

Life and Chemical Sciences

Manufacturing Innovation



THE IMPORTANCE OF MANUFACTURING INNOVATION

The Scottish Life and Chemical Sciences Manufacturing Strategy has set out a bold vision to strengthen the economy and bring business opportunities to Scotland.

In the revised 2025 vision for Scotland, we recognise and respond to the emerging global trends. The ageing population, proliferation of chronic diseases and increasing cost pressures on healthcare payers are now some of the biggest challenges for the Life Sciences sector. These new challenges are creating emerging markets and opportunities, such as:

- digital technologies, creating a paradigm shift in healthcare by assisting patients to be monitored and treated out-with the hospital setting through patient empowered healthcare management;
- advances in genomics and big data, making the future for precision medicine, companion diagnostics, animal and crop health look bright;
- developments in high value manufacturing, including the use of enzymes and continuous manufacturing techniques, driving down costs and creating opportunities for re-shoring production; and
- innovations in the bio economy addressing environmental and food security concerns through industrial biotechnology, agritech and animal health.

CMACs Industrial Director Craig Johnston has led the Manufacturing Innovation theme within the Life and Chemical Sciences Manufacturing Strategy.



'I am delighted that we have been able to showcase here 4 of Scotland's leading themes in Manufacturing Innovation. The depth and breadth of the sector and the integrated Scottish ecosystems from academia to industry with Government support is quite unique globally. In addition to well-known organisations there are also many hidden jewels. This work builds on previous webinar programs, understanding the supportive funding landscape and leadership training on manufacturing innovation, technology commercialisation and scale-up'.



THE FUTURE AMBITION OF MANUFACTURING

Manufacturing Innovation has become a Scottish strength, showcased within the following technology sectors:

1. Continuous Manufacturing & Advanced Crystallisation
2. Industrial Biotechnology
3. Automation
4. Cell and Gene Therapies

These four sectors contribute to a diverse manufacturing innovation ecosystem in Scotland. This is illustrated through the technology roadmaps for each sector as well as industrial case studies demonstrating Scotland's current status and future ambition.

In addition, Scotland has an expansive range of manufacturing innovation in other sectors including medical devices, vaccines and lightweight manufacturing.

The medical technologies (medtech) sector is the beating heart of Scotland's life sciences. Scotland continues to demonstrate its ability to foster innovation and inspire novel medtech product and service development aimed at addressing global healthcare needs.

Also the vaccines market is expected to reach USD 49.27 Billion by 2022 from USD 34.30 Billion in 2017 and has seen further advancement in Scotland with the £44 Million GSK Montrose facility that is dedicated to produce material for millions of vaccines.

Further developing Scotland's manufacturing abilities is the Lightweight Manufacturing Centre, becoming the first step towards creating a National Manufacturing Institute for Scotland (NMIS). It will focus on the manufacture of lightweight components for a range of industries in which lighter materials offer benefits, including, aerospace, automotive, oil and gas, renewables, medical, marine and off-highway transport. This will fill a significant gap in Scottish technical capability in light weighting and advanced materials development.



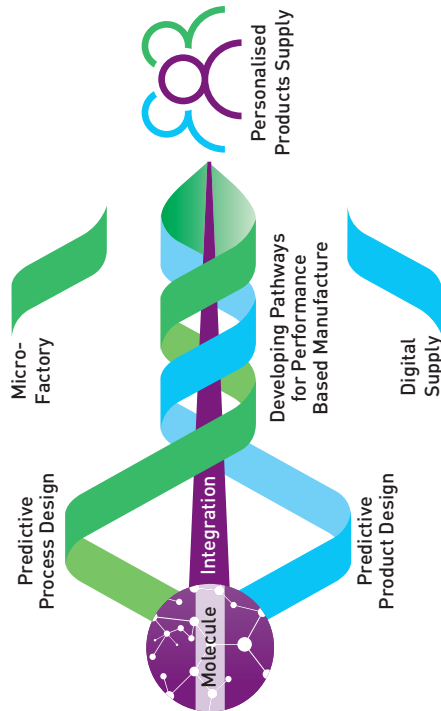
Established in 2011, Continuous Manufacturing and Advanced Crystallisation (CMAC) is a world class national facility for research and training in advanced pharmaceutical and chemical manufacturing. Situated within the University of Strathclyde's Technology and Innovation Centre, CMAC works to accelerate the adoption of continuous manufacturing of pharmaceuticals and transform the supply chains of the future. Along with CMACs academic partners, industry Tier1 members include GSK, AstraZeneca, Novartis, Bayer, Lilly, Roche, Takeda and technology companies who are all working together to advance manufacturing research and the understanding of continuous manufacturing. CMAC has £10 Million from EPSRC as part of the £50 Million program to deliver the Hub research programme, and additional public support from IUK, SFC, SDI, and SE.

