
# Engineering the Future

The action forum for engineering

# An insight into modern manufacturing

**Engineering the Future**

The action forum for engineering

**Engineering the Future** is a broad alliance of engineering institutions and bodies which represent the UK's 450,000 professional engineers.

We are the action forum for engineering and we provide independent expert advice and promote understanding of the contribution that engineering makes to the economy, society and to the development and delivery of national policy.

ROYAL ACADEMY OF ENGINEERING

The Institution of Engineering and Technology

Institution of MECHANICAL ENGINEERS

# Foreword

The nature of manufacturing has changed to reflect advancements in the supply chain, markets, customer demands and engineering design. Data and product innovation now play major roles in the industry; today's manufacturing is often capital-intensive and automated, with a highly skilled and educated workforce. Service innovation and collaboration with supply chains have introduced new avenues of growth for manufacturers, who are adapting their business models to take advantage of the global markets.

This report tells the story of UK manufacturing from the perspective of the businesses involved. This is not about detailed econometric analysis or statistics; however, by using the manufacturers' words and experiences, the report sets out a snapshot of the issues that matter to manufacturers. Some of the issues raised are unexpected, but the hope is that by highlighting them, this report will dispel some myths, reveal the diversity of UK manufacturing and help promote a greater understanding of this sector and how it contributes to the economy.

The report is a project of Engineering the Future, the alliance of the professional engineering institutions. The project has been led jointly by the Royal Academy of Engineering, the Institution of Engineering and Technology and the Institution of Mechanical Engineers.

*An insight into manufacturing* is a complementary report to a series of in-depth reports on UK manufacturing including Professor John Perkins' *Review of Engineering Skills*, *The Future of Manufacturing* Foresight Report, and the All-Party Parliamentary Manufacturing Group's report *Making Good*. Our aim is that this report should be read in conjunction with these studies as it clearly provides evidence, through the voice of the manufacturers themselves, to the inescapable commonalities and overlaps of the industry's concerns.

**Philip Greenish**

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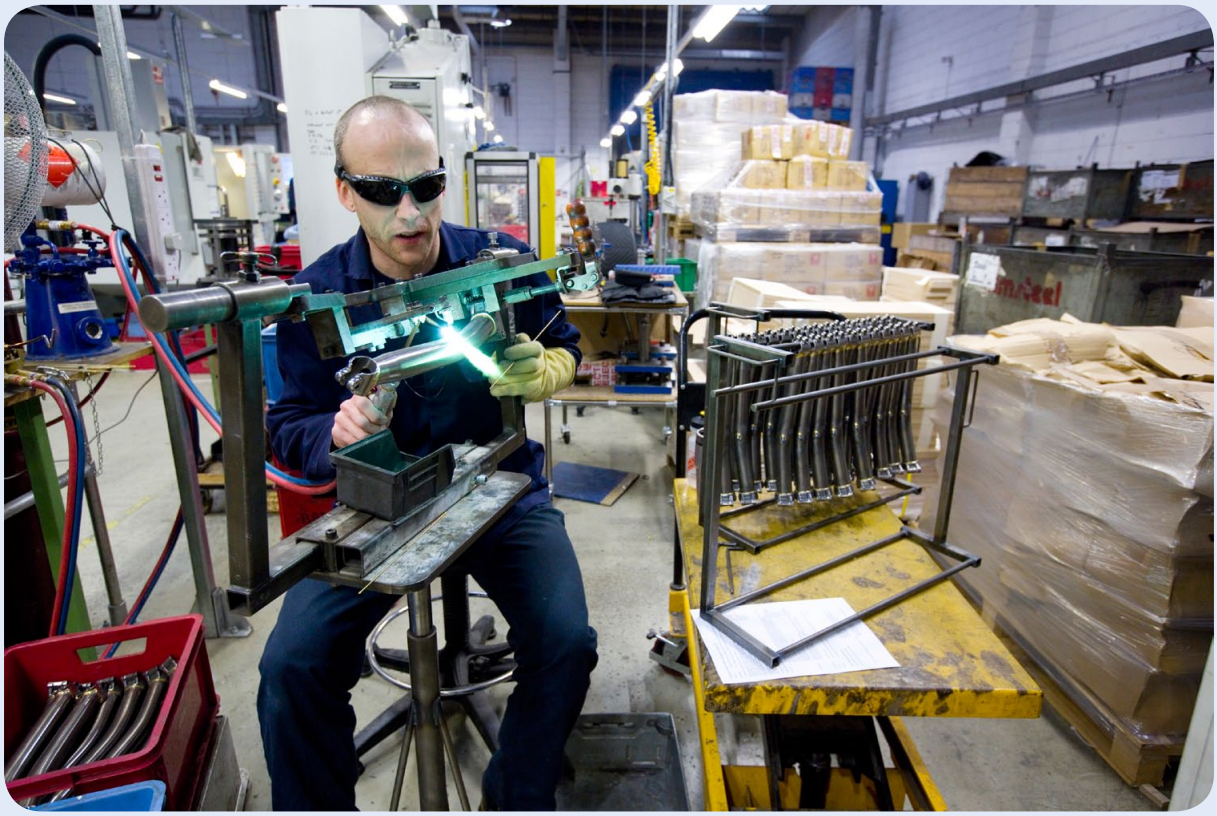


Image courtesy of Brompton

# 1. Executive summary

**Diversity**

**UK manufacturing is diverse in terms of its activities, technology levels and business size. It shouldn't be treated as a single homogenous sector.**

1. UK manufacturing is a vibrant and resourceful part of the economy that is well-placed to deliver growth in globalised markets, to the benefit of the UK economy as a whole.
2. Manufacturing companies capture market share through innovation, an emphasis on quality and increasingly through their service offerings.
3. There are multiple layers to the manufacturing story, and oversimplified generalisations do not reflect how agile and flexible manufacturers need to be to meet new market demands.

**Government support**

**Support for manufacturing needs to be long-term and consistent with an effective two-way dialogue.**

4. Manufacturing companies have a proud record of self-reliance, but this can deter government from understanding how they can provide support.
5. Government's support with exports, research and development and business advice is often seen as being skewed in favour of larger corporations without taking into account supply-chain collaborations.
6. There is a strong sense of continuity and long-term planning that characterises manufacturing businesses, so any intervention/ investment must also be consistent and long-term.

**Skills**

**Skills are fundamental to the success of the UK economy and critical for manufacturers to succeed; however, manufacturers are very concerned that they cannot get the engineers they need.**

7. A recurring theme that was raised by almost all contributors was the challenge of finding skilled workers at all levels.
8. Skill shortages in the short and long terms were noted as a significant constraint on their ability to maximise growth.
9. This is broadly regarded as a key area where government policy could materially enhance the performance of the sector.

# 2. Report structure and methodology

This Engineering the Future report is derived from a set of interviews with UK manufacturers conducted by staff from the partner engineering institutions. The interviews produced qualitative responses to open-ended questions. This means that rather than providing definitive quantifiable data, this report gives a business view of the factors that affect UK manufacturing performance. The aim is to identify things that could be done better to help future development and growth, and to separate the reality of 21st century manufacturing from some of the myths that pervade this area and that owe their origin to badly outdated stereotypes.

This report is reliably the voice of the manufacturers and in many cases we use the manufacturers' own words, usually credited to them. A list of the manufacturers who took part is at the end of the report and we are grateful to them for their input. In addition, a literature review was commissioned from the Warwick Manufacturing Group which informed the overall approach for the interviews.

The companies that have been approached to be interviewed are from the list of organisations nominated by Members of Parliament as part of the All-Party Parliamentary Manufacturing Group's *Made by Britain* campaign, and range from large organisations to small niche manufactures. It is important to note that not all manufacturers survived the 2008 recession and many companies were wiped away due to lack of investment and shortage of customers. The manufacturers who did survive note in this report how they sustained their business and what they believe needs to be done to facilitate their continuous growth.

# 3. Who are the UK manufacturers?

- **Successful UK manufacturers are diverse in size, origins and technologies.**
- **Manufacturing in the UK is successful through innovation in products, processes and in the resilience of individual businesses and the markets with which they operate.**

## Introduction

The distinction between manufacturing and service sectors used to be clear cut: manufacturers were responsible throughout the product lifecycle for the conception, design, production and sale of a physical or virtual product, while service sector companies provided the customer with a service. A significant trend in recent years has been the blurring of this distinction. Manufacturing companies now find new sources of revenue in the 'servitization' of their products, providing after-sales service and support to customers; this is explored in chapter 4 of this report. Manufacturers increasingly have sustainability high on the agenda and take responsibility for the recycling of their products.

Equally, much of the service sector has long been concerned with the delivery and support of manufactured goods, from the retailers to the maintenance employees of the energy utilities, for example, to fit and maintain central heating boilers. In addition, there are some productive industries that are not considered to be part of manufacturing, such as construction and agriculture, although they may share many of the internal mechanisms and external influences that are seen in manufacturing companies.

