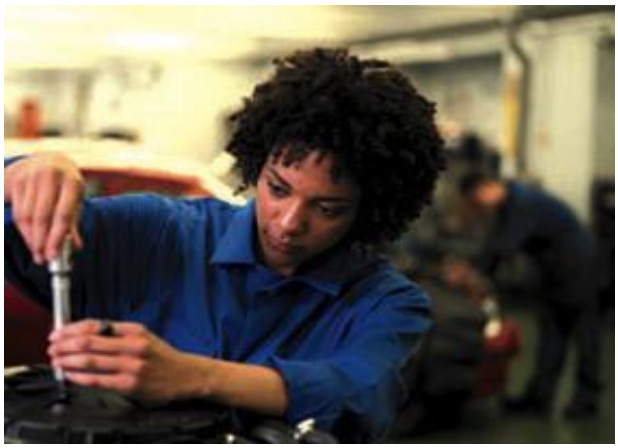
Meeting the future skills needs of employers in the Advanced Manufacturing sector: a provider development project in the East of England, West Midlands and East Midlands

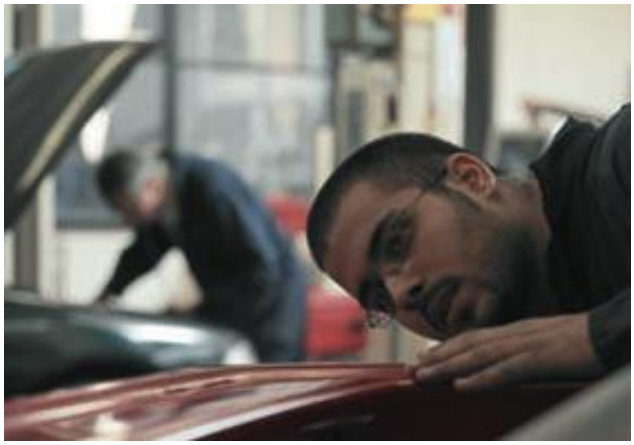
LSIS LEARNING AND SKILLS IMPROVEMENT SERVICE



Foreword

Between December 2010 and March 2011, as part of the Skills and Employer Responsiveness (SER) programme, LSIS funded five projects. The projects aimed to enable groups of providers to identify how they can develop their capacity to meet the future skills that the employers' workforce will require to adopt new technology and working practices, and be globally competitive. Each project focused on a different industry sector or sub-sector.

This report aims to share the learning gained from the project about supporting employers in the Advanced Manufacturing sector.



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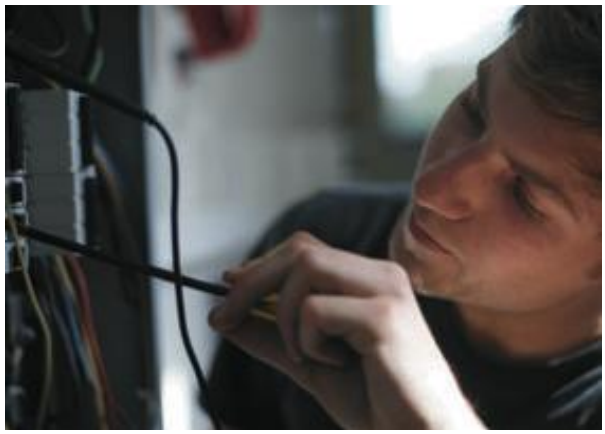

Executive summary

The UK's manufacturing industry will be one of the key drivers of the Government's strategy for growth. Manufacturing industry recovered relatively quickly in the recession and is now very important to the UK to sustain the generation of more jobs in the private sector. Key to sustaining that growth is ensuring that the sector has a very skilled and experienced workforce driven by the needs of today's and future technologies. The pace of change within manufacturing is increasing and the demand for new skills increases accordingly. The importance of the issue was underlined by a statement given by the Minister of State for Further Education, Skills and Lifelong Learning, John Hayes, in the House of Commons in January 2011.

> "The jobs summit held earlier this year demonstrates the Government's commitment to a pro-growth, pro-jobs agenda. We are committed to a huge increase in the number of Apprenticeships leading to technician status; that will nurture the advanced skills we need in manufacturing, technology, and engineering, which are vital to strengthening our economy."

The first issue we encountered was defining the Advanced Manufacturing sector. It became evident that employers and stakeholders, such as employer representative groups, do not have a clear or consistent definition of what constitutes the sector. We started with the notion that the sector actually constituted a number of sub-sectors, which had been highlighted in a previous LSIS report. In our discussions and review we found that there was no commonly accepted definition ; in fact some respondents felt that a definition of advanced manufacturing was unhelpful in that almost every manufacturing organisation has some aspects of advanced manufacturing. In the timescales available we did not want to spend too long on definitions and therefore looked at issues that would affect all sectors rather than specific issues within some specialist sub-sectors.