www.cmac.com



In addition to core pharmaceutical activities, CMAC works with food and chemical industry sectors, an example of which is Swiss multi-national agriscience company, Syngenta who have an important active ingredient manufacturing site in Grangemouth. Together they evaluated the crystallisation of a major agrochemical active ingredient manufactured here in Scotland with funding support from EPSRC.

Syngenta have used the improved fundamental understanding from the project within its own development program to model and further develop its industrial process. This has both improved the productivity and consistency of the production process which has been incorporated into on-going site manufacturing improvements helping to transform medicines manufacturing.



Currently		CMAC Manufacturing Innovation Roadmap		Achieve in Future	
£100m funding portfolio 2011-2016	130 staff and student across a network of 7 leading UK universities	7 Tier 1 partners GSK, AZ, Novartis, Bayer, Lilly, Roche, Takeda	Leading Tier 1 and supply chain partners	Impact of technology on new medicines and £1bn savings in manufacturing	Impact of technology on new medicines and £1bn savings in manufacturing
7 year EPSRC funding secure in 2017 as Future Manufacturing Hub	2016 ISPE Facility of the Year Winner for hub at the University of Strathclyde	MMIC project front end study and Government support	Process development with gram of material through modelling	Medicines Manufacturing Innovation Centre (MMIC) Operational	Impact of technology on new medicines and £1bn savings in manufacturing



IBioIC's vision is to create a truly distinctive, world leading innovation centre for industrial biotechnology (IB). We will accelerate and de-risk the development of commercially viable, sustainable solutions for high-value manufacturing in chemistry-based and life science sectors. In doing so we will establish an innovation and growth engine yielding substantial economic impact and delivering increasing and sustainable wealth creation, prosperity and employment in Scotland.

www.ibioic.com



CelluComp is a dynamic material science company based in Scotland that develops high performance products based on sustainable resources. They have discovered the exceptional opportunities offered by materials produced from non-hydrocarbon feedstocks. With this in mind, their vision is to create material change for good.

Founded by Dr David Hepworth and Dr Eric Whale, CelluComp manufactures a product called Curran® (Gaelic for carrot), consisting of nano-cellulose extracted from food processing by-products and has uses across a number of sectors. Curran® offers exceptional rheological and mechanical

properties for applications, such as paints and coatings, personal care, home care, cosmetics, concrete, drilling fluids, composites and others. Their initial market focus is as a paint additive. Included in paint formulation, Curran® will prevent cracking and increase the scrub resistance of painted surfaces whilst replacing up to 50% of the binder used in conventional paints.






CelluComp now operate from a state of the art manufacturing facility in Glenrothes, Fife where they have increased production to satisfy a healthy demand for this high tech and sustainable composite product.

The company now has the potential to make up to 400 tonnes of Curran® a year, and is planning to upscale production to 10,000 tonnes per year within three years.

"It's taken a long time for the company to reach this point, where we have a product on the market," said CelluComp CEO Christian Kemp-Griffin. "But now we're here, we'll accelerate growth very quickly." He added: "We could become a billion-pound company."

"From concept to adoption, enabling biobased growth."



