



**Future Fit:
the road ahead
for manufacturing**

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Introduction



Manufacturing has been a part of my life for as long as I can remember. Brought up walking the factory floor of my father's small engineering business in the West Midlands, I'm proud to remain involved with the industry today, working alongside manufacturers to help develop their businesses and sustain their growth.

Every week, I learn about new businesses. I see demand for new – and sometimes old – products, understand exciting innovations at the forefront of technology and, most importantly, work with those involved closest with the manufacturing sector. From jet engines to luxury satchels, these businesses produce some of the highest-quality objects in the world. Yet despite their strengths and the industry's role as a vital component of the economy, today's manufacturers face significant challenges.

On top of recovering from a global recession that hit industry giants as well as small, family-run businesses, they now need to embrace seismic technological advancements, run strong day-to-day operations and face increased competition from Europe, the US and the rising economies in China and the Far East. This new environment presents both threats and opportunities to the sector, and as a bank that exists to support its needs, we must have a holistic understanding of its concerns. Only then can we successfully anticipate and prepare for the future too.

To this end, we sought out the insights of academics, industry experts and 300 manufacturing leaders – in particular those running the medium-sized enterprises (MEs) leading the sector in terms of both growth and employment in order to develop a deeper understanding about the aspirations, fears and challenges from the factory floor. With this goal in mind, we hope you will join us in exploring these insights as we work to develop meaningful solutions for a strong and sustainable manufacturing future.



Richard Hill
Head of Automotive & Manufacturing
The Royal Bank of Scotland

Executive summary

What does a successful Scottish-based medium-sized manufacturer look like today? What will it look like in the future? How should its goals, strategies and processes adapt so that it prospers in the fast-paced and increasingly competitive marketplace of tomorrow? And in doing so, how will its needs evolve?

Our research

These are some of the questions and problems that we and global trend analysts The Future Laboratory, in partnership with industry insiders and academics, have looked at extensively. We've used round-table discussion, original quantitative analysis and extensive interviews with nearly 300 medium-sized enterprises (MEs) – from Small MEs (with a revenue of £5–10m), to Medium MEs (£10.1–35m) to Large MEs (£35.1–50m) – across Scotland, the UK, and beyond.

These in-depth, comprehensive interviews were designed to give a deep understanding of the aspirations, fears and hopes from senior manufacturing leaders.

This report reveals a sector built on a solid foundation of high-quality processes, talent for cross-disciplinary collaboration, proven international competitiveness and long-term instincts.

Challenges and opportunities

Medium-sized manufacturers are well positioned to become a leading global force in the second half of the 21st century. However, a careful analysis of the trends, opinions and concerns from within the industry reveals a sector whose future success is threatened by:

- disconnects between the demands of 'Industry 4.0' and manufacturers' planned responses
- global invisibility
- slow take-up of new technologies
- lack of supportive ecosystems
- out-dated business models

Scottish manufacturers are at a crossroads of challenges and opportunities, and face fierce global competition at an unprecedented pace of change. Forced to operate with limited support, many MEs lack a clear picture of the national and international competition facing them. Others, too focused on the day-to-day running of business, have no long-term plan for the future and risk under-utilising the new philosophy, strategies and technologies that will underpin business in the 2020s.

Given these forces, it is evident that now is the time for a new conversation about the support and advice that industry leaders need to become future fit. It's a conversation this report aims to kick-start and which we plan to continue, and deepen, from here on.



Industry 4.0, or smart technology, refers to the fourth industrial revolution which is centered around intelligent manufacturing. It brings together contemporary automation, data exchange and new manufacturing technologies.

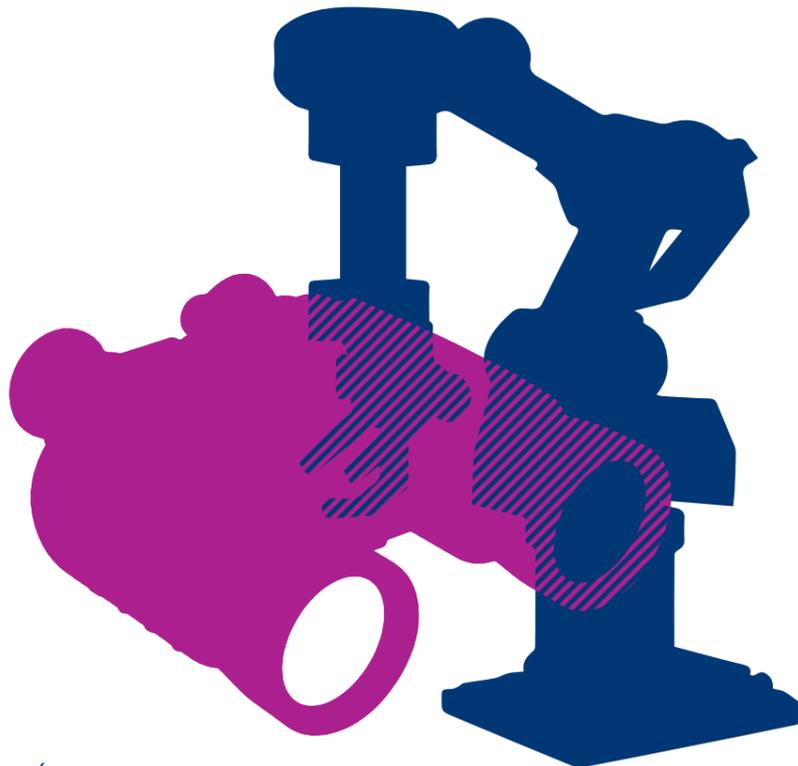
Defining the disconnect: the problem of grip and vision

An analysis of the attitudes, beliefs and aspirations of ME leaders reveals a worrying disconnect between the future realities of global manufacturing and companies' strategic plans to meet and prepare for these shifts.

Further, our research shows that the size of the ME, as defined by turnover, is a key indicator of the values, behaviours and aspirations of ME manufacturers as they plan for the future.

Facing a future that will bring change on a scale so vast it is being heralded as the 'new industrial revolution', the Scottish ME manufacturers are aware that drastic transformation is knocking at the sector's door. Among the nearly 300 UK ME companies surveyed in this report, 91% agree that it will be crucial to accelerate their capabilities over the next 5–10 years to stay competitive.

However, 14% of these vital businesses have no plan in place to help them achieve these goals, and a cautious weariness towards risk and innovation pervades the sector.



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Grip and vision

It's a disconnect that Matthew Grainger, of UK manufacturer Grainger & Worrall, neatly described as "the problem of grip and vision" – keeping a grip on the often overwhelming day-to-day running of a business, while simultaneously developing a bold plan and a practical vision for the future.

