is intended to address the fact that many public-sector clients have mandates to use BIM and MMC which means that they need to invest in early-stage design, visualise the process and bring a collaborative method of delivery. However, the practical application of these policy goals varies widely. Construction companies need predictability, a value-based approach to decision-making and, most importantly, clear consistent language in procurement processes in order to have the confidence to invest in new technologies and processes. Forcing the lowest price in projects is a major barrier to innovation.

> There is a lack of incentives both in terms of government financial support and to encourage the upskilling of skilled labour, so as to be able to utilise innovation in the built environment.
>
> Phillip Hilton-West, Black & White Engineering

> Our curriculum planning process ensures all of our courses closely align to the needs of industry, and capital investment in new facilities like HISCA enables us to respond to the emerging and future needs such as those related to MMC.
>
> Iain Nixon, Education Partnership North East

4.3 Education and Training

The North East England construction workforce is expected to go down slightly from 95,750 in 2022 to 95,300 in 2023 as the recession takes effect. Looking ahead, with a relatively low level of output growth, the region's construction workforce in 2027 is estimated to be 94,800, so only a very minor change and essentially a static level of nearly 95,000 workers over the forecast. The **annual recruitment requirement** (ARR)[120] in North East England of 1.6% per year is slightly below the UK average of 1.7% and means an extra 7,900 workers will be needed from 2023 to 2027.Between 2023 and 2027, the region's **annual recruitment requirement will be 1,580**[121].

The lack of growth in the regional construction industry workforce in North East England follows the national trends. The UK construction sector as a whole has been facing significant concerns regarding the shortage of skilled labour in recent years. A major factor contributing to the lack of skilled workforce in the construction industry is insufficient relevant apprenticeships and training opportunities.

The number of apprenticeships for school leavers has been inadequate, leading to a shortage of skilled workers. Apprenticeship starts for all industries were affected by the pandemic. However, North East England fared worst of all regions with the **largest proportional fall in apprenticeship** starts between 2018/19 and 2019/20 (23% less starts)[122].

While job postings (Figure 19) and apprenticeship starts (Figure 20) within the construction domain remain stationary, the number of trained professionals, - spanning apprenticeships to university graduates - coming out of the region's universities and colleges has yet to return to pre-pandemic levels. Between 2022 and 2023, the Apprenticeship Statistics for England suggest that only 260 construction, planning and the built environment students and 660 Engineering and manufacturing technology students completed their apprenticeships.

> The education sector is not teaching up to date and current trends.
>
> Graham Kelly, BIM Academy

> The lack of a local market is a problem. You've developed all that talent, but it's constantly being exported.
>
> Technology developer, Newcastle

> BIM has become a kind of catalyst for the uptake of other innovations in construction. As soon as you can digitise information, you can start doing all sorts of other things with it.
>
> David Greenwood, Northumbria University

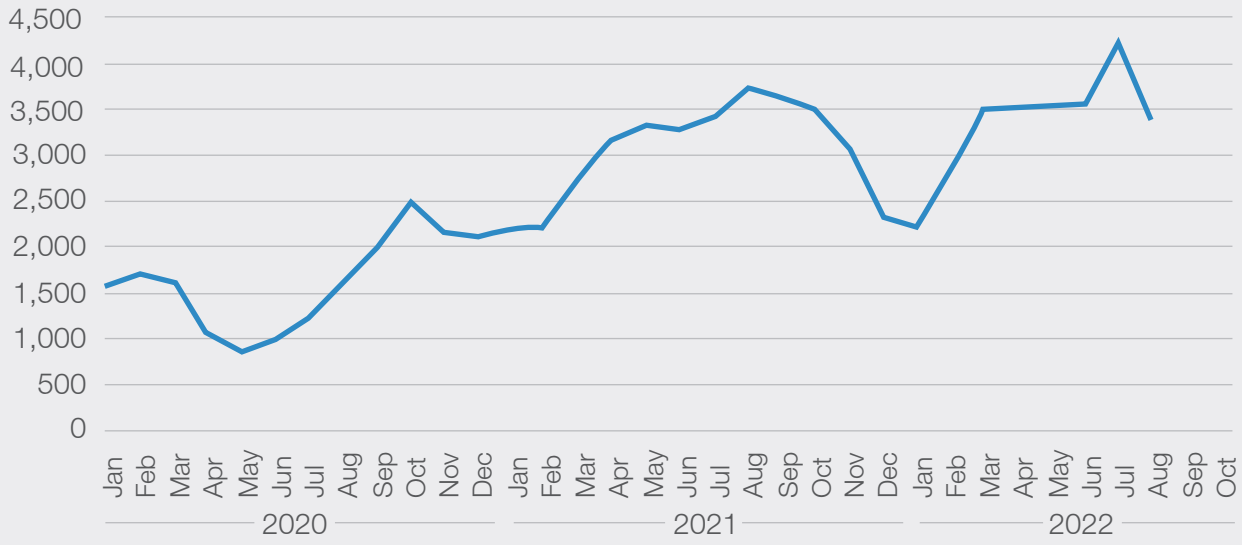


Figure 19: Monthly unique online job postings within the construction sector in the North East England region (**CITB**[123])

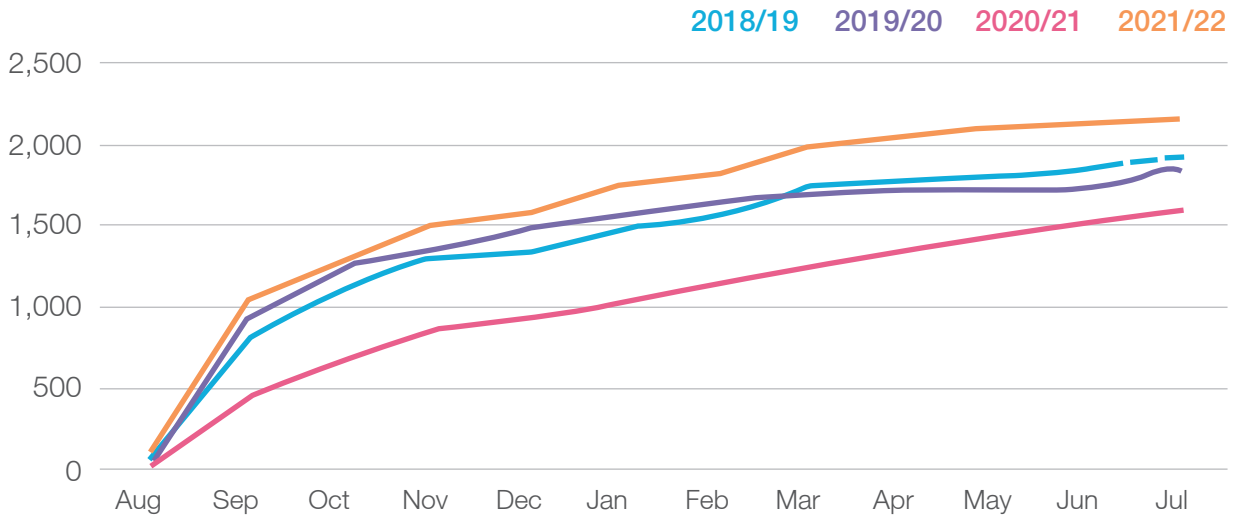


Figure 20: North East cumulative apprenticeship starts for the construction, planning and build environment sector: 2018 to 2022 (**CITB**[124])

The **UK Apprenticeship Statistics**[124] show that the industry still struggles with diversity in both Engineering and Manufacturing technologies and the Construction, Planning, and Built Environment sector (which include construction management and architecture degree apprenticeships). Women made up only 7% of the starts between 2022 and 2023 (Figure 21).

The lack of growth in the number of job opportunities in the local construction industry while having an increasing number of trained professionals, could be an indication that either the market is not ready to absorb the expanding pool of skilled professionals, or that the apprentices are not being equipped with skills that employers are looking for. Either way, the result is that a considerable proportion may be compelled to seek opportunities beyond the region's borders. On a positive note, the **North East Skills Advisory Panel**[126] notes that the qualifications levels of the regional workforce as a whole has been steadily improving.

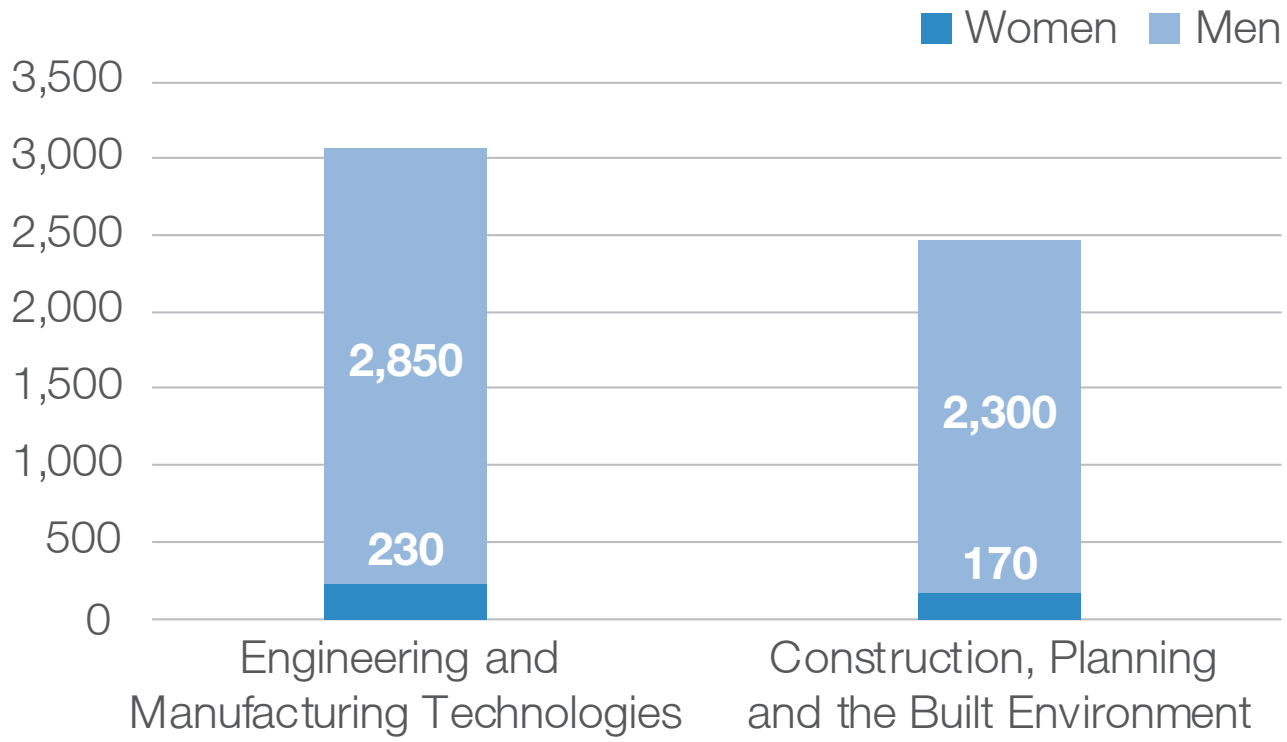


Figure 21: Apprenticeships starts (all levels) for North East England August 2022 to July 2023 (Source: House of Commons Library[126])

4.3.1 Apprenticeships

Figure 22 illustrates the technical fields in which the North East England construction sector is expected to face workforce shortages over the next 5 years. Most of the occupations can be understood as traditional fields within the construction sector. However, "Non-construction professional, technical, IT, and other office-based staff" is the largest occupation category and has the highest ARR, with 350 new positions needing to be filled every year. This category encapsulates all the workforce occupations related to innovation within the construction sector and includes all the workers required to support the industry's transition to Modern Methods of Construction (MMC).

> Northumbria and Teesside (universities) are looking at the competence-based aspects of the apprenticeship to make sure there's an integration between the actual degree and competence-based requirements. I think the fact that they're a year behind some of the other universities, they made sure that they are doing the programme right from the get-go, rather than rushing into it.
>
> Rosalind Thorpe, Chartered Institute of Building

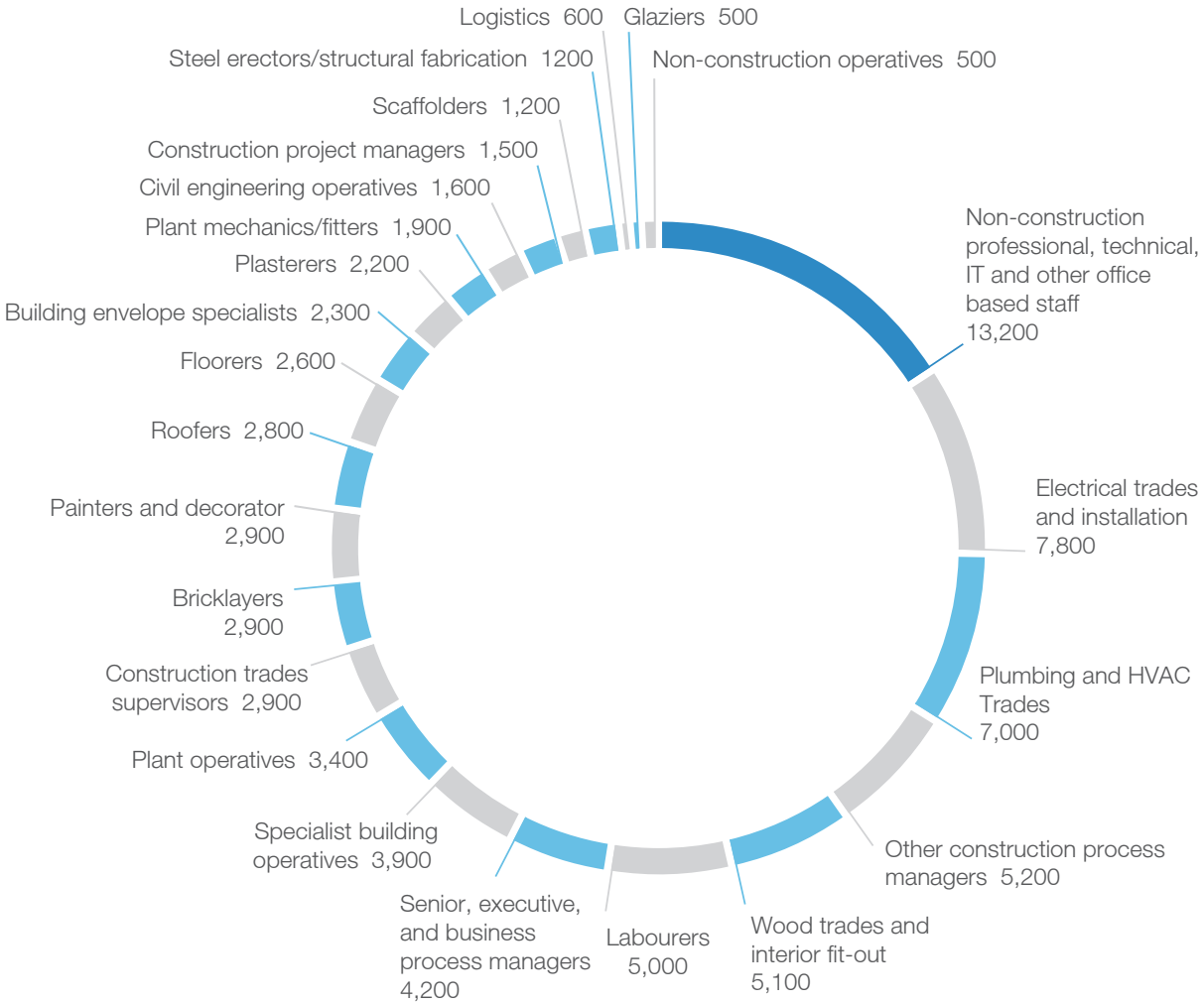


Figure 22: Forecasted required workforce in 2027 within the construction sector in North East England (based on CITB data)

Despite numerous comments from interviewees about the buoyancy of the local construction market, the data suggests that the outlook for job opportunities for the next five years within the "Non-construction professional, technical, IT, and other office-based staff" category mirrors the stagnation observed across other facets of the regional construction industry, and likely influenced by fears of an impending recession.

