

making it

Advanced Manufacturing
in **Liverpool City Region**
to 2020



Liverpool City Region's Advanced Manufacturing and assembly output includes the world-renowned Range Rover Evoque produced at Jaguar Land Rover's Halewood Operations plant.

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Liverpool City Region's research facilities play a major part in developing the Knowledge Economy

EXECUTIVE SUMMARY

Short Term Opportunities that drive competency development and create competitiveness)

National Process Scale-Up Solutions Centre	International exemplar for Marine Ballast Water Treatment	Centre of Excellence in Light-Weighting
Global market leader for smart, non-invasive monitoring	Liverpool City Region: Sustainable Energy Solutions	North West Shale Gas Exploration Platform

Globally Competitive Competencies (building blocks for the future. 10 year development cycle)

City Region has identified opportunities that align with national strategic requirements							
Intelligent systems & embedded electronics	Smart, hybrid & multiple materials	Energy generation management security and storage	Developing and retaining skills to support High Value Manufacturing	Understanding Designing and Manufacturing formulated products	Flexible Adaptive and Scalable Manufacturing	Design and Manufacture for Light-weight vehicles and structures	Managing fragmented value chains
Biological, BioTech and Synthetic Biology processing	Systems Modelling and integrated design simulation	Automation, Mechanisation and HMI	Development and application of advanced coatings	New Business Models	Big Data	Materials Innovation Factory	Quantum Technology
LCR competencies which align with Nationally desirable competencies					Strengths in addition to national framework		

Vision for Liverpool City Region

A global manufacturing hotspot with the smartest networks, talent, technology and investment.

This consultation document has been compiled with a simple question in mind – what is the future for Advanced Manufacturing in Liverpool City Region? Manufacturing in the region is performing well; productivity has increased, even if the sector itself has reduced over the same period.

Across Liverpool City Region (LCR) and the wider North West there are areas for growth in Aerospace, Automotive, Marine, Chemicals, Bio Technology, Energy, Food and Drink sectors presenting opportunities to boost innovation, increase levels of employment and develop a global platform and reputation for the industry.

LCR has modernised its manufacturing base and has developed an industry that is now vibrant and which can be globally competitive. It provides a platform for jobs and productivity growth for the UK economy as well as the local and regional economy.

This year, LCR has worked with a number of partners within Advanced Manufacturing to outline areas where growth can be accelerated. With a shared ambition to stay ahead of the game we have identified short-term opportunities to be exploited, each of which has been identified and endorsed by the industry. We will work on longer-term competencies which will support our ambition to be globally competitive. Each of these competencies is relevant across the manufacturing sector and feeds into different elements of industry across the region. This provides a diverse base for growth.

Resources will shape the products we make and the processes we develop and evolve. If we understand what is coming, we can plan and invest to make the most of the opportunity and to overcome the challenges.

The work we have conducted sits within a national framework and process. It builds on the study conducted by the Technology Strategy Board in 2012 to develop a landscape for the future of Advanced Manufacturing in the UK. LCR has adopted this structure to create a landscape which maps the City Region's competency and develops a roadmap for the next 15 to 20 years.

We must focus our attention and energy on our skills, experience and ability. To be economically competitive, sustainable and innovative we must work together and collaborate efficiently and effectively. This is our landscape for growth and innovation.

Manufacturing has the capacity to change lives. Through biotech research into anti-immunity drugs, light-weight vehicles producing fewer emissions, from relying less on the world's resources to creating a skilled and experienced workforce, manufacturing is driven by sustainability. It can shape our world and its future.

We are already home to 3000+ manufacturing companies, many of them household names like Jaguar Land Rover, Johnson Controls, ABB, Unilever, United Biscuits and Cammell Laird. Others are smaller SME's embracing innovation and working flexibly to create new and world-changing products. From pharmaceuticals to shipping, car manufacturing to energy development the sector employs just under 50,000 people. It generates £3.2 billion for the LCR economy.

Making It has focused on bringing LCR's manufacturing community together to determine how we can meet the challenges and seize the opportunities that are coming. In LCR we recognise the potential of Advanced Manufacturing to create a high value return to the local, regional, national and international economy, the potential to create both jobs and economic growth.

The Making It process has been led by the Liverpool City Region Local Enterprise Partnership with support from the Institute for Manufacturing, University of Cambridge (IFM ECS), BIS, Technology Strategy Board (TSB) and supporting LCR based companies. The unique approach is the most in-depth study into a specific industry of its kind in the UK. It mirrors work undertaken by the Technology Strategy Board in the production of its national strategy for Advanced Manufacturing.

The consultation process has involved a series of workshops with industry experts. The outcomes from these workshops are:

- A detailed understanding of the global and national landscape for Advanced Manufacturing and how the LCR is positioned (Section 4)
- A shared vision for what is possible within the LCR (Section 3)
- A defined set of short-term opportunities that build on our existing strengths but will also provide the foundations for future success (Section 5)
- A focus on competencies – those attributes required by the LCR for sustained competitive advantage, and aligned with national priorities (Section 6)



Detailed accompanying documentation is available at www.liverpoollep.org/makingit.aspx providing a range of resources to inspire the creation of a global hotspot for manufacturing within LCR.

But the story does not end here. We know that there are many companies who haven't yet engaged with the Making It process. There will be a range of views about what the future holds, and differing evidence as to where the opportunities lie. This document is intended to be used to assist consultation to enable us to engage with companies across the City Region on what we might have missed and how we can improve our approach. Full details on how you can get involved can be found in Section 8.

The Making It Programme will look at the future of manufacturing, what we make, how we make it and what we should be making in the future. This follows a national Government-led exercise delivered by the Technology Strategy Board. It brings together the LCR LEP, Liverpool John Moores University (LJMU) and the University of Liverpool, the six local authorities, and the Institute for Manufacturing, University of Cambridge (IFM ECS).

A key role of a university is to share expertise and research, thereby driving business forward and contributing to wealth creation through innovation, knowledge and technology exchange. That is why it is so important that LJMU and the University of Liverpool are involved in this campaign.

Liverpool has always been an innovative City Region and now is the time to work out how we can build on that innovation and establish ourselves as market leaders once more. We are working closely with the private sector to make sure that we develop the right plans for the future and offer the best support to grow our manufacturing industries.

Universities in this City are set for the challenges of the 21st Century, using education through research, scholarship and improvement of skills to provide the right infrastructure to solve these challenges, including in areas concerning the economy and manufacturing.

Vice-Chancellor, Liverpool John Moores University (LJMU)



Liverpool's Life Sciences University Technical College (UTC) provides 14 to 19 year olds with specialist scientific and healthcare education

VISION

LIVERPOOL CITY REGION:

A global manufacturing hotspot with the smartest networks, talent, technology and investment

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Manufacturing has always been at the heart of the City Region's economy from our excellence in ship-building to our current world-leading position in chemicals, vaccines or pharmaceuticals through to the production of one of the world's leading motor vehicles. Sustained investment has contributed to commercial success and a commitment to produce innovative products which respond to economic, social and cultural shifts and changes. Advanced Manufacturing combines industry leading technical knowledge, expertise in creating products, production processes and supply chains which can bring a sustained growth and an environment to foster high economic value in the City Region and beyond. The aim now is to keep LCR ahead of the global competition and create a world leading Advanced Manufacturing environment. The first step of the process is to establish a shared vision for the City Region. This has been done in partnership with stakeholders across the industry at every level of the supply chain.

We can become a global hotspot. A manufacturing environment with four or five clusters of excellence – with one frontier industry – could provide a framework to produce high value goods and services. LCR leads in product design in a variety of sectors including health and diagnostics. It is well positioned to take advantage of jobs returning to the UK as reshoring continues through technology such as additive manufacturing, 3D printing, training and skills. By identifying trends and behaviours in society, cross sector opportunities will arise that can encourage new supply chains. Our ever-growing number of SMEs will drive our capacity as well as the number of high value opportunities in manufacturing.

We need to attract the very best in business, investment and people. Manufacturing needs to be smart, to be of high value and also good for the environment. To maximise this, supply chains must be agile and adaptable to make the most of cross sector opportunities. Knowledge sharing and best practice must be a key behaviour. New skills and a sustainable, self-sufficient workforce are vital.

A capability for a self-funded growth exists in manufacturing. This provides the foundation for a stable planning environment.

It allows the LCR to develop a capability for managing the supply and demand aspects of its skills pipeline. There is self-belief and confidence in our innovation potential which runs at the core of our practice.

Our culture is at the heart of our capacity for growth. To empower this environment of innovation manufacturing must be underpinned by a well-founded sense of community. There must be individual access to skills and qualifications enabling the regional availability of technical and graduate level skills. In the long-term the strategy must reflect the need for a growing collaboration between academia, government and the manufacturing industry itself. Investment must be secured. To help achieve this, and to attract the best individuals to the sector, there must be a redefinition of what manufacturing means.

We have a shared vision for what Advanced Manufacturing should be in LCR. Our next step is to identify the landscape and opportunities for growth.



Jaguar Land Rover's Halewood Operations plant is at the forefront of automotive manufacturing

MANUFACTURING LANDSCAPE

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Advanced Manufacturing is a major employer, industry and contributor to the Liverpool City Region economy. Yet we know we don't exist in a vacuum. Many of the trends and drivers shaping and influencing our industry impact on the national and international picture. If we are to seize the opportunities ahead and prepare for any challenges and threats we need to understand the global and the UK picture, before we turn to our own landscape.