With this kind of diversity, this section of the report makes no attempt to come up with a hard-and-fast definition: instead, we aim to illustrate, through the examples provided in our interviews with manufacturing companies, some of the different aspects that make up a UK manufacturing business.

Essentially, the factors contributing to manufacturing success can be grouped into two categories: the business and entrepreneurial aspects of growing a company; and the application of technology to solve problems in innovative ways. This chapter explores these two aspects of UK manufacturing through brief accounts of how the companies formed in the first place and the directions they subsequently took.

## 3.1 Entrepreneurship, leadership and ambition

Among the companies that we interviewed for this report, there was a very wide range of starting points. But in addition to the diverse origins of the companies interviewed, there were also very different perspectives in terms of ambitions. For many manufacturing companies, growth within a profitable niche is feasible through building on proprietary knowledge and expertise, and this is seen as a sustainable business model that enables them to compete against far bigger groups that are perhaps slower to react to market changes.

### *i. Doing it better*

Some highly successful companies were developed from the drive and ambition of an entrepreneur, taking an idea forward through product or process innovation and doing it better:

**Brompton Bicycles** was started by Andrew Ritchie in his flat in London. He set about designing and making an alternative to current folding bikes. The company initially had difficulty raising finance until a customer, desperate for more of the product, backed the company. From the outset, the design philosophy has been based on innovation and continuous improvement.

Fed up with the poor standard of toddler highchairs that she found in restaurants, Rachel Jones decided to design her own version of a baby seat that could be fitted on to a standard adult-sized chair. The result is **Totseat** (pictured left), which has succeeded in creating a market for a product where none seemed to exist before.

**Future Designs** is an innovative company employing fewer than 100 people in the competitive business of lighting systems for offices. Managing Director David Clements says the firm can compete against multinational competitors because its size enables it to be both lean and agile in terms of meeting specific customer demands.

### *ii. Building on the unexpected and taking new directions*

Some manufacturing successes were born out of the failure of previous companies or unexpected changes in circumstances:

**Vitsoe**, a German producer of high-end furniture (pictured left), went into receivership, leaving Mark Adams, who had been importing the finished goods to sell in the UK, with a choice to make: follow the German firm into closure or take on the manufacturing himself. He chose the second option, negotiated designs rights and moved production of Vitsoe furniture to London.

### *iii. Growing organically*

There were examples of manufacturing success stories that had developed organically from older, sometimes fairly traditional companies:

**Autoflame** specialises in the design and manufacture of combustion control systems for industrial boilers and sells worldwide, with primary markets in North America, the Far East and Europe. It employs 50 people and has grown organically for the past 40 years through innovation and through a network of customers, distributors and contacts that are made through trade association links.

*iv. Mergers and spinouts*

Other manufacturers sprang from the bringing together of companies or individuals from different backgrounds into a new entity or from spinning out a focused company from a bigger group.

**Griffon Hoverwork** is the result of a merger of two smaller companies under the ownership of the Bland group. It makes diesel-powered aluminium-hulled hovercraft primarily for export markets. The merger and ownership by a larger group has enabled significant expansion through the availability of finance, and turnover has increased from £10 million to £32 million in three years, with an increase in staff.

The global computing and business services group **IBM** forms the background to Xyratex, a UK-based spinout company that provides data storage technology. Following a management buyout from IBM, the company has built itself up on the UK skills base despite most of its sales being in the US. It cites constant innovation as the cornerstone of its success.

The variety of manufacturing businesses in our interview sample indicates that there is no single right way to manufacture successfully in the UK. But there are common themes of leadership and ambition, investment in skills, continuous innovation in terms of both product and process, and being comfortable with risk. In addition there has been an increasing trend for the development of more 'intelligent customers' ie the capability of the client organisation to have a clear understanding and knowledge of the product or service being supplied.

## 3.2 The range of technologies

A further source of diversity in UK manufacturing is the range of technologies that are brought to bear in gaining and maintaining competitiveness. The success of the UK-based automotive industry in recent years illustrates the fact that, in talking about manufacturing technology, it's not just the science and engineering incorporated into the manufactured products that are important. There is an advantage to be gained through the implementation of manufacturing process technologies such as precision in process measurement, modelling and automation. The UK motor industry has had success with upmarket and technologically advanced vehicles, but it has also achieved world-leading productivity and competitive advantage through the adoption of new processes and through business practices such as advanced supply chain logistics.

Labels such as 'high technology' are often unhelpful and not a guide to what makes for success in manufacturing. The companies that we interviewed for this report provide for a large variety of sectors through processes that suit their business models, therefore making categorisation of the whole industry difficult. Their routes to success are also diverse and not always predictable. We pick out a few examples here of factors that may apply more generally across the board.

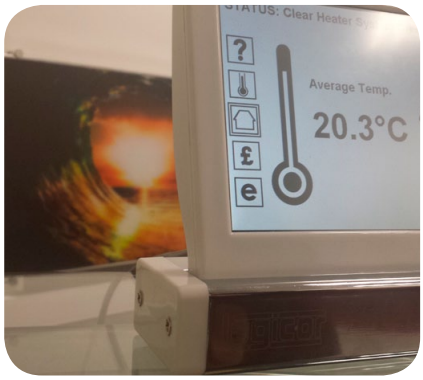
*i. Customisation and personalisation*

**MERU** is a 40-year-old charitable foundation set up by a surgeon and an engineer from a London hospital who saw an opportunity to support families with disabled children through the design and manufacture of specialised equipment that could be tailored to individual need. As well as being innovative and flexible in terms of technology, MERU has an interesting organisational structure, in that it relies on the skills of volunteer engineers for its product and process development.

*ii. Not just high technology*

Office furniture and filing cabinets are the kind of products that might be expected to go to countries where lower labour rates would offer a competitive advantage, but the UK manufacturer **Bisley** (pictured left), through a management buyout, has adapted itself to global competition through investment in manufacturing technologies and dominates its sector.

*iii Harnessing brainpower*




**Logicor** (pictured left) is a company built around the research and development of innovative products that reduce energy and resource use – however, the product range is diverse and includes energy-saving heaters, steam irons and kettles. Logicor is one of a less traditional breed of manufacturers that makes money through innovative design and technology, licensing out a broad range of product ideas often to be made by other companies across the world. It uses UK skills as the basis for its success, and it stretches the conventional definitions and perceptions of what manufacturing is.

*iv Vertical expansion and integration*

Growth through vertical expansion and integration is a standard route for businesses in every sector. **SCA** (pictured left) – a global hygiene and forest products company – has used lean manufacturing techniques to create additional capacity and integrate further products onto their sites to support continuing growth.

**Kesslers** International is a family business in London that has pursued the alternative policy of vertical integration and has grown by taking more and more of the design and manufacturing work involved in the production of retail display units in-house.

# 4. The business of manufacturing

- **UK manufacturers identify opportunities for growth by knowing their markets and their individual businesses.**
- **UK manufacturing is reflected in a diverse range of strategies for growth, and what works for one company may be quite different from the route to success for another firm.**

## Introduction

Manufacturing companies need to develop viable business models that are sustainable with products (or services) that address or establish needs in the marketplace. The next priority is to develop the business, and this chapter addresses different ways in which the companies that we interviewed for this report have identified the opportunities and markets for growth.

We have picked out for discussion six themes that appear to apply to manufacturers of all sizes and are not exclusive to one particular manufacturing sector. Some of these themes overlap with the issues that we identified in the previous chapter in the origination and formation of manufacturing companies; as we noted there, they consist of a mixture of business and technology factors.

In the interviews, we asked the companies to identify activities that they had undertaken in the past and to pick the possible strategies that they might aim to deploy for future growth. The examples which are cited under the various headings in this chapter therefore contain references to past actions and some to projected future plans.

## 4.1 Selling to new markets

Market stability can often sound the impending death knell for companies: in profitable markets, it is inevitable that competitors will enter and erode advantages. To offset this, the UK manufacturers that succeed are those that constantly seek new markets through the extension of product ranges within existing and new geographical regions and the opening up of new areas with innovations.

Examples of the constant search for new markets include the hovercraft manufacturer Griffon Hoverwork. The company has had significant success with contracts in India and Latin America, alongside other export deals with Canada, Kuwait, the UAE and Morocco. Because contract work tends to be inconsistent, Griffon has used its successes to step up its pursuit of other overseas contracts to give itself a more orderly growth pattern and is branching into servitization so it can benefit more from after-sales revenues.

The energy-saving products group Logicor takes a direct route to tie its business plan into the policy objectives of governments in target markets. It has approached government agencies in countries such as the US, South Africa and Australia to set up local manufacturers that will make products that will reduce energy demand locally. The design and innovation of these products is still very much part of UK manufacturing, but the actual production is increasingly undertaken locally to the markets, turning the company at a stroke into a global player.