As one exasperated ME founder put it, "We don't sit down and write a comprehensive five-year plan. How can we? We don't even know what is around the next corner. The best we can do is plan for a need to be agile and flexible so we are ready for change when it comes. The reality is that we are having to invest significant sums in new registrations, new formulations and approvals just to stand still."

However, there are significant differences in future-proofing planning and strategies between Small, Medium and Large MEs.

"The reality is that we are having to invest significant sums in new registrations, new formulations and approvals just to stand still."

Small ME (revenue £5m-10m):

- most conscious about future needs and threats
- feels the pressure of more demanding customers
- sees real product and service innovation as key
- worries about whether they can afford to compete

The nimble newcomers to the sector, Small MEs report feeling less stifled by process and established corporate structure. Yet they're open to new possibilities and are able to move quickly to innovate.

However, this group most acutely feels the pressure of more demanding customers, sees real product and service innovation as key, and worries about whether they can afford to innovate to compete.

More than half of these smaller and more fragile businesses (52%) report that they are wrestling with the rising costs of new equipment, energy and technology, and slightly less than half (48%) are pondering how to react to new legislative demands.

For this size group, the "disconnect" between grip and vision is primarily down to finding the resources and ability to pursue ambitious future plans.

Medium ME (revenue £10.1m-35m):

- feels the most insular
- focused on a tougher trading environment
- recognises that they have many internal challenges
- doesn't know where to start to become future fit

Medium MEs typically focus on a tougher trading environment and dealing with internal challenges as they undertake the difficult transition from owner management to corporate professionalisation. Medium MEs are the “squeezed middle” of the Scottish ME manufacturing landscape.

Problem of transition

Medium ME leaders described to us vividly how time-consuming and emotionally and psychologically draining this transitional moment can be.

One newly arrived Medium ME CEO explained: “There’s no IT department. There’s no customer service team. There’s no proper fiscal control in the finance department. We haven’t diversified our portfolio. So, we’re putting all this in place, but it means a lot of initial investment in terms of both time and money.”

Another new CEO said: “We had four new machines that needed programming to work and I was told, ‘Sean’s gone on holiday and it’s all in his head.’ So the entire business stopped for two weeks.” These MEs also find themselves at the mid-point of a supply chain with only one tier of limited visibility and control in either direction.

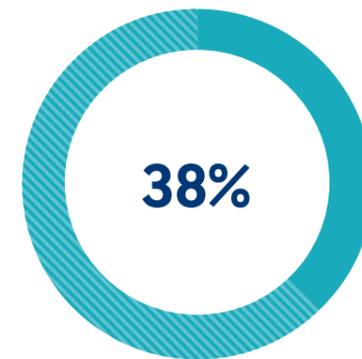
“Medium MEs often have no control on external issues,” says Peter Digby, MD of automotive manufacturer Xtrac. “So they are conservative with a small ‘c’ about growth strategies because they never know what impact a macro-event, like a UK Euro exit, or an oil price shock, will have on their supply chain.”

Our research reveals this sense of isolation can breed an insular and inward-looking mindset amongst Medium ME leaders. This can lead to perilous misunderstandings about how new technologies can future-proof a business against new competitive threats.

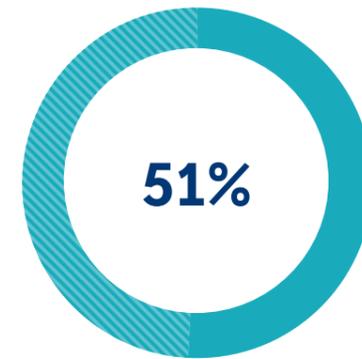
38% said that they are actively looking for alternative materials, such as nanotechnology, and 51% believe that these trends will become widely adopted in the future.

For these Medium MEs the “grip and vision” struggle lies in balancing the creative energies of their management and creating a vision for a profitable high-tech future.

38% are actively looking for alternative materials, such as nanotechnology.



51% believe that these trends will become widely adopted in the future.



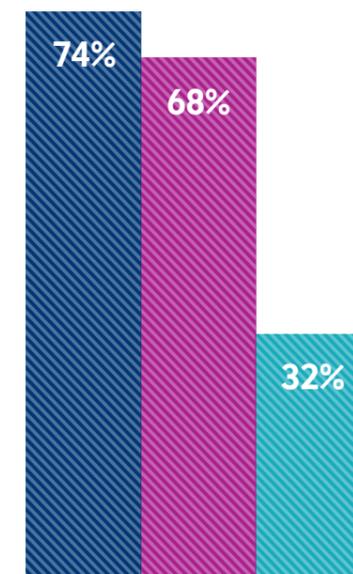
Large ME (revenue £35.1m-£50m):

- is most profit-driven and takes a global view
- sees international competition and rising customer expectations as key threats
- needs greater client visibility, productivity and proximity to customers

These well-established and confident businesses are Scottish plc’s manufacturing vanguard: willing and eager to adopt the new technologies that will establish them as leaders on the global stage.

Profit-driven, commercial and highly professionalised, they aim to be at the forefront of their sector. As one Large ME CEO told us: “We try to be trendsetters wherever possible.”

Almost seven out of 10 (68%) are planning to get more involved with the use of Big Data to boost efficiency and profitability. The same set makes more effective use of existing capacity, and responds to customer demands for personalised products. Three quarters (74%) want greater access to nanotechnologies and new composite materials to drive innovation and increase their resilience in the face of increased international competition.



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- Almost seven out of 10 are planning to get more involved with the use of Big Data to boost efficiency and profitability.
- Large MEs are ready to consider novel strategies to supercharge their future-fit plans, with a third keen to sell direct to consumers in the coming years.

Preparing for the future

Their strong drive to innovate extends beyond the adoption of advanced manufacturing. Large MEs are ready to consider novel strategies to supercharge their future-fit plans, with a third (32%) keen to sell direct to consumers in the coming years.

A future of rising competition is very much at the forefront of the minds of Large ME leaders.

All of them believe they need to dramatically accelerate their technological capabilities in order to compete globally over the next decade.

Large MEs appear to have a firm grasp of both the challenges and opportunities ahead. However, it would be a mistake to assume they need no support and can confidently face the future alone.

Our research suggests an urgent need for advice and support that give Large MEs greater visibility of their entire supply chain, and the changing needs of their customers, to ensure future competitiveness.

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Global invisibility

There is a keen recognition that Scotland's future manufacturing status will be decided by how well it performs against a growing competitive threat from overseas. However, a lack of visibility surrounding the UK's place globally, and hesitation to compete internationally pervades the ME segment.

Scottish and UK MEs sense that the threat of global competition is rising – more than half (54%) of those surveyed said the biggest external challenge to achieving success in the future is the threat of increased competition, with a third (33%) believing that competition will come from Asia.

While the rise of foreign competition is clear, the sector is struggling with a lack of visibility about how well – or badly – the UK is truly performing relative to other countries. Of the MEs surveyed, four out of 10 (41%) believe the UK is outperforming global rivals, a quarter (26%) think the UK is doing worse, and almost a third (30%) believe the manufacturing sector equals the performance of its peers in other countries.