The Global Picture

The past thirty years has seen a significant shift towards a more globalised manufacturing economy and this looks set to continue into the future. The growth of economies such as Brazil, Russia, India and China, and especially increasing wages will drive a growth in consumer demand. Emerging economies present significant untapped consumer markets.

Supply chains will continue to be fragmented and international in scale, reinforcing the importance of logistics and good networks. Finally, the drive towards lowering costs of production looks set to continue, meaning the LCR will meet stiff competition from lower economies.

The National Picture

The process to gain a comprehensive understanding of the landscape and a roadmap for sustained growth in Advanced Manufacturing is based on wider national practice.

In the UK, High Value Manufacturing represents a sustainable growth opportunity with long term benefits. Companies must focus on the economic, the social as well as the environmental impact and results. With a wide consultation with the manufacturing industry nationally, academia and institutions, the key sectors emerging on the national stage include:

- food
- biotechnology
- chemicals
- pharmaceuticals
- medical
- aerospace
- defence and space
- automotive
- rail
- marine (including under-sea)
- nuclear
- energy
- oil and gas
- mining
- built environment
- electronics
- digital economy

Five themes have been identified to form the backbone of the national strategy.

- Resource efficiency, against the backdrop of a scarcity of energy and other resources, this will impact on the UK manufacturing sector. Exploiting a low carbon market, reducing the use of energy and securing materials will be increasingly vital.
- Manufacturing systems must be more effective and efficient. This can make the sector globally competitive as it strives to maximise its manufacturing technologies.
- To truly realise the potential of innovation new materials must be integrated. Original products, new materials, coatings and electronics are at the heart of new manufacturing technologies. Bridging the innovation gap is a vital process.
- The manufacturing process itself must be more agile and cost-effective. This is set against a backdrop of an ageing workforce and an increasing skills shortage with a low mobility. Investment must focus on the manufacturing workforce. The necessary skills must be built and young people must be attracted to manufacturing.
- To create superior value systems, new business models must be realised. This will help to exploit innovation and to capture value.



Mapping the future

Trends and drivers were highlighted from discussions and consultations that identified the principle challenges and opportunities in wider society that would impact on Advanced Manufacturing. At the top of the chain is the increasing cost and scarcity of power and energy driving the importance of the security for supply, the need to use fewer materials and to use less energy – including water – for all outputs. Increasingly there will be a reliance on renewable resources. Resources include people as well as product, and an ageing UK workforce contributory to a skills shortage. To make the sector as competitive as possible, manufacturing needs to be able to influence and adapt to evolving government policy, tax and regulations to maximise competitiveness. This includes sustainability.

A major trend for manufacturing internationally has been the movement east. As resources diminish, transport costs will increase, encouraging repatriation and onshoring. This offers an opportunity to raise the profile and potential of manufacturing in the UK.

Change, Innovate and Compete

R&D and innovation must remain a government priority. Emerging new industries like photonics and renewable energy offer strategic opportunities for global leadership by UK business, especially in multi-disciplinary areas.

Affluence will increase the pace of change. Post-recession and economic downturn, a renewed confidence and desire for growth will fuel innovation.

While onshoring offers an opportunity, the risk to the SME level of a declining UK based supply chain contributes to a shortage in both skills and finance. Accessing finance and credit will increasingly impact on policy timeframes at both an industrial and a political level.

A changing consumer

The rising 'digital economy' affects traditional products, services and processes as well as creating new demands. Manufacturers will need to meet this and stay ahead of the shifting tide to remain competitive and current. Producing in the UK could incur a high cost of production which may affect cost for the consumer and thus their popularity. The growing and ageing population will increase demand imposing a challenge for health, social care and food.

Across the manufacturing sector, the study identified the need for commonalities and shared technology requirements. Light-Weighting is not just a factor for the automotive industry; this new technology can create more cost-effective value chains, reducing reliance on resources. These developments need new design, new technology and new materials.



National competencies

A competency is an attribute of the manufacturing industry that enables businesses to respond to changing global trends and drivers in a way that captures value for the future economy. Competencies tend to impact across a range of sectors, for example good processing skills will be important in both automotive and the food industry.

To achieve High Value Manufacturing the most significant needs are new production processes, driven by scale and economy. Manufacturing needs to be flexible and responsive to seize such new opportunities.

Intelligent systems make process as efficient as product. Data processing and storage is important to streamline process and create cost-effective value chains, especially for SMEs. New composites create the opportunity for new products while alternative and bio-based sources for existing products and process materials as well as organic materials for electronics applications reduces the reliance on resources. Systems modelling and simulation (including prototyping) revamps and simplifies the design process of new products, increasing its accuracy. New power sources reduce the reliance on traditional energy supplies coupled with an increased use in products from waste and virgin biomass.

New high performance materials work harder and create cheaper production methods. Light-Weighting in both design and manufacture is a vital new trend to be tapped into. The focus must be on design to produce an improved and integrated systems design focusing on reducing waste.

Contributors to the study and national consultation were asked two questions; which manufacturing processes and systems are going to be most important for the UK in the 15 to 20 year period highlighted and why? And what are the most promising emerging science, engineering and technology innovations which would address these trends and challenges for the UK manufacturing base and why?

The most significant process and service technologies identified included:

- Additive manufacturing
- Net shape manufacturing
- Robotics and automation
- Customisation
- Small run technologies (including distributed manufacture and 'batch size of one')
- Micro and nano-manufacturing processes
- End of life activities: recycling, re-use, renewing and re-lifing
- Surface engineering (finishing and coating processes)
- Link design and manufacturing more closely
- Integrating technologies and processes
- Bioprocessing for new/replacement materials/fuels
- ICT and enabling ICT structures

The most significant product and services technologies included:

- Materials and materials science (excluding composites)
- Low carbon technologies
- Light-Weight materials
- Biomaterials
- Sensor technologies
- Integrated technologies
- Nanotechnologies
- Energy storage
- Hydrogen fuel cells
- Robots
- Integrated products and services
- New composites
- Nanomaterials

Retail entertainment and consumer goods

Digital entertainment, smart clothing

Pharmaceuticals

Anti-infectives,
pharmacogenetics

Biotechnology

Diagnostic tools
Infectious and microbial disease treatments
Bio manufacturing

Electronics

Smart clothing and textiles, sensor printed electronics, bio-personalised products

Aerospace / Defence / Space

Composites, sensors.
Unmanned Aerial Vehicles
UAVs

Nuclear

A closed reactor
clean-up service

Throughout the Making It process, business, academics, and individuals representing different industries in Advanced Manufacturing shared their thoughts and reflections on trends and competencies that exist for LCR.

The landscape in Liverpool City Region

We know what the trends are globally and internationally. Locally, we must recognise and understand the national landscape but also identify the challenges and opportunities that impact on us locally, and will continue to in the next 15 to 20 years.

We have divided our predictions and interpretation into three periods; the short term up to 2017, the medium term from 2018 to 2025 and the long term from 2026 to 2030.

The growth of emerging markets like the BRIC nations and Asia pose both an opportunity and a threat; it raises the potential of new clients but also competition. LCR must maintain its edge. We need to be able to identify what products, practices and processes business will come to our manufacturing sector for because they will be unable to find them anywhere else.

These following issues were identified by manufacturers for the LCR.

The shortage of resources affects us now and in the future

The financial crisis has meant there is reduced funding and investment, in both public and private sector, there is less money to spend. Couple that in the short term with continued uncertainty over the price of oil and a prime concern is resource. This affects the transport of goods as well as the use of raw materials in creating products. Manufacturing wants to be more sustainable so there is a desire for low cost travel, for light-weight vehicles and for simpler transport infrastructure relying less on costly oil. Systems need to be refocused so that every layer of the supply chain supports this ambition.

In the next five to ten years manufacturers predict resources will be diminishing, leading to a greater impact on the sector itself and this trend will continue. LCR needs to be making changes to its processes as well as its products to meet this trend.

Marine

Carbon fibre ship building, offshore support and services for supply chains

Automotive

Composites, low carbon solutions, sensors and detectors

Food

Food diversification
Innovative food distribution methods
Agri-science

Energy

Waste recycling, offshore wind Combined Heat and Power (CHP) plants, carbon capture and storage

Built environment

Multi modal logistics, sustainable buildings, bio-manufacturing

Chemicals

Bulk chemicals, petrochemicals, advanced material chemistry
Bio processing

Digital economy

Multi modal broadband and communications

Sustainability, in people and product

Over the next decade an ageing population will have a serious affect on the skilled population and those working in manufacturing but also the products we need to invest in. Medicine and products designed to support end of life will be increasingly important. Building a young, skilled manufacturing and engineering workforce is vital.

More green legislation is expected in the coming ten years. More consumers will look for green products and solutions. Therefore, it will become important to promote sustainable credentials, to be ahead of the trend. Cities will grow in size, putting even greater pressure on resources for cities like Liverpool. Buildings themselves will need to be more sustainable to meet both the growing population but also green legislation. At a city, regional, national and international level we will need to be part of the solution and discussion about working in a more sustainable way and meeting demand.