We interviewed and surveyed 15 large key providers and stakeholders delivering advanced manufacturing skills and knowledge training. This resulted in the key themes summarised below:

- There is a requirement for general-technical, specialist-technical and non-technical skills for the future.
- There is a need for new high-level technical skills in both materials and new product development.
- Leadership and management skills needed include project management, commercial and financial management.
- Many employers are trying to balance the need for multi-skilled technicians with the need for specialist technicians with a high level of expertise in a specific skill or product set. Many employers aim to develop a broad base of engineering skills up to Level 3 and then develop specialisms that take learners to Level 4 and beyond.
- Progression routes are needed to ensure learners have structured, national pathways to increase their skills to meet the needs of the Advanced Manufacturing sector.
- National initiatives are needed to ensure providers are fully involved in their development and delivery.

We have used these themes to develop case studies that further examine the issues, consequences and solutions proposed by providers and can be used as the basis for dissemination of good practice. We have also made some recommendations of how providers can go on with the further development of the skills profile of the Advanced Manufacturing sector. Many of these are based around partnership working between providers, providers and employers, and providers and other stakeholders.

1. Project methodology

The project was managed and directed by the project management group (PMG) involving the key partners in the LSIS Skills and Employer Responsiveness (SER) programme. These included ALP, NIACE, the 157 Group and the Association of Colleges. We also included Babcock International, the lead provider in the PMG, and Frank McMahon, Managing Director of NETA, who is the Engineering Skills Champion for ALP. The PMG signed off the delivery plan agreed with LSIS and managed the project through to completion. Some tasks were managed on behalf of the PMG.

1.1 Financial management

ALP appointed a project manager for the project who liaised with the ALP finance team to ensure the budgets were controlled and financial target met.

1.2 Lead provider (LP) role

The PMG agreed the role that the LP would perform during the project. The project focused on the role of training providers in the development of the Future Skills agenda so it was important that a provider oversaw the direction of the project. Babcock International is a large independent training provider that delivers support across a wide range of industries including manufacturing. They are well respected among providers and this helped to establish the credibility of the project.

Babcock's main functions during the project were to:

- support the development of a feasible delivery plan;
- commission the research and interview process;
- ensure all activities are provider focused;
- do the on-going project management;
- coordinate and validate the case studies;
- coordinate the different elements for the final report.

1.3 Babcock International project management and resources

Babcock appointed a project manager (PM) for the duration of the project. She maintained the coordination with the external consultants used in the interviewing and research phases. The Babcock PM also liaised with the ALP PM on a day-to-day basis.

During the project Babcock International used external resources from consultancy, operational and inspection backgrounds. It was important to have external resources because they provided a more 'independent' source of knowledge and ensured that interviews elicited as much information as possible and that there was no sensitivity involved in competitive discussions. The short timescales involved in the project also meant that external resources were needed to meet the deadlines.

1.4 Project management

Key project activities were broken down into key actions tracked on a Gantt chart by the PM. The Gantt chart was circulated regularly and was the main tracking process for the

PMG. The project was split into five main activity phases as follows.

Phases	Task	Delivery methodology
1. Establishing the future skills needs for the sector	Review developing skills needs by talking to employers, providers, stakeholders.	Lead provider appoints a respected expert to carry out this and desk research.
2. Review of provider response	Discuss the response to the developing skill needs with providers. Use one-to-one experts and focus groups to share knowledge and understanding including some individualised consultancy support in the data collection phase.	LP commissions a range of appropriate sector experts to provide the research capability and the one-to-one interviews.
3. Development of case studies	Establish the type of processes providers have used to respond to changing needs, supported by the development of case studies that can be used by other providers.	LP appoints external experts to develop the case studies. Partners to be involved in the development of the models and case studies.
4. Knowledge sharing	Establish a process by which the knowledge gained in the research phases is shared with the provider base and the relevant stakeholders.	Following consultation with the PMG the LP will coordinate an appropriate dissemination plan and ensure respected sector experts are in place to advise providers.
5. Reporting	The lead provider works with partners to develop a report of the activities and research as well as the outcomes.	The PMG supports the LP to develop a report on the project using the external resources as required.

Most providers were involved across several sub-sectors so the focus for the project was on issues with an application across a range of industries and sub-sectors.

