TEES VALLEY COMBINED AUTHORITY | TEES VALLEY MAYOR

ADVANCED MANUFACTURING

March 2018

Contents

1. Foreword

Introduction from Mike Matthews, Tees Valley Sector Champion

1.1 Our advanced manufacturing sector is a continuing source of pride and tradition to Tees Valley people. We are globally competitive, and have well established regional, national and international supply chains. However, my experience of the sector has taught me that we can't just rely on continuing to supply our existing customers. We need to diversify our customer base, by trading with a more and varied range of countries. Not only does this keep our order books full, but fresh competition motivates investment in innovation and also teaches us new skills and techniques to meet customer requirements.

1.2 Growing a business isn't easy, and needs to focus on the bottom line. This doesn't mean skimping on investment, but getting to grips with all aspects of the productivity challenge, whether it be people, plant or process. Getting these things right for all sizes of company will help us to be ambitious in entering new supply chains and markets.

1.3 This report identifies a wider number of actions, but my immediate priorities to help move the sector forward include:

- **Enhancing productivity:**
    - By addressing emerging skills constraints such as provision of technical apprenticeships, enhanced business training for leadership and addressing specific skills gaps related to BREXIT (for example a need for more international marketeers and capacity in customs clearance);
    - Ensuring better use of resources, through tightening supply chains, enhanced local sourcing and more investment in product and process innovation (circular economy opportunities); and
    - Provision of 'fit for purpose accommodation', that is easily accessible to main transport routes and international gateways, with affordable and reliable utilities and broadband.
- **Growing the sector:**
    - By encouraging greater collaboration between companies, so they can invest in innovation and gain access to more sophisticated supply chains;
    - A focus on attracting Tier 1 inward investment; and
    - Returning to productivity, the creation of a productivity measure for the sector and the region, which clearly demonstrates our international competitiveness.

'Tees Valley productivity rates should be our major selling point

to inward investors and potential customers.'

2. Introduction

2.1 The following report provides a high level summary of the scope and scale of opportunity for the advanced manufacturing sector in Tees Valley, as well as a preliminary list of indicative activities.

2.2 The report is based on the following consultation exercise:

- Survey: December 2016: 550 businesses (across all sectors engaged);
- Consultative interviews with sector champions and businesses; and
- 2 Focus Group sessions with businesses and stakeholders.

2.3 The choice and definition of sector for this report emerges from the findings of the Refreshed Tees Valley Strategic Economic Plan (SEP): The Industrial Strategy for Tees Valley 2016-2026, which identified the advanced manufacturing sector as a key priority.

2.4 The Advanced Manufacturing Sector Action in common with the other six priority sector action plans[1] will be updated annually through consultation with our key local partners.

Sector definition

2.5 Advanced manufacturing is broadly described as manufacturing that is intensive in terms of its use of capital and knowledge and utilises a high level of technology and research and development. It can apply to all manufacturing industries but tends to be associated with medium and high tech firms. Advanced manufacturing is more of a concept than a precisely defined sector and it is useful to maintain a broad definition to ensure that the Action Plan is sufficiently flexible to respond to future changes. Key areas include:

- Advanced materials;
- Low Carbon;
- Engineering Design; and
- Offshore Industries.

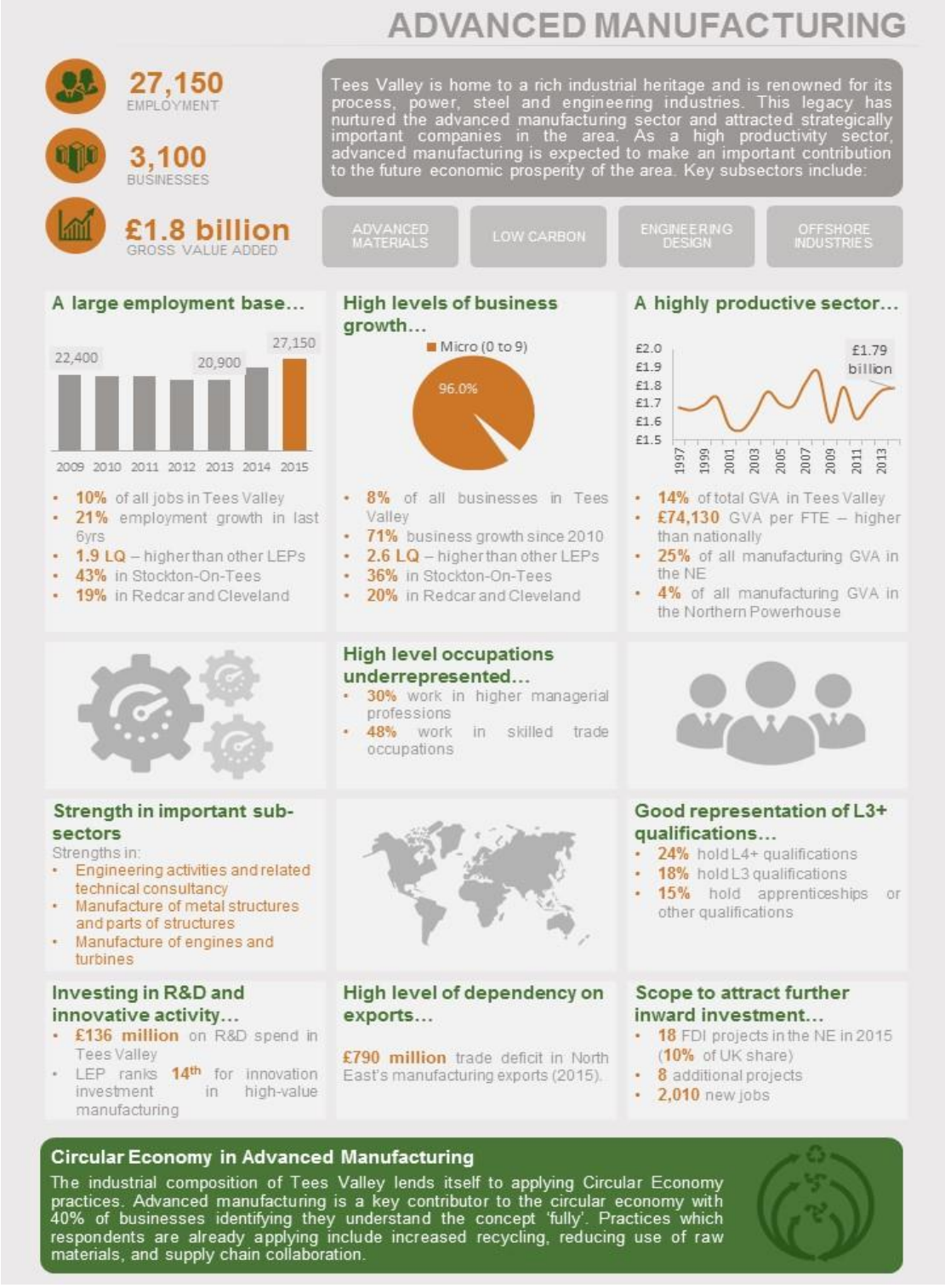
2.6 As a high productivity sector and one of four Northern Powerhouse prime strengths, Tees Valley's Advanced Manufacturing sector is expected to make an important contribution to the future economic prosperity of the area and the wider North, building on close links with the North East manufacturing base in key subsectors including: engineering design and subsea technologies. There are additional strengths in advanced materials, including composites, coating and polymers. These could provide important links to larger consumer based markets in Europe and elsewhere. Detailed sectoral definition contained in Appendix A.