In the longer term as we look 10 to 15 years into the future there are a number of trends we can predict will impact on our work in manufacturing in LCR. Personal carbon taxes and the individual footprint will become more and more important so there will need to be products and a transparency of process to match. Many products will be bio-based. If we invest now in research and production we will be able to lead the way. Water scarcity will mean a need for technologies to help business to continue operation with new products to ease the transition.

Changing consumer requirements

Personalisation is vitally important for manufacturers. The individual and the consumer desire to shape practice and culture around oneself is a trend that will cover every sector from choosing cars and gadgets to genetic medicines, smart clothing and person specific treatments. Personalisation and the power of the consumer will define how manufacturers communicate with their customers as well as the technology we invest in.

Innovation is key

Advanced Manufacturing presents an opportunity for improved quality of life. In Healthcare, IT and consumer goods we can push frontier technologies to create decentralised consumer application. Digital technology is a major factor in this shift of focus.

The cloud, mobile and miniaturisation technology is an area that encompasses both the drive for sustainability as well as cutting edge futuristic innovation.

Moving into the medium-term and in terms of technology there needs to be strength in design, disassembly and end of life products. Recycling, reusing and repurposing; this taps into the need for sustainability. Electronics need to fuel connectivity, building a partnership between industries, clients and consumers.

In the long term we will need to focus on what this means for plants and processes when the time comes to upgrade. The groundwork and preparation must already be done if we are to seize new opportunities.

SHORT-TERM OPPORTUNITIES

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To drive competency development and create competitiveness

Six short-term market opportunities, from a wider list of projects have been identified as part of the Making It process. These opportunities are founded in the LCR's existing strengths and asset base. These are either areas where we have leading technology, companies, researchers or facilities; or where known investments will drive a new market opportunity over the next 2-5 years.

They all also drive wider market trends. The key aspect of each of these opportunities is that they will drive the establishment of core competencies required for longer term success of the LCR manufacturing sector.

Centre of Excellence in Light-weighting

The core of LCR's offering in light-weight manufacturing is the automotive industry, where an increasing demand for greater efficiency combined with high performance is driving the market. Light-Weighting has wide applicability across the automotive, marine, nuclear and aerospace industries, anywhere efficiency and performance demand materials innovation.

To excel, LCR needs to move beyond its current capability to manufacture light-weight product, but bring together research, design and production to create a market niche, as well as the skills and supply chains required to advise and attract international attention.

The identified first step is the creation of a physical facility to act as an identified hub or 'attractor'. This will require investment, but is well-aligned with the UK's ambition and the LCR potential has been strongly endorsed by industry partners.

Global beacon for smart, non-invasive monitoring

From healthcare to engineering, smart monitoring is already an established feature of product design, development and manufacturing. Linked closely with better IT, customers are demanding a greater understanding of product performance. Examples include embedded sensors in batteries for hybrid vehicles, printed sensors on substrates, motion sensors in the building industry and within NHS, procurement for implants, wound management and infection control.

The future is increasingly converged between nano-technology, bio-technology, information technology and conventional electrical engineering. LCR is already leading the way, with patents across a range of sensing technologies, which align well with the existing LCR manufacturing base in automotive, bio-medical, maritime and digital industries.

The critical next steps include the validation, acceptance and scale-up of sensor technologies and manufactured products, and the demonstration of uses within target sectors.



National Process Scale-Up Solutions Centre

The wider industry trend driving the need for enhanced 'scale-up' solutions is personalisation. As products become increasingly bespoke, manufacturers need to move quickly to develop customisation processes and then to quickly commercialise these bespoke products. A number of LCR manufacturers identified opportunities for growth if the right solutions could be found; with solutions likely to come from other industrial sectors, or from within the research sector more widely.

At one level, the Solutions Centre is a very pragmatic proposal that would allow for short-term problem solving. Longer-term, the Centre provides a model for innovation, a network for cross-industry working, and a platform for new research investment

Liverpool City Region: Sustainable Energy Solutions

Over the next five years, LCR will see substantial investment across the energy sector. The Liverpool City Region LEP's Action Plan for Low Carbon provides more depth to these investments, off-shore wind investment, waste-to-energy plants in some of the area's largest manufacturers, and research required for a Mersey Tidal scheme creates a powerful supply chain for research and technology application. This is in addition to the general market demand to lower energy costs and become more sustainable. Investment in sustainable energy solutions is strongly backed by the local manufacturing sector, with the identified first steps to focus on local energy generation, capture skills and competencies in power management, and invest in local energy infrastructure.

Northwest Shale Gas Exploration Platform

Shale gas exploration remains a controversial issue, and LCR, like many other areas is still to agree a way forward. However, it seems probable that the Irish Sea region could provide one of the richest sources of Shale Gas in Europe, and consequently the potential to develop an industrial platform for jobs, investment and growth.

To capture this opportunity, early intervention is required to understand the size of the opportunity, the required technologies, skills and suppliers, and to position LCR as a hub from which the industry could grow. It will be important also to understand the associated risks and communicate clearly with local communities, understand the regulatory environment, and capture value from associated procurement opportunities.

International Exemplar for Marine Ballast Water Treatment

Ballast water is sea water carried by a vessel in its ballast tanks to ensure balance and structural integrity. When a ship docks, ballast must be taken on or discharged, with obvious implications for the marine environment.

Local demand for treatment facilities, driven by the development of Liverpool2 (the new deep sea container facility in the Port of Liverpool), will increase as larger vessels (both cargo and passenger) dock in the Mersey. Physical development zones on either side of the Mersey provide potential locations for new facilities. Combine this with the LCR's already outstanding offer in maritime research and professional services, and the potential exists for world leading exemplar in a global market issue that affects maritime, food, automotive, aviation, and the visitor economy industries.

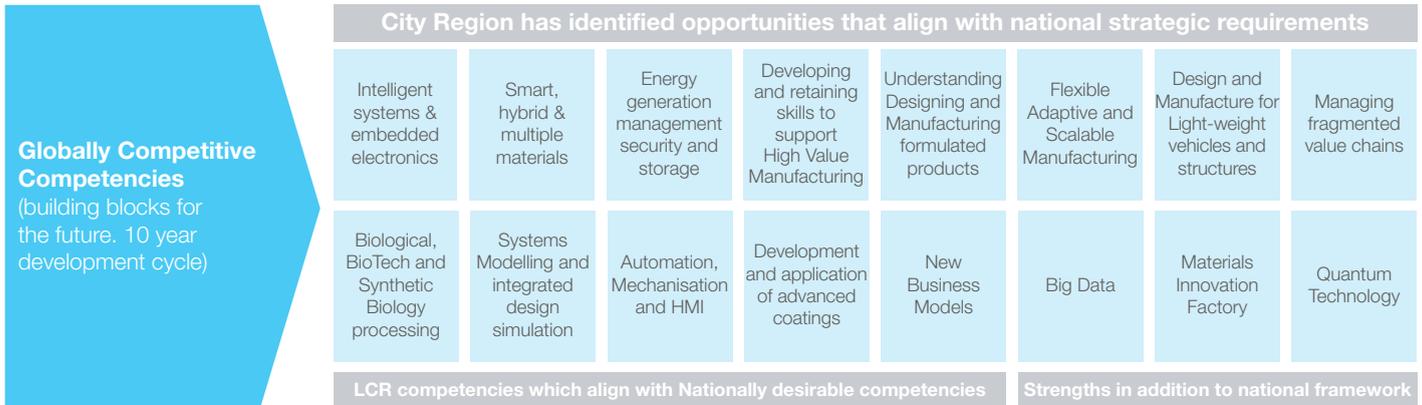


Skills training provision must meet the needs of Liverpool City Region's advanced manufacturers

LONG-TERM COMPETENCY DEVELOPMENT:

6

Building blocks for the future



Light-Weighting

Creating light-weight vehicles does not simply ensure a faster mode of travel. It also reduces the reliance on diminishing resources, meets regulatory and consumer demands for increased efficiency whilst improving performance. Intertwining innovation with sustainability, the production of light-weight vehicles across the automotive, marine, nuclear and aerospace industries can fuel the ambition of an industry to reduce its reliance – and that of its customers – on carbon energy sources. Research, design and manufacturing creates a niche and highly sought after skills set which could elevate the already global reputation of LCR’s automotive industry to a world-leading platform.

The design and manufacture of light-weight vehicles is cross-sector as well as cross-motivated.

The use of innovative materials like carbon fibre makes a vehicle lighter, able to travel faster and use less fuel. For consumer facing manufacturers this meets the need for more efficient vehicles. For manufacturers tasked with getting products from a to b it reduces their overheads and travel time and creates a more efficient infrastructure.

LCR and the wider North West is already recognised as one of the world-leading centres for automotive design and build. From Jaguar Land Rover to Vauxhall in Ellesmere Port to Briggs Automotive Company (BAC), the sector is powered by keeping ahead of the curve and combining technology with consumer needs and demands.

Outside of the automotive sector, light-weight vehicle manufacturing impacts marine and infrastructure, set to be

increasingly significant over the next twenty years with **SUPERPORT** and HS2. As an historic gateway to the world, embracing the latest technology for vehicles can combine the City Region’s transport ambitions with its manufacturing sector.

Light-weight capability would help to encourage continued large scale assembly of wind farm components. It would build on a capability for specialised small scale marine manufacture and the creation of autonomous vehicle manufacturing for the nuclear, ports, defence and medical sector.