### *i Exporting*

Many UK manufacturers survive and thrive through the strength of their export efforts. Exporting into new markets enables manufacturers to capitalise on their investments in plant, machinery and systems – and in people too – to maximise output by accessing an ever-growing number of customers. Fine chemical and pharmaceutical supply chains, for example, are often international and work across boundaries using the most appropriate technology for each stage of manufacture. In the case of the pharmaceuticals industry it may also be required to manufacture in a country in order to sell there, which can lead to more complex supply chains.

**BAE Systems'** business growth has been achieved through not just domestic orders but a growing business in supplying aerospace, defence and security products and systems around the world. Its primary contacts are through governments.

**Renishaw** (pictured left) has grown its business primarily through export markets. Exports account for 94 per cent of its business with the USA and China its biggest markets. Exports to the Far East as a whole were 40 per cent of annual turnover for the year ended June 2013.

### *ii The domestic market*

Growth through exporting is not a route open to all manufacturing companies and not all products are right for export. Among the companies we interviewed there were several that had, for varying reasons, concentrated on the home market and had adopted different strategies to strengthen their hold on local and national markets.

**Bisley's** office furniture and filing cabinets are bulky items where the cost of shipping easily becomes an unacceptably large proportion of the total cost to a customer. This limits the company's exporting potential, but as the same factor applies to its overseas rivals, Bisley has been able to build a very dominant position in its own market. It acknowledges, however, that this tends to tie its fortunes into the wider performance of the UK economy.

**Kesslers'** point of sale display units are similarly difficult to ship, and are often made as a result of particular marketing or promotion campaign in a specific retailer: tailor-made units on fairly short production runs (pictured left). While this limits export opportunities, Kesslers has been investigating whether its business model might be exportable – it has been looking into the establishment of production facilities in other markets.

Even the largest companies are sometimes not large-scale exporters. **Unilever's** FMCG (fast-moving consumer goods) business relies on just-in-time production to supply to the domestic market, and this means that 80 per cent of the products that it sells in the UK are manufactured in the UK.

## 4.2 Mergers, acquisitions and collaborations

One of the ways to grow business is to 'buy' capacity and capability through merging with other companies that bring new customers and markets. This is done through acquisition of companies or product lines or parts of a business, and increasingly through partnership and collaboration arrangements in which UK manufacturers work alongside other companies to develop new markets or new products that they would individually not be able to supply.

International hygiene and forest products company, **SCA**, continues to develop growth through strategic acquisitions in Europe and in emerging markets further afield. By strengthening its global market presence, it is able to capitalise on opportunities created by demographic, economic and lifestyle changes and act as an even closer local partner to customers.

British Aerospace merged with GEC Marconi in 1999 to create **BAE Systems**, a 'national champion' in defence and security markets that complements BAE's earlier focus on other types of defence and aerospace. Since then, the merged group has made other acquisitions, notably strengthening the security focus through the purchase of Detica. The mergers produced rather unheralded gains too: the land and property business was not originally one of the business focuses, but is now a very important part.

**Renishaw** has been a significant developer of its proprietary technologies in metrology and inspection, but it has also been quick to spot opportunities for acquiring small companies that fill in gaps in its product portfolio or that represent technologies for the future. In recent years, for example, it bought MTT, which makes laser sintering (metal 3D printing) machines with high accuracy for precision parts manufacture – an additive manufacturing technology – and MDL, which makes long-range laser scanning equipment and has potential synergies with some of the Renishaw metrology technology.

## 4.3 Business and process improvement and innovation

Manufacturers succeed by making goods of the right quality to the right price and at the right time for the markets they serve. A lot of process improvement work, especially in areas such as automation, can have dramatic impact on all three of these elements, enhancing competitiveness and enabling market demands to be met. The quality of the product also plays a major role in success. For example, a key risk for the pharmaceuticals industry is the provision of product quality as the business risk of product recall and reputational damage is significant.

One of the companies we interviewed made a related point about this as a method of maintaining competitiveness in world markets:

> **"The UK is never going to be able to compete with the salaries of, say, Indonesia, so we just pay the salaries we need to and find savings through improving efficiencies and manufacturing techniques."**

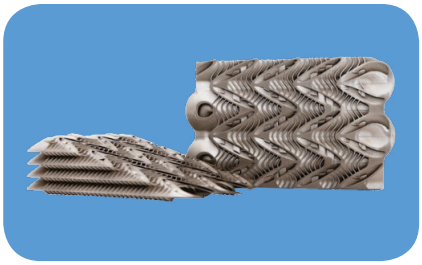
Unilever has made significant investments in automation. This has reduced the numbers of people on its shopfloors, but has conversely increased the numbers of technicians and other technically qualified staff that it needs. Another effect of increased automation is to speed up new product introduction: the group estimates that it now makes 10 times as many different products as it did 20 years ago. Automation often creates new, higher-skill jobs: a theme from many of the interviews was that while automation often replaces unskilled jobs, its net effect is extremely beneficial in terms of overall competitiveness.

Unilever is looking at other potential savings through increasing factory efficiency. It is aiming to reduce machine downtime by using predictive maintenance techniques and machinery design concepts that will raise equipment utilisation rates. And it has also installed energy-efficient machinery and work practices that can help to save some of the 20 per cent of costs that are attributed to energy, with the promise that this will also help to mitigate future energy price rises.

## 4.4 Product innovation

UK manufacturers report that in general discussion the public, and others, frequently confuse invention with innovation. The discovery or the invention of a new product is not in itself a guarantee of success; innovation is about the alignment of invention with market needs and bringing it through into commercial reality. Increasingly, UK manufacturers – and others around the world – are setting up systems within their organisations to achieve this and to maximise the harvest from their innovations. Work at places such as US defence agency DARPA has indicated that innovation is not just a matter of chance: it can be managed and fostered, and there are countless examples worldwide of companies that have been serially successful in bringing new ideas to market.

But alongside the encouragement of innovation management, there is a trend within manufacturing groups towards a culture of continuous innovation which aims to improve existing products through a constant process of updating and refinement. The companies interviewed for this report produced examples of all kinds of product innovation.



**Unilever** is using an 'open innovation' model in which it works with its suppliers to bring new ideas into the business. In a parallel development, it is tackling new markets in the developing world by asking consumers what they want, rather than just assuming that the products already made will be suitable for the new customers.

**Autoflame** patents its products and uses the patenting process to drive its innovation. It also works closely with its customers to educate them on new features and gain feedback on future development ideas and opportunities.

**3T RPD** (pictured left) is actively investigating the potential for remanufacturing and for repair and reverse engineering of legacy components.

For the pharmaceuticals industry, research and development (R&D) productivity has been a significant issue. It is essential that manufacturing is connected to the research themes. This is happen through EPSRC and TSB funding aligned to the area of manufacturing but some chemical / pharmaceutical companies have been slow to win this because the "product" is less readily generalised or identifiable.

## 4.5 Research and development investment

Research and development can often lead to innovation in product and process, and UK manufacturing industry has been criticised in the past for levels of spending on R&D that do not match those in competitor countries such as the US, Japan and Germany. Some of this is changing, and among the companies interviewed for this report are several whose R&D performance is world-class in terms of both the investment made and the outcomes achieved.

**Zeeko** (pictured left), which is a university spinout company developing technologies and machinery for the ultra-precision polishing of large-scale optics, already spends more than 20 per cent of its revenues on R&D and encourages other companies, particularly SMEs like itself, to do likewise.

Lighting company **Future Designs** sees R&D as an important and exciting part of the company which has its own department and the backing of everyone within the business. It spends around five per cent of turnover on R&D and says that tax relief on R&D spending is a great help.

**Coca-Cola Enterprises** emphasises the people aspects of R&D, and is supporting university research programmes that are being set up to research best practices across a range of food and drink manufacturing technologies, with the aim of improving networking between companies.

## 4.6 Service innovation

The divide between manufacturing and service businesses is becoming blurred with the emergence of two complementary trends in a business phenomenon that is known as servitization. On one side, manufacturers have increasingly come to realise that their relationship with their customers does not need to end at the point of sale when the goods are purchased: there is a potentially strong and lucrative business in after-sales support, spares, maintenance and other aspects that help to cement the bond between supplier and customer.

**BAE Systems** says the support service side of the business has grown significantly in the past 10 years, and that includes high-profile defence support work on aircraft such as Tornado and Typhoon, where the group works with the Royal Air Force to provide the industrial capability that would previously have been provided by the RAF itself. It is, it says, "a very different business model which has been developed over the last 10 to 15 years".

**MERU** has been partnering with a commercial company which has aerospace certification to develop an airline seat that will enable disabled children to sit inside aircraft, many of them for the very first time.

**Unilever** is pushing for greater discussion of the social and logistical implications of local manufacture and distribution, working alongside the freight group Stobart to determine what the effects might be on towns and cities.

Another side to this is that customers in many sectors have come to the realisation that what they want to buy is not necessarily a product, but the service that the product can provide. So, for example, airlines are interested in buying aero-engine capability and not necessarily a physical engine as such, and engine manufacturers are now often offering a full product-service system in which they take responsibility for the engines on airliners, their maintenance and availability, under contract from the airlines.