There are some changes ahead in the way apprenticeships will be administered and assessed. Starting 2027, all degree level apprenticeships will become integrated, which means that the universities will conduct their own competency assessments. There is concern among industry bodies that this could lead to a reduction in the quality of competence because completion rates are a government driven standard that universities may be required to meet.

Nevertheless, while there has been effort to grow the number of apprentices entering the construction industry (and industry generally), there has been consideration given (in some disciplines) to the quality and relevance of the education experience and outcomes. The objective is to ensure graduates are competent and "know what they are doing".

There are various funding programmes for apprenticeships (for both employers and students), though none are construction specific. However, large companies like Ryder Architecture and **Esh Construction have developed their own programmes**[128] that provide more routes into construction through apprenticeships, graduate placements, and work experience opportunities.

> In the North East they are attempting to do something that reflects the ethos of the apprenticeship standards. So, they're looking very much at the competence part as well as the learning part.
>
> Rosalind Thorpe, Chartered Institute of Building

> We try to play an active part in shaping the curriculum. We have done this at both university and college level. A lot of our projects have contractual social value commitments. From a bidding perspective, it is a legal requirement now to have a minimum level of social value as part of a scoring mechanism.
>
> John Haynes, Equans

> Technology is moving on so fast in construction that we're in a bit of a flux situation. We've got advancements in digital, and we've got advancements in ways that things are put together.
>
> Jill Nicholls, Institute for Apprenticeships and Technical Education

4.3.2 Educational Content and Competencies

Today, the industry as well as (especially smaller) educational institutions are often focused on addressing immediate industry needs when it comes to skills development. The vast majority of construction training programmes available in the region are focussed on traditional skills. However, by prioritising industry's short-term demands, the education system may be sidelining the proactive education of a workforce equipped to adopt the newest innovation and technology in the construction industry.

The government has set 2030 targets for new skilled workers in electric vehicles, wind energy, new modern methods of construction, and new methods of generating electricity or hydrogen for fuel. There has been significant investment in refreshing and expanding apprenticeship programmes. **Newcastle College Group**[129] has been successfully engaging with large employers, working on a range of "train the trainer" programmes and developing new curricula and competency frameworks (e.g., solar PV panels and batteries).

However, engaging with the construction sector has been challenging because most companies are pre-occupied with immediate needs as opposed to planning ahead. Such "short-termism" can make it difficult for curriculum developers to know what kind of skills companies may need in the future and if there is new equipment that people need to be trained on. At the same time, there have been frustrations among some businesses with how long it is taking to develop new curriculum and then see graduates enter the workforce with the new skills.

Nevertheless, the shift to add education programmes that include elements of construction innovation is underway. Nineteen education providers (HE/FE institutions, companies, industry associations and NGOs) offer programmes at different levels (Figure 23). Examples include Durham University's "computational thinking," Gateshead College's PlanBEE Higher Apprenticeship and BIM Bootcamps, Newcastle University's data-driven approach, and Northumbria University's "digital built environment" subjects that are integrated into their curricula. A complete list is provided in the Appendix.

> Eventually, I suspect there may be no more need for a roofer, a plasterer, or a bricklayer. Everybody will become installers. Some of those traditional occupations might end up being classed as crafts, where they'll be specialists working on heritage buildings.
>
> Industry education expert, Durham

> Construction companies aren't necessarily thinking about what skills they might need in 10 years, so that we can start planning for it now.
>
> Sara Walker, Newcastle University

> If we can blend the traditional components of academia such as architecture or interior design with programming and machine learning, that's what we need to be doing if we really want to thrive in the future.
>
> Steven Charlton, i/o atelier

> We've just started mapping where our programme curriculum, including architecture and civil engineering, is relevant to the sustainable development goals, and trying to consider ways in which the sustainable development goals could be more embedded across the programmes that we deliver.
>
> Sara Walker, Newcastle University

Networks, associations & professional Institutes that offer mid-career training, upskilling and professional development that is applicable to construction innovation.

Association of Project Managers - APM North East

Chartered Association of Building Engineers

Chartered Institute of Architectural Technologists - Northern Region

Chartered Institution of Civil Engineering Surveyors

Chartered Institution of Highways and Transport

CIOB Academy North England

Generation for Change

Institute of Water

Institution of Civil Engineers - North East

Landscape Institute

National Association of Women in Construction

North of England Institute of Mining and Mechanical Engineers

Royal Institute of British Architects - North East

Royal Institution of Chartered Surveyors

Royal Town Planning Institute - North East

The Institution of Structural Engineers

Women in BIM

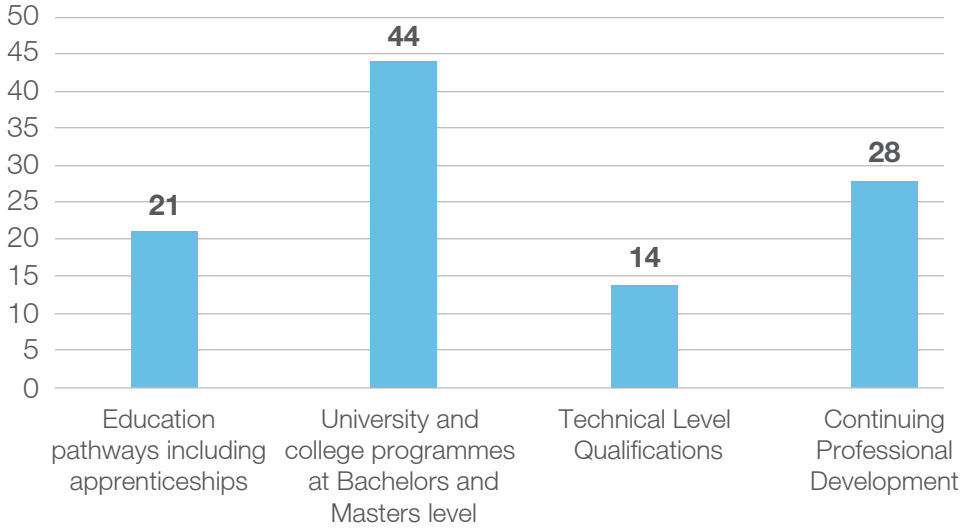


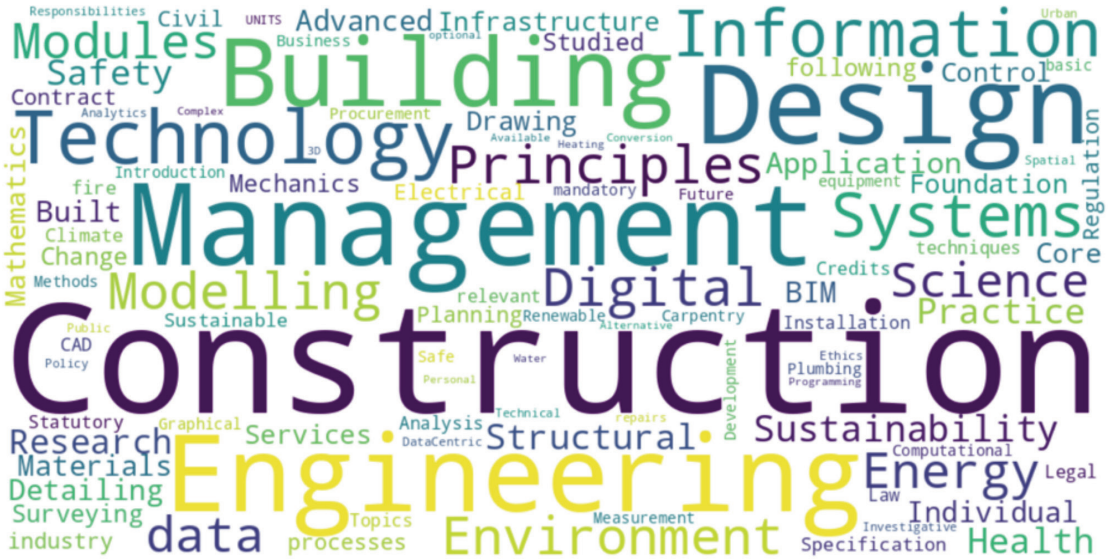
Figure 23: Number of educations programmes offered by organisations with physical presence in region that foster construction innovation

In the interim, the government is funding continuous professional development and upskilling. **Skills Bootcamps**[129] are short, focussed interventions (usually three to six months in duration) intended to top up operational skills and are mainly being used for new technology. The most popular boot camps are in building retrofits followed by heat pumps.

Figure 24 summarises the frequently mentioned keywords in the relevant training programmes offered in the region as an indication of where such programmes are mostly focused. Especially notable is the emphasis on management, information and data. That being said, words such as sustainability, renewable, and environment are less strongly pronounced.

> PlanBEE is a shining example of the innovative change needed to recruit the talent of the future and open opportunities for underrepresented groups. There is an emphasis on practical work-based learning, on collaboration and teamwork, and on understanding the bigger picture around economics, leadership, and technology.
>
> Peter Barker, Ryder Architecture

Figure 24: Frequently mentioned keywords in the regional training programmes



PlanBEE Apprentices, Bank House, Newcastle upon Tyne

There are also 17 professional networks, institutions and associations that have offered, in the past, professional development training and "up-skilling" education for mid-career professionals on innovation-related topics. The technical depth and frequency of these sessions varies significantly.

To better meet the needs of employers, the region has led the development of initiatives like **BuildNE**[131], **Education Partnership North East** (EPNE)[132], which provides support, training, education, and information to help unemployed and economically inactive individuals find work in the construction sector. Education Partnership North East (EPNE)[133] is a regional college group that has been involved with several programmes such as Skills Bootcamps and the Staff Development Forum[134], which is a not-for-profit charitable organisation, representing and working with staff and organisational developers in higher education to enhance the efficiency, effectiveness and organisational performance of the sector and its workforce. ·PlanBEE[135] is an industry driven, higher level multi-disciplinary apprenticeship programme delivered by Gateshead College. Started in 2016, it prepares students for a career in a broad range of technical and professional roles in architecture, building engineering, project management, cost consultancy and construction site management, and provides an alternative work-based route into these jobs rather than via university. Since its launch, PlanBEE has been supported by a consortium of more than 50 local and national businesses and is now branching out overseas.

Looking closer at the training framework for BIM – an area where the region has shown early leadership – learning opportunities are available in the form of boot camps, apprenticeships, university programmes and continuing professional development. The only area that is potentially lagging is in the introduction of BIM into traditional trades programmes. Nevertheless, this diversity of approach offers choice to both employers and students.

> Local innovation talent is being exported, either out of the region or out of the country.
>
> Rob Charlton, Space Group

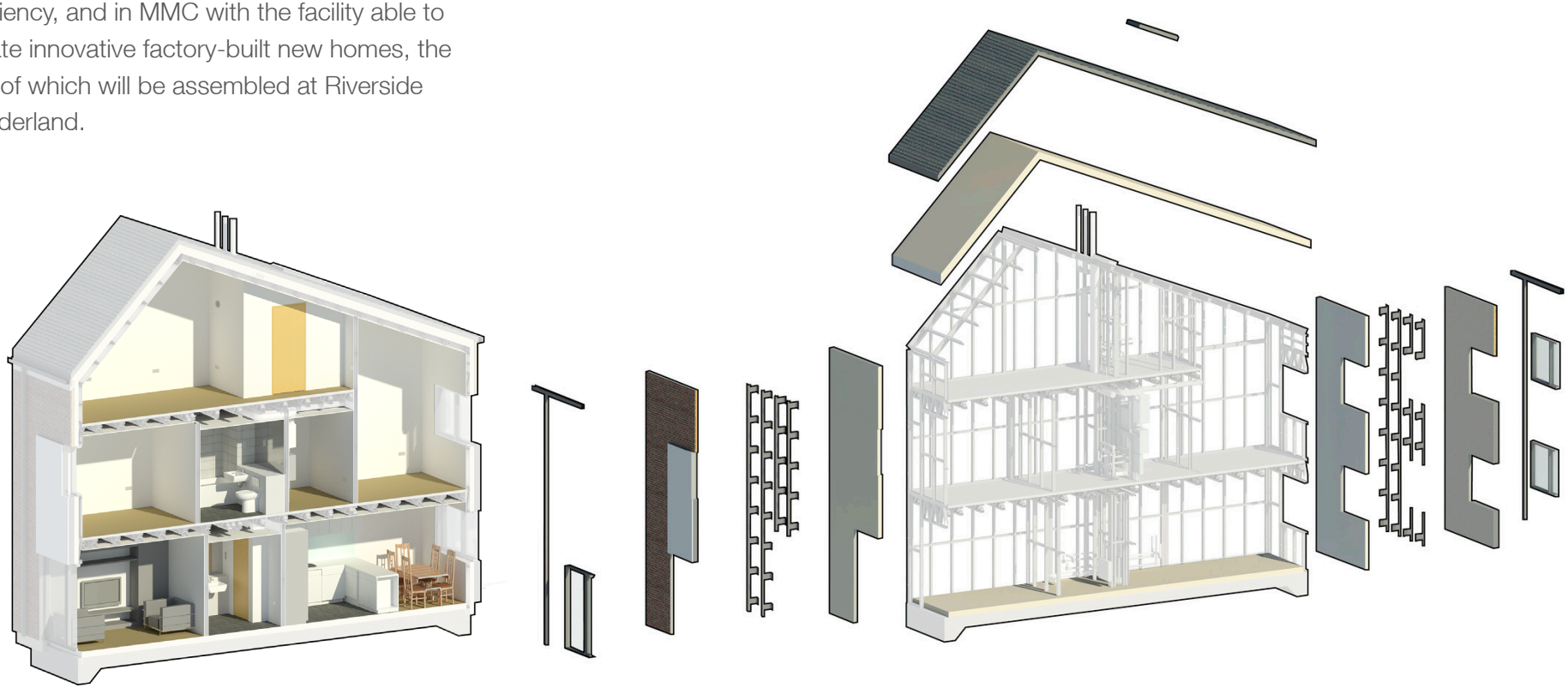
> It's a lovely place to live. Graduates from the universities want to stay, but there aren't the opportunities you might get elsewhere.
>
> Alistair McLeod, OneVoice

> If you look at the model of MIT and what's happened in Boston, the spinouts stay in the area. This is because the university is heavily invested in these companies financially.
>
> Steven Charlton, i/o atelier

> You can see that the local universities have a really good reputation for computer sciences, and Teeside University has got a really good reputation for games design. There's a lot of high tech here. At the same time, you can't overlook the fact that the quality of life here is a lot better.
>
> Richard Ramsden National Innovation Centre for Data (NICD)

The Housing Innovation and **Construction Skills Academy (HICSA)**[136] is in the build phase. It is a joint venture between Sunderland City Council and Sunderland College, part of Education Partnership North East, located in Sunderland that is expected to be complete in May 2025. The new facility will educate and train people in the region on the installation and maintenance of environmental technologies to improve energy efficiency, and in MMC with the facility able to create innovative factory-built new homes, the first of which will be assembled at Riverside Sunderland.

> Back in the 1980s, costs became high for training. But then things have just never really improved with a lot the smaller companies relying on the larger companies to do the training. So the larger companies tend to take them on, but a two or three person firm is always looking for the next job and doesn't have capacity to train somebody. Small companies don't pay the Apprenticeship Levy.
>
> Educator, Newcastle



4.3.3 Skills Retention

The rates of graduate attraction and retention in North East England are low compared to other regions (Figure 25). The majority of construction innovation-related programmes are offered by larger institutions in the region, whose students tend to be more diverse in terms of their geographical origins and, therefore, more likely to leave the region after graduation. There is concern that not enough is being done to encourage these highly skilled graduates to stay in the region.