In the short to medium term it is important to engage with the National Composites Centre, both through LEP and externally. In the long term the ambition must be to make the LCR the place for core skills and competencies.

The world's first road-legal, single-seater production car is the BAC Mono manufactured in Liverpool



Case Study

BAC (Briggs Automotive Company) Ltd is a British sports car manufacturing company opening a new production site at Speke Hall Industrial Estate, Liverpool.

BAC Mono is the world's first road-legal single-seater production car. Awarded GQ's Track Day Car of the Year 2012 and in the same year awarded Top Gear's 'Stig's Car of the Year 2011' the Mono has inspired motor enthusiasts and manufacturers alike. BAC founder Neill Briggs describes the supercar as combining "a purity of design, zero compromise and high performance". Innovation in technology, he says, is vital. "The Mono exemplifies the purest supercar which rejects convention and ornamentation but instead is designed purely for function and beauty in form. Its appearance is unparalleled and it means business, both in terms of how it looks and in performance."

Heralded as a revolution from a design perspective, the Mono refuses to compromise on design and performance. New materials for Light-Weighting, like carbon fibre and aluminium allow for the potential to scale up facilities for a high volume composite manufacturing. "We use wood which is nature's best composite for the floor materials which is impregnated with a waterproof membrane, aircraft grade aluminium, carbon fibre on 44 parts on the interior and exterior of the car, stainless steel and coal drawn stainless steel."

Fuelling the drive to encourage advanced manufacturers in LCR to innovate with new materials, light-weight vehicles is a smart concept that builds a sustainable infrastructure. It develops the skills pipeline, increasing the ability of LCR to attract new firms like BAC Mono.

This focus on innovation may begin at the elite of the car world but it filters along the supply chain. Briggs added "The supercar sits in a unique place in car manufacturing. Its price point allows traditional manufacturers to spend money on research, aerodynamics, new materials etc. That feeds into cars on the road. Think of the S Class Mercedes of 20 years ago. It featured ABS brakes, active ride control, curtain air bags and enhanced safety and performance that, by and large, has now filtered down to the cars everyone drives."



Case Study

NGF EUROPE Limited is a subsidiary company of the NSG Group of Japan, one of the world's leading manufacturers of glass products for building, automotive and information electronics applications. Situated in St. Helens, NGF EUROPE is at the forefront in the manufacture and marketing of specialised Glass Cord products. Alistair Poole is Managing Director:

"What we do is very niche and technical. Our products have several applications but the major one is as the reinforcement in a timing belt for car engines. The glass cord made by us relies on the strength and flexibility of glass fibres to carry the load from one part of the engine to another. The belt, used instead of a chain, reduces emissions and is quieter."

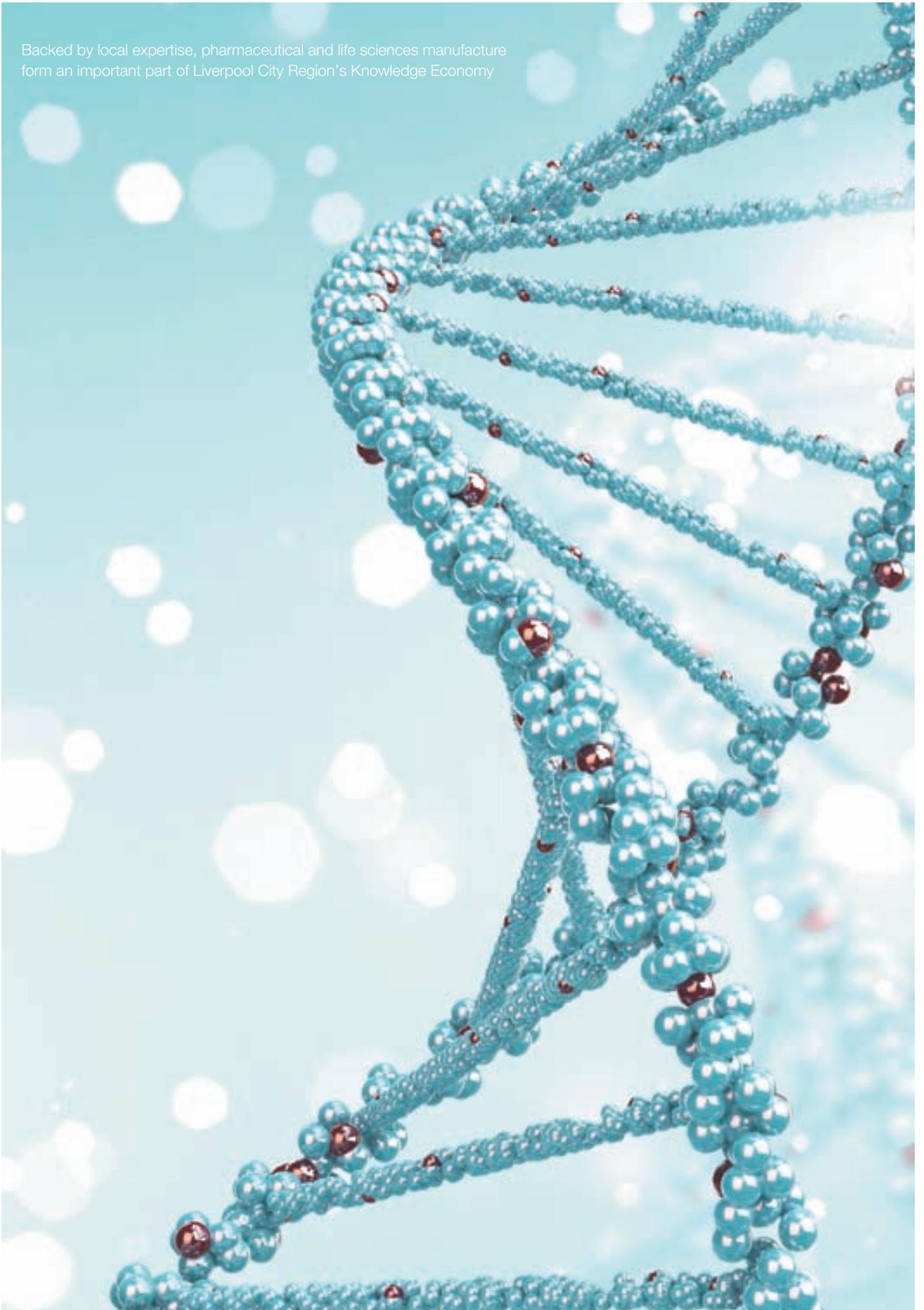
The glass cord is manufactured with a variety of coatings designed to match each customer's requirement. The complete coating of individual filaments of glass yarn with special bespoke resorcinol formaldehyde latex (RFL) formulations compatible with a large number of rubber compounds gives the product "life of engine durability" – up to 300,000 km. It is strong, flexible and durable.

A new technology in 2006 is just now coming to commercial fruition. Normally the belt runs outside an engine in the dry whereas the chain runs in the oil in the engine. The Glasscord® 'Belt in Oil' timing belt system uses an innovative material that allows a car's main engine drive belts to be immersed in oil without degradation.

This innovation results in reduced friction, noise and vibration and makes for a more efficient engine. The new technology features in the Ford Eco Boost Engine launched in 2011 which achieves a 20% better fuel efficiency and 15% reduced greenhouse emissions. It has been named the most eco efficient engine in 2012 and 2013.



Backed by local expertise, pharmaceutical and life sciences manufacture form an important part of Liverpool City Region's Knowledge Economy



Biology and Bioprocess

In LCR the chemicals and pharmaceutical industries are focused on shifting trends and technologies. Personalisation is a trend with the capacity to transform the industry. International firms are looking to researchers, to manufacturers and SMEs to help them service their own clients within the health industry. An ageing population, one of the core challenges facing manufacturing and society in the coming generation, will need this technology to counter the increased cost of on-going treatment as well as a growing reliance on health and support services.

In research and development both in the public and private sector the short term focus is on making diagnosis easier by improving the tools used in healthcare. In five to ten years the principal aim is to develop treatments for infectious and microbial diseases.

As with each corner of manufacturing in LCR, facing reduced resources of energy and funding is a significant challenge. The design and manufacture of products must focus on sustainability and through-life, reducing the need for replacements which place a greater demand on resources.

Creating innovative products using new chemicals, materials and coatings is an important element of keeping the sector competitive. What is important is quality, customer expectation and the need for new products.

Updating processes throughout the chemicals and pharmaceutical sector in LCR will make it leaner and more competitive. To focus on innovation and explore new technologies like macro algae based production, to facilitate bio-processing for new vaccines or tissue engineering and regenerative medicine there has to be an accepted culture shift at every level of the supply chain. The industry needs support if it is to champion the drive towards innovation through the NHS.

Case Study

Mast Group, based in Bootle, is a manufacturer of In Vitro Diagnostics, or out of body testing. Specialising in Infectious Diseases and Microbiology, Mast's primary market in the UK is NHS Hospitals with Clinical Laboratories.

With the NHS consolidating its services and the market itself becoming more regulated, Mast has developed the Isoplex test, a diagnostic product drawing on their experience of molecular biology.

In emergency care in hospitals, or GUM clinics there is a need for diagnosis to be quick, cost-effective and as simple as possible. Isoplex uses just one sample and manages both the DNA extraction and amplification. In an hour, a correct diagnosis can be delivered and the patient can begin receiving the correct treatment immediately.