But this is just one aspect of service innovation in manufacturing: manufacturers are leading the way in collaborative working with customers and with their supply chains; they are partnering with other businesses that can bring complementary skills and services; and they are putting real investment into corporate social responsibility initiatives, many of them to do with wider environmental and sustainability issues.

# 5. The economics of manufacturing

- **UK manufacturing is now growing strongly after taking a hit in the recession.**
- **The manufacturing companies that survived and even grew through the recession were those that maintained focus on their core strengths and strategies.**
- **The recession strongly reinforced the tendency in many UK manufacturing companies to be financially self-reliant rather than requiring assistance from banks and others for their growth plans.**

## Introduction

A subtitle to this chapter is: *How UK manufacturing handled the recession*. The central theme is that while manufacturing companies have put in place growth plans, strategies and activities for normal times – some of them outlined in the previous two chapters – there are economic circumstances that are entirely outside the control of the individual companies that conspire to upset this picture of serenity.

The recession that was brought on through the financial crisis of 2008 severely affected the manufacturing industry, as global markets for products and services shrank, finance for new projects became very difficult, and orderly cutback rather than growth became the priority. As a whole, manufacturing often amplifies the trends in the wider economy, since the goods it produces are often discretionary purchases that can be cancelled or deferred by customers who are themselves feeling the shockwaves of recession.

This chapter consists of three sections. In the first, we asked the companies what effect the recession had had on their businesses, and despite the fact that the recession was deep and widespread, there is quite a variation in the degree to which individual businesses were affected. The second section asked them what actions they took to survive the downturn. And in the third we outline some of the actions and activities that are being adopted to take advantage of recovery and to mitigate any future economic shock of this kind.

There is an overall theme to the chapter. With individual variations, there is a strong message that manufacturers' resilience is firmly based in the business and technology strategies outlined in the earlier chapters, and many of the activities which the manufacturing companies are putting in place reinforce their previous strategies. Activities such as product and process innovation, diversifying into new markets, working more closely with customers and suppliers – these are the attributes of good business in manufacturing, and they are ways to deflect at least some of the worst effects of recession. In tough economic times, you try to do more of these things, not less.

But a second theme emerges, which is that many manufacturing companies have taken as a lesson from the recession the need to be self-sufficient financially and to be very cautious about their future dealings with the financial sector. While the recession accelerated some business trends such as globalisation and the absolute need for cost control, it has also left the manufacturing industry in the UK more wary. In the pharmaceuticals industry there has been some pressure from some global regions as healthcare budgets were cut, but this has been relatively small compared to the loss of exclusivity of leading products.

## 5.1 Variations on a recessionary theme

Not all companies were affected equally by the downturn and nor were the effects uniform in terms of timing. For example, the big dip for Renishaw's machine tool measuring probes came early in the recession, with some of its large customers seeing demand for their machine tools plummeting by as much as 80 per cent in 2008/2009; for a second larger company, BAE Systems, a core event of the recession was the defence review of 2010 which saw major programmes cut.

For a few companies, the straitened economic circumstances presented very little difference to their strategies, or could even be seen as an opportunity.

**Griffon Hoverwork** does not have any true competitors, and the major challenge both before, during and after the recession is to create a market for their hovercraft and to raise awareness of the product among the customers. Trends such as trade barriers that push the company towards offshoring the manufacturing are there in both the good times and the bad.

**Brompton Bicycles** (pictured left) saw the recession as an opportunity, since the market for the company's products is transport, not recreation, and it could market itself as helping its customers to overcome their own personal downturns by saving on commuting costs. It decided to ignore economic figures, and in fact grew the Spanish distribution network tenfold in a period when the Spanish economy shrank by 10 per cent.

But other companies were quickly and severely affected by the recession, though the effects were often unpredictable and not uniform.


**Xyratex** found that the demand for data storage products "effectively ceased" in 2009, and it had to take drastic action to reduce costs, including some reduction in headcount. But within a year, the market reaction to the downturn had proved to be an overreaction, and there was then a sudden surge in demand. The company has put effort into "educating the market" to avoid such short-term volatility in future.

The first real downturn in **Renishaw's** (pictured left) highly successful business career led the group to make redundancies and to ask staff to accept a 20 per cent reduction in wages. The business came back very strongly: the Chinese industrial power-up, barely blinking in the recession, required Renishaw products and a significant amount of the growth that has been achieved since 2008 has come from China, an acceleration of the previous trend.

## 5.2 Surviving the recession

With economic circumstances often some distance beyond their control, the UK manufacturing companies we interviewed took action in the recession to safeguard those aspects of their businesses that they considered core to long-term survival.

As part of its long-term strategy, **SCA** has reorganised its hygiene operations for increased efficiency, market presence and growth. The Group has also strengthened its competitiveness by divesting itself of non-core activities such as its UK packaging business.

**Limpsfield Combustion** (pictured left) gathered all its employees together to tell them that their jobs were safe even if they made nothing for a year. It says that the relief that this brought gave them the confidence to go out and grow the business during the downturn.

**Logicor** had planned for the recession and had green energy products to launch on to the market at the point where consumers were feeling the pinch on energy costs. The company increased its research and development activities during the recession.

**Unilever** found not just a lack of growth but also some shifts in consumer behaviour, and adjusted its own activities to accommodate the changes. This has meant the closure of some plants and the expansion of others, and changes in product mix. The group actively pursued policies that would help maintain its supply chain where it feared that some suppliers might be less resilient.


Image courtesy of Ultra Global

## 5.3 After the recession

Many of the actions and activities that stemmed from the period of recession reinforce the business directions that were in place before the downturn, but there have been changes in emphasis, not all of them expected. The overall effect is that manufacturing companies are now more aware of the need to build resilience into their strategies, and for many of them this means a greater stress on self-reliance.

### *i New markets*

Recession was global, except, perhaps, in China and Australia, but different markets declined and recovered at different times. Manufacturers adjusted their operations to reduce the effects on their individual businesses and to take advantage of new opportunities and this has in some cases changed the long-term focus.

**BAE Systems'** strategy is to take cost out of the business where possible to sustain profit margins, and the recession has confirmed the long-term business shift towards security and international defence markets.

**3T RPD** says that the recession has forced a conservative industry to take steps towards more radical business models, such as partnering arrangements, so that UK plc benefits.

**Autoflame**, which achieved steady growth during the recession and actually took more staff on in the period, has both sought out new markets and improved its internal efficiencies by driving down all forms of waste and improving its cost controls.


Image courtesy of Limpsfield

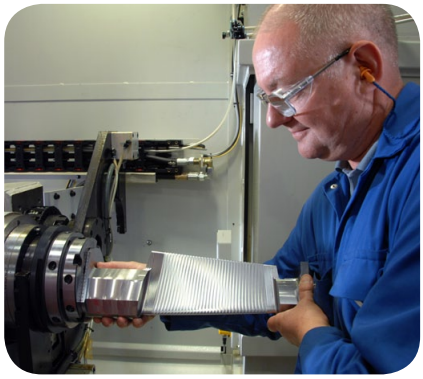
### *ii Sustainable business models*

UK manufacturing companies have in many cases revisited their business strategies to ensure that they have a business model that can take into account the ups and downs of wider economic factors. Much of what they have done is intended to ensure that they do not need to take dramatic and unplanned actions in any future emergency.

The recession has provided a stimulus to programmes which were already happening in many companies to drive down waste, increase production efficiency and adopt greater use of automation. Lean manufacturing and Six Sigma programmes were already important for many companies, but their value was proved during the recession and there is now renewed emphasis on them. The implications for future skill levels are a concern for many manufacturers (see Chapter 6).

### *iii Investing in the future*

A concern among many manufacturing companies during the recession was that they should maintain the capability to take advantage of the upturn whenever it came. To that end, several of the companies that we interviewed noted that they had continued to invest in R&D and innovation as priorities. There were two other areas where they invested, and they represent areas that are long-running worries for many companies and are outlined in greater detail in Chapter 6: the investment in plant and machinery, and the maintenance and development of skills.



**JJ Churchill** (pictured left) brought forward its capital investment programme as it saw the recession as a golden opportunity to invest in long lead-time equipment at sensible prices, and to give the company the ability to 'leapfrog' competitors when recovery came. The investment had a beneficial effect also on staff morale during a difficult time.

The charity **MERU** was not able to afford an apprenticeship scheme as such, but it offered a series of work placements to undergraduates and sponsored a bursary scheme for students.

**Renishaw** maintained its apprenticeship scheme through the lean years and its recruitment into the scheme is now running at record levels. It has increased its involvement with school students and pre-university placement schemes to ensure that the pipeline of future recruits is kept open. .

**GlaxoSmithKline's** future vision for pharmaceutical and consumer healthcare manufacturing requires an increasingly skilled workforce to cope with the rate of change of technology, including continuous up-skilling of the existing workforce.