Strategic Economic Plan (SEP) Target

2.7 The sector currently employs 27,150 FTEs in the Tees Valley with a GVA per head of £74,150, equating to £1.8 billion of output (14% of the Tees Valley economy). The SEP has a target of creating an additional 1,500 advanced manufacturing jobs and increasing GVA per hour by 30%.

[1] Process, chemicals and energy, logistics, health and biologics, digital and creative, culture and leisure and business and professional services.

Figure 2.1 Advanced Manufacturing in Tees Valley

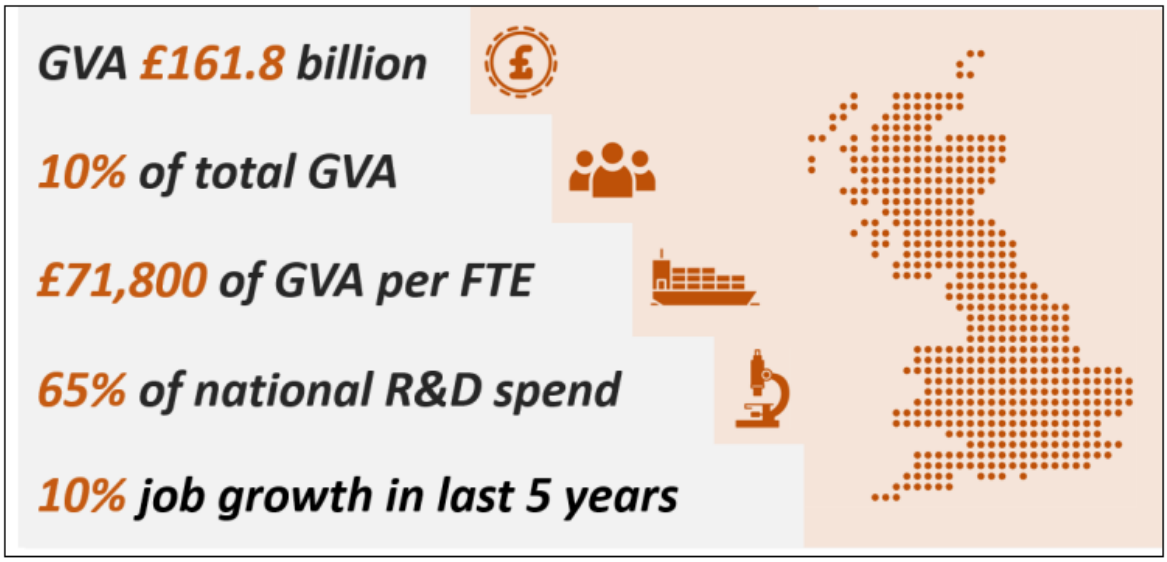


Source: Regeneris Consulting

3. How the sector compares

3.1 Nationally, the broad manufacturing sector in the UK is still highly productive and has been a net contributor to jobs growth and a focus for research and development:

Figure 3.1 Sector national positioning



Source: Regeneris

The sector makes a sizeable contribution to Tees Valley's economy but productivity improvements could be made…

3.2 The advanced manufacturing sector contributed £1.71 billion to the Tees Valley economy in 2015 accounting for 13% of total GVA. The sector makes a sizeable contribution to advanced manufacturing GVA in the North East region (32%) and to the Northern Powerhouse (7%). Relative to the national average the Tees Valley advanced manufacturing sector is on par with a GVA per FTE of £71,400 which is above the North East and Northern Powerhouse figure.

Table 3.1 Manufacturing economic contribution and productivity, 2015

	Tees Valley Combined Authority	North East	Northern Powerhouse	England
Manufacturing GVA	£1.71 billion	£6.93 billion	£46.28 billion	£138.65 billion
Manufacturing GVA (% of total GVA)	13.5%	14.0%	14.6%	9.7%
Manufacturing GVA per FTE	£71,400	£61,200	£69,900	£71,300
All sector (average) GVA per FTE	£56,100	£55,300	£57,600	£68,000

Source: ONS, Regional Accounts, 2015
Note: GVA data corresponds to the SIC (standard industrial classification) broad sector definition of manufacturing (C)

3.3 The latest data shows that as of 2014, output was still below the pre-recession peak, although the sector has been on a growth trajectory since 2011, expanding by 12% since 2008.