There is a growing trend for personalised medicines as well as the need for hospitals to have a more efficient diagnostic procedure. Increasing resistance to antibiotics impacts on the spread of disease. Focused treatment delivered rapidly helps to reduce this risk and is better for patient health. Powerful antibiotics can have side effects, minimising the need for incorrect treatment caused by delays in diagnosis are minimised by Isoplex.

For GUM clinics that treat patients who come in from the street, a quicker diagnosis removes the existing process where samples are sent away and finding the patient once diagnosis occurs to begin treatment can be difficult.





Powering the future

Energy is at the core of manufacturing. Its generation and the development of a sustainable energy strategy and policy will define how the manufacturing industry evolves in the face of diminishing resources. For the next five, ten and 20 years much of the attention of the industry – from R&D to sector leaders – will be focused on how to manage energy, how to secure its supply for business and consumers and to embrace renewable alternatives and reduce the impact of manufacturing on the environment.

Green legislation will impact on design and production across the industry including transport, reinforcing the need for innovation. Sourcing sustainable solutions to minimise the disruption of the supply of goods means investing in alternative energy.

Geography is a major factor in LCR's capacity to be at the core of an energy solution. On the coast of England with the Irish Sea to the west and excellent links to the Atlantic, Liverpool's maritime heritage is famous around the world. It needs to be brought into the 21st century. **SUPERPORT**, the ability to establish LCR as a hub for the transport of goods via sea, rail and road can help challenge firms' lack of finance making it cheaper to distribute goods.

Wave and tidal energy offer an opportunity to help reduce energy costs and the risk of supply distribution. Tidal resources could power the city as well as other towns along the coast. The UK has half of the tidal power resources for the whole of Europe, with Liverpool at the heart of it. There is potential for research and development as well as manufacturing.

Reducing the reliance on carbon based energy sources is a vital area of research for manufacturers. This has business implications for the industry – in terms of meeting the requirements of green legislation and regulation - but also for consumers and the ability to secure supply as resources diminish. New sources of energy could reduce energy prices as well as manufacturing overheads.

Waste energy is an important area of research. Converting waste into a power source would reduce costs and make LCR and UK manufacturing more competitive against the USA and China. The energy supply would be more secure and less reliant on an unpredictable global marketplace. Local energy generation would need more concerted planning but it could increase the visibility of the City Region at national energy requirement planning.

There is a need to incentivise local power generation. Funding opportunities could steer where investment and action should be taken.

Holistic carbon optimisation and the reduction of CO2 emissions through supply chains epitomises a statement of intent which is motivated by a desire to be more sustainable. This is the short-term. In the medium-term developing structural composites could transform energy storage. There are benefits for automotive and transport. Smart Energy Storage – including Combined Heat and Power (CHP) – can change the relationship of traditional manufacturing to energy usage.

Energy is not just a local issue but there need to be incentives for local generation. Tidal or nuclear generation could power the manufacturing sector. There could be an opportunity for energy management to be conducted on a local level, perhaps through local economic partnerships. The manufacturing industry can explore and exploit technology to power this shift and commitment to sustainability but it needs direction. Central government needs to give a clear indication of what is expected from a national energy policy.



Case Study

ACAL Energy is an innovative chemical company developing and licensing a ground-breaking platinum free liquid catalyst, FlowCath®, and is the world's leading developer of low cost Proton Exchange Membrane (PEM) systems used to power fuel cells. ACAL Energy is based in Runcorn.

ACAL Energy, is very much a part of the power generation trend for renewable and zero-emission fuels that can match (or ideally out-do) their fossil fuel counterparts. There are two strands to this trend: the first is energy generation, and the second is energy storage.

Energy generation is what hydrogen fuel cells are all about – fuel cells make their energy from a chemical reaction with two very common elements – hydrogen and oxygen is all they need. For car manufacturers this is very interesting, because a fuel cell car can get its fuel from a pump in under five minutes and can do over 300 miles on a single tank.

The ultimate goal is an electric car that drives, handles and re-fuels like a traditional car. That's why so many manufacturers (Nissan, Honda, Hyundai, Toyota, Daimler, BMW, Audi, Ford and GM), are all launching fuel cell vehicle platforms over the next 2-3 years.

On the energy storage side, one big issue for providers of intermittent green energy - that is anything that depends on the weather to work - is that supply and demand are not always in synch. One option is to turn power into hydrogen, via electrolyzers, so it can be easily stored as a gas, then re-converted back into electricity inside a fuel cell and fed back into the Grid. When size isn't an issue, you can get a huge power output from a fuel cell because hydrogen is very 'energy-dense' – one kilogram of hydrogen has the same amount of energy as one gallon of gasoline, and takes 40 kWh of electricity to produce (this is the same amount of energy that 60 average homes consume in one hour).

ACAL Energy's FlowCath technology is an enabling technology for fuel cell producers as a means of reducing cost, improving performance, and enhancing durability, whilst at the same time increasing the service life of the system. This is a unique offering as no other technologies out there can address all these issues at the same time. Because ACAL owns the intellectual property, they constantly drive to improve the chemistry and design.





Smart systems, smarter technology

Integrating technology, innovation, design and manufacturing is what will elevate LCR's Advanced Manufacturing sector above its global competitors. Through systems modelling, integrated design and simulation - reducing costs and timeframes for new products - to intelligent systems and embedded electronics technology it taps into wider social trends, meeting the demands of consumers and producers alike.

Smart, hybrid and multiple materials operate across the manufacturing industry, powering the automotive sector and enhancing its ability to create cutting edge vehicles, empowering drilling firms to expand their infrastructure and explore new energy sources. Technology is a leveller, enabling both small and large firms to be at the forefront of development. LCR is at the centre of a global advance in smart sensor technology.

Systems Modelling, Integrated Design and Simulation

Embracing technology fuels innovation and design. Systems modelling and simulation reduces the time and investment needed in new product and building development and innovation. It enables designers and manufacturers to get from the drawing board to reality much quicker.

It is vital to create innovative products, to stay a step ahead incorporating the latest tools, techniques and technology available. New chemicals, materials and coatings will help to drive this over the next twenty years. The automotive industry, for example, is looking to smart and hybrid materials to usher in the next generation of vehicles.

Intelligent systems and embedded electronics will drive towards the trend of personalisation, linking manufacturers with consumer. For health, medical as well as lifestyle and life sciences this technology offers the real potential to both change and save lives. Smart clothing and sensors already tap into LCR's knowledge and thought leadership.

Liverpool John Moores University and MedePad collaborated on a patent to produce wireless sensors able to monitor a patients' vital signs, like their heart rate, blood oxygen levels and temperature. Done without hooking the patient up to a machine the sensors are both invisible and undetectable to the wearer. A person's readings are transmitted in real time to devices located many meters away. The smart sensor technology developed by researchers at LJMU's Built Environment and Sustainable Technologies (BEST) Research Institute uses electromagnetic wave sensors which can be woven into fabric including garments and wristbands.

Wearable technology has wide ranging potentials, not just for health but also sport and the military. With an ageing population, widening the application of these sensor devices helps incorporate a cost-saving and efficient approach which is also patient centric and personalised.

Case Study

The General Engineering Research Institute (GERI) is based within Liverpool John Moores University and is active in a variety of fields ranging from optical metrology, advanced manufacturing technology, radio-frequency & microwave research to electronics, image processing and mechanical engineering.

While 3D measurement offers an exciting glimpse into the future of design and manufacturing at present it has its limitations, Professor David Burton from LJMU explains, “It is difficult in a mass market. It is in the technology where we are meeting the limitations in both machining and joining composites.”

To mass produce a car in this way it has to be economically viable but processing composites is not yet far enough along the research process to be able to identify when it might be possible to do this in a mass production environment. “We need automated ways of controlling and measuring both macro and micro surface features for composite materials. Whether it is evolution or revolution – a breakthrough – that gets us there we don’t know.”

“It is in this margin where our future lies,” says Professor Burton. “The margin where we use technology like composites to not just be an also-ran, but a global leader.”



Smart, hybrid, multiple materials

In Advanced Manufacturing the tie between research and production is symbiotic. As manufacturers increasingly want to make more accurate products, elevating them from producing a good product to a market leader for example, they turn to the technology researchers. At LJMU's General Engineering Research Institute, work into 3D measurement and processing of composites offers a glimpse into futuristic models of design and manufacture.