# 6. Challenges and constraints to growth

- **Education and skills are significant issues for UK manufacturers and many companies see them as actual or potential constraints on future growth: this is overwhelmingly the biggest issue where the government could help.**
- **Manufacturers want long-term continuity and commitment in terms of government assistance and advice schemes.**
- **The UK government has an important role to play in terms of promoting best practice and acting as an intelligent and involved customer of manufacturing industry.**

## Introduction

The manufacturing companies we interviewed identified a range of issues that were seen as actual or potential inhibitors to their plans and to their capacity to grow. Some, but not all, of these issues relate to areas where government policy might have a direct or indirect influence. They include points where UK manufacturing companies see themselves as operating under constraints that do not apply to some of their international competitors.

In this chapter, because of the sensitivity of some information and the implicit criticism of some remarks, we have not always identified the companies we are quoting from, but the quotations are taken directly from the interviews. In fact, there are plaudits as well as criticisms. Our interviews with manufacturing companies identified areas where UK policy initiatives and business climate were positively helpful to their plans for growth. These might perhaps be seen as ideas where there is scope to do more and to be more helpful or, conversely, as places where change and cutback could be unhelpful.

Despite this caveat about quantifiable data, however, it should be noted that the key issues of the provision of education and relevant skills to fuel future growth and the need for manufacturing involvement in the development of educational standards and curricula were identified as real or potential constraints on growth by virtually all the companies that were surveyed. There is a real sense that these are defining issues for the growth plans of many businesses across manufacturing sectors and of differing sizes.

By contrast, some issues that are popularly considered to be critically difficult for UK manufacturing companies, such as the provision of finance, were cited by relatively few respondents. It may be that some of these challenges are seen as inescapable and not susceptible to improvement through government or other action. But it may also be that the difficulties have been overplayed and that, for instance, UK manufacturers are more resilient and resourceful in terms of finding the money to finance their growth plans than has been generally thought.

**We have divided the issues that have been identified into three broad categories:**

- The business climate for UK manufacturers
- Resources
- Assistance and advice

## 6.1 The business climate

*i Financial constraints*

Access to finance is frequently cited in official reports and in comments by manufacturing organisations as a significant constraint that has led to the rather turgid overall performance of UK manufacturing industry in terms of investment.

The series of interviews that were conducted for this report found little evidence, however, that this was a defining limitation for established manufacturing businesses, though several companies mentioned problems during the start-up phase in terms of persuading external finance to invest in innovation. There was, in places, a somewhat wry view of the financial sector and its potential to help manufacturers.

**"We wouldn't want to change history as there have been important lessons learned, but maybe one of those lessons was not to trust the banks earlier."**

**"Banks will now lend money that would have been enough maybe two years ago, which might be all right if you were the same size or smaller than you had been. But if you are an expanding business then you cannot get enough money to find the working capital or to fund the expansion of the business."**

Government was not seen as a prime influence in this area, except in businesses directly linked to areas where government is the major customer, such as defence, where greater encouragement for suppliers was seen as a priority. But more broadly, several companies commented that tax incentives to back investment in capital equipment and in research and development were welcome and could be extended.

**"Government should not interfere but should reward companies for self-investment: we are seeing some positive signs of this through the R&D tax credits."**

**"Regarding government policy, the single biggest issue is capital allowances. There is a case for 100% capital allowances: it would mean more could be invested."**

Many of the successful UK manufacturers that we spoke to are, or aspire to be, self-financing, deriving sufficient income from sales to drive both continued innovation and capital investment and eliminating reliance on external sources of finance.

**"We have no relationship with the banking system and our growth has been driven by self-financing. Relying on the financial system for growth would have created a more short-term decision-making culture."**

### *ii Rebalancing the economy*

A consistent theme through the interviews for this report was a desire among the UK manufacturing companies to assert that manufacturing is not 'in trouble' any more than any other sector of the economy. There was a very wide range of views about whether the UK is a good place to manufacture. Several of the respondents said that they specifically tried to manufacture all their products in the UK and that there were particular UK strengths in engineering and innovation disciplines that made this the correct policy for them. Others gave an almost diametrically opposed view, stating that for quality at the right cost they had found no UK alternative to offshoring the manufacture of their products.

Within the ranks of the companies whose main manufacturing activities are in the UK, two specific points emerged which could be regarded as a potential constraint on growth in the UK – or as an opportunity to do better.

The first of these is the targeting of support, where smaller companies believe, rightly or wrongly, that the mechanisms in areas such as R&D funding are skewed in favour of the biggest companies.

**"Funding for research seems to be looking for volume production of tens of thousands, not just tens: we can't scale to these rates."**

The second point here is perhaps related: that many manufactured goods are produced as a result of a series of collaborations across a supply chain, and to concentrate solely on the 'brand name' at the top of the chain may well be unhelpful to suppliers which also need innovation and investment to maintain competitiveness.

**"For the UK in general the government needs to focus on making UK plc attractive from an employment and a tax perspective, and the stimulation and resurgence of the supply chain is the interesting challenge."**

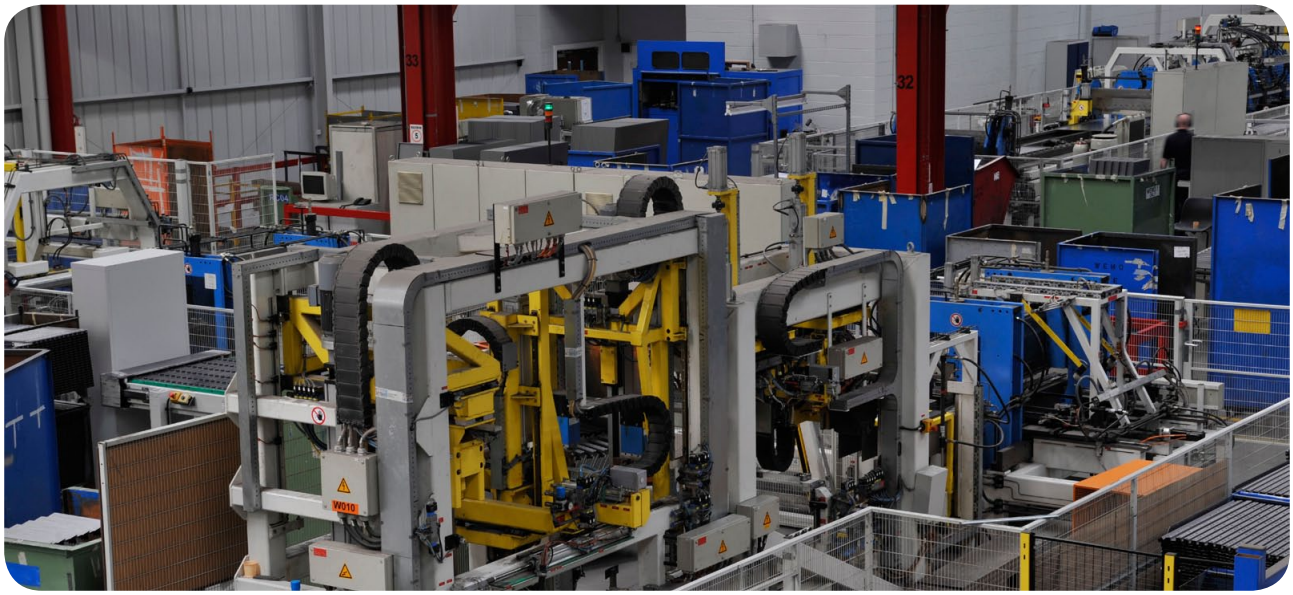


Image courtesy of Bisley

### *iii Regulation and 'red tape'*

Governments and ministers themselves often identify that bureaucracy and overregulation inhibit the capacity to invest and to innovate. While this may be a sound political line to take, in that companies (and voters) do not want unnecessary regulations, there was little evidence from our interviews with manufacturers that current rules and regulations posed a general constraint on the ability of manufacturers to do business. Some specific examples were however cited, including:

**"We employed a Malaysian PhD student who received notice of deportation, and we ended up having to go to court to verify that he worked for us."**

**"Employment tribunals are a lot of time and effort regardless of whether you win or lose and are too easy to instigate.**

There were specific areas such as exporting where government and its agencies were widely seen as having the scope to be more helpful (see Section 6.3iii below). But there is acceptance too that on topics such as environmental controls, health and safety provision and workplace conditions the UK has standards and practices that necessarily force it to compete on factors other than costs and prices with some nations that might been seen as competitors.

One interview summed up an overall view in rather an extreme way:

**"We want as little government interference as possible: we are trying to run a business."**

More broadly, there is a widespread desire for government to be helpful but unobtrusive.

### *iv Long-term planning*

The government is an important customer for many manufacturing companies, especially in the defence and aerospace industries. The role of customer in these sectors is viewed not just in terms of buying end-products, but in the support given to product development; and this in turn is not just about research grants and collaborative R&D programmes, but about supporting the industrial infrastructure through supplier development schemes and through encouraging centres of excellence and clusters where companies in similar areas of technology can benefit from geographical proximity to each other and to educational and research facilities.