> It's important to inform the construction industry on what's available regarding innovation including training and education on processes and practice.
>
> Graham Kelly, BIM Academy

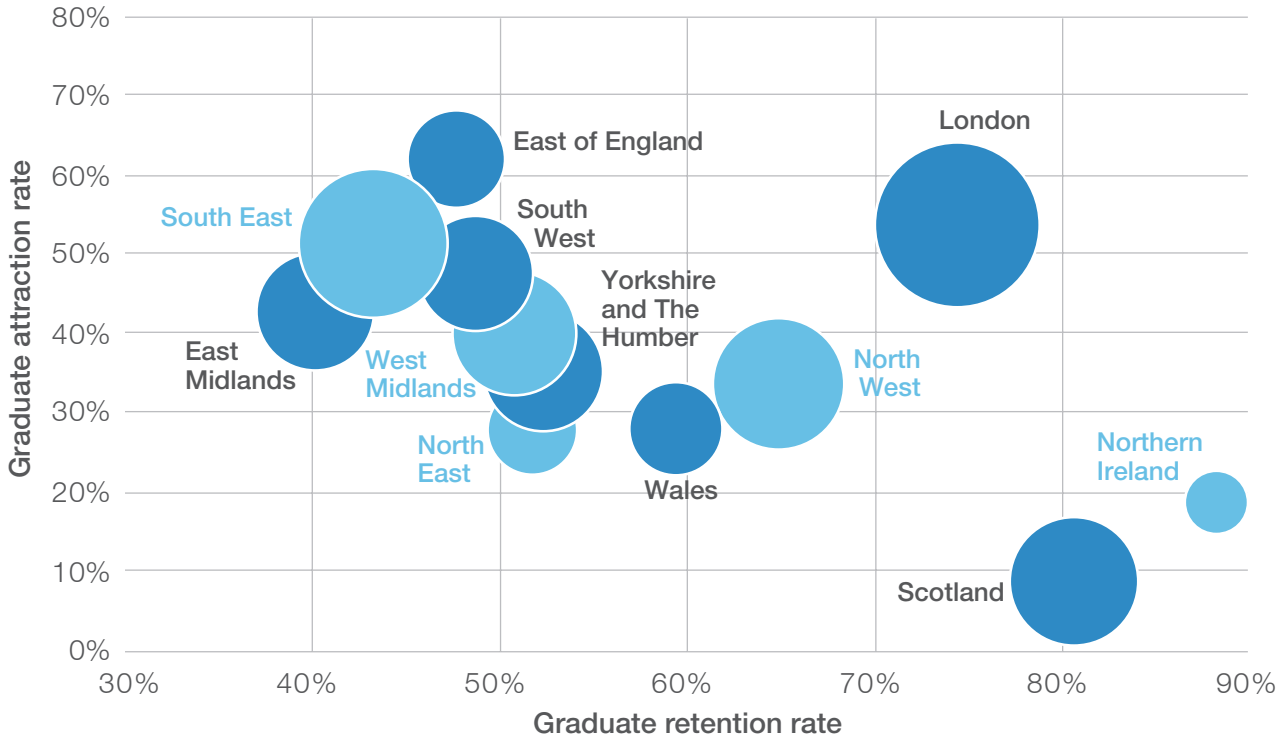


Figure 25: Regional graduate retention and attraction rates based on HESA data. The bubble's size for each region represents the total number of new workers who graduated from universities located in that region (based on the academic year 2018/19). (Source: West Midlands Regional Economic Development Institute[137])

> We've had frustration with the inadequacies of some established educational programmes, in terms of content, delivery and relevance – particularly architecture, which sometimes takes a very traditional, siloed approach.
>
> Peter Barker, Ryder Architecture

Figure 26 shows that most of the construction innovation-related programmes are offered by larger institutions. Refer to Appendix A1 for data collection methodology.

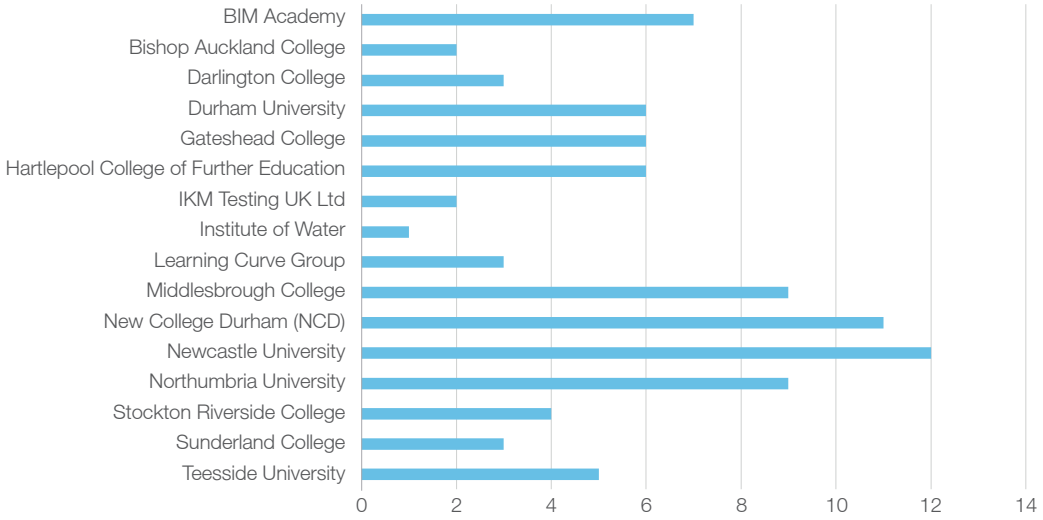


Figure 26: Number of related programmes offered by the educational organisations in the North East England region (the size of organisation in terms of number of employees increases from left to right).

Figure 27 indicates that many of the organisations try to cover different types of educational programmes, which can subsequently be an indication of their awareness regarding the significance of educating the local workforce. This is especially notable in the case of relatively larger organisations.

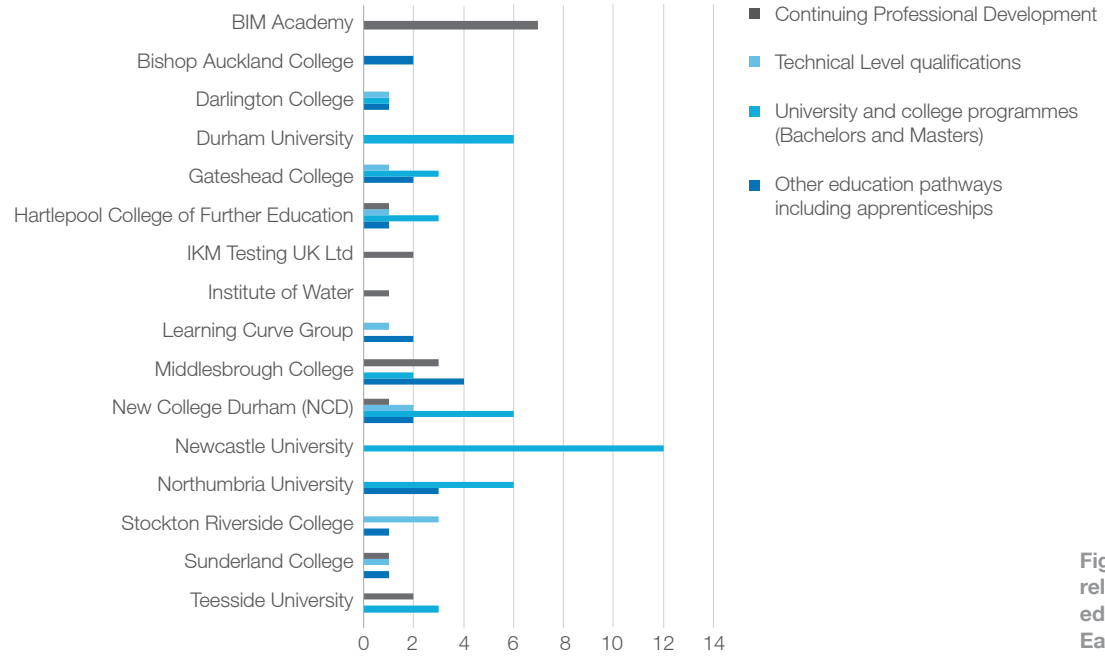


Figure 27: Different types of innovation related programmes offered by the educational organisations in North East England.

4.3.4 Accessibility of Education Programmes

Finding training on emerging design and construction practices either for apprentices or mid-career professionals is challenging. Apprenticeships are promoted by individual colleges, and most do not explicitly state the extent to which they teach modern technologies. For those already in the workforce, there is no centralised portal for construction education and training.

4.4 Community, Diversity and Inclusion

The North East England construction industry is tightly knit both geographically and in terms of inter-corporate relationships – "everyone knows everyone". There are numerous networks and opportunities to engage, share ideas and team up on initiatives.

Innovation appears to foster diversity in companies, and innovative companies tend to be at the forefront of efforts to attract workers from outside the industry and from a range of backgrounds.

The **CE Comparing Value Report**[138] notes that, "there is powerful regional focus on fairness, inclusion and respect, and recognition of the importance of skills to support the transition to a net zero society."

The following organisations and groups are leading the charge:

- Building Equality
- Business in the Community
- Generation for Change (G4C)
- National Association of Women in Construction
- Women in BIM

> I don't think the North East region is like any other region, we're very well connected. Everyone knows each other. There's only one really big conglomerate of cities, which is Middlesbrough. Newcastle and Sunderland. We're not too far apart.
>
> Darush Dodds, Esh Group

> If we can reduce the level of competition, and collaborate with the other local authorities more, then the whole region will benefit.
>
> Michelle Percy, Newcastle City Council - NCLeus project

> There are companies coming through that are female led, which is exciting to see. Unfortunately, many boards still don't have much diversity and are stuck in very traditional ways of doing things.
>
> Sam Cryer, Thermulon

The **2022 Constructing Excellence NE conference "All In"**[139] was themed around inclusion. However, when it comes to education and training, more could be done to raise awareness of construction as a valid and rewarding career path. Programmes such as **BuildNE**[140] and organisations like **Class of Your Own**[141] are important models that can be applied to educational gaps such as sustainability skills, retrofits and circularity.

> There are things we could learn about where National Innovation Centres for Ageing and for Data (NICA and NICD) first came from. It all started with the development of the Helix on the old brewery site. There was an aspiration to turn the city into a living lab, to collocate business with academia and elements of local and central government.
>
> John Haynes, Equans

> The North East of England has a distinct advantage of close connectivity across the industry and proven experience in driving joint initiatives at regional, national and international levels.
>
> OneVoice Strategy[137]

PlanBEE

PlanBEE is a unique, award winning apprenticeship programme launched by a group of North East employers in 2016. The programme was inspired and founded by Ryder Architecture who identified a skills and talent gap in the sector and collaborated with Gateshead College and key players in the industry to develop an innovative higher apprenticeship. PlanBEE includes topic areas highly relevant to the future of the built environment including MMC, net zero, retrofit, building safety and digital twins. The programme prepares young people for a career in a broad range of professional roles in design, construction and management roles. It provides an alternative work-based route rather than via university. 74 apprentices, many from diverse and underrepresented backgrounds, have graduated from the programme to date, with over 98% progressing to successful professional careers.

PlanBEE London Apprenctices

5 Findings

Findings

There are 264 companies in North East England that are actively engaging in an array of built environment technologies to varying degrees. BIM is the most commonly referenced technology followed by other types of design and construction software, prefabrication and digital twins. These companies have the potential to leverage about £6 billion in output and a labour force of over 20,000 skilled workers to create a dynamic construction technology cluster. The devolution deal that is creating the new North East Mayoral Combined Authority (NEMCA) offers a singular opportunity to construction technology leaders to open a formal dialogue on technology development opportunities and applications in public housing and infrastructure projects.

There is substantial work taking place within research labs relating to renewable energy, biomaterials and sustainability. There is a significant stimulus infrastructure in place to support innovation adoption which simply needs to be pointed in the construction industry's direction. While investment in construction-specific technologies has been limited, the region has been successful in raising innovation-related funding for other sectors.

Education and training programmes are in the midst of significant evolution, driven not just by built environment demand for new, relevant skills but also high-growth sectors such as renewable energy, digital media and electric vehicle manufacturing. Developing new curricula and graduating students with new skills can take a long time. Innovative training programmes that were conceived as "stop-gap" solutions to meet the needs of industry leaders have garnered international attention and can be further scaled and expanded.

There was a diversity of opinion about where the region fit in the national construction innovation ecosystem and how well positioned it is. Some interviewees felt that North East England was leading by some margin in areas of digital technology – notably BIM: others thought that most of the national effort was happening elsewhere – mostly in London and Manchester. Some felt that the region had held a leadership position but was "resting on its laurels" and was not doing enough to capitalise on its early gains.

Despite early successes, there can be no doubt that innovation diffusion in the regional construction industry is at an early stage of development. There are 9,750 registered construction businesses in North East England. The 264 companies that have been identified as active in construction innovation only comprise about 2.7% of the total. These companies represent the earliest "Innovator" stage. To build a robust innovation ecosystem and a critical mass of businesses, will require identifying and then engaging with the next tier of "early adopters". This means there is significant local market opportunity for local innovation diffusion.

Nevertheless, given the region represents the smallest regional construction economy in the UK, it has a strong mix of technical know-how, industry leaders, and collaborative spirit to develop a vibrant construction technology cluster that is founded upon BIM and digital technology expertise. The adoption of digital tools is considered a “game-changer” in the efficient delivery of building projects and is a key focus of the UK government, and international investors. These innovations could help the region grow if they were able to scale up.

> **I think the North East has an amazing potential to bring more innovation up here – the manufacturing heritage, the land, the buildings that are available to it. If, as a start up, you do need space to make things, then I think it’s a no brainer really. So I think we’re on the verge of the North East being a really interesting place for innovation and construction.**
>
> Advanced materials developer, Sunderland

Summary of Findings

Strengths and opportunities

- Early leadership in BIM has resulted in a robust digital construction cluster.
- Vibrant cluster of advanced materials technologies have application to construction.
- Collaboration and community.
- Presence of large companies with national and global reach.
- Local market is fiercely competitive, but this fosters creativity.
- Ample high-quality research horsepower.
- Presence of innovative education programmes.
- Affordable rents and available space for start-ups – “a great place to live”.
- Available data and KPIs to benchmark innovation.
- Incubators are helping large and small companies collaborate on innovation.
- Innovative local construction education programmes gaining international attention.

Gaps and challenges

- Slow to capitalise on early leadership in BIM.
- Industry short term-ism.
- Lack of regional industry data to track industry health and performance.
- Lagging in the shift to low carbon bio-based materials.
- Innovation is happening but knowledge is not being shared.
- Lack of construction-specific innovation funding and investment.
- Lack of incentives to innovate.
- Over-complication of research support programmes.
- Regional “invisibility”.
- Inconsistent procurement processes.
- Regulatory challenges.
- Lots of talk, less action.
- Labour and IP “flight”.
- Lack of change management support.

5.1 Strengths

Overall, the region has a number of advantages when it comes to adopting innovation in construction and there are areas in which it is and can continue to play a leadership role. In particular, the emerging cluster of companies involved with digital technologies for construction offers a unique competitive advantage to North East England. There is a strong history of manufacturing that has established large companies in other sectors that invest heavily in R&D and there is affordable space for new companies to get started.

1

Early leadership in BIM has resulted in a robust digital construction cluster

The region developed an early reputation as a cluster of expertise in BIM and digital technology. International leaders in IT such as Estonia have already established a **digital construction cluster**[142], along with Singapore and California. However, there is nothing similar in the rest of the UK.

Not only are there several large software companies that are operating at a global level, that are born and bred in the region (NBS, Viewpoint) but there are 100 companies of all sizes and disciplines that are active in BIM and could be organised to formally proliferate and validate the technology. The North East England BIM cluster is supported by 19 network organisations and some innovative education programmes (BIM Academy, PlanBEE, NEIOT.). Adoption of BIM technology is currently in the policy spotlight. Given labour constraints, the use of digital technology may be key to the region fully delivering on the £69m of investment in housing and regeneration that will come as part of the North East Mayoral Combined Authority amalgamation deal.

To further amplify the market opportunity, there is the potential to leverage the presence of large companies that work outside the region, and economic development programmes that could not only support local early adopters but also aggregate their accomplishments to create a regional “shop window” for investors in digital technology products and services.