Table 1: Providers and stakeholders involved in project

Association of Learning Providers	Stakeholder
Association of Colleges	Stakeholder
157 Group	Stakeholder
SEMTA	Stakeholder
Engineering Employers' Federation	Stakeholder
Babcock International	Provider
West Nottinghamshire College	Provider
Birmingham Met College	Provider
NETA	Provider
Hull City Council Training	Provider
Bedford Training Group	Provider
Training 2000	Provider
GTA England	Provider
Motor Industry Training	Provider
Interserve	Provider

Babcock International (Training Division) was the lead provider for this project. Their role was to project manage the phases of the project and coordinate activity of the partners.

Babcock Training is part of a company with a long engineering heritage. For over a century, Babcock has been one of the largest names in the engineering industry.

The initial research work covered a wide range of literature from several sources but the main research materials on future skills were from the sector skills councils such as SEMTA and employer bodies such as the Engineering Employers Federation (EEF). Annex 1 lists the key research documents.

Annex 2 is a paper that draws out the main themes arising from conversations and interviews with stakeholders and providers.

It sets out some key issues that affected the impact of future skills requirements on the sector, but the project focused on issues that directly affected providers and on which they could make a major impact. As a result of this analysis we produced a set of themes that we would use to create a framework for subsequent discussions and interviews. The themes were as follows:

1. Provider intelligence – how do providers predict and monitor the need for future skills?
2. What new skills will assessors/tutors need and how will they get them?
3. How will the sector include future skills needs in Apprenticeships?
4. What are the barriers to Higher Level Apprenticeship delivery?
5. Can providers support employers on business/management skills?

These themes informed the next phases of discussions but they are not an exhaustive list.

In phases two and three Babcock International coordinated a series of interviews with providers to explore these themes and other issues around future skills. We extended the general discussions with some providers to explore some very specific responses they had made to the demands of employers. From this we created case studies that were descriptions of the internal processes the providers had been through so that other providers might consider how they might respond to similar needs.

The case studies covered issues such as the recruitment process, the intelligence-gathering process and curriculum development. Although some confidentiality issues do arise we have developed models that will at least highlight the areas for other providers to consider. The main body of the report contains the key findings from these interviews and discussions.

In the final phases of the project we have begun to share the research findings and work with providers to think through the issues. We initiated a short survey that raises some of the topics under discussion and got further input from providers. See Annex 3 for a summary. We also did some work on analysis of the Apprenticeship programme in the Engineering sector and have included a statistical analysis at Annex 4.

The final section of this report is a series of recommendations of themes that can be taken forward as perspectives on future skills needs in advanced manufacturing. The wide range of organisations covering the Engineering and Manufacturing sectors makes this a complex area in which to drive coherent and effective skills policies yet employers in advanced manufacturing have clear skills needs and training providers delivering funded training support have an important part to play in meeting these skills needs.

Our analysis and work indicate that there is a lot more individual providers can do to ensure they are aware of and responding to those skill needs. We hope this project has highlighted some key areas in which providers can work together and make a real impact in this important employment sector.

2. Introduction

This project was managed by the partnership established to run the Skills and Employer Responsiveness (SER) programme in the East of England, West Midlands and East Midlands. That partnership involves sector representative bodies including the 157 Group, Association of Learning Providers (ALP), Association of Colleges (AoC), NIACE and some major providers including West Nottinghamshire College and Birmingham Metropolitan College. All the regions and major partners believe that the Advanced Manufacturing sector will be a key driver of the UK economy and a key driver of the demand for new skills. This project therefore set out to work with providers and other sector stakeholders to develop understanding of the need for new skills and start to support the development of the sector's capacity to respond to that demand for new and higher skills levels.

The 2010 LSIS report *Skills for economic growth* looked at the key sectors in each region. A figure from the report, reproduced below, shows that six of the nine English regions had Advanced Manufacturing as a priority sector – the most highly ranked sector.