**"The government has to sustain a coherent long-term plan for the sectors such as military aircraft, shipbuilding and submarines. It needs to set the right environment, such as a competitive tax regime and long-term skills. It's about sustaining the UK's place in the world."**

More widely, there is a requirement from many manufacturing companies for consistency and continuity in government policies that affect business.

**"They need to provide a long- or medium-term strategy stating their overall aims."**

**"If the government and the tax conditions stay stable, then we can grow."**

But several manufacturing companies in the interviews that we conducted were at pains to stress that the role of the government in their businesses was limited, and should remain so.

**"If any company thinks that the government is going to cause its success or failure then they may as well give up now. A business that thinks the government is the reason it is succeeding or failing is finished. The government has a part to play but it is a tiny part."**

## 6.2 Resources

### *i Education and skills*

This subject provoked more comment from the manufacturers we interviewed than any other in the scope of this report. Almost universally, the companies we spoke to are seeing skill shortages, particularly in the engineering and science areas that are central to manufacturing, as a potentially severe constraint on their ability to grow in future years – and in some cases they are already seeing this effect.

The problems on education and skills are exacerbated by the looming retirement of many existing employees within UK manufacturing: experienced technical staff with 30 or more years behind them are nearing the ends of their careers in large numbers. The concerns are voiced by both large and small companies.

**"There is still a shortage of people who want to go into engineering, manufacturing and the supply chain. There is a lack of students coming into apprenticeship schemes with the right science skills."**

**"There are a lot of misconceptions about manufacturing among young people: that it is badly paid, has high redundancy rates and is dirty, physically demanding work."**

This is an area where manufacturers have considerable worries about the direction of policy and the delivery of education within the schools and colleges.

**"The lack of career advice and the national curriculum losing modules in design and technology at secondary level will have a negative impact on future manufacturing. By taking away the chance to see the link between real world applications of STEM (science, technology, engineering, mathematics) subjects at school there is a risk that students will not take STEM subjects to a higher level."**

**"Engineering graduates have been taught to pass exams. Academia is letting the country down and we have to teach our recruits the ways of the world before teaching them about the business."**

Several of the interviews revealed particular problems with the recruitment of senior design engineers, and one SME said that there were particular difficulties if the company was not large or well-known. Many smaller firms are technology leaders, and they face problems in finding specialised staff: one reported a six-month search for a particular role, with the job eventually filled by a recruit aged 60.

**"We have to teach our apprentices to grow up. Colleges provide very generic skills when we need to have more of a technical skilled approach."**

**"One of our factories was looking for 15 new technicians and got 500 applications; but they were happy with the quality of only two of them."**

Image courtesy of Coca-Cola Enterprises

The option for many of the companies interviewed, including both SMEs and household names, is to 'grow their own' staff through apprenticeships that lead on to higher qualifications and to develop new skills in existing employees. But even here there are concerns: that skilled staff will be 'poached' by other companies just at the point when they are becoming really useful and also that there is, for smaller companies, often a shortage of opportunities to develop wider skills through external courses.

**"Training an apprentice costs an estimated £80,000 but it's a necessity for the advance of manufacturing. The best staff we have are ex-apprentices and people who came up through the business."**

**"It is difficult to find part-time courses for postgraduate apprentices. There are only general engineering courses, business studies, computing or anthropology. Sometimes it is necessary to phone 50 to 60 providers to find a course."**

### *ii Environmental compliance*

UK manufacturing companies are among world leaders in the provision of 'clean-tech' and other environmental engineering services and products, and environmental regulation is not seen as a constraint on current business in the UK. Rather, there are important opportunities to be gained from the spread of environmental standards globally. In addition, environmental compliance is seen widely as an important part of corporate social responsibility.

### *iii Energy costs and infrastructure*

Increasing energy costs are a concern for businesses of all kinds, and many manufacturers are intensive energy users. In that energy prices are dictated by world markets, there may be limited scope for individual governments to exert any degree of meaningful control. But there is an expectation in some quarters that the UK government at the very least keep a watching eye on how energy cost changes are handled elsewhere to ensure that the UK manufacturers are not put at a disadvantage when changes occur.

More directly, energy supply is part of a broader range of concerns about infrastructure provision within the UK where the government is seen as the principal driver of events, even where the industries are now no longer in public ownership. The potential shortfall in UK energy supplies that has been identified when ageing current assets are retired can be equated with other concerns about facilities such as the road and rail networks and airport capacity.

## 6.3 Assistance and advice

### *i Innovation and R&D support*

Manufacturing companies developing innovative products and new process technologies are supported by a wide range of schemes that enable them to tap into publicly-funded research and to link with the academic community. A long-standing criticism of UK work in this area – though the phenomenon is seen in other countries too – is that there has been strength in the underpinning theoretical research that has not been brought through to marketable products: a so-called 'valley of death' in which good ideas perish.

Government and European research programmes have sought to bridge this gap with the creation of new agencies and new funding mechanisms, and the manufacturing companies we interviewed seemed mostly to be pleased and encouraged by this approach.

**"We received funding from the Technology Strategy Board for an additive manufacturing cell, and the Regional Growth Fund has also made a big difference. The TSB has also provided us with good links to universities."**

**There have been some good schemes that connect research and production; including the establishment of the link up with TSB High Value Manufacturing and the recent successful bids for Advanced Manufacturing Supply Chain funding – these have included pharmaceuticals and fast moving consumer goods (FMCG) as well as automotive and aerospace.**

Government support for manufacturers has improved significantly since the financial crash in terms of help for exporting (UKTI), research and development, and business advice (TSB, KTNs and Catapults) is increasingly effective. But there is concern that initiatives in some areas are skewed in favour of larger corporations or fail to take into account the supply-chain collaboration that underpins much innovation.

### *ii Manufacturing advice and business process development*

The UK government has moved in recent years into the provision of strategic advice for manufacturing companies through the Manufacturing Advisory Service (MAS). This is a mix of the advice services on process development, productionising and technology that are offered by technical and engineering consultancies and the business, management and markets service traditionally the domain of the management consultants and by previous local business schemes. The MAS was originally delivered through the Regional Development Agencies, but on their abolition was reworked as a national service under the Department for Business, Innovation and Skills.

MAS and similar ventures have been widely accepted as useful mentoring for smaller businesses and the only criticism of such schemes from the interviews related to individual points where there was a reported mismatch between the advice offered and the expertise already inside the company.

**"It doesn't help business when you just say we'll help you write a business plan for free."**

### *iii Exporting and market development support*

Manufacturers account for more than 50 per cent of the UK's export trade, and exporting provides the opportunity for growth and for access to markets that are in some cases growing rather faster than can be expected from the UK market. In many areas of manufacturing, business is global.

**"Winning international business is simply crucial."**

For the largest companies that have been operating internationally for a long time, export support is at high government and diplomatic level, and in industries such as defence the government role is often crucial as both supporter and customer. In all cases, these big international companies have substantial resources of their own directed towards their global activities: government support is often needed because there is frequently a political element to their activities.


Image courtesy of JJ Churchill

**"We have 25–40 per cent of exports currently to mainland Europe and we have no desire at this stage to expand into emerging markets as there is plenty of 'low hanging fruit' that we can go for now."**

**"We do not currently have any major competitors, but our main concern is finding new markets to deliver our UK-built products to, as current global trade barriers increasingly seem to force us to manufacture outside the UK."**

It's a very different picture with small manufacturing firms. For smaller companies which may have very limited knowledge of other markets and other constraints in terms of size, capacity and ambition, the support to exporters that comes from several UK government agencies in terms of advice and practical on-the-ground assistance may be just as crucial – but represents a big challenge to deliver because the requirements are so diverse and individual. Our interviews with manufacturing companies provided evidence of this diversity of need.

**"The UKTI Working Capital Loan Scheme seems to be a very cumbersome process that needs to be validated for every order that you take. We question whether UKTI has the business acumen to understand the problems that businesses are involved in day to day."**

With these highly diverse requirements, it is not easy to identify themes and trends, but criticisms tended to revolve around two aspects: the bureaucratic procedures that some of the trade advisory schemes appear to require; and a broader complaint that UK agencies and authorities abide by and uphold international rules that are being widely flouted or bent elsewhere.

This even-handedness has other consequences too:

**"Work is being funded by UK government that supports a foreign competitor of ours to produce competitive products."**

**"If we were to be cynical, we might say that it feels as if Britain is a bit naïve. We are very open and very happy to compete and very good at trying to play on a level playing field. Whereas most other countries aren't."**

# 7. Key messages

**General findings**

**1.** UK manufacturing is a vibrant and resourceful part of the economy that is well-placed to deliver growth in globalised markets, to the benefit of the UK economy as a whole. Manufacturing in the UK ranges from huge corporations that are often part of multinational groups to niche businesses supplying specialist products and services.