Why?		2017	2018	2019	2020	Benefits
<p>Scotland has a number of competitive advantages in developing this sector:</p> <ol style="list-style-type: none"> 1 It is small and well connected with effective collaboration between industry, academia and government 2 It has a skilled workforce and strong academic capabilities based on existing industry in chemical manufacturing, engineering and refining which are highly transferrable to the bioeconomy. 3 It has unique natural resources in marine, industrial and municipal wastes 4 It has established active IB companies of all sizes 5 It has physical infrastructure at Grangemouth to significantly lower the cost of manufacture 	<p>Strategic Leadership</p> 	<p>Promote Scotland on international scale</p> <p>Raise awareness of Scotland's IB activity</p> <p>Represent company members at EU level</p>	<p>Bring flagship investment to Scotland</p> <p>Advocate for the industry to influence IB friendly Government policy</p>	<p>Create compelling case for inward investment</p>	<p>Enhance Scotland's place as a leading location for IB on a global stage</p>	
<p>Developing Value Chains</p> 		<p>Increase IB awareness through Network Integrator project</p> <p>Expand IBIoIC reach into new sectors</p> <p>Attend and participate in events out with mainstream scope of IBIoIC</p> <p>Extend technology scope</p> <p>Extend supply chain activity</p> <p>Connect to EU and Global value chains and webs</p>	<p>Design and manage awareness events for wider industry</p>	<p>Include companies in broad supply chain to support companies to deliver competitive IB products and services</p>		
<p>Investing in Value Chains using Biology</p> 		<p>Provide funding support for industry/academic projects</p> <p>Provide mentoring and support for growing businesses</p> <p>Catalyse the establishment of an IB</p> <p>Provide access to IBIoIC Technical Network</p>	<p>Extend project focus from TRL3-5 to include TRL5-7</p> <p>Enable set-up of IB investment fund</p>	<p>Supporting and funding growth to allow IB development, commercialisation and exploitation</p>		
<p>Skilled Workforce</p> 		<p>Support and sponsor collaborative MSc in IB</p> <p>Maintain industry driven PhD programme</p> <p>Support HND in IB through Colleges</p> <p>Contribute to strategic delivery of STEM across Scotland</p>	<p>Develop part-time option for MSc</p>	<p>Interdisciplinary skills available to support IB companies</p>		
<p>Accelerating Commercialisation</p> 		<p>Provide access and support to RBPC</p> <p>Provide access and support to FlexBIO</p> <p>Coordinate access to UK facilities through BioPilotsUK</p> <p>Support development of Marine Bioprocessing Centre</p> <p>Support the exploitation and development of synthetic biology strengths in Scotland</p> <p>Support the construction of bespoke demonstration plants</p>	<p>Increase technical and commercial capabilities through CPD for IB industry</p>	<p>Support the development and demonstration of new technologies and manufacturing processes</p>		

Just as IT fundamentally changed the workplace during the 1980s/90s, a silent revolution is now underway that will transform the productivity and capabilities of Scotland's businesses. Automation technologies can help companies significantly boost the speed, accuracy and safety of business processes. The 'fourth industrial revolution' has arrived.

This new revolution is being enabled by data - a digital revolution driven by advancements in computing and robotics.

BOOTH WELSH
Integrated Engineering Services

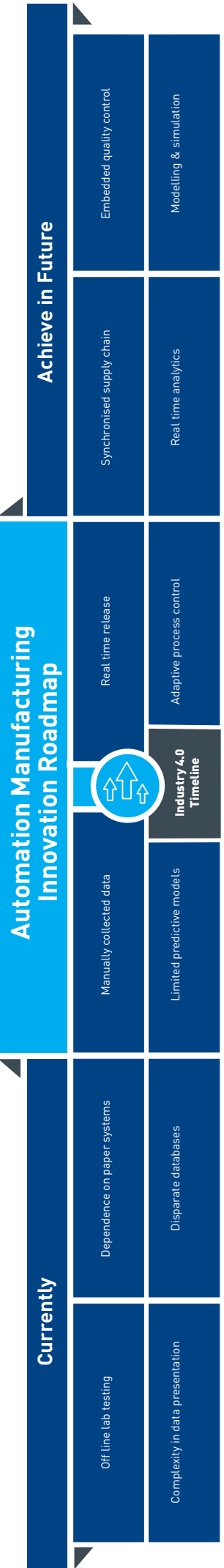
Booth Welsh is a UK Engineering Services Company located in Irvine and part of the international Clough Group. Recently they worked with a global drinks company, which produces many well established brands, operating across 200 sites across 30 countries globally, including distilleries, packaging plants, warehouses and cooperages.