2 **Vibrant cluster of advanced materials technologies have application to construction**	The region has developed a small but exciting cluster of innovative materials technologies that have applicability to construction. North East England is home to a number of national experts in graphene, aerogels, paints and coatings, low carbon materials (notably minerals and aggregates), renewable energy systems and bio-based materials, all of which need support from the construction industry to commercialise and scale up.
3 **Collaboration and community**	Collaboration occurs at the project, sectoral and industry levels. The North East England built environment sector is tightly knit both geographically and in terms of inter-corporate relationships – “everyone knows everyone”. There are numerous networks and opportunities to engage, share ideas and team up on initiatives.
4 **Presence of large companies with national and global reach**	Innovator companies tend to be large. They employ approximately 20% of the region’s construction labour force. 30% of enterprises operate across the country and 14% are in at least one location overseas. Some of these businesses may have the capacity to invest in technology and to provide impetus to the market.
5 **Local market is fiercely competitive, but this fosters creativity**	The North East England built environment economy is small by comparison to other regions and very competitive. Local firms have to be creative and agile to be ahead of the curve if they are to compete in other regions. The fact that the region can be a tough place to do business is, ironically, a major spur for innovation.

6 Ample high quality research horsepower

With several highly-rated research universities on the doorstep along with 18 labs and numerous centres of excellence, there is ample research horsepower that can be brought to bear on developing and commercialising new technologies and processes for the construction industry. The region has also successfully established a group of National Innovation Centres which provides valuable experience in cluster development.

7 Presence of innovative education programmes

Industry and educators have collaborated to develop a number of innovative and transformational education programmes (such as the PlanBEE higher apprenticeship) and to provide "short, sharp interventions" for key skills such as green construction and digital technology (e.g., Boot Camps). Some of these programmes are subsidised or free. There are also a number of colleges and private companies that offer a selection of BIM and MMC (BIM Academy, Sunderland College, NEIOT, TCS CAD & BIM Solutions) and sustainability (Bidwell, HLA Services).

8 Affordable rents and available space for start-ups

North East England has some of the most **affordable office and industrial space**[143] in the country. There are also several incubators that provide serviced office space, access to equipment, etc. to help new ventures get off the ground.

9 Available data and KPIs to benchmark innovation

It is important to establish and report on regional key performance indicators (KPIs) to benchmark investments in innovation and demonstrate impacts in terms of project delivery predictability, reliability, client satisfaction, and more. Constructing Excellence has been publishing **national industry KPIs**[144] for many years. This data provides a good starting point for benchmarking innovation. It could be further built on with annual surveys of local firms to assist in keeping track of progress, successes and challenges. Using the region's skills in data analytics will also offer opportunities to collaborate with technology developers from outside the immediate construction sector.

10

Incubators are helping large and small companies collaborate on innovation

There are several incubators and catalysts that are set up to help small companies collaborate with large ones. For example, Dynamo and IC3 which has industry specific knowledge and is well connected to both academia and industry. **Sunderland Software City**[145] runs innovation challenges that purposefully bring small and large companies together for the purpose of technology development.

11

Innovative local construction education programmes gaining international attention

Digital construction technology training programmes that have been created in North East England are not only helping to address local skills gaps but are also being exported to other jurisdictions. BIM Academy has been training professionals all over the world, **Turner & Townsend are working with Class of Your Own in Dubai**[146] and PlanBEE has recently been adapted as a micro-credential programme by the **British Columbia Institute of Technology**[147] – the largest technical training institution in western Canada.

5.2 Gaps and Challenges

Across the country, the construction industry has struggled with labour shortages, inflationary prices and post-pandemic recovery. However, there are some challenges that are particularly prevalent in the region stemming from local circumstances.

1 Slow to capitalise on early leadership of BIM

It is very difficult to sustain early leadership in innovation particularly in a cyclical industry like construction. Often there has not been the extra support required from stimulus organisations, funders, and governments to maintain investment and support when markets turn.

2 Industry short-termism

Construction is characterised by margin pressures which stifle innovation. Many businesses lead a hand-to-mouth existence, struggling to keep costs down in the face of inflationary pressures in wages, materials and services. This feeds short-termism in management, procurement, and investment in education and R&D. Construction firms are prioritising the short-term need for traditional skills and not sufficiently planning ahead. There is no strategic planning process that helps companies of all sizes consider their long-range training and technology needs.

Further, the conversations about technology and innovation that contributed to this report were primarily focussed on solving near-term issues and improving the design and construction processes. There was less discussion on topics related to later in the building life cycle such as building operations (and occupant engagement), the adaptive re-use of buildings and the circular economy, yet technology has an important role to place in addressing these challenges.

3 Lack of regional industry data to track industry health and performance

There is insufficient data on if, and how successfully, the industry is adopting new technologies and the impacts of innovation on productivity and performance. Information such as GVA generated by firms engaged with construction technology, the technology providers themselves and the value of exports from these companies is lacking. Given the unique characteristics of the region, it would be useful to establish KPIs that can help pinpoint issues and highlight success.

4 **Lagging in the shift to low carbon bio-based materials**

Although the region is home to the Hub for Biotechnology in the Built Environment, the adoption of biobased materials (notably timber) into local projects is lagging. This is unfortunate because Arup estimates that a shift from current supply chains and methods to regionally grown and processed biobased construction could **generate up to £1.9 billion**[148], with the gross value added to the economy having the potential to reach £14.8 billion. Even a partial shift would have a profound economic impact on the region.

5 **Innovation is happening but knowledge is not being shared**

Tracking and reporting on innovation is vital for ensuring knowledge can be shared accurately and in a timely fashion. There appears to be innovation happening in projects and in research labs in the region, but even public/private sector and political leaders are often unaware of what kind of innovations start-ups are working on. Indeed, there are some innovative "rapid-response" solutions to skills development such as the green and digital skills boot camps, but none of the companies interviewed mentioned them.

A small well-connected community can help to disperse information informally, but there appears to be a lack of a coordinated centralised platform for case studies, testing programme results, site web-cam footage, videos, etc.

6 **Lack of construction-specific innovation funding and investment models**

There is a lack of funding both in terms of government financial support to bring relevant innovations into the marketplace and to encourage the upskilling of already skilled labour. There is also a lack of timely scale-up, commercialisation support that can be sustained over long periods. Innovation funding tends not to recognise that construction timelines and returns are different from other sectors and projects can take many years.

7 **Lack of incentives to innovate**

The construction industry is risk averse, and innovation "safety nets" need to be established to manage the risks associated with attempting something new in a construction project. These can take the form of government backed guarantees, insurance policies, etc. There is significant potential for governments at the regional and national level to provide financial backing for both projects and research support (as they have in the past for catalytic initiatives like the Sunderland Software City) and for other sub-clusters to the digital technology space. That way, "con-tech" can join fintech, healthtech, agtech and others in organised funding categories, export programmes, etc. This is particularly important in the light of the recent announcement that the region will host the national **Digital Launchpad**[149].

8 **Over-complication of research support programmes**

Funding and research support programmes, where they exist, can be difficult to access because they are not set up to meet the needs of construction projects. A significant amount of construction R&D takes place on projects rather than in labs. These innovations demand a high level of risk management and long commercialisation runways. At the same time, opportunities for project-based R&D tend to emerge at short notice. Support programmes need to be quick and simple to access.

9 **Regional "invisibility"**

Despite government efforts through Levelling Up and Northern Powerhouse, North East England struggles to promote its expertise and accomplishments outside the region, and to attract investors – either for projects or for early-stage capital. Simply by being in the north can mean the region is not "front-of-mind" for some investors.

10 **Inconsistent procurement processes**

Construction companies need predictability and clear direction from clients in order to have the confidence to invest in new technologies and processes. Adoption of innovation into construction projects often requires a value-based approach to decision-making. Many public-sector clients have mandates requiring targets in relation to BIM, MMC, Retrofit, Net Zero and social value but there is often a lack of clarity understanding and consistency in procurement processes which hampers adoption.

11 **Regulatory challenges**

There are many regulations that are inconsistent with encouraging the adoption of innovative products and practices. There is over-complication in some areas, and gaps in others. For example, issues are around compliance and enforcement (lack of clarity, onerous requirements based on traditional solutions, etc.) can stymie innovation at the earliest stage. Also, procurement routes and framework agreements need to not only set clear requirements related to the adoption of innovative products and approaches, but also establish value-based criteria for assessing bids (e.g., life cycle costing and total cost of ownership metrics) rather than solely focussing on the lowest capital cost.

12 **Lots of talk, less action**

Overall, there is a profusion of networks, associations and catalysts all vying to foster innovation but there are insufficient platforms for meaningful exchange of information on key innovation topics. Those that exist have some but not all of the information sought by users, which may dilute the value and diminish users' motivations to access the information.

13 **Labour and IP "flight"**

The North East England construction market is small compared to the rest of the country and struggles to retain home grown talent and technology. Large education institutions attract students from geographically diverse backgrounds but not enough is done to help them stay in the region. Similarly, early-stage companies sometimes move out of the region to be closer to investors and talent.

14

Lack of change management support

Where incentives and funding exist for innovation, it tends to be focused on capital investment in technology as opposed to enabling the organisational change needed to accommodate it. For example, the shift from craft-based project delivery to modern methods of construction (factory-based production) requires a different business model. Further, the industry still struggles with a lack of diversity and the fact that only 7% of the 2023 regional cohort of engineering, construction and built environment apprentices are women suggests that systemic change is needed within the industry to make it more attractive to non-traditional workers. Change management support for construction companies to increase opportunities for women and other minorities in leadership roles will help to encourage prospective workers to envisage meaningful career paths for themselves.

Conclusions

6

6

Conclusions

Skills shortages and spiralling costs are ongoing threats that the construction industry needs to get ahead of to avoid stagnation in the face of investment opportunities. Innovation is critical to companies of all sizes to avoid falling behind. Embracing innovation can be one of the most effective strategies for kick-starting post-recession growth. A proactive allocation of resources towards expanding the work opportunities, and training and educational initiatives becomes not only prudent but imperative.

The construction innovation ecosystem identified in this study makes up 2.6% of the total number of construction businesses in the region. This suggests that innovation proliferation is still at the early stages and stimulus is needed to encourage early adoption by the rest of the industry.

However, there is a tremendous opportunity to establish the region as the UK's digital construction cluster. The alignment of skills, presence of early adopters, training programmes, stimulus support and significant investment expected with the new Combined Authority deal, offers the region a singular opportunity to position itself alongside global leaders in this emerging field.

6.1 Recommendations

Summary of Recommendations

- Prepare a construction technology cluster development strategy, pitch document and communication plan (with timelines) that builds on the region's leadership in digital construction.
- Create a centralised innovation "exchange".
- Nominate a construction innovation "champion".
- Engage with and nurture the start-up community.
- Develop a dedicated construction innovation investment programme and funding plan (private and public sector).
- Undertake a long-range education planning process.
- Create a regionally specific innovation KPI dashboard.
- Support and celebrate the strong community spirit in the region's construction innovation space.
- Actively promote the region's strengths in construction sector innovation both nationally and internationally.
- Showcase the region's affordable available space to develop testbeds and "sandpits".

This study provides a first look at the emerging construction innovation ecosystem that is evolving in North East England. There are notable strengths and opportunities for further development and the timing to move forward is good. However, there is more work to do.

The clustering analysis in this study offers a starting point for developing realistic, actionable strategies for shaping the economic future of the region's built environment sector, and the future of the many people and institutions that support it. The following are recommendations for further developing the cluster.

1

Prepare a construction technology cluster development strategy, pitch document and communication plan (with timelines) that builds on the region's leadership in digital construction

The region is an early adopter of digital construction technology and there have been some valuable lessons learnt from initial cluster development efforts. Arguably, the early efforts may have been too far ahead of the curve, but now that BIM, MMC, Retrofit and Net Zero have become banners for industry modernisation policies nationally and internationally, the time is right to re-commit to this work. The prominence of the region's digital capabilities can be leveraged to accelerate investment in other emerging areas such as prefabrication, sustainability and advanced materials.

To this end, it is important to first engage with the 113 companies that are active in emerging BIM and digital construction technologies and to reinvigorate the various supporting stimulus organisations to develop a detailed digital construction cluster development strategy and pitch document that pinpoint exactly where the opportunities are, where investment will make a big difference and what the resulting impacts in terms of growth would be. Clear timelines for action are important to build momentum.

This work should also include a communication and outreach plan to sell the message beyond the region that North East England is home to an important cluster of digital expertise and that this is where construction innovation is happening in the UK. A great deal is going on in terms of technology development, education and training advancements and innovative projects that others are not aware of. Celebrating success can also help to stimulate greater industry cohesion and get more local firms excited and engaged.

2 Create a centralised innovation "exchange"

Barriers to innovation in the building industry are generally rooted in an information dissemination problem. Practitioners need information that is both thorough and concise for the needs of real-world building projects in an easily accessible and timely fashion. This challenge is further complicated by the fact that there are so many different stakeholders each of whom have their own information requirements.

A centralised innovation "exchange" is needed to show leadership, gather information, share knowledge, coordinate networks and events. This could help the construction industry to record and track what is happening in research labs, in education planning processes and on construction sites.

There is no centralised location where practitioners can follow what is currently being researched in the region's many labs and testing centres. Research funders may be encouraged to publish updates on the projects they are supporting on their own websites. Alternatively, an online forum could be set up for researchers to share information about what they do, the specialised equipment and facilities they operate and the projects they are working on.

There are numerous examples in other jurisdictions ranging from virtual platforms (such as the Vancouver **Zero Emissions Building Exchange**[150]) to physical spaces (such as the **New York Building Energy Exchange**[151]). The goal is to provide easy-to-find information that has been sourced and organised in a way that is of most use to industry. Information could include case studies, best practice details, technical templates and other solutions. Depending on capacity, this entity can serve as an innovation advisor, finding "pathways" to resolution of issues where information and/or best practices does not yet exist. It can also monitor the application of best practices to capture ongoing feedback on how the information is being deployed. Additional roles for such an entity could include advocacy, education programme outreach and promotion, and promoter of established networks and events.

3 Nominate a construction innovation "champion"

Nurturing the region's construction innovation cluster requires the sustained (and funded) efforts of a knowledgeable, passionate and respected leader. This individual effectively could be the "face" of construction innovation in North East England and evangelise on behalf of the region's innovators.

4 **Engage with and nurture the start-up community**

Early-stage ventures that are developing solutions for the construction industry need very specific support (both from the financial and market engagement perspective) that is tailored to construction industry timeframes and procurement processes. Although there are several programmes to that help start-ups get in front of large companies, there is no construction-specific regional forum for start-ups to promote their solutions.

5 **Develop a dedicated construction innovation investment programme and funding plan (private and public sector)**

A combination of low margins, inertia and long project life cycles holds innovation back. A **dedicated innovation investment programme** could be established as part of the Combined Authority devolution funding that covers incremental costs in the design and construction of innovative, low carbon buildings that demonstrate emerging technologies or processes.

6 **Undertake a long-range education planning process**

Although there are number of organisations hard at work at developing and delivering new education programmes, a long-range education planning process needs to be launched that is visible and involves broad consultation and engagement with industry (not just the large firms) and educators to looking ahead at what skills will be needed in time for educators to develop curriculum and train students.

7 **Create a regionally specific innovation KPI dashboard**

Construction innovation and clusters have been difficult to pin down due to the large number of SMEs and the fragmented nature of the industry. Address the lack of useful, timely data on innovation adoption and its impacts on the health and performance of the industry by establishing a **regionally specific innovation KPI dashboard** that combines 3rd party public data with regularly commissioned industry surveys to ensure that innovation investments are delivering benefits. Sustained effort is needed to continue to track and report on the "health" of the industry to show the value of innovation investment in terms of improved profitability, performance and customer service.

8 Support and celebrate the strong community spirit in the region's construction innovation space

While it would be helpful to streamline catalyst support for construction innovation, it is also important to leverage existing efforts rather than creating new initiatives. There is a strong sense of community spirit and a lively collection of industry networks, many of which have invested time and effort in creating important connections, frameworks and networks that may have been ahead of their time when they started but are now very relevant and need help to grow. For example, there are 19 networks that talk about BIM. They may discuss similar topics but target different audiences. A BIM network board that helps all of these organisations flourish may be useful.