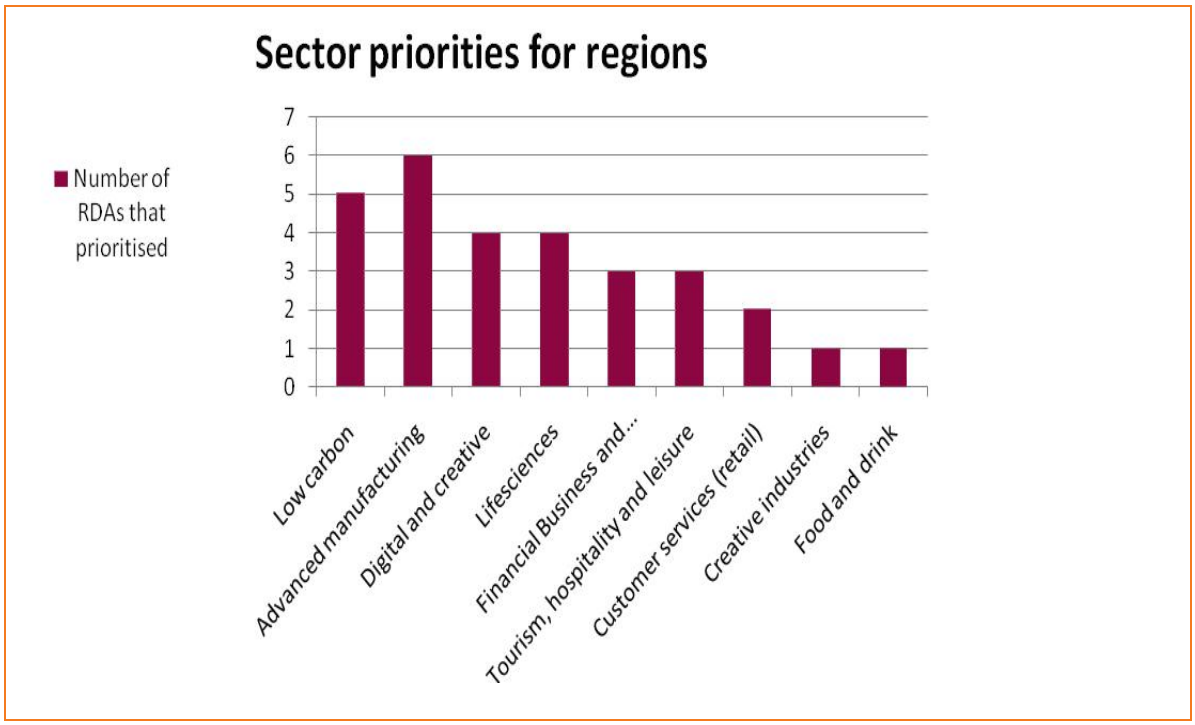

Figure 1: Number of English regions reporting sectors as a priority

The three regions covered by the ALP/157 Partnership all had a keen interest in the development of advanced manufacturing and the issues being addressed were of national concern. The project therefore included all providers in its brief, including independent training providers and colleges. We also included partners from the three regional partnerships we have been working with.

2.1 Definitions

Although there are clearly manufacturing sectors that are classified as “advanced” (nanotechnology, plastic electronics, etc) the concept of advanced manufacturing is essentially both sector-free and time-dependent. The “advanced” nature of manufacturing does not depend on the sector but on the state of development of the manufacturing approaches and techniques involved. Also, what is “advanced” now will be mainstream in five years’ time and “traditional” in 10–20 years. For example, there are already scientific papers that speak of “traditional” approaches to thin-film polymer manufacture.

Advanced manufacturing also does not relate only to brand new, high-technology sectors. In many ways it might be better to see “advanced manufacturing” not as a unique and discrete industrial sector or collection of sectors but as a set of technologies and techniques that have substantial and far-reaching import for all manufacturing, no matter how currently “traditional” it may be.

Notwithstanding this, of course, the development of the skills-base for these techniques and technologies will require specific education and training. This is not so much because of “new” skills (most of the main elements of advanced manufacturing are already in use in the UK to some extent) but because the substantial enhancement and broadening of skills are needed to enable these advanced techniques, and their benefits, to be quickly established in the mainstream of UK manufacturing.

The “overlap” of advanced manufacturing skills between “advanced manufacturing” clusters and other manufacturing industries is clearly illustrated by skill areas such as systems engineering, modelling, materials engineering, characterisation, and so on. All these skill areas are already in use in manufacturing in fields as widely separated as motor vehicle production, advanced textiles and food production.

For further development of a national agenda to develop advanced manufacturing it will be necessary to identify, in detail, where and how existing education and training needs to be enhanced to permit advanced manufacturing techniques to grow across the whole span of the UK manufacturing industry.

2.2 The Advanced Manufacturing sector and sub-sectors

These include:

- Aerospace;
- Plastic/printed electronics;
- Silicon electronics;
- Industrial biotechnology;
- Composites; and
- Nanotechnology.

We have also identified “sub-sectors” that make use of these techniques to a greater or lesser extent. These are listed below together with the regions that mentioned them as priorities for advanced manufacturing:

- Advanced Engineering: North East; South East; South West; West Midlands; Yorkshire and Humber;
- Advanced marine engineering: South East;
- Aerospace: East Midlands; North West; South East;
- Automotive: East Midlands;
- Composites: East of England; South West;
- Industrial biotechnology: East of England; North East; South East; Yorkshire and Humber;
- Micro and nanotechnology: East of England; North East; South West; Yorkshire and Humber;
- Plastic electronics: East of England; North East;
- Rail manufacture: East Midlands.