Individual companies have their own strategies and routes to success; this diversity is a source of both strength and resilience, as has been shown in the industry's survival during the recession and in the current strong growth and recovery.

However, the diversity of business type and of technologies covered means that there are few universal panaceas that can be applied across the whole of manufacturing to promote future growth.

**Government support**

**2.** Manufacturing companies have, in very many instances, a proud record of self-reliance; however, this is not always positive as it deters government from understanding how they can support UK manufacturing.

Government support in terms of exporting, research and development is seen as effective, but there is concern that initiatives in some areas are skewed in favour of larger corporations or fail to take into account the supply-chain collaboration that underpins much innovation.

Government organisations like BIS, UKTI, TSB and MAS that are invested in supporting manufacturing need to be aware that manufacturers have had to find alternative, independent methods of financial and business support, more out of desperation than out of choice. Localisation of manufacturing may also be driven by international customers as the market in many sectors is already global.

**3.** There is a strong sense of continuity and long-term planning that characterises manufacturing businesses, and therefore any intervention or investment must also be consistent and long-term.

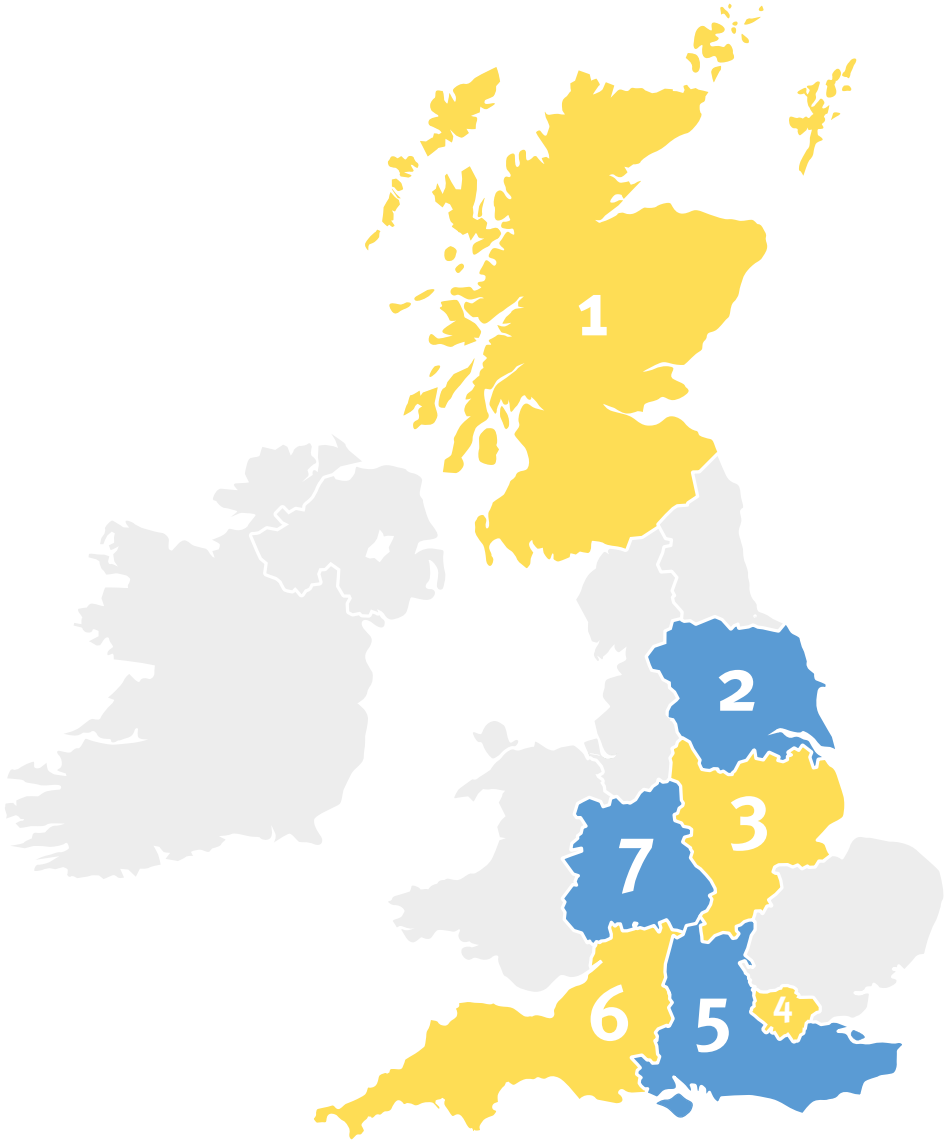
This applies not just only in obvious areas such as financing, but to broader strategic factors such as business advice, regulatory issues, and research funding. Government support for manufacturing is seen as effective – when it works – but there are entire sections of manufacturing working in the shadows that do not get any support; the government's reach is not far enough.

**Skills**

**4.** A recurring theme that was raised by almost all contributors was the challenge of finding skilled workers. Their concern over the quality and quantity of skilled technicians and graduates and the output of the UK education system is the single strongest message that manufacturers wanted to send to government and academia.

The calibre of graduates that apply for manufacturing roles is not high enough and therefore many organisations have invested in apprenticeship schemes – even in times of financial hardship – that have been consistently training young workers so that organisations can in effect 'grow their own' work force.

# The companies that participated




### 1. Scotland

| | |
|---|---|
| **Totseat** | www.totseat.com |

### 2. Yorkshire & Humberside

| | |
|---|---|
| **Coca-Cola Enterprises** | www.cokecce.co.uk |
| **Logicor Group Ltd** | www.logicor.co.uk |

### 3. East Midlands

| | |
|---|---|
| **Zeeko** | www.zeeko.co.uk |

### 4. London

| | |
|---|---|
| **Autoflame** | www.autoflame.com |
| **Brompton Bicycles** | wwwbrompton.com |
| **GSK** | www.gsk.com |
| **Kesslers** | www.kesslers.com |
| **Limpsfield Combustion** | www.limpsfield.co.uk/wp |
| **Vitsoe** | www.vitsoe.com |

### 5. South East

| | |
|---|---|
| **3T RPD** | www.3trpd.co.uk |
| **Bisley** | www.bisley.co.uk |
| **FUTURE Design** | www.futuredesigns.co.uk |
| **Griffon Hoverworks** | www.griffonhoverwork.com |
| **Meru** | www.meru.org.uk |
| **Smiths Harlow** | www.smiths-harlow.co.uk |
| **SCA** | www.sca.com/hygiene |
| **Unilever** | www.unilever.co.uk |
| **Xyratex** | www.xyratex.com |

### 6. South West

| | |
|---|---|
| **Renishaw** | www.renishaw.com |
| **Ultra Global PRT** | www.ultraglobalprt.com |

### 7. West Midlands

| | |
|---|---|
| **JJ Churchill** | www.jjchurchill.com |

# Acknowledgements

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- Joe Chapman
- Sahar Danesh
- Thomas Man
- Katherine MacGregor
- Philippa Oldham
- Rachel Pearson
- John Pullin
- Christopher Richards
- Courtney Thornberry


Image courtesy of Kesslers

# Biographies

## 3T RPD

3T RPD is the UK's largest Additive Manufacturing (AM) supplier and the only one with both AS9100 (Aerospace) and ISO13485 (Medical) production certifications.

3T RPD's goal is to be the first choice metal and plastic AM supplier in Europe, which involves the challenge of developing from Rapid Prototyping to AM Production.

## Autoflame Engineering Ltd

Autoflame Engineering Ltd, established in 1972, manufacture the Autoflame Combustion Management System; a micro-modulation burner control system which is used on a commercial or industrial boiler system to reduce fuel usage and cut harmful greenhouse gas emissions.

Autoflame engineered solutions are proven and trusted for some of the most demanding and critical combustion applications throughout the world. Their burner management systems, the result of many years or practical experience, maximise the efficiency of boiler plant, dramatically reducing fuel consumption and harmful emissions.

## Bisley

Bisley is Europe's leading steel storage manufacturer, spanning both consumer and professional markets.With a history that can be traced back to the 1930s, Bisley is one of the UK's manufacturing success stories and now employs nearly 1,000 people at its factories in Surrey and South Wales, plus a showroom on London's Great Portland Street. In recent years, Bisley has developed its international business significantly and it is now responsible for 50% of the business. Bisley's broadening geographical span covers Europe, Russia, the Middle East and North America.

More recent innovations include the InnerSpace™ high-density mobile storage system and the Bite™ mobile storage system. Bisley's heritage and intensive research and development programme means that it is at the forefront of new thinking about storage in the workplace.

## Brompton Bicycle

Brompton Bicycle designs and manufactures the famous Brompton folding bike, which marries the performance of a full-sized, agile bicycle with the convenience of a portable, storable package. It is a personal transport solution that fits into people's lives at home, at work and all points in between, without forcing a compromise. Every bike is still hand brazed and built in London.