The facts paint a different and more optimistic picture according to Peter Marsh, journalist and author of *The New Industrial Revolution*.

“I asked a smart, well-informed friend where he thought the UK sat in a world manufacturing league table. He said about halfway down,” says Marsh. “In fact, we’re the 10th largest manufacturing country out of 200 countries. That puts us up there amongst the major global players, ready to take advantage of the next industrial revolution.”

This positive competitive position does not seem to have registered with many UK businesses, however. Only half (50%) of ME manufacturers expect to find new customers overseas in the next five years, and nearly four out of 10 (38%) see their future business confined to the UK.

As one senior executive confessed: “Mainly, we tend to do everything inwardly.”

Inward looking

A desire by many to remain entrenched in familiar domestic markets appears to have its roots in serious doubts about whether Scottish and UK manufacturing is equipped. It's an attitude summed up by the views of a managing director from one Large ME: “We tried exporting overseas a couple of years ago and got burnt. I don't think we'll try that again.”

However, this attitude is dangerous given the accelerating preparations for a “Smart Manufacturing” future, which can already be seen overseas. In the US, 35% of manufacturers now collect and use data generated by smart sensors to enhance manufacturing and operating processes, according to data from PwC. That figure is likely to rise rapidly over the next five years as a series of new national initiatives add momentum to the speed of technology uptake. The Smart Manufacturing Leadership Coalition, the first US open smart manufacturing platform, will create a nationwide collaborative information network for data-based industrial applications, according to law firm Pinsent Masons.

Inspired by Germany's Industry 4.0, 'Made in China 2025' aims to comprehensively upgrade Chinese industry.



Transformative technologies

The US is far from alone in readying its ME manufacturers for the transformative technologies to come. “For the first time in history, UK rivals – Germany, Japan, China and, to a lesser extent, India – are planning a managed industrial revolution,” says Karthik Sundaram, a manufacturing analyst at global research consultancy Frost & Sullivan.

“China is joining hands with Germany, seeking to cut out two or three stages of normal development to make a great leap forward to Industry 4.0. ‘Made in China 2025’ is China's answer to the global manufacturing story and has also resulted in a strategic partnership between Chinese and German manufacturing. “I do not find the UK on the radar of advanced manufacturing,” says Sundaram. “Representatives from the country, or from its medium-sized manufacturing sector, never seem to be present at the many international strategy meetings taking place around the world to discuss how to adopt and optimise the new technologies that are emerging.”

“All the other 27 EU countries have set ambitious advanced manufacturing targets, even Italy and Spain. But this does not seem to include the UK,” he says.

“Unless there is a major initiative very soon, it's going to be almost impossible for the UK to catch up. By 2025, it could be a distant also-ran in global manufacturing.”

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Technology gaps and opportunities

Hesitancy to embrace new technologies and feeling overwhelmed by a future of servitisation and high-value, linked-up manufacturing threatens the future competitiveness of Scottish manufacturing. However, our MEs are well positioned to take advantage of Scotland's strong foundation of academic and research excellence to become global leaders of this space.

“UK manufacturers can no longer afford to be conservative in their future strategies. They need new technological thinking and collaborations – or they will be left behind,” says Sundaram.

There's no doubt that ME leaders accept this position. More than two thirds (68%) of MEs surveyed believe that technologists will be the most in-demand skill set by 2050, yet in spite of this, there is little energy for exploring how to meet these needs.

The disconnect between the desire to innovate and the awareness of trends set to shape the industry may be down to MEs being risk-averse to innovation. This could be because manufacturers experience blind spots about the usefulness of some emerging technologies that industry experts identify as key.

For example, less than a third (31%) see access to nanotechnology and new materials – cited as major areas of global opportunity for Scottish medium-sized enterprises by industry experts – as means of future-proofing their businesses.

An observation by one of the leaders interviewed for this report illustrates the worrying perspective:

“We haven't really needed to innovate. The equipment we use has been making us money since the 1980s so you have to ask: why do we need to change?”

Servitisation: developing services-based solutions to add value over and above the standard product offering.

More than two thirds (68%) of MEs surveyed believe that technologists will be the most in-demand skill set by 2050.



Better technology

However, with costs falling, MEs need to be advised that smart production will allow them to establish a global lead in areas such as connected, driverless cars, and drone technologies where the UK's regulatory framework give them natural advantages.

“Without rapid adoption of these new advanced technologies, UK MEs will be significantly disadvantaged in a future where manufacturers will be using Big Data to compete for capacity anywhere in the world,” says Dick Elsy, CEO of manufacturing innovation incubator HVM Catapult.

“But should they take on board emerging Big Data techniques quickly, they will be able to double our GDP in manufacturing by using every spare bit of capacity.”

Education around the growing importance of new materials and nanotechnology to future growth and success is vital for MEs – particularly the often-isolated ‘squeezed middle’ Medium MEs – as they face up to global competition.

However, major manufacturers such as British Aerospace (BAE) and Jaguar Land Rover (JLR) offer gold-plated templates for innovating in a changing world. JLR's Virtual Innovation Centre at its engineering, design and testing facility in Gaydon, Warwickshire is a globally recognised Virtual Reality test bed for next-wave manufacturing techniques.

As Elsy, of HVM Catapult, says: “UK aerospace and automotive have become world leaders by making big improvements off the back of innovation. They've introduced radically new technologies which give productivity improvements of up to 50%. And that's driven by knowledge, not by cutting labour costs, or using cheaper energy.”

He goes on to say, “There is a lot to be learnt by MEs from the way that big companies like JLR and BAE work. They are pointing the way to global success for some of our more promising MEs.”

Case study: Sharing in Growth

Sharing in Growth is an ambitious programme to raise the capability and competitiveness of UK aerospace suppliers to share in the growth of aerospace and other global markets.

It was set up in 2013 to deliver a £250m programme of intensive supplier development. The first 25 beneficiaries have already secured contracts worth more than £1 billion from improved productivity and competitiveness.

“The thing we're trying to achieve here is to develop highly valued manufacturing in the UK both for our generation and for those to come.”

Andy Page, CEO,
Sharing In Growth



Following on from success

Among the MEs connected to the aerospace and automotive supply chains – or inspired by it – current global success is already being seen as a blueprint for future strategies. Virtual prototyping technologies and composite materials developed for automotive purposes are driving innovation in other sectors.

“Virtual prototyping means that engineers no longer have to create endless, expensive physical prototypes to test out new designs,” says Paul Markillie, Innovation Editor at The Economist. “Instead they can test out a new car or machine digitally using amazing simulation software models, saving loads of time and money. Our world-class expertise in Formula 1 means that the UK is already very, very good at this, and has all the talent and equipment in place.”