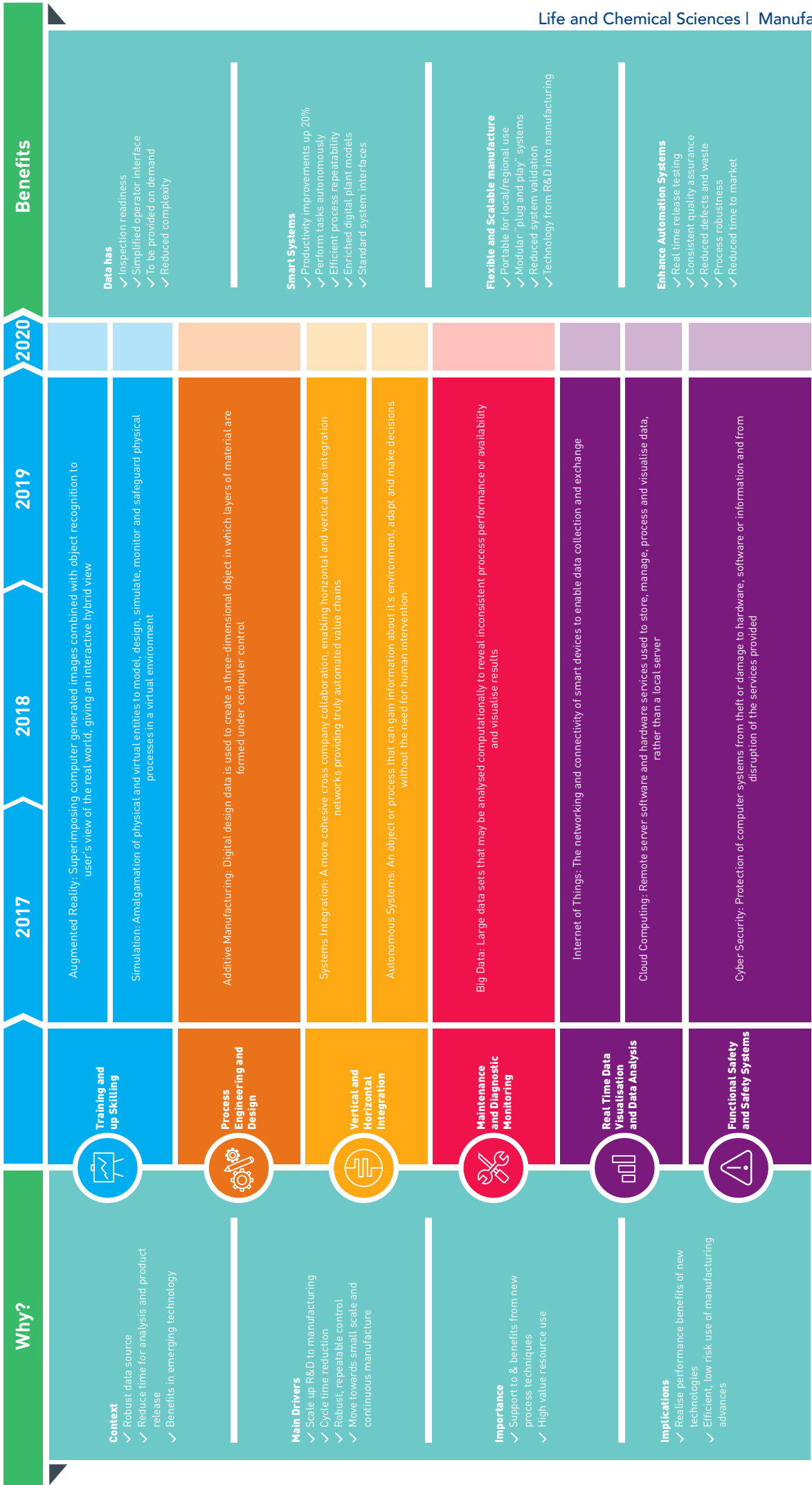
Booth Welsh provided software modifications to existing Siemens PCS7 Distributed Control System for

new filtration line and manufactured a new IO panel. Client software testing and live loop checking was conducted using a second plant controller, purchased specifically for the project, to minimise the large costs associated with extended plant downtime.

Booth Welsh provided extensive knowledge of the site and business and Siemens solution partner status in obtaining value for money and ongoing support for their PCS7 system. Also seamless in-house panel