The Tees Valley Business Survey found that advanced manufacturing businesses have experienced average business performance in the last 12 months, with 37% of businesses reporting improved performance, 29% reporting stable performance and 29% reporting deterioration in performance. Key reasons for improved performance include **expansion into new markets, having a formal plan or growth strategy**, and an improvement in demand for advanced manufacturing outputs. Of those experiencing deterioration, the most commonly cited reason was the **decline in key supply chains.**

Improvements to productivity could be made through new product and process innovation, specifically in relation to the use of materials and greater supply chain diversification.

The advanced manufacturing sector employs 10% of the Tees Valley workforce, with approximately 17% of the business base:

3.4 Although the number of employees declined between 2009 and 2013, there was a net increase of 21% or around 4,750 employees between 2009 and 2015, with a total for the sector of 21,900 employees. This is due to significant increases in employment in 2014 and 2015 of around 3,700 and 2,550 employees respectively, corresponding with the general growth in economic output over the period. In comparison, the number of employees in the sector grew by 5% in the NPH and 6% in England, over the same period. Overall, the sector has grown relatively well since 2009 with a compound annual growth rate in employees of 2.8%. This compares to a 0.7% growth rate in the Northern Powerhouse and 0.9% in England.

Just over half of advanced manufacturing businesses (51%) reported recruiting new staff within the last 12 months in the Tees Valley Business Survey. This is slightly lower than the sector-wide level (56%). Principal workforce concerns relate to recruitment and retention of staff, particularly related to technical or practical skills (65%) and planning and organisational skills (35%). Sector feedback has identified that post BREXIT an enhanced need for international marketing skills and customs clearance experience.

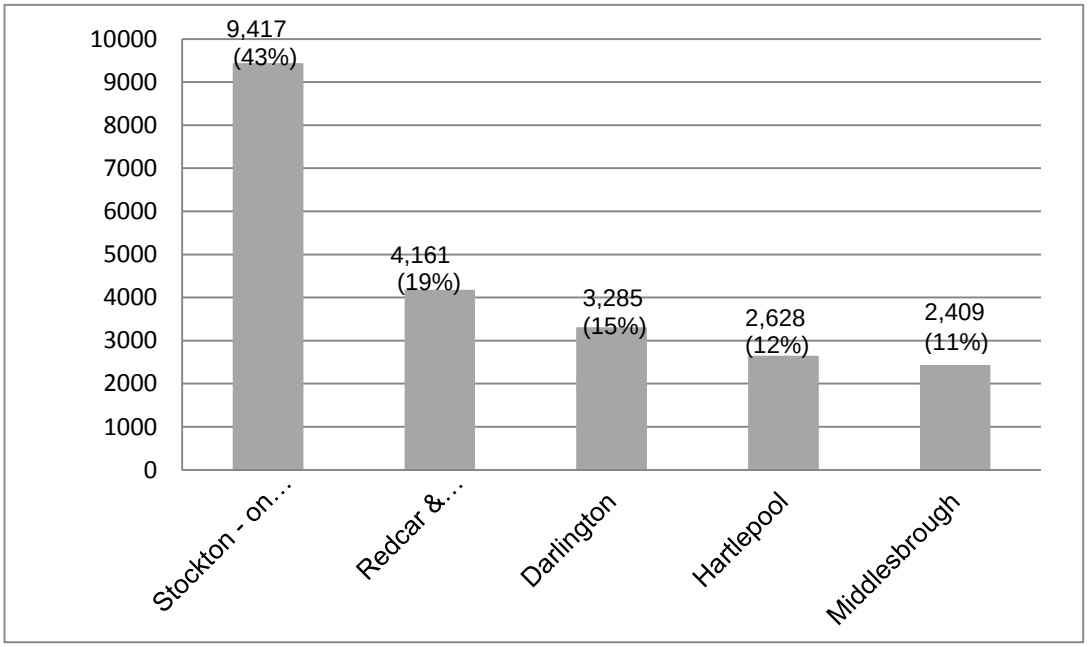
3.5 According to the ONS, there are currently 3,105 advanced manufacturing enterprises in the Tees Valley area, representing 8% and 2% of the advanced manufacturing business base in the Northern Powerhouse and England respectively. The number of businesses has steadily expanded over the years. The business base has grown by 71% since 2010 with most of this growth, just over 70%, achieved in 2014 and 2015.

3.6 Advanced manufacturing businesses in the Tees Valley area have an average of 9 employees per business. A large proportion of advanced manufacturing businesses in Tees Valley have fewer than 10 employees (96%). This is a much higher proportion than nationally (88%). By comparison, only 4% of advanced manufacturing businesses have over ten employees, compared to 12% nationally.

Although the business base is expanding, the overall proportion of jobs is not being maintained, with more local companies chasing fewer business opportunities. Although average business size is still higher than the national average, there is a need to **focus on those companies which have the greatest potential for growth**, as these tend to be both **''jobs rich and more productive''.**

3.7 At a local level, all local authorities, except Middlesbrough, have a greater concentration of employment in advanced manufacturing compared to nationally. The highest concentrations are in Redcar & Cleveland and Stockton-on-Tees, where advanced manufacturing accounts for 11% and 10% of all employment respectively.