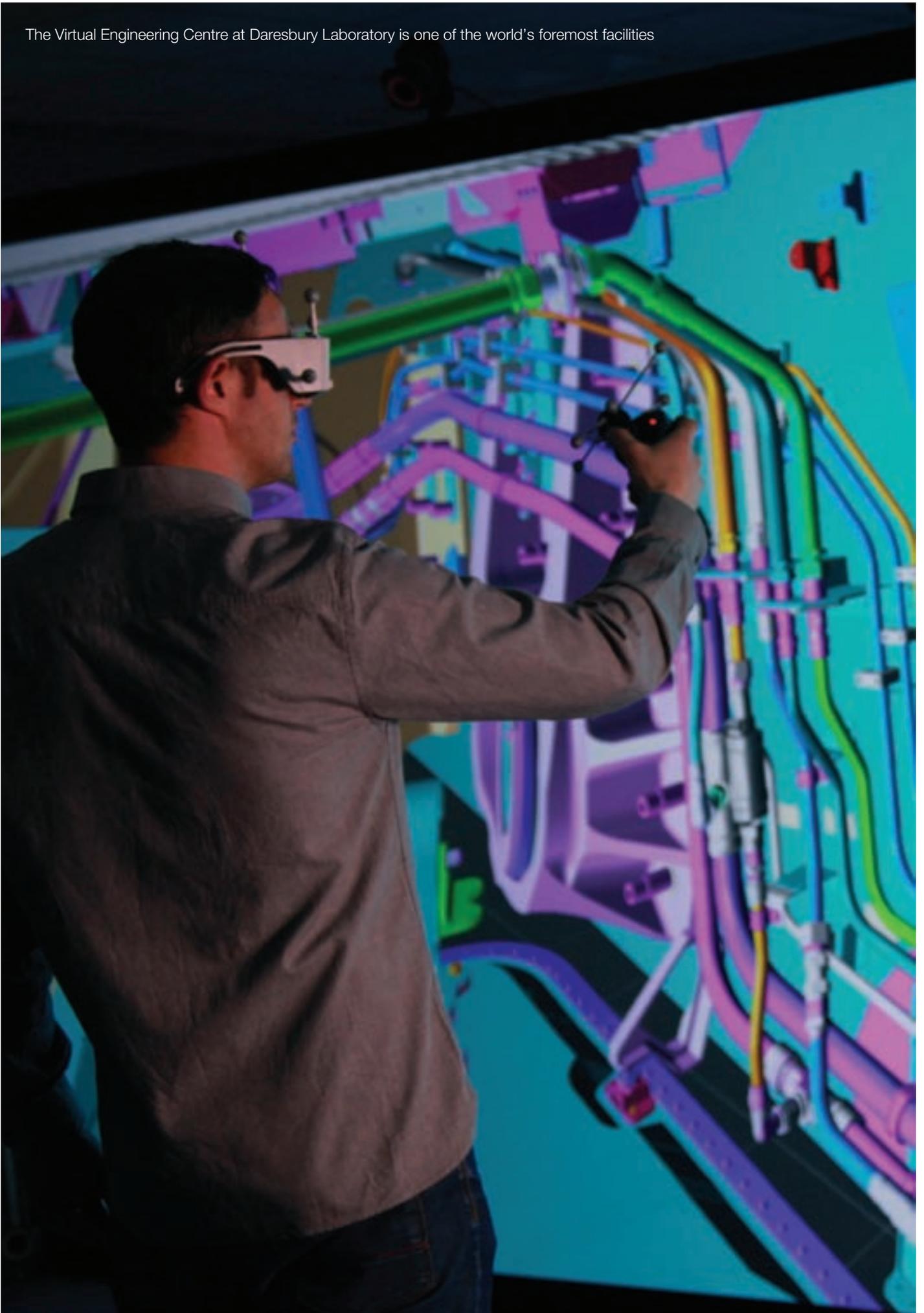
As manufacturers pursue ever more optimal design, success or failure is determined by ever finer margins on often complex 3D surfaces and this is true at all scales – from the macro to the micro.

Inspection of highly intricate 3D surfaces at macro level is becoming increasingly important, manufacturers need to not only perform the task but integrate it with their design operations.

Research in this area holds out the promise of one day having automated, high-speed, non-contact shop floor inspection via new optical systems that pass that data back for comparison with the original CAD solid model of the part.

In the automotive industry there is a drive towards producing the composite car. Mass producing such a vehicle that works optimally, maybe still some way into the future, but for manufacturers like JLR it remains an ambition.

The Virtual Engineering Centre at Daresbury Laboratory is one of the world's foremost facilities



Case Study

The Virtual Engineering Centre (VEC) was established in 2010 with a remit to support the Northwest aerospace sector and wider industry by providing a focal point for leading and emergent virtual engineering technology, research and expertise. A University of Liverpool, School of Engineering led project, the VEC is located at Sci-Tech Daresbury.

The VEC has a unique capability in the UK providing a focus on harnessing the latest technology development, expertise, leading academic research and science infrastructure to accelerate product development, drive product innovation, quality and safety, reducing costs and time to market across advanced manufacturing sectors. VEC Director, Dr Gillian Murray says: "What I'm most proud of is the work we have done to bring investment to the area. Having the biggest supercomputer in the region has brought the VEC to the forefront; it's encouraged a lot of inward investment of companies relocating from France and others within the

region taking over smaller companies. Small firms start to cluster and build new relationships which makes you become a bigger player in the marketplace."

The VEC are constantly investigating the latest emergent technologies and research in advanced modelling, simulation and Virtual Reality applied within an engineering and advanced manufacturing context. Recent examples include:

- working with Bentley Motors to evaluate and integrate new Virtual Reality technologies into their design process to speed up product development timescales, enable design modifications to be made at earlier stages in the process and before investment in costly tooling has been made.
- developing new workflows in collaboration with Jaguar Land Rover to optimise their modelling and simulation processes to maximise vehicle performance in pedestrian safety.

Dr Murray adds: "We're breaking down barriers using this technology. SMEs need dedication and they need support. Innovation can often be time intensive for both big firms and small ones so we bring them both together, making it easier for both sides."

**VIRTUAL
ENGINEERING
CENTRE**



Flexible, scalable, adaptive

Change is coming. Manufacturing needs to be able to adapt to fluctuating markets, to new innovations, technology and infrastructure to remain cost-effective, agile and to remain on a path to growth. By sharing knowledge and experience, developing new models and processes LCR can help to strengthen its already modernised industry.

Understanding trends is a vital step in meeting a need to stay flexible and scalable. Personalisation increases focus on the customer. Technology is the product which meets this need; process is the valuable culture to enable it.

At every stage of LCR's Advanced Manufacturing industry, SMEs are at the forefront of delivering innovative research and ideas. By their very nature SMEs are flexible and scalable but to be able to contribute effectively to the supply chain – and remain successful – they need to meet distinct challenges. For new technology, finding a route to market needs support and investment. SMEs like Mast Group Ltd in Bootle respond to shifts in the global marketplace by investing in innovation, developing products to meet a shifting need. SMEs need on-going support throughout the process from concept, design and manufacture.

Understanding the customer more effectively, as well as understanding the market as precisely as possible, is vital for manufacturers at every stage of the supply chain if sustained growth is the ultimate ambition. In the short-term, understanding the effects of regulations on the consumer and the industry, mapping raw materials, their usage along with energy supply (together with price) is at the core of shaping behaviour. If flexibility is the goal then a system enabling a fast response helps to build an increased capacity. A fast reaction makes it easier to meet customer requirements. To increase capacity further there needs to be easy access to finance. Business planning and future proofing can help prepare smaller firms for this shift in behaviour. R&D teams can be involved to develop and modify the process.

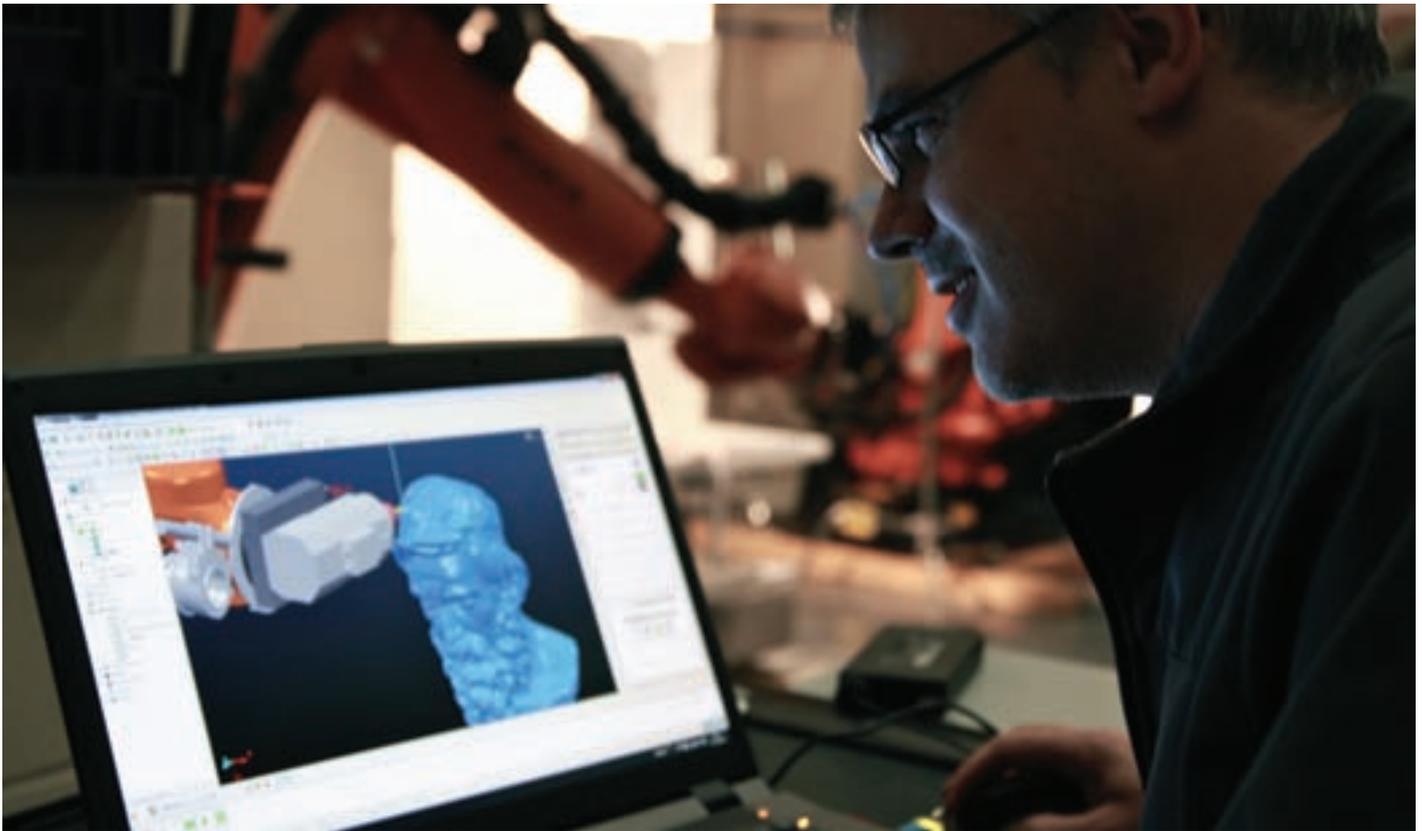
In the long term this commitment to flexibility results in an ability to understand and adapt to technological changes, to develop a skilled and trained workforce and work within a scalable transport infrastructure. Back up supplies of raw materials ensure no disruption to supply. As capacity increases then supply needs to meet demand.