He adds, “Over the next decade, it will be increasingly used in other areas of engineering and manufacturing to create optimised and efficient designs for equipment, materials and buildings. This will combine with our expertise in the use of novel composite materials – developed by the aerospace industry – to allow our MEs to become world leaders in creating huge, joint-free shapes with less stress points and weaknesses.”

UK government regulations will allow MEs to apply these templates for success to two emerging manufacturing sectors – driverless cars and pilotless drone aircraft – expected to see dynamic growth in the 2020s.

“UK regulations mean that we can become a world centre for drone development as we are one of the few countries where you can test-fly them relatively easily,” says Markillie.

“Developing applications for disease and pest control of crops are areas wide open for development by UK MEs.”

Behind the wheel, ahead of the curve

Lee Hopley, chief economist at the manufacturers’ organisation EEF, sees driverless cars as another global manufacturing opportunity for UK MEs for similar reasons. She thinks that government regulations allow them to be tested on our roads, unlike many of our competitor nations.

“We’ve got fantastic technical capabilities, good design skills and a decent regulatory framework in the UK that could allow us to get ahead of the curve globally in testing technologies such as driverless vehicles,” she says.

Both Hopley and Markillie feel that UK MEs have a global advantage in manufacturing future medical and life science solutions, too.

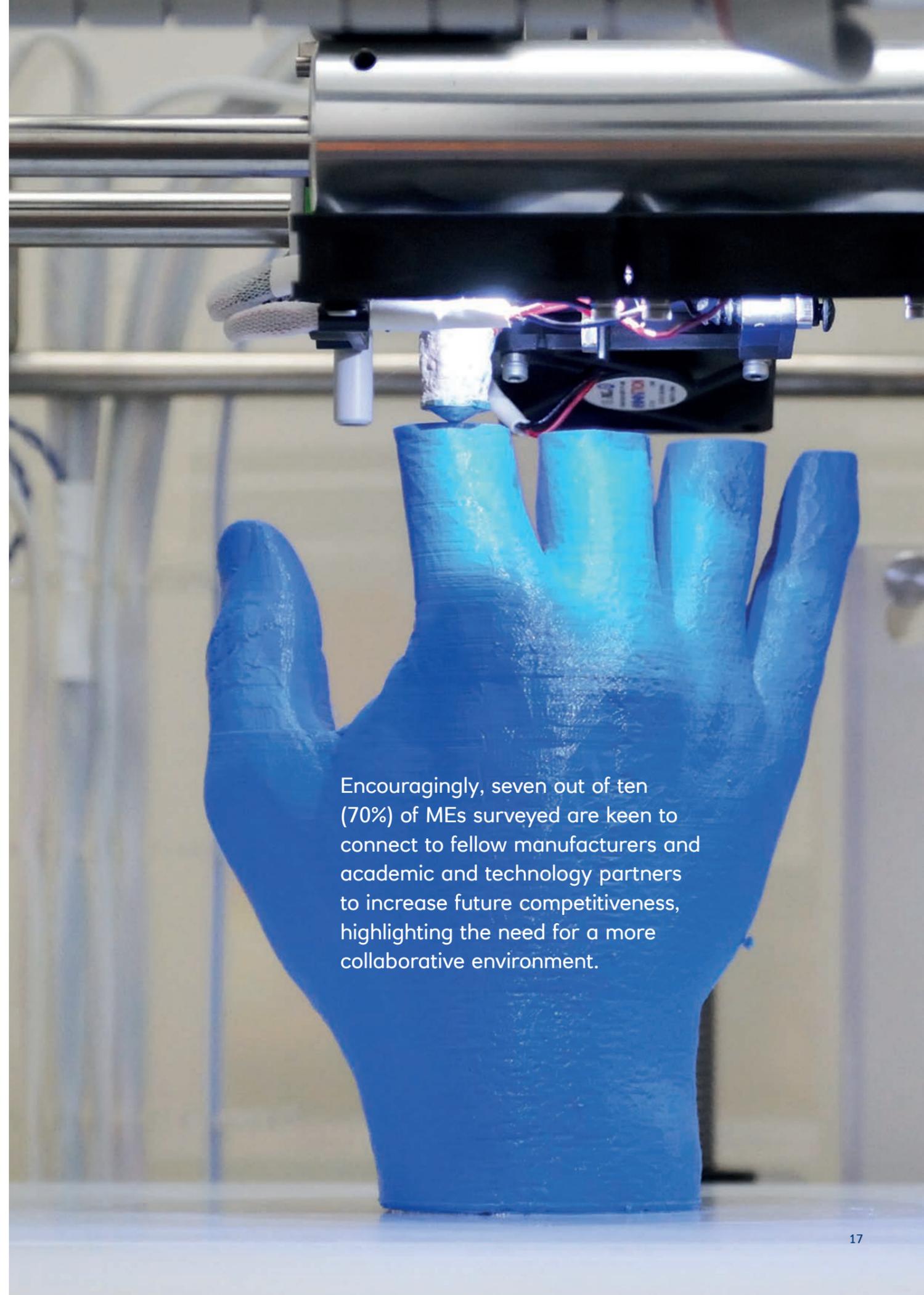
“Our strength in applications for life sciences could put us at the forefront of 3D printing for medical purposes, creating customised surgical implants and, eventually, tissue and even organs from personalised CAD files,” says Markillie.

Encouragingly, seven out of ten (70%) of MEs surveyed are keen to connect to fellow manufacturers and academic and technology partners to increase future competitiveness, highlighting the need for a more collaborative environment.

Hopley feels that manufacturers in the UK are often paralysed by a lack of advice and support on which new technology will work best for their business.

“UK MEs have not always found it easy to identify the right technological solution for them, and how they implement it, and how they get the most out of it, quickly and profitably,” she says.

“There’s a lot of work to be done to help MEs, using experts to work through their supply chains to make sure that they’re aware which technologies are going to be most appropriate for them.”



Encouragingly, seven out of ten (70%) of MEs surveyed are keen to connect to fellow manufacturers and academic and technology partners to increase future competitiveness, highlighting the need for a more collaborative environment.

Fragmented ecosystems and weak supply chains

Support networks within the industry are powerful tools for giving MEs the connections and confidence to become global exporters, but many Scottish MEs appear to operate in an insular culture.

No man is an island, and no business can stand alone to innovate and grow in a world of ever-increasing global competition.

The effect of connected support networks is widely recognised. Successful high-growth businesses tend to coalesce in geographical ecosystems of mutually-supporting and reinforcing activities and skills, according to industry analysts Llewellyn Consulting.

Their recent CityUK report, Enhancing the ability of UK SMEs to Export, finds that MEs benefit hugely from attending “dating events”, bringing together finance providers, companies with export experience and businesses looking for opportunities in international markets.