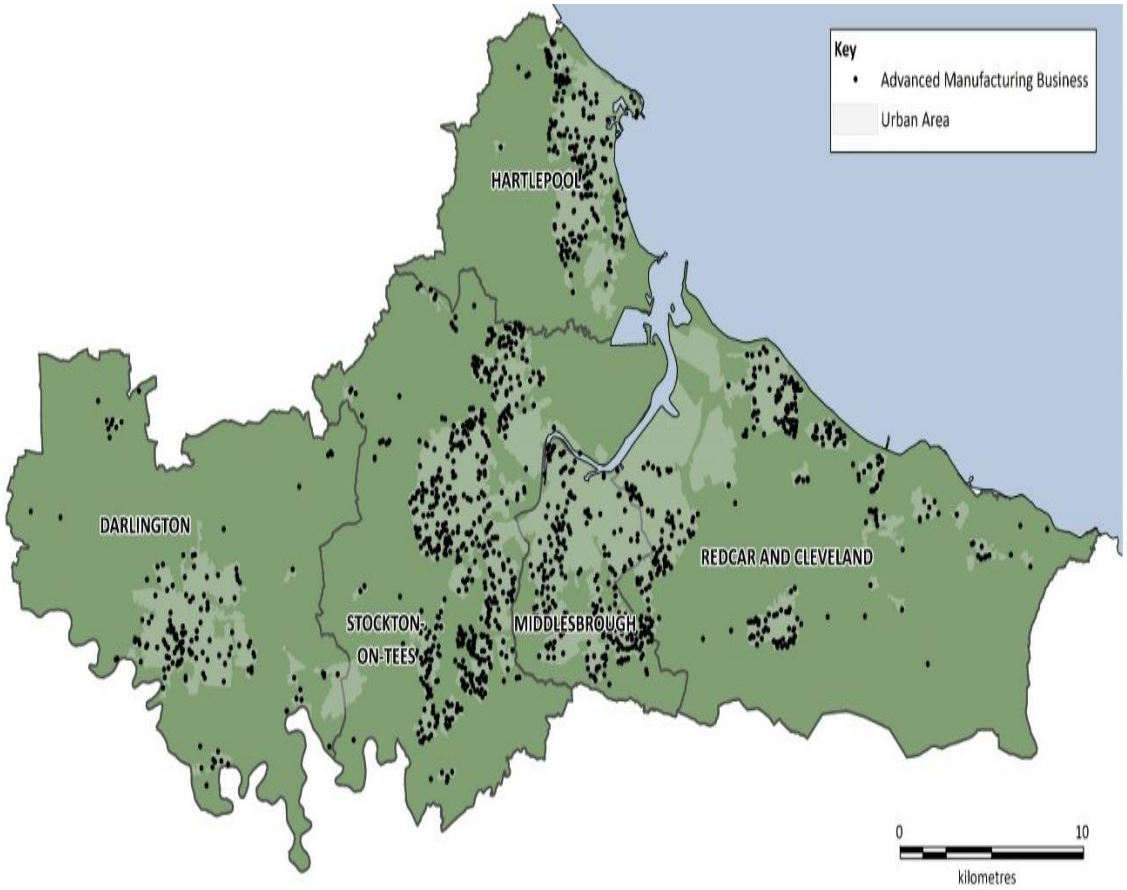
Figure 3.2 Number of advanced manufacturing employees by Tees Valley district, 2015



Source: ONS, 2016

3.8 The table below illustrates the location of all companies across the Tees Valley:

Figure 3.3 Location of Advanced Manufacturing Businesses



Source: FAME Database

3.9 Examples of larger advanced manufacturing businesses with HQ functions located in Tees Valley[2] include:

- Con Mech Group Ltd (300 employees, registered in Darlington);
- Elring Klinger Ltd (240 employees, registered in Redcar);
- Mech-Tool Engineering Ltd (190 employees, registered in Darlington); and
- Wilton Engineering Services Ltd (190 employees, registered in Middlesbrough).

3.10 Examples of large advanced manufacturing businesses (<250 employees) with HQ functions located outside Tees Valley include:

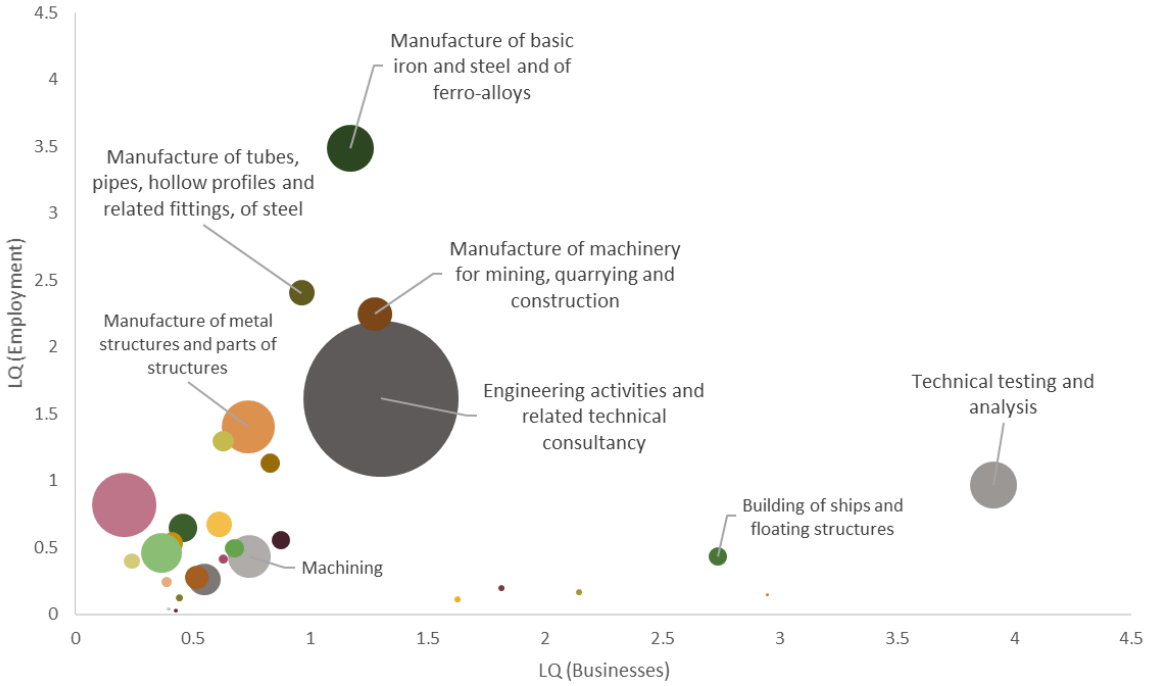
- British Steel – based in Redcar and Cleveland and HQ in Scunthorpe; and
- Nifco – based in Stockton on Tees and HQ in Tokyo.