9 Actively promote the region's strengths in construction sector innovation both nationally and internationally

Construction has not historically been a major export industry for the region, but the range of products and services that are geared towards digital design and project delivery, sustainability and advanced materials offer the potential to grow new markets nationally and internationally. In terms of national and international trade, 83 companies (31% of the inventory of innovative businesses) are operating in at least one location outside the region. North East England has a **strong exporting pedigree** on which to build and a wealth of trade and investment support organisations, such as the North East Local Enterprise Partnership, that have established robust international relationships across the EU, North America, Asia and beyond . Major sectors for exported goods include transportation (notably off-highway equipment) and power-generating machinery, both of which have a tangential relationship to engineering and construction, offering the potential to leverage existing relationships and grow construction-related exports.

In terms of exported services, the presence of multinational engineering firms (Arup, WSP, Arcadis, etc.) not only helps to scale up local innovations, but also bring in new ideas from elsewhere. Digital services are growing in export importance offering potential sales channels to the region's emerging BIM cluster.

10

Showcase the region's affordable available space to develop testbeds and "sandpits"

North East England is blessed with affordable space, and attractive buildings in which companies can play with new technologies. Often, construction companies need plots of land to build mock-ups, try new equipment and store materials (notably for prefabrication projects, but also for salvaged materials). Testbeds and "sandpits" can be provided either by local governments or research institutes whereby innovation opportunities can be developed for public infrastructure, space is provided for testing, mock-ups and demonstrations, etc.

6.2 Final Thoughts

Nurturing a construction innovation ecosystem relies primarily on broad industry support. The region has developed a strong sense of community and willingness to collaborate, and there are lots of venues for meeting and talking. The conversations with industry leaders that underpinned this study were universally insightful and enthusiastic. Not only did 51 busy people make time to talk, but they were happy to share their ideas and were keen to stay informed of progress.

It is therefore important to build on this energy and goodwill. Construction is a notoriously difficult industry in which to build cohesion, but this study shows that there is a critical mass of innovators in North East England, the region has the stimulus support needed to take the next step, a proven track record of establishing other technology clusters and the political impetus through the Combined Authority devolution deal to make an important mark on the UK's business landscape.

Appendix

4

A1. Research Methodology

Review Process for Enterprises, Stimulus Organisations and Education Programmes

Each company's website was then reviewed for any mention of technologies, products or practices that contribute to improving the productivity and performance of the region's construction industry. This list was adjusted as the research progressed.

For large enterprises that operated nationally out of multiple locations, the reported turnover generated in North East England was estimated by dividing total turnover by the number of locations identified on their websites.

For small enterprises where turnover was reported as "less than £2 million", turnover was calculated by doubling the average salaries of the number of employees to include overhead and profit (Table 10). The number of employees were taken from those listed on the website, or if no data available, were assumed to be sole proprietors. Average salaries for the region were used from **CIBSE 2022 Salary Survey**[153] for consultant engineers (civil, structural, mechanical, electrical, software, etc.), quantity surveyors, and contractors. The **9B Careers 2022 Architectural Salary Survey**[154] was used for architects including planners, landscape architects and interior designers. For all other enterprises, average salary proxy of £45,000 was used. Given that salary data was based on 2021 surveys, 6.2% inflation was added in line with the Bank of England's **May 2023 Monetary Policy Report**[155].

It was not possible to weight the turnover or number of employees based on some companies only allocating a portion of their business to innovative activities.

	2021 Average salary	**2023 Turnover per employee including inflation, overhead and profit**
Consulting engineers, sustainability (CIBSE) - also software services, drones, acoustics	£43,500	£92,190
Quantity surveyors (CIBSE), also asset management	£44,250	£92,394
Architects (9B), also planners, interior designers	£43,404	£96,111
Contractors, construction services and trades (CIBSE)	£46,500	£98,766
Other (proxy)		£90,000

Table 10: Assumed average turnover per employee for small enterprises.

The technologies with which companies were involved were identified from a review of their website and, where possible, from interviews. The list of technologies included:

Design-oriented technologies:

- Building Information Management (BIM) and digital collaborative platforms
- Software for design and construction business optimisation
- Digital data collection and management
- Building energy performance analytics
- Digital twins
- Mapping and geo-enabled systems (GIS, GPS, LIDAR)
- Image capture and photogrammetry
- Visualisation, Augmented and Virtual Reality systems.

Construction automation - supporting work through digitisation:

- Robotic process automation (RPA), such as automated forecasting, estimating, virtual marketplaces, etc.
- Construction site safety technologies
- Construction scheduling and site logistics software
- Drone surveying
- Sensing and sensor integration
- Artificial intelligence (AI) and machine learning
- Blockchain technologies

Industrialised and componentised construction advances:

- Modern methods of construction (MMC) (prefabrication, modular, product platforms, building kits, digitally enhanced manufacturing of componentised elements and assemblies)
- Advanced equipment for construction (tools, vehicles, cranes, etc.)
- Additive manufacturing and 3D Printing
- Physical robots
- Wearable technologies
- Facial recognition and biometrics

Advanced materials and systems, sustainability and circularity:

- **Low carbon:** products and materials with low embodied carbon, are recyclable, carry environmental product declarations.
- **Health and Safety:** products and practices that protect workers, promote occupant wellbeing, biophilic design, fire and life safety systems, etc.
- **Circular:** products and practices that promote zero waste and a circular economy (retrofits, recycling, up-cycling, high value applications of low value materials, deconstruction, restoration).
- **Advanced materials:** develops, manufactures or works with novel products and systems (graphene, aerogels, biotech, nanotech, etc.)
- **Building systems:** develops, designs, installs or operates “smart” building diagnostics, intelligent facility management systems, “connected” building equipment and controls
- **Energy:** manufacture, design and installation of low energy, renewable and onsite / micro energy systems (heat pumps, solar, wind, geothermal, etc.) and controls.
- **Energy performance analysis:** building performance modelling, analysis, Passive House, etc.
- **Net zero:** products, systems, commitments, reporting (e.g., ESG) that support net zero goals.
- **Water:** water conservation solutions, water efficient technologies, purification, on-site water treatment systems.

The review of education programmes involved a review of the websites of architecture, engineering and construction courses at all universities and colleges in the North East of England. To be included in the analysis the web page had to mention any of the construction technologies in the table above, include generic keywords such as “digital” or “sustainability”, or pursued an innovative pedagogical approach. Knowledge gaps were filled via consultation with education professionals.

Consultation Process

Individuals from 66 businesses, stimulus organisations and education providers were identified through recommendation by the project Steering Group. The goal was to gather a wide range of perspectives from across the industry and across the region. Of these, 51 participated in a 45 to 60 minute interview (Figure 28). Three people represented more than one organisation. The discussion guide is provided below.

Five of the interviewees were not based physically in the region, however their perspectives were considered important because they had a good understanding of the topic, they could place regional activities in the national context, or they could discuss crossover with other areas.

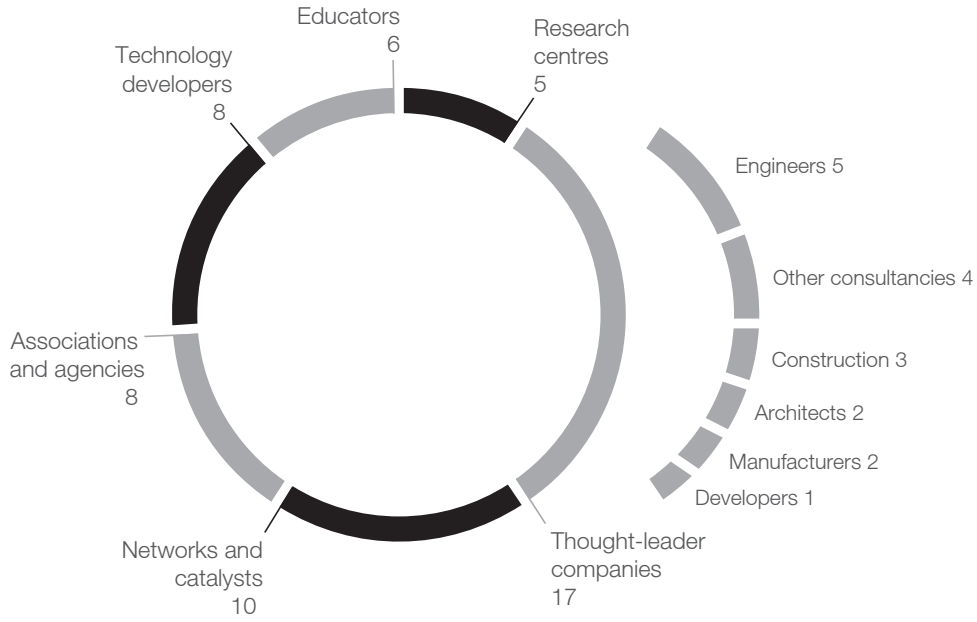


Figure 28: Distribution of interviewees by organisation type

North East Construction Innovation Ecosystem Interview Guide

Part 1 General information for all interviewees

1 What does your company or organisation do that relates to construction innovation, in field of technology, products or education?

2 How many people work within your organisation in the NE?

3 Generally, how would you describe the state of the construction sector in the northeast UK? How innovative is it, does it lead in any particular areas?

4 Where are the gaps?

5 Networks, catalysts, membership-based groups are important for staying connected, learning and sharing ideas. What groups are you or your organisation part of (or would like to be part of) that are focussed on advancing construction innovation?

Part 2A: for businesses only

1 What innovative technologies, products or services does your company offer? Is this core to your business and where is your customer base?

2 How many people in your firm work on this innovation?

3 Can you provide an estimate of your company's turnover last year and what proportion was related to this innovation?

4 Do you think the region offers sufficient support for construction innovation, commercialisation, and market entry? Where are the strengths and what needs to be done better?

5 How would you describe the state of construction education and training in the northeast? What is working and what is not?

Part 2B for education and training providers only

1 What is innovative about the education and training programmes and courses that your organisation offers related to construction?

2 Generally, is the available education and training meeting the construction industry's demand? Are there specific topics that need to be addressed?

3 Is there sufficient funding support from Government? If not, where are the gaps?

4 Who are your education and training programmes targeting?

5 What role models do you look to in terms of education and training innovation?

6 What is your organisation doing to encourage under-represented groups into the construction sector? These groups include women, minority groups, underprivileged youth, etc.

Part 2C: for research centres, catalysts, member-based organisations, governments, NGOs, only

1 Building on your initial description of your organisation, can you describe specific programmes and activities that your organisation offers that are designed to advance construction innovation in the region?

2 Would you be able to provide a list of member companies who you think are strong in construction innovation?

3 What do you think about the level of R&D support in the region? Is it easy to develop new ideas?

Part 3: Wrap-up – all interviewees

1 As part of this project, we are collecting data such as turnover, number of workers – is the any other information that you think would be useful to know about the construction innovation space? What would you like to read about in the report?

2 Are there any examples of bridging innovations from other sectors that you think could be brought to bear in construction?

3 Is there anyone you think we should talk to about construction innovation in the northeast UK?

4 Finally, is there anything else you would like to add related to the state of construction innovation in the northeast of England?