These ecosystems are central to dynamic growth because they provide a greater opportunity for specialisation, productivity enhancement, and the emergence of centres that drive innovation, their research shows.

Failing support

Currently, however, many Scottish MEs – and particularly Medium MEs – must endure ecosystems and supply chains fragmented by 30 years of rapid globalisation. Across much of the UK ME manufacturing sector, businesses are isolated, vulnerable to economic shocks and unaware of technological changes on the horizon.

Consequently, the forgotten army of medium-sized manufacturers often feels itself to be exactly that: a vast scattering of niche businesses with no sense of connection to a larger, more meaningful, regional or national sector.

As Rupert Greenhalgh, at New Economy Manchester, says: “One of the key reasons why supply chains are weak in the UK is that they are fragmented.”

There are more immediate and practical impacts, too. Poor ecosystems can hamper an ME’s day-to-day performance as well as its ability to be innovative for the future. “If you’ve lost your manufacturing and production infrastructure and support, then you may lose not only your higher volume business, but your ability to innovate,” says Professor Sir Mike Gregory, former Head of Manufacturing and Management at the University of Cambridge, and of the Institute of Manufacturing.

Missing connections

The serious impact of this lack of connectedness is plain to see. Four out of ten (40%) MEs feel that poor visibility of customers’ future plans is a major internal challenge. Almost a third (30%) fear they lack expertise and knowledge, and 28% that they lack innovation.

Unsurprisingly, MEs told us that they feel hard-pressed to meet certain challenges. These include personalised manufacturing, digital connectivity, sustainability, and struggling to shape and determine future markets. They also report being confused about how to tackle disloyal customers, complex OEM supplier criteria, and consolidating competitors.

It’s a lesson that has not been lost in the US, one of the UK’s key global competitors, and a country where industrial ecosystems had been similarly shattered by successive waves of globalisation.



Case study: Renishaw

The only British company to make additive manufacturing machines that can print metal parts. Its expertise is in dimensional measurement and medical devices, and is now applying its engineering technologies to allow the 3D printing of customised medical implants, lightweight aerospace and automotive components, and efficient heat exchangers and specialised injection-moulding inserts.

Renishaw collaborated with Empire Cycles to produce the world’s first 3D-printed metal bike frame and seat post.

If you’re an ME in one of these fragmented supply chains, it’s hard to work collectively, in a joined-up way, which leaves you suspicious of competitors, nationally and locally, rather than seeing them as possible collaborators in growth and success.

Repairing the damage

Suzanne Berger, professor of political science, co-chair of MIT's Production in the Innovation Economy project and author of Making in America, says urgent work is underway in the USA to repair the damage.

"Our research concluded that the most important thing to do was to try to create resources in an ecosystem that the small or medium companies could use," says Berger.

"In the US, Manufacturing Innovation Institutes are beginning to re-build these ecosystems. The Federal Government is offering a substantial amount of money in defined project areas, such as 3D printing, new materials and digital manufacturing. It encourages small and large businesses and universities to form teams to compete for funds and create ecosystems for innovation – and it is starting to work."



Taking a stand

But Germany is, perhaps, the best example of a country with a supportive ecosystem.

The German Mittelstand model of interconnected medium-size regional businesses, banks, R&D scientific establishments, and skills centres has been developed and fine-tuned for half a century. It gives an individual business visibility of its entire supply chain, access to the best advice and guidance on new thinking, talent and technologies, and a global perspective on emerging strategies. Importantly, it enables MEs to innovate, and anticipate future developments in their sector.

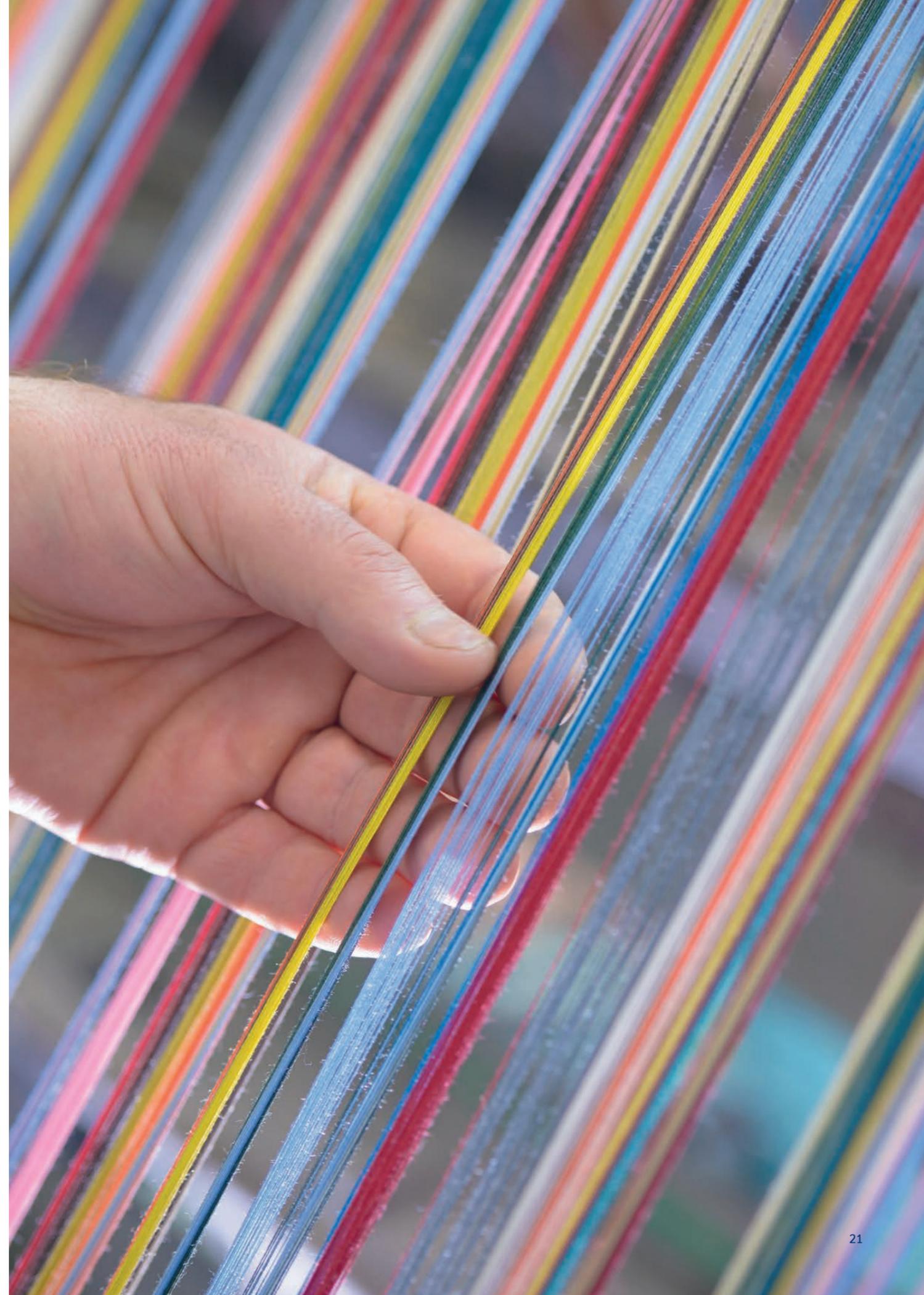
However, templates already exist in the UK for the cross-sector and cross-disciplinary support networks that MEs need for future fitness.