[2] Source: FAME Database, 2016

Tees Valley has a number of sub-sector strengths…

3.11 The proportion of jobs relative to England as a whole reveals that the Tees Valley has employment and business concentrations in a number of advanced manufacturing sub-sectors including the manufacture of basic iron and steel and of ferro-alloys, technical testing and analysis, and engineering activities and related consultancy.

Figure 3.4 Proportion of Jobs by TVCA's advanced manufacturing sub-sectors



Source: ONS, 2016

Note: The size of the bubble is proportional to the amount of employment in the sub-sector. The location quotient compares the concentration of businesses and employment in the sub-sector in the TVCA area, relative to the concentration of businesses and employment in the sub-sector in England.

International Benchmarks

3.12 The UK has fallen down the world rank of manufacturing nations in the last decade, from the 5th biggest manufacturer in terms of total output between 1970 and 2004, the UK is now 9th.[3]

Country	Manufacturing output:		% of total output	% of world manufacturing
	$ billions	Per head, $		
China	1,882	1,400	28%	19%
United States	1,843	5,700	12%	19%
Japan	1,001	7,900	19%	10%
Germany	680	8,400	23%	7%
South Korea	369	7,400	30%	4%
India	290	200	17%	3%
France	267	4,000	11%	3%
Italy	257	4,300	15%	3%
UK	**247**	**3,800**	**11%**	**3%**
Taiwan	190	8,100	30%	2%
Mexico	170	1,400	18%	2%
Canada	150	4,200	11%	2%
Brazil	145	700	11%	1%
Russia	140	1,000	15%	1%
Spain	134	2,900	13%	1%
Turkey	120	1,600	18%	1%
Indonesia	110	400	22%	1%
Switzerland	95	11,600	19%	1%
Poland	94	2,400	19%	1%
Netherlands	87	5,200	12%	1%

Source: UN Conference on Trade and Development (UNCTAD)

There is potential for the sector to attract further inward investment, particularly through re-shoring of investments…

3.13 Recent national analysis of manufacturing have given careful attention to identifying those elements of advanced manufacturing systems with the most potential to capture significant value for the Tees Valley economy. This section reflects on these discussions, and distinguishes four advanced manufacturing perspectives that can be useful to characterise the investment need. We then go on to examine policy responses in competing investment hotspots.

[3] Source: House of Commons Briefing Paper, August 2016, Manufacturing – International Comparisons

Figure 2.5: Areas for New Investment

Source: Emerging trends in global advanced manufacturing: Challenges, Opportunities ad Policy Responses, University of Cambridge, (2016)

3.14 Focusing on these four areas, we can summarise some of the flagship policies used in competing Advanced Manufacturing Hotspots, including USA, Germany and China.

Table2.3: – Advanced Manufacturing Programmes in Competitor Economies					
Initiatives	**Description**	**Product Innovation**	**Process Innovation**	**Supply Chain**	**Customer Demand**
Manufacturing USA Institutes **(USA)**	Network of linked advanced manufacturing institutes aimed at addressing the investment gap in pre-competitive applied R&D, and de- risking new technology and material scale-up	**XX**	**XXX**	**X**	
National Manufacturing Innovation Centres **(China)**	Innovation centres focused on boosting technology and innovation in key areas such as next-generation ICT, smart manufacturing, new materials, additives and pharmaceuticals	**XX**	**XXX**	**XX**	
Cluster of Excellence in Integrative Production Technology for high-Wage Countries **(Germany)**	Manufacturing research cluster focused on new technologies required to address the future individualisation, hybridisation and self- optimisation of production.	**XX**	**XXX**	**X**	
Intelligent Technical Systems OstWestfalenLippe alliance **(Germany)**	Consortium of private and public technological innovation organisations that focus on key manufacturing digitalisation topics at the heart of Industry 4.0.	**X**	**XXX**	**X**	**XX**
Notes: xxx - primary emphasis xx - secondary emphasis x - miinor emphasis	**Product innovation** – competing on speed of new technology development **Process innovation** – competing on product mix flexibility and factory productivity **Supply Chain** – competing on reconfigurable supply chain capabilities **Customer demand** – competing on superior knowledge of demand and higher levels of satisfaction				

Source: Emerging trends in global advanced manufacturing: Challenges, Opportunities ad Policy Responses, University of Cambridge (2016)

3.15 For Tees Valley to compete with these established hubs, there is a need to focus on the following indicative activities:

- Manufacturing Institutes (potentially Institutes of Technology);
- Enhanced collaboration (collaborative networks) leading to clustering of activities and addressing the lack of critical mass; and
- Active promotion of new materials, digitisation and servitisation.

4. Key Assets & Innovation Ecosystem

4.1 The table below identifies the major innovation, learning and other assets within Tees Valley which could have a significant influence on the sector's development in the area.