A2. Enterprises

Architecture

ADP Architecture
https://adp-architecture.com

Arcadis
https://www.arcadis.com

Arcus Consulting
arcus.uk.com

Aura Newcastle
https://www.auranortheast.com

Blake Hopkinson Architecture + Design
https://bharchitects.co.uk

Bryonn Architecture
https://www.bryonnarchitecture.com

Building Design (Northern)
https://bdnltd.com

Cummings Architects
https://www.cummingsarchitects.co.uk

Dark Skies Design
https://darkskiesdesign.co.uk

Elliott Architects
https://www.elliottarchitects.co.uk

Faulkner Browns Architects
https://faulknerbrowns.com

Fitz Architects
https://www.fitzarchitects.co.uk

Focus Architecture and Surveying
https://www.focus-as.co.uk

Grace Choi Architecture
https://www.gracechoi.co.uk

Gradon Architecture
https://www.gradonarchitecture.com

GSS Architecture
http://gssarchitecture.com

GT3 Architects
https://www.gt3architects.com

Hoot Architecture
https://hootarchitecture.com

Howarth Litchfield Partnership
https://howarthlitchfield.com

JDDK Architects
https://www.jddk.co.uk

Lovingly Engineered Architecture
leap4.it

MawsonKerr Architects
https://mawsonkerr.co.uk

Milbank Architecture
https://milbankarchitects.co.uk

Mosedale Gilatt Architects
https://www.mgarchitects.info

Napper Architects
https://www.napperarchitects.co.uk

Newton Architects
https://www.newtonarchitects.com

Norr Architects
https://norr.com

Pyramid Architectural Design
https://pyramiddesigns.co.uk

Richard Ruddick Architecture
https://www.rr-architecture.co.uk

Ryder Architecture
https://www.ryderarchitecture.com

Architecture

Simulations
https://simulations-ltd-architects.business.site

Space Architects (Europe)
https://www.spacearchitects.co.uk

Space Group
https://www.spacegroup.co.uk

Stovell & Millwater
https://www.davidstovellandmillwater.co.uk

Seymour Architecture
https://www.seymourarchitecture.com

Asset Management

Broadoak Asset Management
https://broadoak-am.uk

Grainger Plc
https://www.graingerplc.co.uk

Northumberland Estates
https://northumberlandestates.co.uk

Northumbria Healthcare Facilities Management
https://nhfm.co.uk

pX Group
https://www.pxlimited.com

Your Homes Newcastle
https://www.yhn.org.uk

BIM Services

BIM 73
https://bim73.co.uk

BIM Academy
https://www.bimacademy.global

BIM Technical Solutions
https://bimts.co.uk

BIM.Technologies
https://bimtechnologies.co.uk

bimstore
https://www.bimstore.co

CM Design Engineering
https://www.cmdesigneng.co.uk

Design On Demand
https://designondemand.co.uk

H&S Design Solutions
https://www.hsdesignsolutions.com

Midland Structural Services (Northern)
http://www.mssnorthern.com

Peek Home
https://peekhome.co.uk

Simpson Coulson
https://scceltd.com

South Durham Draughting
https://www.sd-draughting.co.uk

TCS CAD & BIM Solutions
https://www.cadservices.co.uk

Construction

Applebridge Construction
https://applebridge.com

Armstrong Electrical
https://armstrongelectricalneltd.godaddysites.com

Balfour Beatty
https://www.balfourbeatty.com

BAM Construct UK
www.bam.co.uk

Bowmer + Kirkland
https://www.bandk.co.uk

Brims Construction
https://brimsconstruction.com

CA Group
https://www.cagroup.co.uk

Cool Designs
https://www.cdlweb.info

Damian Cronin
https://www.linkedin.com/company/damian-cronin-limited/about

DMS Insulation Ltd
http://www.dmsteesside.com

Equans
https://www.equans.co.uk

Esh Construction
https://www.eshgroup.co.uk

Fisher Construction Consultants
https://www.fisherccl.co.uk

FJ Booth Construction
https://fjbooth.com

Geoffrey Robinson
http://www.geoffreyrobinson.co.uk

H.Malone And Sons
https://www.hmalone.co.uk

Hathaway Roofing
https://www.hathaway-roofing.co.uk

Hewitt Envelope Systems
https://www.hewittcontractors.co.uk

Howard Russell Construction
https://www.howardrussell.net

Intelect (UK)
https://intelectuk.com

John Flowers
https://johnflowers.co.uk

John N Dunn Group
https://jndunn.co.uk

Kaefer
https://kaeferltd.co.uk

Karbon Homes
https://www.karbonhomes.co.uk

Kier
https://www.kier.co.uk

LJJ
https://www.ljjcontractors.com

Meldrum Construction Services
https://meldrumcs.com

MGM Construction
https://mgmconstruction.co.uk

Construction

Morgan Sindall Group plc
https://www.morgansindallconstruction.com

Pbu (UK)
https://www.pbul.co.uk

Rotary Building Services
https://www.rotarybuildingservices.com

Sir Robert McAlpine
https://www.srm.com

Smulders Projects UK
https://www.smulders.com/en

Surgo
https://www.surgo.co.uk

Swift Timber Homes
https://swifttimber.co.uk

T. Manner and Sons
https://tmanners.co.uk

Tilbury Douglas Construction
https://tilburydouglas.co.uk/

True North Construction
truenorthconstruction.co.uk

Wilmott Dixon
https://www.willmottdixon.co.uk

Demolition

Ashcourt Group
https://www.ashcourt.com/aycliffe-quarry

MGL Group
https://www.mglgroup.co.uk

Newcastle Wood Recycling
https://www.welovewood.org

O'Brien Demolition / Timec 1484
https://www.g-obrien.co.uk

Thompsons of Prudhoe
https://thompsonsofprudhoe.com

Tynedale Roadstone / MGL Group
https://www.mglgroup.co.uk

Development

Adderstone
https://www.adderstonegroup.com

Amethys Homes
https://amethysthomes.co.uk

Banks Group
https://www.banksgroup.co.uk

Barratt Developments PLC
www.barrattdevelopments.co.uk

Bellway
https://www.bellway.co.uk

Gentoo Homes
https://www.gentoohomes.com

Development

Jomast Developments
https://www.jomast.co.uk

Keepmoat Homes
https://www.keepmoat.com

LTS Refurbishment
https://www.ltsr.co.uk/

Mandale Group / Mandale Homes
http://www.mandale.com

Miller Homes
https://www.millerhomes.co.uk

Persimmon Homes
https://www.persimmonhomes.com/locations/north-east

Rivergreen Developments
https://www.rivergreendevelopments.co.uk

Tees Heritage
http://teesheritage.org.uk

Thirteen Property Development
https://www.thirteengroup.co.uk

Drone Services

Droneworks North East
https://droneworksnortheast.co.uk

Dropzone Images
https://dropzoneimages.co.uk

Sky Drone
https://www.sky-drone.co.uk

Survey Drones / Northern Bear (Safety)
https://survey-drones.com

Energy Assessment

EPC Northeast
https://www.epc-northeast.co.uk

Focus 360 Energy
https://focus360energy.co.uk

Green Energy Consulting
https://greenenergyconsulting.co.uk

Greener Homes (Ne)
https://www.greenerhomesconsultancy.co.uk

HartlePower C.I.C
https://hartlepower.co.uk

Engineering

Actemium Automation Teesside
https://www.actemium.com

AECOM
https://aecom.com

Apex Acoustics Limited
www.apexacoustics.co.uk

Arrowbuild & Civil Engineering
https://www.arrowbuildltd.co.uk

Arup
https://www.arup.com

Black & White Engineering
https://bw-engineering.com

Castle Building Services
https://castlebs.co.uk

CK21
https://www.ck21.co.uk

Crawford Higgins Associates
http://www.crawfordhiggins.co.uk

Cundall
https://www.cundall.com

Dunelm Geotechnical & Environmental
https://www.dunelm.co.uk

Dyer Engineering
https://www.smarterstrongertogether.com

Eastgate Engineering
https://eastgateengineering.com

Fab Shop
https://fab-shop.co.uk

Fairhurst Group
https://www.fairhurst.co.uk/about/bim

Hydram Engineering
https://hydram.co.uk

Hydrock
https://www.hydrock.com

K Home International
http://www.khe.co.uk

Liebherr Sunderland Works
https://www.liebherr.com/en

Link MEP
https://www.linkmep.com

Mammoet (UK)
https://www.mammoet.com

Mott MacDonald
https://www.mottmac.com/digital

Ryder Geotechnical
https://www.rydergeotechnical.com

Sibco Engineering
http://www.sibco.com

Up North Engineering
https://www.upnorthgroup.com

Wardell Armstrong
https://www.wardell-armstrong.com

WSP
https://www.wsp.com/en-gb

Interior Design

ACRE Design
https://acredesign.co.uk

Custom Design
https://customdesign-ltd.co.uk

George Bond Interior Design
https://georgebond.tv

Haus12 Interiors / Jesmond Kitchen Studio
https://haus12.co.uk/

HS Interiors
https://hsinteriors.co.uk

NVision Studios
https://nvisionstudios.co.uk

IT, Software

Atlas Cloud
https://www.atlascloud.co.uk

Autodesk
https://www.autodesk.co.uk

Causeway Technologies
https://www.causeway.com

Clixifix Limited
https://www.clixifix.com

Ctrl Hub
https://ctrl-hub.com

DEF Software
https://www.def.co.uk

Faithful & Gould
https://www.fgould.com

Gray Fox Consulting
https://wearegrayfox.co.uk

Identity Consult
https://www.identityconsult.co.uk

Map Group (UK)
https://www.mapgroupuk.com

Monstar Lab IT services
https://monstar-lab.com

NBS Enterprises
https://www.thenbs.com

Nebula Labs
https://www.nebulalabs.co.uk

North SV
https://north.tech

PlaceChangers
https://www.placechangers.co.uk

Sapere Software
https://www.sapere.co.uk

Semphos
www.semphos.com

Serios Group
https://www.seriosgroup.com

The Nine Software Company
https://www.ninesoftware.co.uk

IT, Software

Tidy International
https://tidyinternational.com

Trench Networks
https://trenchnetworks.com/sectors/construction

TwinView
https://www.twinview.com

Viewpoint Construction Software
https://www.viewpoint.com/en-gb

Waterstons
https://www.waterstons.com

XBIM
https://xbim.net

Manufacturer

AKV Cladding Products
https://akvltd.com

Akzo Nobel
https://www.akzonobel.com

Applied Graphene Materials
https://www.appliedgraphenematerials.com

Applied Scientific Technologies UK
https://www.appliedst.co.uk

Aspen Aerogel
https://www.aerogel.com

Bespoke Concrete Products
http://bespokeconcrete.co.uk

Clayton Glass
https://claytonglass.co.uk

Crabtree
https://www.crabpress.co.uk

Dane Architectural Systems
https://danearchitectural.co.uk

Doby Cleats Ltd / Doby Verrolec
https://www.dobyverrolec.com/en

Dragonfly Insulation
https://www.dragonflyinsulation.co.uk

Ebac
https://www.ebac.com

First Graphene
https://firstgraphene.net

Formica Limited
https://www.formica.com/en-gb

Graphene Composites
https://graphenecomposites.com

Heraeus Conamic UK
https://www.heraeus.com/en

IBSL Group
https://www.ibslgroup.co.uk

Insulcon
https://insulcontechnical.com

Isoclad
https://www.isoclad.co.uk

Javac (UK)
https://www.javac.co.uk

Jobling Purser / James A. Jobling & Co.
https://rocbinda.com

Manufacturer

Low Carbon Materials
https://www.lowcarbonmaterials.com

Lynx Precast
https://www.lynxprecast.co.uk

Magnet
https://www.magnet.co.uk

Marshalls Mono
https://www.marshalls.co.uk

Materials Solutions
https://materialssolutions.co.uk

Nano-Purification Solutions
https://www.n-psi.co.uk

Nicholsons Sealing Technologies
https://www.nicholsons.co.uk

Permoid Industries
https://permoid.com

Premo
https://premofabs.com

Roman
https://roman-showers.com

Roof Truss Company Northern
http://www.roof-truss.co.uk

S and B EPS
https://sandbeps.com

Sotech
https://sotech-optima.co.uk

Spartan UK
https://spartan.metinvestholding.com/en

Tees Components
https://teescomponents.co.uk

The Expanded Metal Company
https://www.expandedmetalcompany.com

Thermulon
https://www.thermulon.com

W. McGovern & Co
www.wmcgovern.com

Zentia Profiles
https://www.zentia.com

Other Consultancy

Bidwell Management Systems
http://www.bms-services.com

Colour Urban Design
https://www.colour-udl.com

Energess Surveys & Maintenance
www.energess.co.uk

Low Carbon Journey
https://uk.linkedin.com/in/tom-jarman

ONE Environments
https://www.one-environments.co.uk

Paul Johnson Garden Design
https://www.pauljohnsongardendesign.co.uk

Other Consultancy

Sam Nattress Gardens
https://www.samnattress.co.uk

Sintons
https://sintons.co.uk

Summers Inman
https://www.summers-inman.co.uk

TGP Landscape Architects
https://www.tgp.uk.com

Turner & Townsend Limited
https://www.turnerandtownsend.com

Prefabrication

Acrol Modular Buildings
https://www.acrolmodular.co.uk

Algeco
https://www.algeco.co.uk

CoreHaus
https://www.corehaus.co.uk

Eos Framing
https://www.eosframing.co.uk

Finley Structures
https://www.finleystructures.co.uk

G. E. R. Portable Buildings
http://www.gercabins.co.uk

Merit
https://www.merit.co.uk

Tekbuild
https://tekbuildlimited.co.uk

Tiny Eco Homes
https://www.tinyecohomesuk.com

Renewable Energy

eco trust
https://www.eco-trust.co.uk

Gener8 Power UK
https://www.gener8poweruk.com

HLA Services
https://hlaservices.co.uk/services

Integral Energy
integralenergy.co.uk

Lucans Energy
https://lucans.uk

Marshall and McCourt Renewable Energy & Heating Solutions
https://marshallandmccourt.co.uk

Renewable Energy

Oakes Energy Services
http://www.oakesenergy.co.uk

Power Roll
https://powerroll.solar

SolarStyle
https://solarstyleuk.com

Sustainable Energy Engineering
http://www.susenergy.co.uk

Time To ACT / GreenSpur Wind
https://www.greenspur.co.uk

Safety Systems

Barrier
https://barriergroup.com

Draeger Safety UK
https://www.draeger.com/en_uk

Fire Logistics
https://www.firelogistics.co.uk

Isoler
https://isoler.co.uk

Seaward Electronic
https://www.seaward.com/gb

Testing

IKM Testing UK
https://www.ikm.com/ikm-testing-uk

Lucion Group
https://luciongroup.com

Palintest
https://www.palintest.com

Pass (Portable Appliance Safety Services)
https://www.tester.co.uk

Site-Lab
https://site-lab.co.uk

Turbo Control Systems
https://turbo-controls.com

Bridging Technologies

Automotive

ADM Pressings
https://admpressings.co.uk

Caterpillar (UK)
https://www.caterpillar.com

Cummins
https://www.cummins.com/eu/countries/uk

Finning UK
https://www.finning.com

Hitachi Construction Machinery UK
https://www.hitachicm.co.uk

Komatsu
https://www.komatsu.eu/en/company/komatsu-uk

Rotary Power
https://rotarypower.com

Sarens (UK)
https://www.sarens.com

Non-construction Engineering

Mech-Tool Engineering
https://mechtool.co.uk

Rosen (UK)
https://www.rosen-group.com

Wilton Engineering Services
https://www.wiltonengineering.co.uk

Manufacturer

BEL Valves
https://www.belvalves.com

CMP Products
https://www.cmp-products.com

Derek Parnaby Cyclones International
https://www.parnaby.co.uk

Envision AESC UK
https://envision-aesc.co.uk

Mersen
https://www.mersen.co.uk

Modus
https://www.modus-ltd.com

Psi Global
http://www.psiglobal.co.uk

Responsive Engineering
https://responsive-engineering.com

Salem Tube International
https://salemtube.net

Manufacturer

Specialist Machine Developments (SMD)
https://www.smd.co.uk

Subsea Innovation
https://www.subsea.co.uk

Tharsus / Universal Wolf
https://tharsus.com

Union Electric Steel UK
http://www.uniones.com

Renewable Energy

Agiletek Engineering (part of Tekmar)
https://investors.tekmar.co.uk

TechnipFMC
https://www.technipfmc.com

IT, Software & Digital Media

Opencast Software
https://opencastsoftware.com

PROTO
https://www.proto.co.uk

SCADA Ltd
https://scada-international.com

A3. Stimulus Organisations

Governments and Public Agencies

Darlington Borough Council
https://www.darlington.gov.uk

Department for Business and Trade (DBT)
https://www.gov.uk/government/organisations/department-for-business-and-trade

Environment Agency
https://www.gov.uk/government/organisations/environment-agency

Institute for Apprenticeships and Technical Education
https://www.instituteforapprenticeships.org

Invest Newcastle
https://investnewcastle.com

Invest North East England
https://investnortheastengland.co.uk

NEPO
https://www.nepo.org

Newcastle City Council NCLEUS
https://ncleus.com

Newcastle Gateshead Initiative
https://www.ngi.org.uk

Governments and Public Agencies

North East Local Enterprise Partnership (North East LEP)
https://www.northeastlep.co.uk

North of Tyne Combined Authority
https://www.northoftyne-ca.gov.uk

Northern Powerhouse Industrial Strategy
https://northernpowerhouse.gov.uk

Salix
https://www.salixfinance.co.uk

South Tyneside Council - Construction and technical services
https://www.southtyneside.gov.uk

Stockton Borough Council
https://www.stockton.gov.uk

Tees Valley Combined Authority
https://teesvalley-ca.gov.uk

UK Research and Innovation (UKRI) - Innovate UK
https://www.ukri.org/councils/innovate-uk

Industry Associations and Professional Institutes

Association for Project Safety - Region: England North
https://www.aps.org.uk

Association of Project Managers - North East Branch
https://www.apm.org.uk

British Association of Construction Heads (BACH)
https://bach.ac.uk

Chartered Association of Building Engineers https://cbuilde.com

Chartered Institute of Architectural Technologists - Northern Region
https://architecturaltechnology.com

Chartered Institute of Building - CIOB Academy North England
https://www.ciobacademy.org/?s=bim&post_type=product&type_aws=true

Chartered Institution of Civil Engineering Surveyors
https://www.cices.org

Chartered Institution of Highways and Transport
https://www.ciht.org.uk

Civil Engineering Contractors Association
https://www.ceca.co.uk/

Developing Consensus
http://www.developingconsensus.com

Institute of Water
https://instituteofwater.org.uk

Institution of Civil Engineers - North East
https://www.ice.org.uk

Industry Associations and Professional Institutes

Landscape Institute
https://www.landscapeinstitute.org

National Association of Women in Construction
https://www.nawic.co.uk

NIMA (formerly the UK BIM Alliance)
https://wearenima.im

North of England Institute of Mining and Mechanical Engineers
https://mininginstitute.org.uk

Northern Counties Builders Federation
https://www.ncbf.uk/

Royal Institute of British Architects - North East
https://www.architecture.com/my-local-riba/riba-north-east

Royal Institution of Chartered Surveyors
https://www.rics.org/

Royal Town Planning Institute - North East
https://www.rtpi.org.uk/find-your-rtpi/rtpi-english-regions/rtpi-north-east

The British Machine Vision Association
https://www.bmva.org

The Federation of Small Business
https://www.fsb.org.uk

The Institution of Structural Engineers
https://www.istructe.org

Catalysts and Incubators

Advance Northumberland
https://www.advancenorthumberland.co.uk

Centre For Process Innovation Limited (CPI) https://www.uk-cpi.com

Digital Catapult - North East Tees Valley region https://www.digicatapult.org.uk/about/regions/northern-east-tees-valley

Darlington Innovation Centre
https://darlingtonworkspace.co.uk/innovation-central-darlington

Dynamo North East
https://www.dynamonortheast.co.uk

Ignite North East
https://ignite.io

Make UK Modular
https://www.makeuk.org/about/make-uk-modular

Materials Processing Institute
https://www.mpiuk.com

Ministry of Building Innovation and Education (MOBIE)
https://www.mobie.org.uk

One Voice
https://cene.org.uk/onevoice

ORE Catapult - National Renewable Energy Centre
https://ore.catapult.org.uk

RTC North
https://www.rtcnorth.co.uk

Catalysts and Incubators

Durham City Incubator
https://dcincubator.co.uk

Durham University - Venture Lab
https://www.durham.ac.uk/study/careers-employability-enterprise/our-services/start-new-ventures/explore-ideas-and-launch-new-ventures/hazan-venture-lab

Newcastle Helix
https://newcastlehelix.com

North East Business and Innovation Centre
https://www.ne-bic.co.uk

North East Technology Park (NETPark)
https://www.northeasttechnologypark.com

Sunderland Software City
https://www.sunderlandsoftwarecity.com

Investors

F W Capital
https://fwcapital.co.uk

North Star Ventures
https://northstarventures.co.uk

Networks

Building Equality
https://www.buildingequalityuk.com

Built Environment Networking
https://www.built-environment-networking.com

Business in the Community
https://www.bitc.org.uk/leadership-teams/leadership-boards/north-east-leadership-board