This is not a process to be done in isolation. Working cross-sector across LCR can empower and reduce the reliance of numerous manufacturers fighting for limited resources.

Technology, or cross-investment, is another tool for creating cost-effective and efficient processes that makes a sector more flexible and adaptive. Both aerospace and the automotive sector highlight the potential of additive manufacturing, or 3D printing, as an important step for cutting costs.

Small-scale and miniaturisation will be increasingly significant for the Pharmaceuticals sector; cutting costs as well as reducing the reliance on resources. Creating novel conversion processes for scale, economy and efficiency are important for Chemicals.

The benefits of growth and development need be felt throughout the supply chain. To fully benefit, there needs to be a focus on building new business models to realise superior value systems. Fragmented value chains needs to be managed. The benefit of getting from drawing board to the road quickly and efficiently is vital.



Case Study

CNC Robotics produce robotic machining solutions for many different industry applications and for all ranges of industries and company sizes, from big bluechip corporations to SMEs and other entry level companies. CNC Robotics is based in Liverpool. Jason Barker explains how technology can revolutionise how a firm works, but that the investment is a major consideration:

“CNC machines are very good at what they do, what they are designed to do. But while the cost might be £100k, £200k or £400k the relative robot could be £50k, £60k. There is a significant saving with a robot. Until fairly recently that saving has not been obtainable because there have not been the integrators to be able to use those software toolpaths.

What we are doing is embracing a world where the manufacturers are reluctant to spend any capital to buy new equipment. Their return on investment (with that new equipment) is higher, with a greater speed (to make the product) and accuracy because the robot we make is faster. We are creating a product that makes our customer’s products more profitable. They are streamlined, optimised and reduce their costs by introducing this new technology.”

He adds: “From major firms to SMEs, the decision whether to invest in traditional technology or opt for a new model is a difficult one. These robotics are cheaper to purchase but as a brand new technology it does not have a track record.”

“When you talk about scalability we have a raft of clients who all come from different backgrounds and different areas of manufacturing; from big blue chip companies to a pumpkin carver in the US and everyone in between. The same robot can make an aeroplane wing, can make an ice sculpture, can make a pumpkin for Halloween. It’s the same technology, the same software it’s just the application that’s different. We marry the customers need with the application. You can apply robot technology to anything – that’s why we’re one of the top 250 companies in the UK.”





Robots created and built in Liverpool City Region are transforming manufacturing processes in numerous industries all over the world

CAREERS IN MANUFACTURING

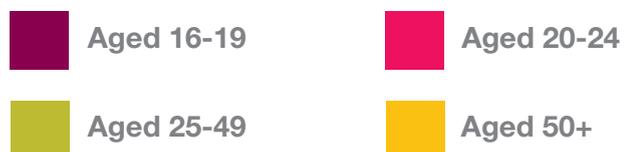
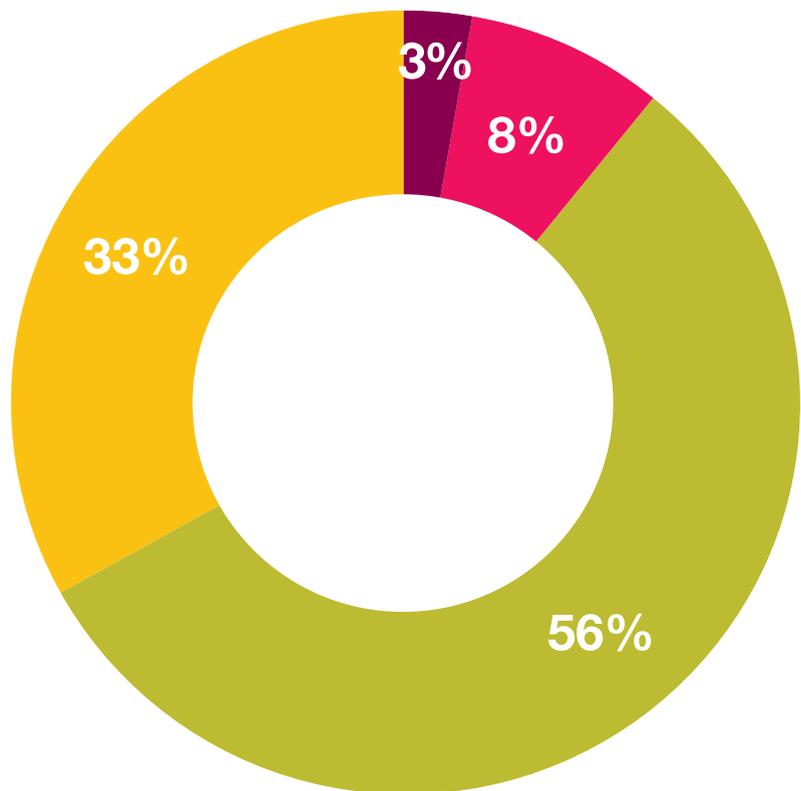
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Where is the future of manufacturing? The process of developing this roadmap has seen LEP communicate with every tier of manufacturing in LCR. Working with employers the LCR has recently published a Skills For Growth Agreement setting out a plan for realising potential and how stakeholders can make this happen.

With every company, multinational to SME, producer to supplier one concern has been raised time and again; how do we create the skilled workforce we need to achieve our aim?

Innovation is at the heart of Advanced Manufacturing. Yet to fully embrace that, and to develop a sustainable strategy to grow and expand, we need a world class workforce to meet our world class ambition.

Skills and education must be at the centre of our roadmap because we find ourselves facing a challenge. Our people are our most valuable asset. Yet our workforce is ageing. We are not attracting young, skilled workers to manufacturing. 10% of the UK's working population works in our industry, in LCR it is 13%. One in three of our manufacturing workforce is over 50. Just 11% is aged under 24, with just 3% aged 16-19.



Local companies provide valuable support and practical experience to students at Liverpool City Region's University Technical Colleges



A young and highly skilled workforce will generate more money for the local, regional and national economy. If we can create innovative business models and products in the North West we can benefit the UK economy by an added £160m annually. Over ten years that figure rises to £1.33bn*.

Yet fewer graduates are turning to Advanced Manufacturing. Employers voice their concerns about the level of skills among both undergraduates and graduates. Some look abroad to India and China to fill their vacancies. If LCR and the UK is losing out in terms of talent and skills its manufacturing industry will suffer. We need to attract the very best candidates and we need to increase the level of skills among young people.

We have two separate goals;

- Improve the skills of young people to create an ambitious, talented and proficient young workforce capable of creating and contributing to a world class industry
- Make manufacturing an attractive opportunity for young people

Manufacturing needs to be increasingly involved in education. No longer can business lament the quality of graduates; instead it must be involved to develop the workforce it needs.

Innovative programmes have been established by manufacturers around the UK to inspire and invest in education. LCR can learn from these and incorporate into our own relationships between industry and educational outlets. Rolls Royce in Derby has a variety of education outreach programmes working with youngsters from the age of five involving practical and process based initiatives in engineering.

Teaching young people about the opportunities in manufacturing, from building jet engines to exploring how a product gets from the drawing board to the back of a freight train, encourages them to see manufacturing as an employment alternative.

Our industry needs to work more holistically. Projects like the Shared Apprenticeship Scheme can help to identify excellent candidates and promote alternatives to university.

Manufacturing needs to improve its relationship with university and further education colleges. There needs to be a partnership between industry and academia. This creates a more skilled and inspired workforce but also a more versatile employer.

Manufacturers need to provide the right environment for employees to learn and develop. To create world leaders in our industry we must develop the models for them to succeed. LCR has the opportunity to become a world leader in Advanced Manufacturing. We want to create a self-perpetuating crop of excellent young candidates in manufacturing. We want international firms to source new members for their team from our skilled young people. This will not damage our own infrastructure because we will have created a machine that is constantly providing the industry with excellent young professionals.

The numeracy and practical problem solving skills of 14-18 year olds needs to be developed. Manufacturers know the skills they need. There should be greater practical project and process management tasks within the school curriculum.