## Coca-Cola Enterprises

Coca-Cola Enterprises, Inc. (CCE) is the world's third-largest independent Coca-Cola bottler. CCE is the sole licensed bottler for products of The Coca-Cola Company in Belgium, continental France, Great Britain, Luxembourg, Monaco, the Netherlands, Norway, and Sweden.

In Great Britain, Coca-Cola Enterprises Ltd employs some 4,000 people across England, Scotland and Wales at more than 10 sites, six of them manufacturing plants. They produce 25 different soft drinks brands – the majority of them under licence from the Coca-Cola Company, including the iconic Coca-Cola brand, which is the country's best-selling soft drink.

## FUTURE Designs

Established in 1991, FUTURE Designs builds and provides best quality luminaires and bespoke lighting solutions with a proud heritage of meeting the exacting demands of diverse clients from the commercial sector, education, healthcare authorities, financial institutions and retail groups.

They commit to deliver the very best lighting solutions, from concept through to installation, supported by a carefully managed programme of research and development, after sales service and support.

Investment in the development of their products and new innovations is continuous. Working in the most up-to-date facilities they offer specialist lighting design and manufacturing bringing projects from concept to complete realisation.

## GlaxoSmithKline

GSK is one of the world's leading research-based pharmaceutical and healthcare companies, developing and supplying medicines to improve patients' quality of life.

They employ more than 97,000 people in over 100 countries and make prescription medicines, vaccines, over-the-counter medicines, oral care and nutritional healthcare products.

They are proud of their strong, open relationship with the NHS and their British heritage.

They have a challenging and inspiring mission: to improve the quality of human life by enabling people to do more, feel better and live longer. This mission gives them the purpose to develop innovative medicines and products that help millions of people around the world.

## Griffon Hoverwork

Griffon Hoverwork is the world leader in the design and manufacture of hovercraft, offering pioneering new solutions, expert advice, training and consultancy.

Their custom designed hovercraft are used worldwide in multiple commercial and military roles including, fast attack, surveillance, humanitarian aid and disaster relief, providing a reliable and economical solution.

### JJ Churchill

JJ Churchill is a 3rd-generation, family-owned, precision engineering business employing 124 highly-skilled and motivated people. Sectors include aerospace, power generation, defence and diesel engine, with products such as gas-turbine blades and complex diesel engines assemblies. Continuous investment in advanced machine tools, manufacturing software and metrology supports our long-term growth position in our sectors of choice.

### Kesslers

Kesslers International is Europe's leading designer and manufacturer of retail merchandising solutions. They operate from a world class plant of 130,000 square feet with a multi ethnic highly skilled workforce of 250.

They have a high rate of new product introduction with 80% of their products each year being new and produce, on average, 1200 new CNC programs, 6 injection moulding tools and 35 vacuum jigs each month.

Their in house processing includes injection moulding, thermoforming, extrusion of plastics; Sheet metal and wood processing on CNC machines and lasers; powder coating spraying and silk screening as well as assembly and installation.

### Limpsfield Combustion Engineering

Limpsfield Combustion Engineering was originally set up to design, test and manufacture industrial burners to operate efficiently throughout their firing range regardless of the fuels they are required to fire.

In 2013, after a busy and exciting period of growth in which the Limpsfield brand was firmly established and recognized as a world leader in the manufacture of burners and combustion equipment, Limpsfield won the Queen's Award for Enterprise in International Trade.

### Logicor

Logicor's pedigree lies in eco-friendly R & D activity, and whilst over the past 10 years of their existence they have brought a number of products to market, it was only in 2013 they established a purpose-commissioned factory to manufacture their CHS range. This environmentally friendly cutting edge technology is proving highly successful. They source from within the UK where ever possible to meet their exacting quality delivery and cost demands.

They strongly believe that manufacturing businesses located in the UK can compete, with those in other locations around the world, in most areas but will always surpass in the quality of the products produced in the UK.

### MERU

MERU (Medical Engineering Resource Unit) is a unique engineering charity that designs and manufactures specialist equipment for disabled children and young people when no other product exists to meet their needs, together with a range of ready-made products to aid independent living.

### Renishaw plc

A global engineering technologies company, Renishaw supplies products used for applications as diverse as jet engine and wind turbine manufacture, through to 3D printing, dentistry and brain surgery. The FTSE 250 listed company employs 3,300 people globally, with wholly owned subsidiaries in 32 countries and annual sales of £347 million.

### SCA Hygiene Products UK Ltd

SCA is a leading global hygiene and forest products company that develops and produces sustainable personal care, tissue and forest products. In the UK, SCA has a number of manufacturing operations and markets many strong brands – including the leading global brands TENA and Tork as well as regional brands such as Bodyform, Plenty, Cushelle and Velvet.

### Smith's (Harlow) Limited

Smith's (Harlow) Limited is a private high precision subcontract engineering company established in 1948 to serve the aero-engine and airframe sectors. The company has CNC and NC machines and continually updates them in order that the highest levels of precision may be obtained within the shortest delivery times. These encompass tool changing, pallet loading and multi spindle capabilities.

### Totseat

The Totseat chair harness was created from necessity to keep a small child safe during lunch, when the highchair proffered was too filthy to use. Anchoring a baby safely, in any adult chair, the Totseat adapts swiftly and easily to fit chairs, and babies of all shapes and sizes. Since launching in 2005, the multi-award winning Totseat has become the leader in its field, selling in more than 40 countries.

The Totseat was originally manufactured in the UK but production moved offshore following the collapse of the UK factory. Designed entirely from a safety perspective, the Totseat is a complex product to manufacture with the majority of the production cost coming from the labour component of manufacture. Quality control in bespoke, offshore, textile factories has been found to be far superior than that experienced in the UK, despite wishing this not to be true!

## Ultra Global PRT

Ultra Personal Rapid Transit (PRT) is a new and innovative on-demand system for developed or urban environments. It is designed to meet the need for congestion free, multi-origin, multi-destination public transport. Using small driverless electric vehicles that run on guide ways, the lightweight and flexible nature of the system enables it to be retrofitted into a broad range of environments and provide transportation that is environmentally friendly and operationally efficient.

Ultra's first PRT system is situated at London's Heathrow Airport and transports passengers to and from Terminal 5 and the Terminal's dedicated Business Car Park. The system which has been in operation since May 2011 has just celebrated carrying its one millionth passenger. Ultra are now looking to export the technology internationally and have recently carried out a study in feasibility study in the Brazilian city of Florianopolis with a further study in Taiwan currently underway.

## Unilever

Unilever's origins in the UK date back to 1885 when William and James Lever launched Sunlight, the world's first branded and packaged laundry soap. London is home to one of their two global headquarters, the other being in Rotterdam in the Netherlands. They have two global research facilities at Port Sunlight and Colworth, as well as manufacturing sites and distribution depots dotted around the UK.

## Vitsœ

Since 1959 Vitsœ has made the furniture of the German industrial designer, Dieter Rams. In 1995 Vitsœ and its production were relocated from Germany to the UK. Export sales now exceed 60% and Vitsœ has its own shops in London, New York, Los Angeles, Munich, Copenhagen and Tokyo to ensure a direct relationship with its end-user customers.

## Xyratex

Xyratex is a leading data storage technology company with more than 25 years of unique experience. From disk drive heads and media to enterprise storage platforms and High Performance Computing environments, their innovative technology solutions help make data storage faster, more reliable and more cost-effective. They lead through innovation. Their research and development activities are essential to ensure their products remain competitive both economically and technologically as the data storage industry continues to evolve at a rapid pace.

## Zeeko

Established in 2000, Zeeko has progressed from being a start-up company with innovative technology to polish ultra precision surfaces for telescope mirrors and other optical surfaces, to become a market leading company with a wide polishing and metrology product portfolio that competes impressively in a global market place. Zeeko remains to be an innovative, young and dynamic technology based business with globally protected Intellectual Property extending to over 52 worldwide patents.

Zeeko specialise in the manufacturing and commercialisation of Ultra-Precision Polishing Machines famously known as the Intelligent Robotic Polishers (IRP). Zeeko Ltd manufactures corrective polishing machines for fabricating high precision optics, orthopaedic joints, semiconductor applications and precision moulds in a number of different materials.

Zeeko has worked hard to establish itself as a viable business and, having learned some of the skills needed to survive and prosper, it has more recently developed a number of ideas for ways in which the business and the product base can grow laterally across sectors, thus protecting the business in times of market slow-down.

## Engineering the Future:

Engineering the Future is a broad alliance of the engineering institutions and bodies which represent the UK's 450,000 professional engineers.

We provide independent expert advice and promote understanding of the contribution that engineering makes to the economy, society and to the development and delivery of national policy.

The leadership of Engineering the Future is drawn from the following institutions:

The Engineering Council; EngineeringUK; The Institution of Chemical Engineers; The Institution of Civil Engineers; The Institution of Engineering and Technology; The Institution of Mechanical Engineers; The Institute of Physics; The Royal Academy of Engineering.