Constructing Excellence in the North East
https://cene.org.uk

Construction Alliance North East
https://www.constructionalliancenortheast.co.uk

Construction Industry Council North East
https://www.cic.org.uk

Construction Innovation Hub
https://constructioninnovationhub.org.uk

Generation for Change (G4C)
https://cene.org.uk/g4c/g4c-north-east

International Centre for Connected Construction (IC3)
https://www.northumbria.ac.uk/business-services/engage-with-us/international-centre-for-connected-construction

Innovation SuperNetwork North East England https://supernetwork.org.uk

Networks

Net Zero Hub
https://www.neynetzerohub.com

Net Zero North East
https://www.netzeronortheastengland.co.uk

Newcastle College Group
https://www.ncgrp.co.uk

Super Innovation Network
https://supernetwork.org.uk

Women in BIM
https://womeninbim.org

Research

Durham University Engineering Research - Advanced Materials, Electronics & Communications
https://www.durham.ac.uk/departments/academic/engineering/research/challenges/advanced-materials-electronics--communications

Durham University Engineering Research - Future En-ergy Systems
https://www.durham.ac.uk/departments/academic/engineering/research/challenges/future-energy-sysytems

Durham University Engineering Research - Sustainable Infrastructure
https://www.durham.ac.uk/departments/academic/engineering/research/challenges/sustainable-infrastructure

Hub for Biotechnology in the Built Environment http://bbe.ac.uk

National Innovation Centre for Ageing (NICA) https://uknica.co.uk

National Innovation Centre for Data (NICD)
https://www.nicd.org.uk

Newcastle University - Architecture Research Collabo-rative (ARC)
https://www.ncl.ac.uk/apl/research/arc

Newcastle University Research Group - Digital Construction
https://www.ncl.ac.uk/engineering/research/civil-engineering/geotechnics-structures/digital-construction

Newcastle University Research Group - Electrical Engineering
https://www.ncl.ac.uk/engineering/research/electrical-electronic-engineering

Newcastle University Research Group - Geotechnical and Structural Engineering
https://www.ncl.ac.uk/engineering/research/civil-engineering/geotechnics-structures

Newcastle University Research Group - Mechanical Engineering
https://www.ncl.ac.uk/engineering/research/mechanical-engineering

Research

Northumbria University Digital Built Environment Research Group (DigiBE)
https://www.northumbria.ac.uk/about-us/academic-departments/architecture-and-built-environment/research/built-environment-digital-futures

Northumbria University Sustainable Construction Futures
https://www.northumbria.ac.uk/about-us/academic-departments/architecture-and-built-environment/research/construction-technology-process-and-management

The National Green Infrastructure Facility
https://www.ukcric.com/how-we-can-help/facilities/national-green-infrastructure-facility

A4. Education and Training Providers

Adult Learning and Bootcamps

Gateshead College - Construction & Built Environment
https://www.gateshead.ac.uk/im-an-adult/skills-bootcamp-green-skills

Learning Curve Group
https://www.learningcurvegroup.co.uk/

New College Durham (NCD)
https://www.newcollegedurham.ac.uk/adults/bootcamp/skills-bootcamps-in-green-skills

Redcar and Cleveland College
https://www.cleveland.ac.uk/skills-bootcamps

Apprenticeships

Bishop Auckland College - Construction and Motor Vehicle Department
https://www.lcwc.ac.uk/courses/t-levels/construction

Darlington College
https://darlington.ac.uk

Education Partnership North East
https://educationpartnershipne.ac.uk

Gateshead College - Plan BEE
https://www.gateshead.ac.uk/planbee

Hartlepool College of Further Education
https://www.hartlepoolfe.ac.uk

Learning Curve Group
https://www.learningcurvegroup.co.uk

Middlesbrough College
https://www.mbro.ac.uk

New College Durham (NCD)
https://www.newcollegedurham.ac.uk/adults/bootcamp/skills-bootcamps-in-green-skills

North East Institute of Technology (NEIoT)
https://neiot.ac.uk/subjects/construction

Northumbria University - Architecture and Built Environment
https://www.northumbria.ac.uk/study-at-northumbria/courses/master-of-architecture-degree-apprenticeship-dtpara1

Sunderland College - Construction & Building Services
https://sunderlandcollege.ac.uk/courses/school-leaver/vocational-courses/construction-building-services

Technical Level Courses

Darlington College
https://darlington.ac.uk

Education Partnership North East
https://educationpartnershipne.ac.uk

Gateshead College - Construction & Built Environment
https://www.gateshead.ac.uk/courses/t-level-in-architectural-design-and-surveying

Hartlepool College of Further Education
https://www.gateshead.ac.uk/courses/t-level-in-architectural-design-and-surveying

Learning Curve Group
https://www.learningcurvegroup.co.uk/courses/learners/level-3-diploma-in-engineering-and-technology-rail-pathway

Middlesbrough College
https://www.mbro.ac.uk

New College Durham (NCD)
https://www.newcollegedurham.ac.uk/courses/construction-civil-engineering/level-3-national-diploma-in-construction-and-the-built-environment

Technical Level Courses

North East Institute of Technology (NEIoT)
https://neiot.ac.uk/subjects/construction

Stockton Riverside College
- Construction Programme
https://www.stockton.ac.uk/construction

Sunderland College
- Construction & Building Services
https://sunderlandcollege.ac.uk/courses/school-leaver/vocational-courses/construction-building-services

University and Colleges (HNC, HND, Bachelors, Masters)

Darlington College
https://darlington.ac.uk/courses/construction-and-building-trades

Durham University
- Department of Engineering
https://www.durham.ac.uk/departments/academic/engineering/postgraduate-study/taught-courses

Hartlepool College of Further Education
https://www.gateshead.ac.uk/courses/t-level-in-architectural-design-and-surveying

Gateshead College
- Construction & Built Environment
https://www.gateshead.ac.uk/subjects/construction-built-environment

Middlesbrough College
https://www.mbro.ac.uk

New College Durham (NCD)
https://www.newcollegedurham.ac.uk/courses/construction-civil-engineering/hnc-architectural-technology

Newcastle University
- Engineering Department
https://www.ncl.ac.uk/engineering

Newcastle University - Transport Engineering, Planning and Management
https://www.ncl.ac.uk/postgraduate/degrees/5440f

Newcastle University - Renewable Energy, Enterprise and Management
https://www.ncl.ac.uk/postgraduate/degrees/5160f

Northumbria University
- Architecture and Built Environment
https://www.northumbria.ac.uk/study-at-northumbria/courses/construction-project-management-with-bim-with-advanced-practice-msc-ft-dtscjp6

Teesside University
- Engineering & Construction
https://www.tees.ac.uk

Continuing Professional Development

Autodesk
https://www.autodesk.co.uk

BIM Academy
https://www.bimacademy.global

Class of Your Own
https://www.classofyourown.com/

Chartered Association of Building Engineers
https://cbuilde.com

Chartered Institute of Architectural Technologists - Northern Region
https://architecturaltechnology.com

Chartered Institute of Building - CIOB Academy North England
https://www.ciobacademy.org/?s=bim&post_type=product&type_aws=true

Chartered Institution of Civil Engineering Surveyors
https://www.cices.org

Chartered Institution of Highways and Transport
https://www.ciht.org.uk

Expedient Training Services
https://www.expedient-training.co.uk

Fire Logistics Ltd
https://www.firelogistics.co.uk

Gateshead College - Construction & Built Environment
https://www.gateshead.ac.uk/subjects/construction-built-environment

HLA Services Ltd
https://hlaservices.co.uk/services

IKM Testing UK Ltd
https://www.ikm.com/courses/category3191.html

Institute of Water
https://instituteofwater.org.uk/uk-water-industry-course

Institution of Structural Engineers
https://www.istructe.org

Learning Curve Group
https://www.learningcurvegroup.co.uk/

Institution of Civil Engineers - North East
https://www.ice.org.uk

Landscape Institute
https://www.landscapeinstitute.org

Middlesbrough College
https://www.mbro.ac.uk

National Association of Women in Construction
https://www.nawic.co.uk

NETA Training Group
https://www.neta.co.uk/home

New College Durham (NCD)
https://www.newcollegedurham.ac.uk/adults/bootcamp/skills-bootcamps-in-green-skills

North of England Institute of Mining and Mechanical Engineers
https://mininginstitute.org.uk

Royal Institute of British Architects - North East
https://www.architecture.com/my-local-riba/riba-north-east

Continuing Professional Development

Royal Institution of Chartered Surveyors
https://www.rics.org

Royal Town Planning Institute - North East
https://www.rtpi.org.uk/find-your-rtpi/rtpi-english-regions/rtpi-north-east

Sunderland College - Construction & Building Services
https://sunderlandcollege.ac.uk/courses/school-leaver/vocational-courses/construction-building-services

TCS CAD & BIM Solutions
https://www.cadservices.co.uk

Teesside University - Engineering & Construction
https://www.tees.ac.uk

Agencies

British Association of Construction Heads (BACH)
https://bach.ac.uk

Construction Industry Training Board
https://www.citb.co.uk

Engineering Construction Industry Training Board
https://www.ecitb.org.uk

Newcastle College Group
https://www.ncgrp.co.uk

North East Local Enterprise Partnership, Northern Skills Advisory Panel
https://www.northeastlep.co.uk/31149-2

References

1 **OECD, "The Measurement of Scientific and Technological Activities: Proposed Guidelines for Collecting and Interpreting Technological Innovation Data, Oslo Manual", n.d.** https://www.oecd.org/science/inno/2367614.pdf

2 **Department for Business & Trade and Department for Business, Energy & Industrial Strategy, "Policy Paper: Construction Sector Deal", 22 July 2019.** https://www.gov.uk/government/publications/construction-sector-deal/construction-sector-deal

3 **North East Combined Authority,** https://northeastca.gov.uk

4 **North East Local Enterprise Partnership, "Welcome to North East England, a place that works".** https://www.northeastlep.co.uk/about-us/north-east-england

5 **North East Evidence Hub, "Business engagement in innovation",** https://evidencehub.northeastlep.co.uk/report/business-engagement-innovation

6 **UK Department for Business, Energy & Industrial Strategy, "Industrial Strategy: building a Britain fit for the future", 27 November 2017.** https://www.gov.uk/government/publications/industrial-strategy-building-a-britain-fit-for-the-future

7 **Constructing Excellence, "One Voice – Driving Change: north East Construction Strategy 2020 – 2025".** https://cene.org.uk/wp-content/uploads/2021/09/One_Voice_Strategy_low_res-1.pdf

8 **Net Zero North East England,** https://www.netzeronortheastengland.co.uk

9 **North of Tyne Combined Authority, "Just Transition in the North of Tyne".** https://www.northoftyne-ca.gov.uk/projects/just-transition-in-the-north-of-tyne

10 **North East Evidence Hub, "Exploring Apprenticeships in the North East LEP area",** https://evidencehub.northeastlep.co.uk/exploring-apprenticeships-in-the-north-east

11 **North East Evidence Hub,** https://evidencehub.northeastlep.co.uk

12 **North East Evidence Hub, "Digital Technology Evidence Base",** https://evidencehub.northeastlep.co.uk/digital-technology-evidence-base

13 **North East Evidence Hub, “Advanced Manufacturing Evidence Base”,** https://evidencehub.northeastlep.co.uk/advanced-manufacturing-evidence-base

14 **Companies House, Free Company Data Product,** http://download.companieshouse.gov.uk/en_output.html

15 XBIM, https://xbim.net

16 **CITB Construction Skills Network, “The Skills Construction Needs: North East Five Year Outlook 2022 – 2027”.** https://www.citb.co.uk/media/a3pdcfop/csn-lmi-north-east.pdf

17 **Office of National Statistics, Dataset A01: Summary of labour market statistics, 15 August 2023.** https://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/employmentandemployeetypes/datasets/summaryoflabourmarketstatistics

18 **Constructing Excellence, “Comparing Value Across England and Wales”, 2022.** https://constructingexcellence.org.uk/wp-content/uploads/2022/07/Comparing-Value-Across-England-and-Wales.pdf

19 **CITB Construction Skills Network, “The Skills Construction Needs: North East Five Year Outlook 2022 – 2027”.** https://www.citb.co.uk/media/a3pdcfop/csn-lmi-north-east.pdf

20 **North East Evidence Hub, “GVA by industry: How different sectors contribute to the value of the goods and services produced in North East”, 18 July 2022.** https://evidencehub.northeastlep.co.uk/report/gva-industry

21 **Office of National Statistics, “Output in the construction industry: sub-national and sub-sector”, 11 August 2023.** https://www.ons.gov.uk/businessindustryandtrade/constructionindustry/datasets/outputintheconstructionindustrysubnationalandsubsector

22 **CITB Construction Skills Network, “The Skills Construction Needs: North East Five Year Outlook 2022 – 2027”.** https://www.citb.co.uk/media/a3pdcfop/csn-lmi-north-east.pdf

23 **CITB Construction Skills Network, “The Skills Construction Needs: North East Five Year Outlook 2022 – 2027”.** https://www.citb.co.uk/media/a3pdcfop/csn-lmi-north-east.pdf

24 **CITB Construction Skills Network, “The Skills Construction Needs: North East Five Year Outlook 2022 – 2027”.** https://www.citb.co.uk/media/a3pdcfop/csn-lmi-north-east.pdf

25 **Office of National Statistics, "Output in the construction industry: sub-national and sub-sector", 11 August 2023.** https://www.ons.gov.uk/businessindustryandtrade/constructionindustry/datasets/outputintheconstructionindustrysubnationalandsubsector

26 **Office of National Statistics, North East, Facts and figures about people living in the North East.** https://www.ons.gov.uk/visualisations/areas/E12000001

27 **Constructing Excellence, "Comparing Value Across England and Wales", 2022.** https://constructingexcellence.org.uk/wp-content/uploads/2022/07/Comparing-Value-Across-England-and-Wales.pdf

28 **North East Evidence Hub, "GVA by industry: How different sectors contribute to the value of the goods and services produced in North East", 18 July 2022.** https://evidencehub.northeastlep.co.uk/report/gva-industry

29 **North East Evidence Hub, "Productivity by industry: Data on output per hour in the North East region by sector", 30 March 2023,** https://evidencehub.northeastlep.co.uk/report/productivity-by-industry

30 **Office of National Statistics, "Output in the construction industry: sub-national and sub-sector", 11 August 2023.** https://www.ons.gov.uk/businessindustryandtrade/constructionindustry/datasets/outputintheconstructionindustrysubnationalandsubsector

31 **Office of National Statistics, Construction statistics, Great Britain: 2021, 18 November 2022.** https://www.ons.gov.uk/businessindustryandtrade/constructionindustry/articles/constructionstatistics/2021

32 **Department for Business & Trade and Department for Business, Energy & Industrial Strategy, "Policy Paper: Construction Sector Deal", 22 July 2019.** https://www.gov.uk/government/publications/construction-sector-deal/construction-sector-deal

33 **North East Combined Authority,** https://northeastca.gov.uk

34 **The Building Safety Act requires that duty holders and Accountable Persons for buildings to create and maintain a golden thread of information, throughout a building's life cycle. The golden thread is both:**
- **the information about a building that allows someone to understand a building and keep it safe, and**
- **the information management to ensure the information is accurate, easily understandable, can be accessed by those who need it and is up to date.**

More information at: https://www.gov.uk/government/publications/building-regulations-advisory-committee-golden-thread-report/building-regulations-advisory-committee-golden-thread-report

35 **Department for Business & Trade and Department for Business, Energy & Industrial Strategy, "Policy Paper: Construction Sector Deal", 22 July 2019.** https://www.gov.uk/government/publications/construction-sector-deal/construction-sector-deal

36 **North East Combined Authority,** https://northeastca.gov.uk

37 **UKRI, "Regional SME innovation clusters to receive up to £75m boost to economies", October 2023.** https://www.ukri.org/news/regional-sme-innovation-clusters-to-receive-up-to-75m-boost-to-economies

38 **Tolent, a construction company with £200m in revenues in 2021, and Metnor Construction, which reported £63m in revenues in 2022. Both firms suffered from the knock-on effects of the collapse of other developers, contractors, and supply chain partners. Begbies Traynor Group, "Construction sector woes deepen as lag effect of inflation spike erodes wafer-thin margins", 22 June, 2023.** https://www.begbies-traynorgroup.com/construction-sector-woes-deepen-as-lag-effect-of-inflation-spike-erodes-wafer-thin-margins