2.3 Skills themes

Manufacturing is vital for the future prosperity of the UK and, given that the developed world has moved much traditional, labour-intensive manufacturing off-shore, “advanced manufacturing” represents the primary avenue for achieving a dynamic and lucrative industrial base. A further risk to the UK economy is that the UK has lost a lot of its indigenous engineering equipment manufacturers and machine tool manufacturers. Today, and for the foreseeable future, most of our highly technical manufacturing equipment will need to be imported from Germany, Japan and the United States.

The underlying theme of all existing research into advanced manufacturing is that its further development in the UK will require a step-change in the level of knowledge and skill in the workforce and the further development of a solid cadre of well-educated technicians to match (and, if possible, exceed) the scientific and mathematical competences of employees at this level in countries such as Japan, Germany, and Singapore. Advanced manufacturing in the UK requires a flexible workforce with strong specialist skills in the areas of science, technology, engineering and mathematics (STEM subjects) and design.

This has to be understood in the context of advanced manufacturing requiring fewer but more highly trained employees. The actual numbers required by a UK manufacturing sector moving fast towards an advanced manufacturing-based future are unclear, but they are likely to be lower than the numbers required to operate equivalent traditional manufactories. This will certainly change the balance of skills required in the Advanced Manufacturing sector and unless the UK can attract a higher share of the global market for these industries this will be reflected in lower absolute numbers employed in the sector. The drive for higher skill levels is therefore essential to attracting employers and maintaining the numbers employed in the sector.

A number of key themes that emerged from discussions with providers and stakeholders and from existing literature on the skills required for advanced manufacturing as outlined below.

1. Multi-disciplinary

In contrast to the situation perhaps a few decades ago, there are no longer clear delineations between industrial "sectors" in terms of the ranges of skills they require and this greatly influences their needs as to both professional and technician-level staff.

Most companies require multi-disciplined people, capable of seeing and using the links between disciplines such as chemistry, biology and physics, and with a holistic understanding of the links between disciplines and sectors.

2. Well-rounded skills

It is clear from the literature that the development of entrepreneurial and dynamic advanced manufacturing will require people who have not only very high-level professional and technical skills but who are skilled in a wide range of business skills.

3. Careers information, advice and guidance

Although skills are of vital importance to the development of advanced manufacturing in the UK, it is also necessary for teachers and careers staff to understand not only the importance of manufacturing but the way in which modern manufacturing works and the attractiveness of careers in the field.

There is much work going on in this direction but, up to now, it has been largely directed at attracting young people into science and engineering careers in general. Perhaps the effort should be expanded to highlight the exciting and challenging careers available in advanced manufacturing.

One independent training provider has focused on the development of engineering careers with their local schools. This is covered in more detail in one of the case studies.

Year 9 activity days allow students to experience the tools and techniques used by engineers in an advanced manufacturing working environment.

The provider has now compiled many inspiring case studies about learners who have gone on to employment in highly technical engineering environments. (NETA Training Ltd)

3. Design

Designers will need to understand the capabilities of advanced manufacturing techniques so that they can design components, equipment and products that make full use of the significant advantages offered by them. This area, although centred on computer-aided design (CAD), assembly line or production robotics, CNC machine operation and computer-aided engineering (CAE), also now overlaps to a large extent with fields such as systems engineering and virtual engineering.

Designers also need to be aware of the potential for additive manufacturing, unmanned systems and the use and application of robotics.

4. STEM (Science, Technology, Engineering and Mathematics)

"STEM skills are valuable, but in short supply" (Babcock)

Advanced manufacturing depends on the UK having a body of highly educated and trained engineers and scientists capable not only of making best use of existing advanced manufacturing approaches but of developing those techniques further and creating new ones. Young people's interest in advanced manufacturing must be fostered and developed through advanced science and mathematics and by teachers who are knowledgeable about their application in advanced manufacturing.

This process will be vital in creating not only a body of highly knowledgeable and skilled scientists and engineers but an even larger number of highly numerate and scientifically-aware technicians. The significant development of STEM subjects at school and college, and their promotion and development in engineering and science at university level, is therefore vital.

OECD evidence shows that almost 25% of UK employees in manufacturing have a first degree in science or engineering. This is lower than in China (more than 45%) but ahead of the United States (around 15%).

Even at the most basic level, employers have highlighted the lack of laboratory skills and of multi-disciplinary skills in current A-level students so the need to expand and reinforce the teaching of advanced multi-disciplinary science to A-level (and equivalent) students is equally important.