"The Advanced Propulsion Centre, set up in 2014 with matched government and industry funding, is encouraging big companies to form consortiums with MEs and research institutes to pool their long history of expertise," says Dr Rupert Lewis, Head of Automotive at the Department of Business Innovation and Skills.

HVM (High Value Manufacturing) Catapult Centres around the UK are becoming another key source of technological advice and mentoring for manufacturers. "These centres are very impressive and they've come a long way in a relatively short space of time. These are the institutions that are really going to be quite key in joining manufacturers up with some of these new process technologies," says Lewis.

"In the North West, we are forming groups of textile MEs and technologists to create high-tech, functional garment technology to make clothes that do things like sense changes in body temperature or blood pressure," says Rupert Greenhalgh, Chief Business Analyst at New Economy Manchester.

The future of manufacturing is to blend divergent disciplines together like this to capitalise on growth opportunities. But greater and more coherent efforts are needed to build an improved, and more innovative, version of the German Mittelstand model for the entire UK.



Outdated business models and value-added manufacturing

MEs are keenly aware that, for Scotland, the era of pure-play manufacturing is fading. Recognising the international threat to non-value-added manufacturing, tomorrow's ME leaders know that to thrive in the future they will have to function as full service providers.

Moving up the value chain and reaping the benefits of skilled, knowledge-intensive, 'servitised' high-value manufacturing (HVM) will ensure a range of financial and strategic advantages for Scottish MEs in the future.

While these activities may stretch from investing in R&D at one end to recycling at the other, our research has found that updating business models to meet the demands of HVM is already reflected in ME manufacturer's feelings about customers' needs.

Of the MEs surveyed, almost half (46%) believe that in the near future, customers will want to design their own products to be manufactured automatically.

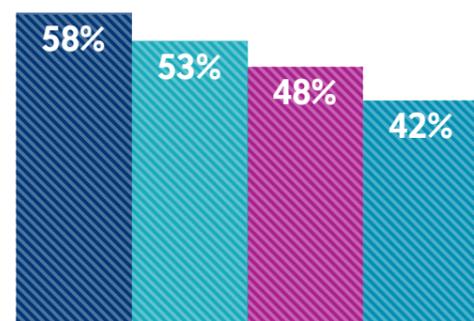
While changing business models to meet these new demands will be a challenging journey for MEs, our research has identified several key areas where the UK's existing strengths will aid the sector in seeking out strategies to ensure future success.

Volume to value

The need to move from low-cost volume production to the creation of high-value products for smaller audience marks a shift from 'pile 'em high' to mass customisation and niche manufacturing. The skill set of the typical factory worker will need to adapt to accommodate this change, and ME manufacturers will have to work hard to retain or recruit technically trained staff across all levels.

Smart production

Despite falling costs, Scottish MEs lag behind global manufacturing competitors in the adoption of big data, automation and robotics. It is widely recognised, however, that all three factors hold the key to facilitating better, smarter, more profitable production. With the use of smart production techniques, MEs could take advantage of a future in which businesses rely on information rather than inventory, reducing the need to hold large amounts of stock or wrestle with lead times.



- Almost six out of 10 say their customers will expect more flexibility.
- Over half say they must find more proactive solutions to customer demands.
- Almost half believe they must offer faster time frames for customers with more complex needs and requirements.
- Over four out of 10 feel customers will require much more collaborative partnerships moving forward.

New materials

New materials bring multiple benefits to MEs. While the UK is leading the way in the medical sector, huge potential in manufacturing remains.

Leading by example

An R&D boom, driven by the UK's aerospace and automotive success story, is being given further momentum by British manufacturers providing leading global examples of servitisation in practice.

Rolls-Royce's 'power by the hour' model, in which a customer buys the power the aero engine delivers and Rolls-Royce provides all of the support, including maintenance, is an innovative model within the sector, generating substantial business revenue through service provision.

Innovative ownership models

New business models such as innovative ownership structures should also be considered, argues Peter Digby, chairman of ME automotive manufacturer Xtrac. The company has been largely owned by its employees since a management buy-out in 1997. Digby believes the staff-ownership model has made the business much more resilient and coherent.

"It has bred an intense sense of loyalty and involvement for every single employee," he says. "If I ask one of the guys on the shop floor what he thinks about a new plan or development and he says 'Well, if it was my money...', I'm able to say, 'Stop right there – because it is your money.' The guys really take it on board at that point. Anyone in this business feels able to approach anyone in management and suggest ideas because they've all got a personal investment in our future."

Overseas competitors are also demonstrating that novel business models can encourage stability as MEs shift from family or founder owned to more professionalised operations.

"In Denmark, as in many of the Nordic countries and Germany, family ownership can transition to a foundation status in a tax-efficient way, and that is attractive when long-term survival of the firm is a primary objective," says Professor Willy Shih of Harvard Business School.

"There are criticisms around whether foundation status slightly stifles innovation because firms are relieved from competitive market pressures. But if forces are put into place to maintain competitiveness, it is certainly a model the UK could consider because it encourages stability and long-term investment."

Case study: UNMADE

London-based knitwear fashion startup UNMADE focuses on customisable design by enabling consumers to participate in the design of their next purchase.

The vertically integrated company aims to disrupt the knitwear market by opening up the concept of mass customisation. Consumers can hack into industrial knitting machines to create a different, personalised design every time.

UNMADE only holds digital stock, reducing the risk of unsold items at the end of the season. With a minimum order of one, there is no risk of penalties for short production runs.

Case study: Just Egg

Just Egg has unveiled a recycling plant to reuse its waste egg shells. The Leicester manufacturer uses between 1.2 and 1.5 million eggs per week to make Scotch eggs, salads and other food.

Founder Pankaj Pancholi was spending about £40,000 a year on disposing of hundreds of tonnes of egg shell before embarking upon a project with the University of Leicester's Chemistry department to see if the waste could be put to better use. A team led by Professor Andy Abbott from the university discovered that the shells could be ground down to a fine powder which could be useful in the production of certain types of plastic as a filler agent.

Pankaj said: "It is very exciting. I always thought there must be a use for the egg shells and we are delighted that we are nearly at the end of the project. It is one of a kind in Europe."