39 **Department for Business & Trade and Department for Business, Energy & Industrial Strategy, "Policy Paper: Construction Sector Deal", 22 July 2019.** https://www.gov.uk/government/publications/construction-sector-deal/construction-sector-deal

40 **Cabinet Office, "Government Construction Strategy", 31 May 2011.** https://www.gov.uk/government/publications/government-construction-strategy

41 **UK BIM Framework,** https://www.ukbimframework.org

42 **The Minister for the Cabinet Office acting through Crown Commercial Service, Offsite Construction Solutions, 22 December 2021,** https://www.find-tender.service.gov.uk/Notice/032155-2021

43 B**uilding Safety Act 2022,** https://www.legislation.gov.uk/ukpga/2022/30/contents/enacted

44 **UK Net Zero Carbon Buildings Standard,** https://www.nzcbuildings.co.uk

45 **UK Department for Environment, Food & Rural Affairs, "Understanding Biodiversity Net Gain",** https://www.gov.uk/guidance/understanding-biodiversity-net-gain

46 **Part Z,** https://part-z.uk

47 **MakeUK, Manufacturing Sector net Zero Roadmap, 24 January 2022.** https://www.makeuk.org/insights/reports/manufacturing-sector-net-zero-roadmap

48 **UK Department for Energy Security and Net Zero, "£1.8 billion awarded to boost energy efficiency and cut emissions of homes and public buildings across England", 22 March 2023.**
https://www.gov.uk/government/news/18-billion-awarded-to-boost-energy-efficiency-and-cut- emissions-of-homes-and-public-buildings-across-england

49 **Esh Group,** https://www.eshgroup.co.uk

50 **Grainger plc,** https://www.graingerplc.co.uk

51 **Northumbria Healthcare Facilities Management,** https://nhfm.co.uk

52 **Equans,** https://www.equans.co.uk

53 **Magnet,** https://www.magnet.co.uk

54 **Northumbria Healthcare Facilities Management,** https://nhfm.co.uk

55 **Esh Group,** https://www.eshgroup.co.uk

56 **Karbon Homes,** https://www.karbonhomes.co.uk

57 **NBS Enterprises,** https://www.thenbs.com

58 **Causeway Technologies,** https://www.causeway.com

59 **Viewpoint construction software,** https://www.viewpoint.com/en-gb/?selected-locale=en_gb

60 **Thinking digital,** https://thinkingdigital.co.uk

61 **BIM Show Live,** http://www.bimshowlive.co.uk

62 **CITB Construction Skills Network, "The Skills Construction Needs: North East Five Year Outlook 2022 – 2027".**
https://www.citb.co.uk/media/a3pdcfop/csn-lmi-north-east.pdf

63 **Constructing Excellence, Construction KPIs Annual Report.** https://constructingexcellence.org.uk/kpi-reports

64 **Building Safety Act 2022,** https://www.legislation.gov.uk/ukpga/2022/30/contents/enacted

65 **North East Evidence Hub, "Digital Technology Evidence Base",** https://evidencehub.northeastlep.co.uk/digital-technology-evidence-base

66 **UKRI, "Regional SME innovation clusters to receive up to £75m boost to economies", October 2023.**
https://www.ukri.org/news/regional-sme-innovation-clusters-to-receive-up-to-75m-boost-to-economies

67 **North East Automotive Alliance, "North East Automotive Sector",** https://northeastautomotivealliance.com/automotive-sector

68 **North East Evidence Hub, "Emergent Markets - Autonomous and Electric Vehicles".**
https://evidencehub.northeastlep.co.uk/emergent-markets-autonomous-and-electric-vehicles

69 **Komatsu UK,** https://www.komatsu.eu/en/company/komatsu-uk

70 **Hitachi Construction Machinery (UK) Ltd.,** https://www.hitachicm.co.uk/?utm_source=organic&utm_medium=local&utm_campaign=hebburn

71 **Caterpillar UK,** https://www.caterpillar.com

72 **North East Automotive Alliance,** https://northeastautomotivealliance.com

73 **UKRI, "Regional SME innovation clusters to receive up to £75m boost to economies", October 2023.**
https://www.ukri.org/news/regional-sme-innovation-clusters-to-receive-up-to-75m-boost-to-economies

74 **Offshore Renewable Energy Centre (ORE Catapult),** https://ore.catapult.org.uk

75 **British Geological Survey, Directory of Mines and Quarries, 2020.**
https://www2.bgs.ac.uk/mineralsuk/download/dmq/Directory_of_Mines_and_Quarries_2020.pdf

76 **Ashcourt Group, Aycliffe Quarry,** https://ashcourt.com/aycliffe-quarry

77 **OneVoice,** https://cene.org.uk/onevoice

78 **International Centre for Connected Construction,**
https://www.northumbria.ac.uk/business-services/engage-with-us/international-centre-for-connected-construction

79 **Developing Consensus,** http://www.developingconsensus.com

80 **North East Combined Authority,** https://northeastca.gov.uk

81 **Constructing Excellence in the North East,** https://cene.org.uk

82 **North East and Yorkshire Net Zero Hub,** https://www.neynetzerohub.com

83 **Net Zero North East England,** https://www.netzeronortheastengland.co.uk

84 **UK Green Building Council,** https://ukgbc.org

85 **Durham University,** https://www.durham.ac.uk

86 **Newcastle University,** https://www.ncl.ac.uk

87 **Northumbria University,** https://www.northumbria.ac.uk

88 **Teesside University,** https://www.tees.ac.uk

89 **Centre for Process Innovation,** https://www.uk-cpi.com

90 **International Centre for Connected Construction,**
https://www.northumbria.ac.uk/business-services/engage-with-us/international-centre-for- connected-construction

91 **Hub for Biotechnology in the Built Environment,** http://bbe.ac.uk

92 **Arup and Material Cultures, “Circular Biobased Construction in the North East and Yorkshire’, 2021.**
https://www.ynylep.com/Portals/0/adam/Stories/dZPBWh5Fz0mcAqqNaH1neA/Body/211015_MC2105_NEY_REPORT_FINAL_ISSUE_SPREADS_COMPRESSED-1.pdf

93 **Materials Processing Institute,** https://www.mpiuk.com

94 **Northumbria University, Construction, Technology, Process and Management research group,**
https://www.northumbria.ac.uk/about-us/academic-departments/architecture-and-built-environment/research/construction-technology-process-and-management

95 **Centre for Process Innovation,** https://www.uk-cpi.com

96 **Offshore Renewable Energy Centre,** (ORE Catapult), https://ore.catapult.org.uk

97 **North East Technology Park,** https://www.northeasttechnologypark.com

98 **Darlington Innovation Centre,** https://darlingtonworkspace.co.uk/innovation-central-darlington

99 **Cushman & Wakefield UK Industrial Market Beat Q2 2023,** https://cw-gbl-gws-prod.azureedge.net/-/media/cw/marketbeat-pdfs/2023/q2/emea/2023_q2_uk_li_marketbeat.pdf?rev=958e660cf5874d22a67ce2f11e39a9a0

100 **Newcastle Helix,** https://newcastlehelix.com

101 **The Faraday Institution,** https://www.faraday.ac.uk

102 **Offshore Renewable Energy Centre (ORE Catapult),** https://ore.catapult.org.uk

103 **"NBS joins Byggfakta to bolster growth", 2020.** https://www.thenbs.com/about-nbs/press-releases/nbs-joins-byggfakta-to-bolster-growth

104 **Business Live, "SpecifiedBy snapped up by Causeway in second major North East deal in a week", 2021.** https://www.business-live.co.uk/enterprise/specifiedby-snapped-up-causeway-second-21872710

105 **North of Tyne Combined Authority,** https://www.northoftyne-ca.gov.uk

106 **North of Tyne Combined Authority funding opportunities,** https://www.northoftyne-ca.gov.uk/support/funding-opportunities

107 **North of Tyne Combined Authority, "North of Tyne 'Brownfield' investment aids delivery of 231 new homes in Newcastle", October 2022.** https://www.northoftyne-ca.gov.uk/news/greatwall

108 **North East Growth Hub Made Smarter Adoption North East** https://www.northeastgrowthhub.co.uk/scheme/finance-and-funding/made-smarter-adoption-north-east

109 **Innovate UK Bridge AI,** https://iuk.ktn-uk.org/programme/bridgeai

110 **Innovate UK KTN Opportunities,** https://iuk.ktn-uk.org/opportunities

111 **Northstar Ventures,** https://northstarventures.co.uk

112 **FW Capital,** https://fwcapital.co.uk

113 **North East Local Enterprise Partnership, The North East Commercial Property Investment Fund.**
https://www.northeastlep.co.uk/projects-and-funding/projects/the-north-east-commercial-property-investment-fund

114 **University of Cambridge, "Centre for Digital Built Britain completed its five-year mission and closed its doors at the end of September 2022".** https://www.cdbb.cam.ac.uk

115 **European Commission, European Regional Development Fund.** https://ec.europa.eu/regional_policy/funding/erdf_en

116 **Thermulon Aerogels,** https://www.thermulon.com

117 **Department for Levelling Up, Housing & Communities, UK Shared Prosperity Fund: prospectus,1 August 2022.**
https://www.gov.uk/government/publications/uk-shared-prosperity-fund-prospectus/uk-shared-prosperity-fund-prospectus

118 **Sunderland Software City,** https://www.sunderlandsoftwarecity.com

119 **UK Research and Innovation, Transforming Construction.**
https://www.ukri.org/what-we-do/our-main-funds-and-areas-of-support/browse-our-areas-of-investment-and-support/transforming-construction

120 **CITB Construction Skills Network, "The Skills Construction Needs: North East Five Year Outlook 2022 – 2027".**
https://www.citb.co.uk/media/a3pdcfop/csn-lmi-north-east.pdf

121 **CITB Construction Skills Network, "The Skills Construction Needs: North East Five Year Outlook 2022 – 2027".**
https://www.citb.co.uk/media/a3pdcfop/csn-lmi-north-east.pdf

122 **Niamh Foley, "Apprenticeship Statistics Briefing Paper, House of Commons Library, Number 06113, 30 March 2021.**
https://researchbriefings.files.parliament.uk/documents/SN06113/SN06113.pdf

123 **CITB Construction Skills Network, "The Skills Construction Needs: North East Five Year Outlook 2022 – 2027".**
https://www.citb.co.uk/media/a3pdcfop/csn-lmi-north-east.pdf

124 **CITB Construction Skills Network, “The Skills Construction Needs: North East Five Year Outlook 2022 – 2027”.**
https://www.citb.co.uk/media/a3pdcfop/csn-lmi-north-east.pdf

125 **Niamh Foley, “Apprenticeship Statistics Briefing Paper, House of Commons Library, Number 06113, 30 March 2021.**
https://researchbriefings.files.parliament.uk/documents/SN06113/SN06113.pdf

126 **UK Apprenticeship Statistics, House of Commons Library, 21 February 2023.**
https://commonslibrary.parliament.uk/research-briefings/sn06113

127 **North East Local Enterprise Partnership, Northern Skills Advisory Panel, “Local Skills Report”, March 2021.**
https://www.northeastlep.co.uk/wp-content/uploads/2021/05/NEL1080a-North-East-Skills-Advisory-Panel-Local-Skills-Report-v5.pdf

128 **Esh Group, “12 Apprentices Lay Career Foundations as Esh Construction Invests in the Future: Engineers, groundworkers and quantity surveyors are among the new recruits”, 7 October 2021.**
https://www.eshgroup.co.uk/news-social/12-apprentices-lay-career-foundations-as-esh-construction-invests-in-the-future

129 **Newcastle College Group.** https://www.ncgrp.co.uk

130 **Department of Education, “Find a Skills Bootcamp: North East”, August 2022.**
https://www.gov.uk/guidance/find-a-skills-bootcamp/north-east

131 **Gateshead College, BuildNE.** https://www.gateshead.ac.uk/im-unemployed/buildne

132 **Education Partnership North East.** https://educationpartnershipne.ac.uk

133 Staff Development Forum, Developing Excellent Practice. https://sdf.ac.uk

134 PlanBEE. https://www.gateshead.ac.uk/planbee

135 **Riverside Sunderland, “Housing Innovation and Construction Skills Academy (HICSA) - we want your views”.**
https://www.riversidesunderland.com/articles/housing-innovation-and-construction-skills-academy-hicsa-we-want-your-views

136 **Kostas Kollydas and Anne Green, "Graduate pathways: Identifying patterns of regional retention and attraction", West Midlands Regional Economic Development Institute (WMREDI) at the University of Birmingham, January 2022.** https://www.birmingham.ac.uk/documents/college-social-sciences/business/research/wm-redi/wm-redi-project-docs/theme-1/graduate-attraction-and-retention/17.12.2021-graduate-pathways-identifying-patterns-of-regional-retention-and-attraction-final.pdf

137 **Constructing Excellence, "One Voice – Driving Change: north East Construction Strategy 2020 – 2025".** https://cene.org.uk/wp-content/uploads/2021/09/One_Voice_Strategy_low_res-1.pdf

138 **Constructing Excellence, "Comparing Value Across England and Wales", 2022.** https://constructingexcellence.org.uk/wp-content/uploads/2022/07/Comparing-Value-Across-England-and-Wales.pdf

139 **Constructing Excellence, "ALL IN - Enhancing Built Environment Businesses Through Inclusion", conference brochure, 2022.** https://cene.org.uk/wp-content/uploads/2022/03/9168_All_In_Brochure_op.pdf

140 **Gateshead College, BuildNE.** https://www.gateshead.ac.uk/im-unemployed/buildne

141 **Class of Your Own.** https://www.classofyourown.com

142 **Estonian Digital Construction cluster.** https://estoniandcc.com

143 **Lambert Smith Hampton, Total Office Cost Summary (TOCS) 2022 Summary Cost Breakdown.** https://www.lsh.co.uk/-/media/files/lsh/research/2020/tocs2020data_v1

144 **Constructing Excellence, Construction KPIs Annual Report.** https://constructingexcellence.org.uk/kpi-reports

145 **Sunderland Software City,** https://www.sunderlandsoftwarecity.com

146 **Turner & Townsend, "Inspiring the Middle East's next generation of built environment professionals", 21 July 2023.** https://www.turnerandtownsend.com/en/news/inspiring-the-middle-east-s-next-generation-of-built-environment-professionals

147 **British Columbia Institute of Technology (BCIT), "BCIT launches pilot program to help high school students into the workforce", May 31, 2023.** https://commons.bcit.ca/news/2023/05/ace-microcredential

148 **Arup and Material Cultures, “Circular Biobased Construction in the North East and Yorkshire’, 2021.** https://www.ynylep.com/Portals/0/adam/Stories/dZPBWh5Fz0mcAqqNaH1neA/Body/211015_MC2105_NEY_REPORT_FINAL_ISSUE_SPREADS_COMPRESSED-1.pdf

149 **UKRI, “Regional SME innovation clusters to receive up to £75m boost to economies”, October 2023.** https://www.ukri.org/news/regional-sme-innovation-clusters-to-receive-up-to-75m-boost-to-economies

150 **Zero Emissions Building Exchange (ZEBx), Vancouver, Canada.** https://www.zebx.org

151 **Building Energy Exchange (BE-Ex), New York, USA.** https://be-exchange.org

152 **North East Local Enterprise Partnership, “Global North East: Driving growth in North East trade and exports, June 2021.** https://www.northeastlep.co.uk/wp-content/uploads/2021/06/North-East-trade-and-export-report_FINAL.pdf

153 **CIBSE Journal, “Hays 2022 Salary Survey: holding all the cards”, February 2022.** https://www.cibsejournal.com/general/hays-2022-salary-survey-holding-all-the-cards

154 **9b Careers, 2022 Architectural Salary Survey Results.** https://www.9bcareers.com/career-support/2022-architectural-salary-survey.aspx

155 **Bank of England, Monetary Policy Report - May 2023.** https://www.bankofengland.co.uk/monetary-policy-report/2023/may-2023#:~:text=Monetary%20Policy%20Summary-,Monetary%20Policy%20Summary,0.25%20percentage%20points%2C%20to%204.5%25

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