5. Science/engineering skills

Universities and colleges need to ensure that their science and engineering courses keep up with the science and technology at the forefront of advanced manufacturing, for example in:

- nanotechnology;
- advanced materials science;
- advanced metrology;
- additive techniques (for both electronics and component manufacturing);
- microbiology and genetics;
- lithography; and
- production and process techniques.

Higher-level students need to understand manufacturing techniques and product and process development, including the latest ideas on factory design and process flow. Although all these subjects (and production engineering) are highly specialised in their purest forms, it is essential that students across all science and engineering disciplines gain a solid understanding of the way in which they affect the evolution of new ideas and concepts into marketable products/services.

Employers need people who can combine STEM qualifications with a wider set of skills, such as team-working and communication abilities, enabling them to work flexibly across a range of activities within companies. Similarly, the education and training of higher-level students needs to be broader and include skill areas that have not traditionally been generally considered essential for engineers and scientists:

The innovations in technology that characterise advanced manufacturing are created from cross-disciplinary fertilisation. This gives rise to the need for individuals with an understanding of multiple scientific disciplines, and the different target markets and supply chains arising from the innovations. These cross-disciplinary skills feature in the development of lean manufacturing techniques that have been adopted by a number of employers. Lean manufacturing is a process adopted from the Toyota Production System and focuses on increasing efficiency by focusing on wasteful production processes.

Traditional work-based learning providers have focused on Intermediate and Advanced level Apprenticeships, and have not really been involved in the development of and delivery of more vocational engineering qualifications at higher levels. This must be an important area of focus for providers in the next few years.

6. Advanced manufacturing technology and techniques

Our review of literature and discussions with stakeholders suggested that the key technologies and techniques required for the skills base of advanced manufacturing were:

- nano devices and materials (still largely at the research and development stage – requiring post-doctoral scientists – but quickly moving into potential new manufacturing areas);
- catalyzed nano-wire growth;
- metrology;
- bottom-up and top-down fabrication (self-assembly);
- additive manufacturing (as the main engineering target of the above);
- optical, e-beam and ion beam lithography (and block co-polymer techniques);
- sol-gel techniques;
- polymer chemistry and advanced thin-film techniques;
- liquid phase deposition;
- characterisation skills (eg using advanced microscopy);
- process engineering – process improvement techniques;
- food science and technology;
- biofermentation;
- solar cell technology, advanced batteries;
- plastics, paints and pharmaceuticals;
- genetic and associated products;
- micro-biology;
- chemical engineering (including microbial chemistry);
- colloidal chemistry;
- anaerobic digestion technologies.

7. Management skills

The location and negotiation of suitable tranches of venture and working capital for advanced manufacturing developments and start-ups is very important. Subsequent effective financial management is as important for the success of advanced manufacturing start-ups as the science and engineering behind them.

It is important, too, that engineers and technicians – whatever their main subject of study – understand vital aspects of modern business management. These include competitive advantage, business-modelling, supply chain management, cash-flow and balancing revenue streams, intellectual property rights, data security management, quality control systems and lean manufacturing techniques.

Many sources stress the fundamental need in advanced manufacturing for research skills at both technician and professional level and from what would traditionally be regarded as research facilities (eg universities and research laboratories) to the operational areas of an advanced manufacturing unit. Perhaps more than in traditional manufacturing, all staff in advanced facilities will need to work in collaboration with research organisations/ higher education institutions, ensuring that researchers can work effectively with technicians and engineers.

Finally, the entrepreneurial nature of much of the sector's activity means that knowledge of marketing and selling is essential to many engineering managers.

8. Technical skills

"Will we have enough people with the right skills to meet the sector's changing needs?"

Future manufacturing enterprise will require fewer employees at operative and craft levels and many more higher technicians and professional staff. At the technician level it is important that schools are producing highly educated young people for the colleges and universities to develop into advanced technicians for sectors such as biotechnology, advanced materials (plastics and composites), aerospace (with an emphasis on both syllables), medical equipment manufacturers, and so on.

The development of advanced manufacturing in the UK will need to begin with the education of teachers on the potential of these technologies and the great careers available in advanced manufacturing. Much of this sort of work is already under way for STEM and the science subjects at GCSE level and there is clearly potential for development through the new GCSEs in science subjects (especially the inter-disciplinary subjects), through new Apprenticeship frameworks, and through closer links between schools and local companies.

9. Findings

Table 2 below contains details of the responses to interviews with six providers and reflects the issues raised in a survey of providers where we had 15 responses. It identifies current activities, barriers and what actions providers are taking to overcome these.

The key themes arising from responses are summarised below.

- There is a requirement from employers for general-technical, specialist-technical and non-technical management skills. It is very challenging for providers to ensure they can meet the balance between these skills demands as they can be different for every employer.