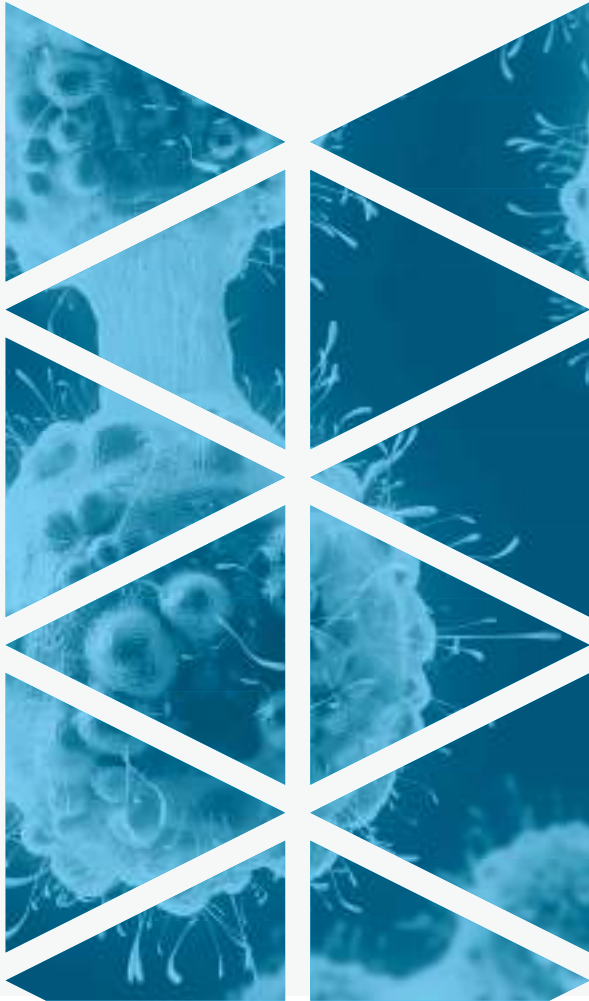
manufacture and plant downtime was minimised to 2 days by utilising a second identical control system. Being separate from the live site system and a separate IO panel allowed field IO testing to the new IO panel to be conducted without disrupting existing operations. Working with Booth Welsh resulted in a quick project turnaround within 6 months which was ahead of time by two weeks and on budget.





Advanced therapy medicinal products (ATMPs), including breakthrough cell and gene therapies, offer unprecedented promise in areas of high unmet medical need. Scotland is a leader in medical research and now has a recognised position in the discovery, development and services associated with advanced therapies.

This emerging industry is at a critical stage in moving research into manufactured products with the focus now on manufacturing scale-up in order to commercialise these therapies. In this context, Scotland has the opportunity to secure its position as a global hub for developing and manufacturing these cutting edge therapies. This roadmap closely aligns with the 2016 report "Advanced Therapies Manufacturing Action Plan – securing and attracting advanced therapies manufacture in the UK" delivered by the Medicines Manufacturing Industry Partnership.