Table 4.1 Summary of Key Advanced Manufacturing Assets

Asset	Sector-Specific Offer
Education and Skills	
Teesside University	School of Science and Engineering offers various courses in manufacturing and engineering across undergraduate and postgraduate levels and opportunities for PhD research. The University also offers a degree level apprenticeship in electronic systems design engineering.
Apprenticeship Hub	A one stop shop advertising apprenticeship opportunities in the area
Careers Hub	Offers resources and guidance to show the wide range of progression routes and career opportunities available within Tees Valley.
Tees Valley Skills Event	An annual event targeted at 13 to 18 year olds, exhibiting Tees Valley employers, universities, and learning and training providers. The event aims to highlight routes to employment, education, apprenticeships and training and to showcase the advanced manufacturing as well as other target industries
Centres of Excellence	
Technology Futures Institute (Teesside University)	An international leader in key areas of research and innovation related to sustainable engineering, advanced manufacturing and process engineering, and measurement and control systems.
Digital Futures Institute (Teesside University)	Host to a range of research activities in computing including machine intelligence.
Materials Processing Institute	MPI provides research, development and technical services to a wide range of industrial clients. The traditional steel focus of the Institute has been expanded to include non-ferrous metals, ceramics, wood, polymers and composites. MPI includes a Small to Medium-sized Enterprise Technology Centre (SMETC) to initiate, support and grow small innovative companies. The SMETC presents a route for SMEs to access to the Institute's knowledge, skills and extensive scientific network, thus accelerating innovation and providing further assistance though the identification and support of public funding proposals
The Welding Institute (TWI)	A leading independent materials research and technology support organisation, with strengths in relation to fabrication, welding, and coating technologies. Based at Teesside Advanced Manufacturing Park (TAMP), TWI offers state-of-the-art training in welding, inspection, non-destructive testing and underwater techniques alongside full research and consultancy services. TWI also has a Low Carbon Energy Manufacturing Technology Centre, which houses the latest technologies for reduced pressure electron beam welding, tandem twin wire submerged arc welding, SurfiSculpt, electron beam texturing, composites and microwave drying.
Centre for Subsea Technology Awareness (C-STATE)	Provides specialist training and education in the subsea engineering and service sectors. Offers a range of apprenticeships, further and higher education qualifications, being developed by Darlington College and Teesside University.
The Wilton Research and Technology Centre	Provides office, laboratory and pilot plant accommodation facilities to encourage innovation, research and product development in the process industries. Through its Innovation Accelerator, it provides incubation support for innovative businesses within the science, technology, engineering and life sciences sectors.
The Centre for Process Technology (CPI)	Designated as the process element of the government supported Catapult centres. CPI provides open access to research and development and process

	proving facilities relating to Industrial Biotechnology, Printable Electronics, Chemistry, Anaerobic Digestion and Thermal Technologies.
Hartlepool College	Fully functioning aircraft hangar and support facilities for aeronautical sector. The College is also moving into the servicing/maintenance of electric vehicles.
Large Employers with R&D Activity	
Wilton Engineering Services	A multi-discipline Engineering Services provider based on a 50-acre site by the River Tees in Middlesbrough. Specialises in Engineering Design, Fabrication and Construction, Analysis, and Coatings and Services for the onshore and offshore energy industry.
Mech-Tool Engineering (MTE)	Global supplier of solutions protecting people and equipment from fire, blast and radiant heat hazards for the offshore and onshore oil and gas, nuclear, renewable energy, chemical and petrochemical industries.
Elring Klinger	Design and manufacture of speciality gaskets and sealing solutions for engine, transmission and exhaust applications. The only European production location manufacturing gaskets and shields in one facility.
Sites and Facilities	
Teesside Advanced Manufacturing Park (TAMP), Middlesbrough	Located next to Riverside Park Industrial Estate, the site will host an Offshore Wind Validation Centre which will provide research into fabrication methods for offshore wind turbine towers and foundations, plus validation services aimed at helping manufacturers prove their validity to prospective financiers and insurers.
Support and Business Networks	
Teesside Engineering Network	The network champions engineering companies in the area, provides a forum for engineering and manufacturing companies to learn about local projects, meet with other businesses in the supply chain as well as face to face networking.
Tees Valley Business Compass	Provide relocation grants, support and advice on financing.
Tees Valley Enterprise Zone	There are 12 enterprise zones in Tees Valley, split into two types: Enhanced Capital Allowance Enterprise Zones, and Business Rate Relief Enterprise Zones. A number of these have facilities and incentives targeting advanced manufacturing businesses.
Tees Valley Apprenticeship Grant for Employers	Available to all SMEs employing apprentices between 16 and 24. Provides a grant of £1,500 to encourage firms to take on apprentices.
Tees Valley Catalyst Fund	Businesses can apply for short-term finance to fund performance investments from £100,000 to £2million. Finance is available for anything up to 24 months.
SSI Taskforce Funding	Secured £80 million of government funding in response to the closure of the steelworks in Redcar. A number of new funds have been designed to support companies and individuals affected by the closure, plus a grant scheme available for other Tees Valley companies who can demonstrate local growth and expansion opportunities.
Other Enabling Infrastructure	
Durham Tees Valley Airport	Currently has passenger routes to Amsterdam Schiphol (KLM) and Aberdeen (Eastern).
Tees and Hartlepool ports (Teesport)	UK's third busiest and largest exporting port accommodating over 5,000 ships a year. The port services the petrochemical, manufacturing and engineering sectors. The port is connected to the rail network and links to the A66 and A19.
Other Ports	There are a number of other port-related facilities in Teesside, including AV Dawson near Middlesbrough.
Rail	Passenger and freight connections going South to London and North to Glasgow and Edinburgh. Key rail freight facilities include Teesport cargo handling and warehouse facilities and AV Dawson.
Roads	A1(M) and A19 provide a link to the North and South while the A66 provides a link to the West.

Planned Projects	
The National Horizons Centre (NHC)	Aims to address the growth needs of some of the most rapidly expanding UK technology sectors. It will specialise in providing the full range of skills for the bio industries and in applying digital technologies to improve performance and productivity in advanced manufacturing. The Centre will provide specialist laboratory, pilot plant facilities alongside teaching and conferencing space.
Graphene Application Centre	Based alongside the CPI, the centre will enable companies to take graphene enabled products from dispersion, to application, and onto commercialisation, with testing and characterisation at every step. Graphene has the potential to transform many products, and could be used in sensors, flexible screens, high-capacity batteries and ultra-fast transistors.