  The requirement for new technical skills comes directly from the need to develop new products and new materials. New products requiring new technical skills that were highlighted included 3D televisions, domestic wireless networks and compute-integrated manufacturing. New technical skills are required for working with new materials such as composites and silicon electronics. In addition, new areas of technology are developing, such as industrial biotechnology and nanotechnology.

- Employers have also identified that their staff lack the management skills required in the new advanced manufacturing arena. We highlighted the need for management skills earlier but specific examples of the skills required project management, quality assurance management, leadership, commercial and financial awareness, innovation, product development and design, efficiency, change management, interpersonal skills, and communication.

It was also clear from our findings that providers have to work very hard to understand the needs of employers throughout the learning process. This close working relationship with employers is essential to the development of solutions to the future skills needs in the sector and is perhaps the most important issue raised by providers.

"The college works closely with local businesses to provide team leader and management training. This has come about because employers within the engineering advanced manufacturing sector have prioritised business improvement training in order to increase or maintain their bottom line during the recent times of austerity." West Nottinghamshire College.

"We maintain regular face-to-face contact with employers to both promote the benefits of employing an apprentice and to promote other services the college offers. Frequent consultation and industry visits help the college become more aware of employers' needs and issues." Birmingham Metropolitan College.

Table 2: Provider feedback – future skills needs

	Area	Detail
Current Activity & Successes	Forums or discussion groups	Establishing employer forums to discuss skills needs School forums to share information on employers and labour market needs Providers getting involved in industry forums organised by SSCs, ALP, etc
	Establishing working partnerships	Establishing close working links with SSCs and National Skills Academies Working relationships with employer representative bodies such as CBI, Engineering Employers Federation
	Knowledge sharing	Knowledge sharing between tutors and employers. Collaboration with schools to develop technical knowledge Developing skills taster days for potential learners Employers providing equipment for schools, colleges and training providers. Tutors and assessors doing work placements with employers to update skills
	Curriculum development	Developing workshops to review programme content Employers involved with SSCs and providers to review qualification development Employers involved in Apprenticeship framework development Developing bespoke training to support Apprenticeship and skills development

	Area	Detail
Barriers	Skill needs of apprentices	Apprentices lack interpersonal skills Lack of technical skills within the Engineering Diploma Programme-led Apprenticeship programme previously provided a route to knowledge and skill development. Need a replacement programme Schools are often incentivised to retain students on academic courses
	Updating knowledge	Schools and colleges not always up to date with industry requirements in terms of career options Some qualifications can get out of date Some 'new' technical skills are not covered in qualifications, eg rapid prototyping Qualifications need to be updated frequently Employers are demanding multiskilling for all employees, which can prove difficult and expensive to deliver.
	Training facilities	Many schools, colleges and providers have inadequate facilities to deliver advanced manufacturing training. Advanced manufacturing requires expensive training and development programmes.
	Employer involvement	Senior management are often not involved in the skills and training issues. Providers have to engage employers at the highest level. Employers often do not accept the restrictions of being involved in government-funded training Employers have to take ownership of the skills development and in particular Apprenticeship framework development.

Actions to overcome barriers & ways to evolve

Area	Detail
Working with schools	Providers and employers must work with schools to improve the delivery of the Engineering Diploma. Providers must develop better links with schools to update knowledge and improve careers advice. Providers must involve their employers in schools and college links. Initiatives to promote manufacturing within schools must be supported by providers and employers. Provider staff should spend time in the schools supporting learning and they can provide opportunities for school staff to spend time with providers or employers. Providers should take part in careers fairs and recruitment events to promote manufacturing.
Management skills	Providers can offer team leading and management skills. Management units can be added to technical frameworks. Providers can offer commercial training to employers to supplement subsidised training. Topics include acceptance of change, management of change, interpersonal skills and communications, teamwork and leadership, and financial awareness.
Curriculum development	Providers need to develop knowledge and understanding of commercial and financial awareness, innovation, simultaneous engineering, design for manufacture, quality, understanding of process and production processes, work study and efficiency, continuous improvement programmes and waste elimination. Providers need to be flexible and include new skill needs in training programmes.
Business development	Providers should use more sales and business development staff. Create links with higher education providers. Develop plans to deliver Advanced and higher Apprenticeships. Increase skill levels within assessors and tutors.
	Advanced manufacturing training needs to develop knowledge and understanding of commercial and financial awareness, innovation, simultaneous engineering, design for manufacture, quality, understanding of process and production processes, work study and efficiency, continuous improvement programmes and waste elimination, acceptance of change, management of change, interpersonal skills and communications, teamwork and leadership.