Bridging the gap: how MEs can become world-class competitors

The future of Scotland's ME manufacturing sector is bright with promise and potential. But the experts, industry insiders and analysts who contributed to this report believe that a two-pronged strategy can clear a path for them to transform world-class potential into world-class performance.

This strategy comprises of Progressive mentorship and Industrial ecosystem 2.0.

Progressive mentorship

Trusted guidance, advice and support would have a transformative effect on Scottish MEs. Notably, they need to adopt appropriate advanced technologies to allow them to shift from low-cost, high-volume strategies to High Value and mass customisation. It's hoped such mentoring could ease the transition.

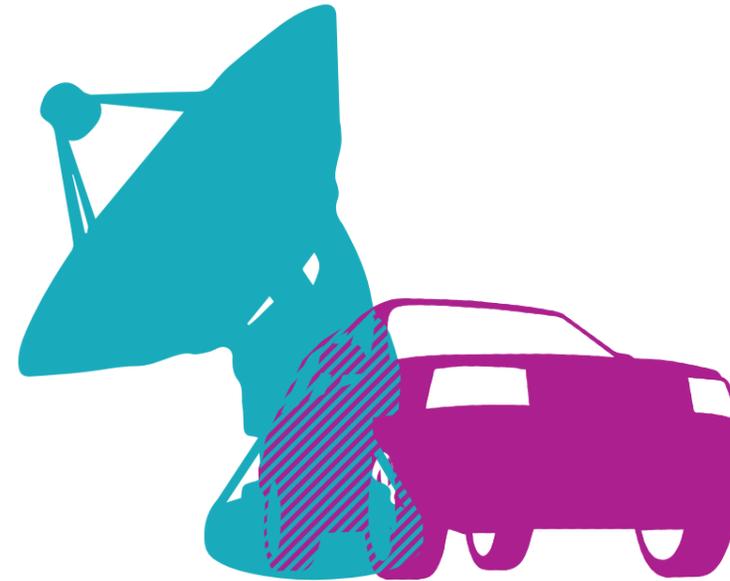
Dick Elsy, of HVM Catapult, believes that mentoring around the need to dramatically speed up engagement with smart technology will allow MEs to become part of a progressive future.

Tim Lawrence, manufacturing specialist and partner at PA Consulting Group, says: "This is a big moment for UK MEs – but they need advice and guidance to tell them how they can grasp it. We all know about graphene. But there are a number of other novel materials coming out that hold the potential to be game-changers and in which the UK could lead the world."

Professor Willy Shih, of Harvard Business School, believes this fresh style of progressive mentoring would help MEs to create workforces fit for the future, too.

"They need to understand how the shape of manufacturing is changing, and the sort of workforces they will need to address that," says Shih.

"At the moment there is a tremendous demand for industrial engineers who can run advanced manufacturing operations. But, increasingly, even operator-level jobs will require a fair amount of technical training, and that's where MEs will need advice about the talent they will need to recruit, train and retain to succeed."



Incubation

There is a growing number of innovation incubators, such as HVM Catapult, that specialise in converting ME legacy strengths into future growth by plugging them into new technologies.

"We de-risk innovation for MEs by giving them access to the latest technology, production processes, and allow them to try it out before they buy," says Elsy, of HVM Catapult.

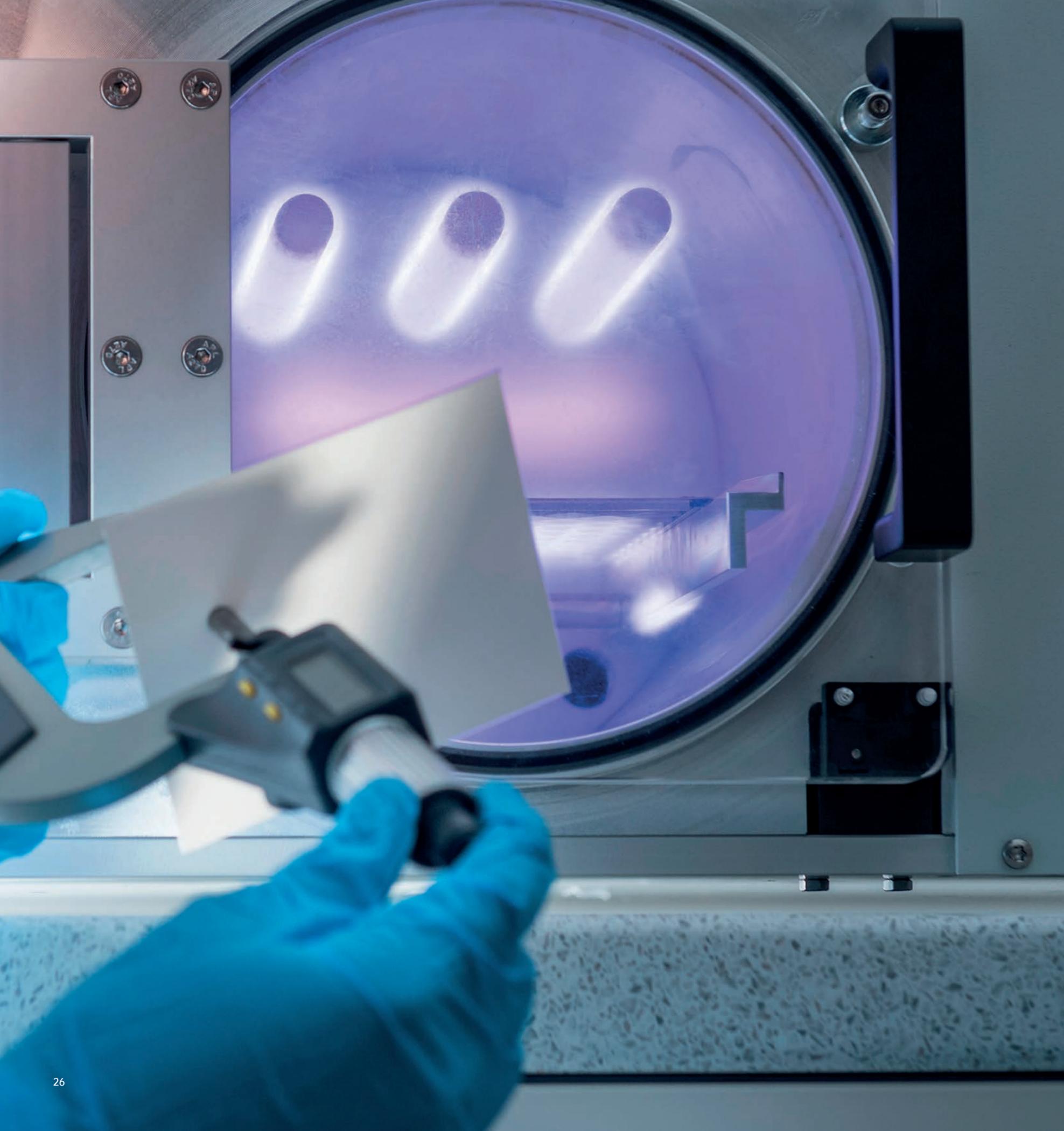
"That takes away some of the nerves about investment in plant and gives them the courage to make the next move and grow into bigger, more successful businesses." But there is an information gap here. Karthik Sundaram, of Frost & Sullivan, points to a lack of "honest brokers" who MEs trust to connect them to sources of innovation inspiration.