Source: Regeneris Consulting, Desk based analysis, 2016

5. Trends and Policy Context

Table 5.1 Summary Pestle Analysis: Advanced Manufacturing Sector	
Issue	Impact on Sector
Political:	
• Impact of BREXIT	• Ambiguity regarding emerging trade relationships, research development and innovation knowledge exchange and regulatory environment.
• Devolution and recent mayoral election	• Ability to draw on a Tees Valley Investment Fund and a tailored business support scheme. Also, potential for Mayoral Development Corporations (MDC's).
• Relationship with Northern Powerhouse and opportunity to access Northern Powerhouse Investment Fund	• Possibility of accessing equity and loan funding to support local businesses and projects
• Industrial Strategy and focus on cultivating world leading sectors	• Consideration of a possible Sector Deal
• Post-16 education reforms including introduction of the Apprenticeship Levy and from 2020 T-Levels will come on stream	• Shift to demand-led training and private sector contributions. Devolved control of Adult Education Budget will align training to need.
• Post-18 education reforms- in particular stressing value for money and links to the industrial strategy	
Economic	
• Availability of skilled labour, in particular aging workforce	• Skills shortages and gaps impacting on growth and competitiveness
	• Driver of investment interest
• Labour costs	• Sector specific and location attributes to attract investment
• Re-shoring of production	
Social/Cultural	
• Consumer attitudes towards price, quality, brand, ethical standards etc	• Drivers of product demand and willingness to pay
Technological	
• New Material Usage	• Potential use of new materials such as graphene, which will augment potential product use. Need for enhanced innovation to embed new materials into existing production processes.
• Transformative enabling technologies including Industrial Digitalisation (Industry 4.0) changing the shape of the sector	• Taking advantage of transformational enabling technologies such as 3D printing, composites and robotics and leveraging support from locally based institutions could enhance sector competitiveness
• Servitisation	• Potential to expand the sector and realise supply chain integration and efficiencies
Legislative	

• European regulation versus UK regulation • Meeting low carbon policies and legislation	• Uncertainty over future environmental, safety and labour market regulations affecting investment decisions and competitiveness
Environmental	
• Favourable planning and regulation environment • Availability of investment sites	• Provision of Enterprise Zones incentivises advanced manufacturing occupiers • Highly accessible sites to supply chain and markets; availability of location incentives

Source: Regeneris Consulting

6. Summary SWOT Analysis

Confidence –Globally competitive sector with strong local supply chains and tie into a few but large scale exporters across all sectors. Need to further develop critical mass within the sector.

People & Ed – an adaptable and technically adept workforce, supported by strong locally based training providers in the Higher and Further Education

Innovation – strong innovation infrastructure, in particular the TAMP site and testing facilities at CPI and MPI.

Property – good availability of sites and flexible local planning

Connectivity – excellent port access, openness to Europe

Growth – sector uniquely susceptible to £ and feedstock prices.

Growth – Few business start-ups/ scalable companies.

Growth – Need to diversify supply chains and enter new export markets.

People and Education –Ongoing skills mismatch: ageing worker & strong technical needs

Innovation – branch plant makes it hard to secure investment

Property – access of sites to broadband

Transport – weaknesses in road, air and rail reported and impact on disrupting supply chains

Growth - Potential related to Circular Economy

People & Ed.– opportunities related to Apprenticeship levy

Innovation – use of new materials, automation, servitisation and digitisation and also untapped potential of local institutions within innovation ecosystem

Property – possibility to explore potential of Freeport operation

Transport – consideration of improving air links and also benefits of gigabit region

Growth – international competition displaces Tees Valley companies

People and Ed – unable to attract new and qualified talent

People and Ed- loss of major employers impacts on regional training capacity

Innovation – failure to embed national catapults as drivers of change

Property – viability gaps prevent future developments

Transport – access to European port restricted post BREXIT.

7. Indicative Actions

Emerging Proposition

7.1 The Tees Valley Advanced Manufacturing sector has specific strengths and specialisms which include the manufacture **of basic iron and steel and of ferro-alloys, technical testing and analysis and engineering activities and related consultancy**. In addition, **the area has a developing expertise in advanced materials, including thermal technologies and photonics.**

7.2 The concept of the 4th Industrial Revolution ('Industry 4.0' or '4IR') is gathering pace as a driver of change, introducing new technologies and techniques that will change products, processes and supply chains in the manufacturing sector. These changes can create value across the local manufacturing ecosystem (digitisation and servitisation), resulting in increased sales and growth in market share. New technologies will support:

- Smarter supply chains (greater coordination, real time information sharing, better tracking of assets and inventory and integrated planning and production)
- Smarter production (use of data analytics, new production techniques and technologies such as autonomous robots, multi-purpose production lines and augmented reality) to improve yield and speed up production and allow business models such as mass customisation to be pursued
- Smarter products (rapid innovation and a faster time to market is enabled by data collected from products, remote diagnostics and remote/predictive maintenance)

Source: EEF, 2016, The 4th Industrial Revolution – A Primer for Manufacturers

7.3 The other Tees Valley opportunity that is part of the Industry 4.0 narrative but not readily identified from the discussion above relates to the advanced materials sector. Advanced materials can be classed as any material that offers an advantage over a traditional alternative. It may be a completely new material such as graphene, an existing material that has been improved, two or more existing materials that are combined to create a new improved material system like an advanced composite, or it may be a new way of using existing materials. Tees Valley has an established specialism in several sub-technologies, most strikingly in composites and polymers. The properties of these materials may include, for example, higher strength to weight ratio, or better fatigue and corrosion resistance than other materials such as metals. The market for composites and advanced materials is large, including aerospace, automotive, energy & environment and marine engineering. Making the most of the supply chain links within and beyond Tees Valley in these key areas would help embed local firms in some of the fastest growing and lucrative consumer markets.

7.4 The Tees Valley advanced manufacturing cluster is well placed geographically and technologically to take advantage of future trends in production techniques and business organisation, Attention should be focused on:

- Attracting additional profit centres from existing multi-nationals within the region.
- Equipping existing firms to sell their products and services on a wider international and national platform. This includes opening new opportunities for advanced material production in key consumer and capital manufacturing.
- Using the area's excellent innovation infrastructure and specialism in process base innovation to attract higher value-added activities, especially in flow processing and advanced material production.