These issues formed the basis of our more detailed discussions with providers on specific issues that had a major impact on the delivery of high-level skills. We selected five providers to develop a case study, each covering a range of issues identified by the research.

	Issue	Detail
Provider 1	Progression routes	Improved progression routes beyond L3
Provider 2	Progression routes	Meeting employers' needs through more effective progression
Provider 3	Framework components	Ensuring Apprenticeship frameworks meet the needs of advanced manufacturing employers
Provider 4	Improving careers guidance	Through improved links with employers and schools
Provider 5	Creating links within the Advanced Manufacturing sector	Creating effective links between stakeholders in the Advanced Manufacturing sector

The case studies identify the issues and the actions that providers have taken (or propose to take) to address those issues. The discussions have been very wide ranging, reflecting the different issues and responses. We followed a structure that includes the following stages:

- identify issue(s);
- review causes and consequences;
- proposed solution(s);
- processes affected/adopted;
- consequences and impact.

This common structure will enable providers and stakeholders to share some of the experiences of providers elicited in the discussions. You can find the case studies separately. It was clear that the process of change for providers was essential but there were no quick and easy solutions. As one training provider commented;

"Skills are evolving all the time as technology and manufacturing techniques develop and at present older, more traditional techniques coexist with new ones. Industry is changing and the equipment used in the manufacturing industries is becoming increasingly high-tech. However it is clear that this process of evolution cannot be completed overnight." Bedford Training Group

10. Recommendations

As we have outlined in this report the Advanced Manufacturing sector is not really a sector and encompasses a wide range of industries and functions. As a result it is very difficult to pull together a series of clear recommendations with coherence for all providers. However, a number of key themes have arisen from the project that we feel would be useful to take forward. We have tried to relate these recommendations back to the themes that have been part of all of the phases of the project.

The first set of recommendations relates to the **strategic processes** that providers might adopt:

1. Providers should ensure that their business planning and self-assessment process includes a review of the future skills requirements of the industry sectors in which they are operating.

2. Providers should ensure that they understand which stakeholders are providing data and insights into the future skill needs of the sector. This should include a review of all the relevant and related sector skills councils.

3. Providers should establish effective working relationships with sector-based employer and government-funded agencies such as SEMTA and EEA. They should consider establishing relationships with organisations and agencies outside their immediate sector if they have plans to expand their delivery. This should be done before, not after, expansion is considered.

There are a number of recommendations or observations about **defining the sector**:

4. The definition of advanced manufacturing varies between industry sectors and can therefore sometimes be confusing. Providers should be careful not to use the term in a way that excluds smaller employers who sometimes see the word advanced as excluding some types of manufacturing.

5. Where possible, providers should use inclusive terminology that covers all the activities associated with future skills in advanced manufacturing. Almost every sub-sector and aspect of advanced manufacturing will be affected by the issues outlined in this paper so it is important that providers do not imply that the issues around skills in advanced manufacturing affect only a few specialist areas and sub-sectors.

We have made some recommendations about how to **take forward the core findings** of the project:

6. The case studies could be used as an opportunity for all providers to review how they respond to the needs for future skills development.

7. Providers could set up and support peer development groups to see if the case studies provide a model for raising awareness of the issues and developing effective and practical solutions for providers.

8. The peer groups could develop more detailed case studies that could create models

to support providers' self-assessment and improvement processes. Pump-priming funding support to set up this type of activity would be very effective.

9. Providers should consider how they can integrate management skills as well as technical skills in their training programmes. Employers increasingly see management skills as an important part of the training process.

10. Providers should review their capacity to deliver Higher Apprenticeship frameworks or at least review the possible partnership approaches to delivery. This may also include delivery of Foundation Degree-level programmes.

11. Advanced manufacturing needs to be promoted at all available opportunities as a career of choice. In light of the new structure of all-age careers, review guidance needs to be given to this service and to schools regarding career progression options in advanced manufacturing.

There are some recommendations regarding the **overall review of future skills** in this sector because providers need to be more involved in driving the agenda:

12. Establish a provider-based group to meet regularly and discuss future skills requirements. This group may be an extension of the current sector-based groups run by employer representative bodies or a new group that would cross provider types.

13. Complete a regular review of the future skills needs from a provider perspective. Many stakeholder groups complete analysis of the future skills needs but we recommend that a review is completed from the provider perspective. This should include a review of all national initiatives relating to advanced manufacturing.

14. A provider group should be established to review the long-term development of the Advanced and Higher Apprenticeship frameworks in advanced manufacturing. This group should involve stakeholders such as SEMTA, EAL and EEA as well as the National Apprenticeship Service.

Annexes