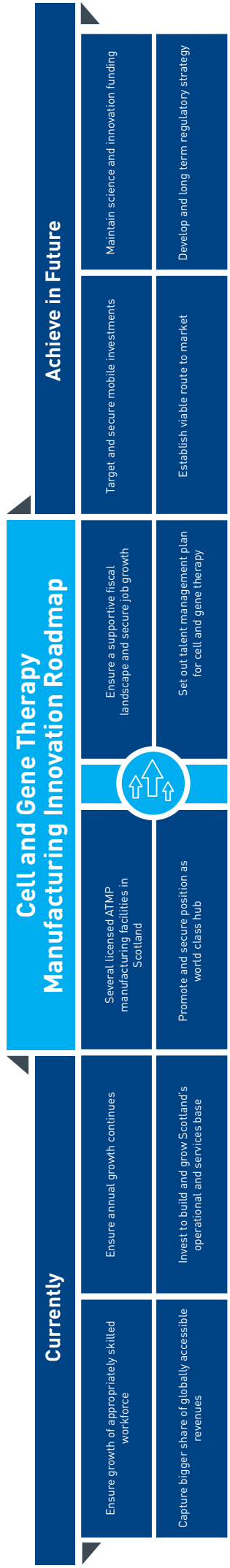


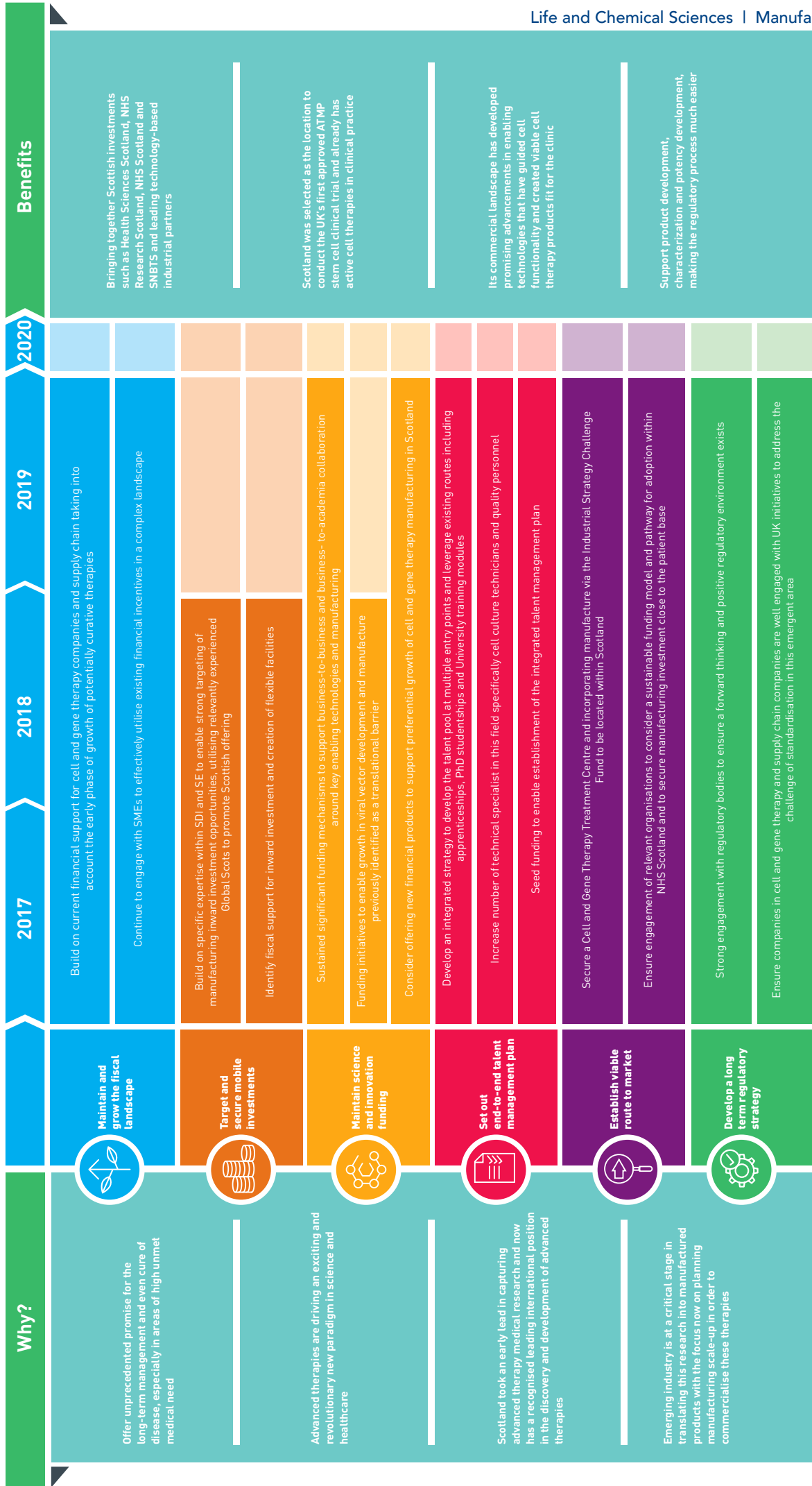
Roslin Cells was founded in 2006 by the Roslin Institute with the support of the University of Edinburgh, the Scottish National Blood Transfusion Service and Scottish Enterprise. The company initially focused on the development of cell therapies and pluripotent stem cells for applications in research, drug discovery and therapy.

Now operating as Roslin Cell Therapies Ltd, they are world leaders in the development of cell therapies and pluripotent stem cells for applications in research,

drug discovery and therapy. Roslin Cell Therapies Ltd provide integrated and custom-designed product development and manufacture service solutions for cellular therapies intended for clinical trials. With an experienced and professional Cell Therapy Development and GMP operations teams and a custom designed MHRA licensed GMP Cellular Therapy Facility, they offer a complete portfolio of services to match client needs, from procurement, GMP translation, process and assay development and qualification, technology transfer, GMP manufacture,

storage and distribution. Based at the Edinburgh BioQuarter, strong links are held with a wide network of researchers, clinicians and Regulatory Agencies, providing a strong platform in which to support clients to the clinic and beyond. Through a strong commitment to quality and delivering outstanding and personalised customer service, Roslin Cell Therapies is well placed as the partner of choice for those wishing to manufacture cell-based therapies for clinical trials.





“In 40 years in the Life Science Industry I can’t remember a more exciting time for manufacturing. Increased funding and focus on innovation provides us with a great opportunity to accelerate the adoption of new technology to improve manufacturing productivity.”

Dr. Clive Badman OBE
Head of PTS Pre Competitive Activities, GSK

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and Advanced Crystallisation (CMAC)**

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