The image of manufacturing

Creating a skilled workforce is vital for manufacturing but the industry also needs to be able to attract the brightest and the best graduates.

The image of manufacturing needs to change. This is an exciting, global career with creative opportunities and excellent pay. We need to encourage graduates to stay in manufacturing once they have finished an industry-relevant degree. We need to encourage more young people to choose manufacturing as a career.

Communication with young people has to start early, as young as five when they are deciding about what job they might want to do. In secondary school decisions are made early about which subjects to take. Manufacturing needs to be seen as a viable option before then.

Our sector needs to work with teachers to help them paint a more positive picture of manufacturing.

We need to show graduates that this is an exciting sector with real potential. Along with the Manufacturing Futures Group we need to promote an understanding of what Advanced Manufacturing is and the career opportunities for every graduate. We need to have an ambassadorial role to spread our message.

When manufacturing is represented in the media we need to reflect a more creative and aspirational industry. Too often the picture is of factory lines and the story is of a declining industry. We need to communicate positive messages and provide pictures which accurately reflect the work we do.

* Liverpool City Region Skills for Growth: Advanced Manufacturing, 2013 (NWBLT, 2013)



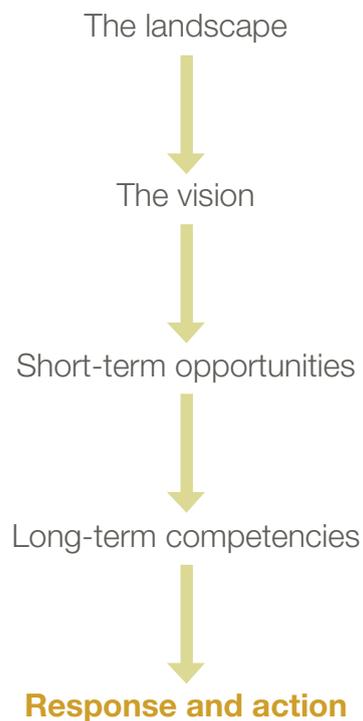
Low Carbon Energy opportunities including Off Shore Wind Farm assembly processes represent advances in manufacturing

Throughout this consultation, we have sought to answer the following question: What is the future for Advanced Manufacturing in LCR?

Working through the Making It process, we have heard from some of LCR's leading companies to map out the future Advanced Manufacturing landscape, and set out a clear vision of what LCR can achieve.

Our message here is clear. The City Region has modernised its manufacturing base and has developed an industry that is now vibrant and which can be globally competitive into the future.

To be so, we must focus on the long term building blocks that will drive the industry, and accelerate our short term opportunities as a mechanism for doing so. In this document we have set out a summary of what we think these opportunities and competencies look like.



We now need to hear from you.

Are you a local manufacturing company but haven't yet had your say?

Are you a potential investor, looking to the future success of the LCR?

Do you work with Advanced Manufacturing companies and can help us to build the world's best manufacturing environment?

For further information go to www.liverpoollep.org/makingit.aspx or email us at makingit@liverpoollep.org

Energy generation, storage, management and security

Energy storage, energy management and transport focusing on energy cost, security and novel generation technology. New energy sources including next generation nuclear and energy transmission with low loss and low visual impact.

Biotech, biological and synthetic biology processing

Alternative bio-and synthetic bio-based sources for new and existing products and processes. Processing of biologics for pharmaceutical and medical applications.

Design and manufacture for light-weight vehicles, structures and devices

Light-Weighting to reduce energy consumption and emissions, reduce costs and increase efficiency. Composite, new and hybrid structures design, fabrication, joining and assembly. Multifunction component design and manufacture.

Systems modelling and integrated design/simulation

Systems modelling and simulation tools, integrated system design, simulation and validation. Virtual prototyping, materials models, functionality and design. System integration of high complexity products.

Automation, mechanisation and human/machine interface

Process automation and human machine interface. Autonomy applications, particularly in production and servicing.

Understanding, designing and manufacturing formulated products

Understanding design and manufacture of formulated products for relevant sectors across the supply chain.

Smart, hybrid and multiple materials

Design, modelling and manufacturing processes of multi-metallic components and high performance materials. Structures and components with integrated functions and tailored material properties and location-specific properties. Enhanced, faster joining capability with a range of materials.

Intelligent systems and embedded electronics

Robust 'live' data capture and comprehensive capture and use of product/process information. New sensor/NDT devices and smart and multi-functional components which are embedded and/or intelligent. Large area, printable, cheap electronics, integrated with other manufacturing processes for energy management, security, packaging and light weighting. Integration of electronics into product and materials design.

Development and application of advanced coatings

Development and application of advanced coatings across multiple sectors.

Flexible, adaptive manufacture

Flexibility of production and manufacturing supporting customised and rapidly reconfigurable manufacturing. Adaptive manufacturing including single step, flexible reconfiguration and process technology that can adapt to feedstock of different types and compositions and mass customisation techniques.

Managing fragmented value chains to support High Value Manufacturing (HVM)

Managing complex value delivery across the value chain in multiple locations and exploiting 'economies of small scale' to develop and produce close to the customer.

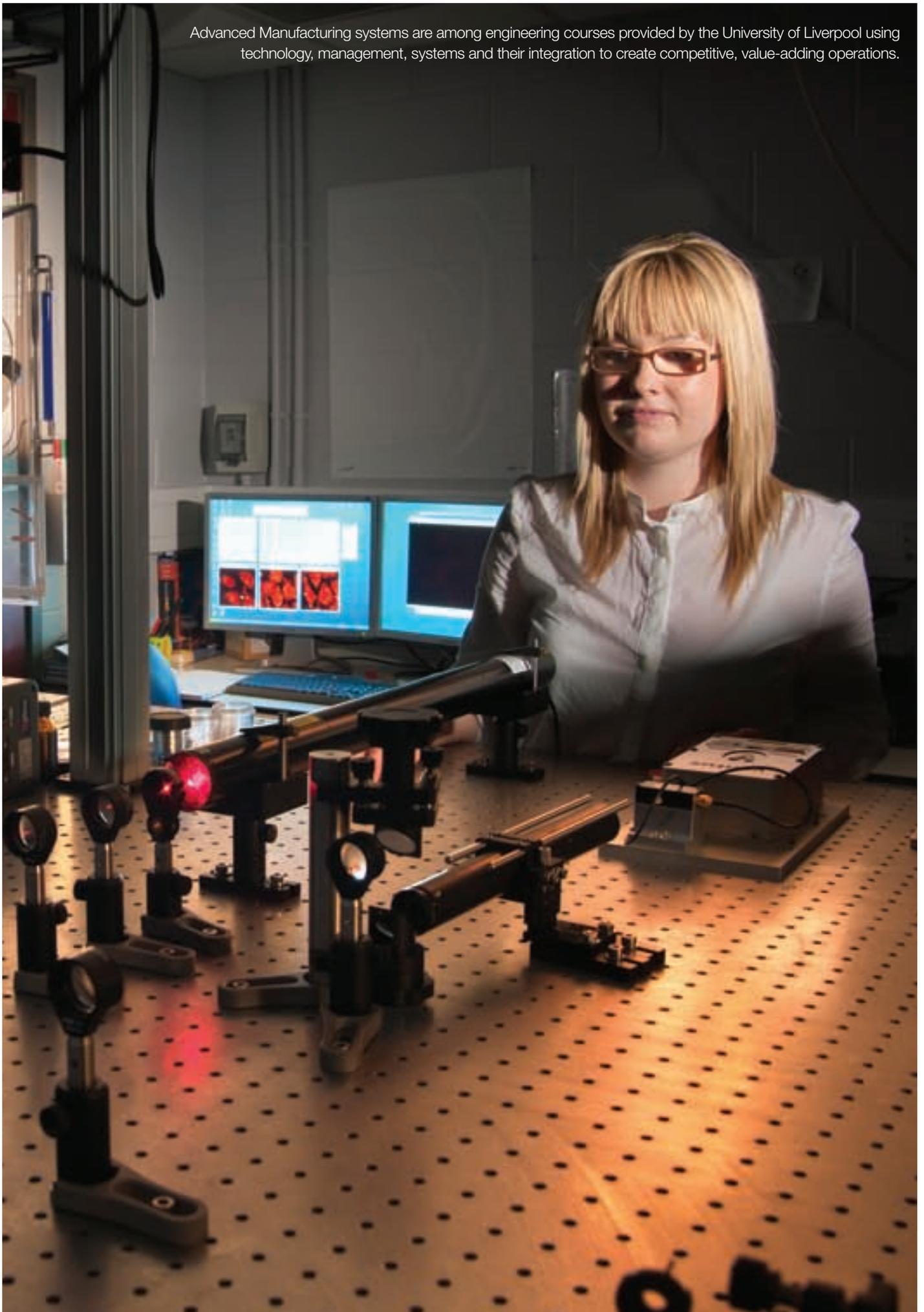
Building new business models to support High Value Manufacturing (HVM)

New business models, with flexible arrangements to create new value.

Developing and retaining skills to support High Value Manufacturing (HVM)

Associated training and skills in HVM, provision of employees with cross-disciplinary skills and the ability to combine knowledge.

Advanced Manufacturing systems are among engineering courses provided by the University of Liverpool using technology, management, systems and their integration to create competitive, value-adding operations.



FURTHER INFORMATION

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