Nature of Opportunity/Need	Actions	Timeframe for Delivery	Delivery Mechanism
Diversifying supply chains and entering new export markets	• Creation of an inward investment prospectus and infrastructural support (linked to industrial symbiosis);	Preliminary scoping work being undertaken	Sector led
	• Additional In-market (export) Support/ Trade Development Role;	Awaiting roll out (2018)	Sector led
To further develop critical mass within the Advanced Manufacturing sector by attracting foreign direct investment to key sites which will enhance the size and scale of the sector in Tees Valley and also provide opportunities for internationally sourced knowledge transfer	• Undertake audit of associated consultancy/servitisation businesses within the region and identify mechanisms to engage/create opportunities for international benchmarking and sourcing of foreign direct investment opportunities/international supply chains.	Preliminary scoping work being undertaken	TVCA led
	• Use demonstration space to attract (out of region) university spin-outs to the region	Awaiting roll out (2018)	TVCA led
Addressing the opportunity of enhanced digitisation and servitisation by ensuring knowledge transfer	• Use digital technologies to ensure access to export markets and enhanced collaboration	Awaiting roll out (2018)	TVCA led
	• Development of key sector networks to encourage knowledge transfer/collaboration;		
Few business start ups/scalable companies	• Support enhanced graduate enterprise	Preliminary scoping work being undertaken	Sector led
	• Focused Strategic Account Management to develop scalable companies within the sector;		
Mitigating the high costs of doing business within the Tees Valley through reducing energy and raw material costs	• Undertake resilience study to ensure utilities infrastructure is future proofed	Medium term	Sector led
	• Use investment in innovation (sector networks) to mitigate the high costs of doing business in Tees Valley, including use challenge funds to develop innovative circular economy and/or resource efficiency solutions	Awaiting roll out (2018)	TVCA led
Ensuring the competitive advantage of the local innovation ecosystem	• Development of Materials catapult, including ○ Development of a pipeline of applied research projects aimed at addressing material processing needs: and ○ Provision of demonstrator projects for alloy development	Medium term	Sector led

Nature of Opportunity/Need	Actions	Timeframe for Delivery	Delivery Mechanism
Ongoing job vacancies and skills mismatch	• Career inspiration programme	Preliminary scoping work being undertaken	TVCA led
	• Skills diagnostic for business compass	Preliminary scoping work being undertaken	TVCA led
Many job applicants lack basic (often interpersonal) skills	• In-work training programmes	Preliminary scoping work being undertaken	TVCA led
Need for technical / specialist retraining for changing market conditions	• Developing centres of excellence / Institutes of technology approach	Preliminary scoping work being undertaken	Sector led
	• Address gaps in marketing and customs clearance work	Preliminary scoping work being undertaken	Sector led
	• Addressing the workforce challenge by middle management training and a programme of progression planning	Preliminary scoping work being undertaken	Sector led
Need for greater clarity regarding use of apprenticeships	• Signposting apprenticeship opportunities and promoting progression	Preliminary scoping work being undertaken	TVCA led
Ensuring that there is 'fit for purpose' business accommodation	• Updated sites and premises study identifying sectoral needs	Medium term	TVCA led
Need for enhanced broadband speed and coverage	• Roll out of full fibre network appraoch	Ongoing	TVCA led

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8. Appendix A – Sectoral Definition

Table A.1 Definition of the TVCA's advanced manufacturing sector

SIC code	Description	SIC Code	Description
2410	Manufacture of basic iron and steel and of ferro-alloys	2712	Manufacture of electricity distribution and control apparatus
2420	Manufacture of tubes, pipes, hollow profiles and related fittings, of steel	2731	Manufacture of fibre optic cables
2511	Manufacture of metal structures and parts of structures	2732	Manufacture of other electronic and electric wires and cables
2512	Manufacture of doors and windows of metal	2733	Manufacture of wiring devices
2521	Manufacture of central heating radiators and boilers	2790	Manufacture of other electrical equipment
2529	Manufacture of other tanks, reservoirs and containers of metal	2811	Manufacture of engines and turbines, except aircraft, vehicle and cycle engines
2530	Manufacture of steam generators, except central heating hot water boilers	2812	Manufacture of fluid power equipment
2540	Manufacture of weapons and ammunition	2813	Manufacture of other pumps and compressors
2550	Forging, pressing, stamping and roll-forming of metal; powder metallurgy	2814	Manufacture of other taps and valves
2561	Treatment and coating of metals	2815	Manufacture of bearings, gears, gearing and driving elements
2562	Machining	2821	Manufacture of ovens, furnaces and furnace burners
2571	Manufacture of cutlery	2841	Manufacture of metal forming machinery
2572	Manufacture of locks and hinges	2849	Manufacture of other machine tools
2573	Manufacture of tools	2891	Manufacture of machinery for metallurgy
2591	Manufacture of steel drums and similar containers	2892	Manufacture of machinery for mining, quarrying and construction
2592	Manufacture of light metal packaging	2893	Manufacture of machinery for food, beverage and tobacco processing
2593	Manufacture of wire products, chain and springs	2894	Manufacture of machinery for textile, apparel and leather production
2594	Manufacture of fasteners and screw machine products	2895	Manufacture of machinery for paper and paperboard production
2599	Manufacture of other fabricated metal products n.e.c.	2896	Manufacture of plastics and rubber machinery
2611	Manufacture of electronic components	2899	Manufacture of other special-purpose machinery n.e.c.
2612	Manufacture of loaded electronic boards	2931	Manufacture of electrical and electronic equipment for motor vehicles
2640	Manufacture of consumer electronics	3011	Building of ships and floating structures
2651	Manufacture of instruments and appliances for measuring, testing and navigation	3030	Manufacture of air and spacecraft and related machinery
2652	Manufacture of watches and clocks	3040	Manufacture of military fighting vehicles
2660	Manufacture of irradiation, electromedical and electrotherapeutic equipment	7112	Engineering activities and related technical consultancy
2670	Manufacture of optical instruments and photographic equipment	7120	Technical testing and analysis
2680	Manufacture of magnetic and optical media	7219	Other research and experimental development on natural sciences and engineering
2711	Manufacture of electric motors, generators and transformers	7490	Other professional, scientific and technical activities n.e.c.

Source: Tees Valley Combined Authority