"There is an important mentor or facilitator role waiting to be filled here," says Sundaram.

"Most MEs are so busy working out how to simply survive the next decade that they are not looking further than incremental changes to what they already do. A mentor could be the body that has the individual conversations at company level to persuade businesses that doing things the way they have for the last 40 years is not going to work in the next 20."

Our research suggests there is a hunger for this sort of mentorship amongst MEs.

"Most MEs are so busy working out how to simply survive the next decade that they are not looking further than incremental changes to what they already do."



Our quantitative study revealed that two thirds (65%) of Large MEs and more than half (52%) of Small MEs would value a technology audit to help them improve and modernise their business.

Industrial ecosystem 2.0

A major rebuilding operation needs to be launched to create a new generation of robust, resilient and joined-up industrial ecosystems. These will support Scottish MEs as they prepare to take on the world's manufacturing elite.

Instead, ecosystem 2.0 needs to be focused on access to advice and information: hubs that connect MEs to the best, most up-to-date thinking and practice across the entire manufacturing sector.

"You need to build the ecosystem around university specialisms, government grant funding, supply chain people, and heads of ME businesses," says Rupert Greenhalgh, at New Economy Manchester.

"You might call it old-school clustering, but it's more sophisticated than that. You don't pick winners but you closely watch emergent key enabling technologies and you cleverly and quickly plug them into appropriate MEs."

Tim Lawrence, of PA Consulting Group, agrees. "You create your ecosystem around particular industries to more effectively support businesses in driving through this technology. We need to encourage more of these ecosystems, not just focus on the MEs. Unless you have the ecosystem, MEs won't grow," he says.

The right support

Scottish MEs are enthusiastic about support networks that provide access to novel forms of business support and advice. UK-wide, six out of 10 Large and Medium MEs would sign up for forums giving them access to expert advice to improve their competitive edge, according to our research.

One Small ME leader told us: "I like events that bring together lots of businesses of all sizes from many different sectors because that kind of diversity produces views that challenge our own."

Rupert Lewis, at the Department for Business Innovation & Skills, has seen the ME enthusiasm for ecosystem events at first hand. "Our Automotive Investment Organisation runs "meet the buyer" speed-dating-style events where MEs get a chance to meet buyers and pitch to them, and hundreds of people turn up," he says.

Clearly, the emergence of ecosystem 2.0 will be pivotal in the drive to turn Scottish MEs into future-fit businesses ready to take on the world's other manufacturing superpowers. But a question mark remains over who will take the lead in creating a coherent regional and national ecosystem.

As Greenhalgh, at New Manchester Economy, says: "There's a danger a university will go off navel-gazing, and that the MEs will be too busy with everyday fire-fighting in their businesses to get these ecosystems up and running. So the question is: who should the catalyst or facilitator be?"

The answer to that question could well be critical to the future of Scottish manufacturing as a global force.

Conclusion

History is full of tipping points – moments when crucial decisions are made and structures put in place that can make the difference between success and failure in the years ahead. Scotland's exciting, multi-talented ME manufacturing sector is at such a point.

Scottish MEs are strong, often inspiring, businesses. They embody many of the characteristics that companies will need to succeed in the competitive global manufacturing landscape of the 2020s.

This country's long, honourable industrial heritage remains evident in the legacy skillsets, stable long-term instincts and collaborative talents of thousands of proud small and large MEs with deep and sustaining roots in regions and localities.

But their ability to help the nation cement a position amongst the world's manufacturing elite in the decade ahead depends on the creation of a new national and regional web of support and advice. Businesses need more than finance; they need to harness intelligence that will let them see the opportunities, threats and – crucially – the how-tos.

In the past, our close and valued relationships with the automotive sector – one of the brightest lights of UK manufacturing – allowed us to uncover complex issues inhibiting the industry's growth. From this discovery – made possible by our ability to hear the industry's frustrations first hand – we were able to find proactive ways to address these issues, and led to meaningful growth for the industry.

And we're already well down the line with building a series of solutions and support systems to aid the potential and aspirations of the sector. We'll do this by developing progressive mentorship that can plug MEs into the advanced technologies, the most up-to-date thinking and R&D, and the best new business models and practices. Through that, we will step up and play our part to reverse the lack of confidence that is troubling the ME sector today.

More than that, we will look to a new paradigm of "industry support" that addresses the fuller spectrum of business needs.

In doing so, our aim for MEs is that when industry changes happen in the future, they'll be ready to meet them head on; empowered by a partnership set on supporting them as they look towards a profitable and sustainable future.

Today, we intend to use the hours of research that helped form the conclusions of this report as a means to strengthen and enrich the nation's manufacturers. Vitality, they will allow us to anticipate and respond to industry inhibitors before they pose a problem.



Our methodology

The Future Laboratory deployed four distinct strands of research and analysis to identify and explore what the future will hold for medium-sized manufacturers in the UK.

A quantitative survey of 286 MEs, across sub-sectors from food and textiles to chemicals and electronics, established current and future attitudes to growth, technology adoption, strategic planning, supply chain visibility and support ecosystems.

In-depth, one-hour qualitative interviews with C-suite executives at 11 different UK MEs, across a diversity of regions and sub-sectors, provided a granular understanding of key concerns, aspirations, and future growth plans and strategies amongst today's manufacturing leaders.

Extensive desk research by our editorial research team identified brands, organisations, institutions, media reports, and current academic research around emerging and future trends in manufacturing.

A series of detailed qualitative interviews with a wide range of manufacturing experts, including sector analysts, leading academics, journalists and commentators, company CEOs, and the heads of manufacturing institutes and incubators, explored major future challenges and opportunities for UK ME manufacturers, and pinpointed and examined key emerging global social, economic, and technology trends that will shape the future of UK manufacturing into the 2020s.

About The Future Laboratory

The Future Laboratory (TFL) is one of the world's most renowned future consultancies. Their team of analysts and researchers uncover and interrogate emerging consumer and business trends across 14 industry and lifestyle sectors globally.

With a combination of quantitative, qualitative, and in-field research teams, TFL investigates the impact of economic, social, cultural, political and technological change to design robust, actionable strategies for brands.

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Our manufacturing specialists are based throughout Scotland and are available to visit you on-site to discuss your ambitions for your business.

For more information on how we can help you, or to arrange for one of our specialists to get in touch, please contact us:



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