UK COMMISSION FOR EMPLOYMENT AND SKILLS

Technology and Skills in the Aerospace and Automotive Industries

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Technology and Skills in the Aerospace and Automotive Industries

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Executive Summary

Introduction

To enable the Advanced Manufacturing sector to realise its potential, it is vital to understand how technological advances impact upon skills needs. This research aims to go beyond high-level skills data that is currently available and focuses on skills requirements of three technological areas within the aerospace and automotive sectors: Additive Manufacturing, Composites and Plastic Electronics. Addressing these skills challenges will help the sector better respond to performance challenges and opportunities.

Additive Manufacturing (AM) is a term used to describe the manufacture of products using digitally controlled machine tools and is often termed 3D printing. The approach differs from traditional manufacturing in that all Additive Manufacturing processes use a layer-by-layer approach to build up components rather than through machining from solid, moulding or casting (Materials Knowledge Transfer Network, 2012).

Composites have been defined as consisting of a bulk material (the ‘matrix’) and a reinforcement of some kind such as fibres, particles or flakes, usually added to increase strength and stiffness. This report focuses on what are termed advanced composites (Structural Fibre-reinforced Polymer Matrix Composites) used in automotive and aerospace applications and characterised as light weight higher performance materials.

Plastic Electronics has been defined as devices on flexible surfaces that make it possible to produce flexible, bendable or stretchable electronic products, which may use printing techniques, but can also be deposited onto flexible surfaces in other ways. Plastic Electronics can also refer to the use of printing techniques in relation to devices on rigid surfaces.

The UK Aerospace sector

The UK has world class capabilities in the manufacture of sophisticated parts for modern aircraft and this has led to the creation of a high-technology, high-skill industry. The UK aerospace sector is the number one aerospace industry in Europe and globally second only to the U.S. The appeal of the UK for global aerospace manufacturers stem from its highly-skilled workforce, institutional knowledge and strong science and research base.

The UK has developed a strong comparative advantage in four key, high-value, complex areas of modern aircraft; wings, engines, aero structures and advanced systems.

The adoption of new technologies such as Composites and Additive Manufacturing is starting to extend through the aerospace supply chain and Plastic Electronics has significant potential in the future. Due to the scale of investment required the industry has yet to take full advantage of these new materials and technologies.

A characteristic of the aerospace industry is its large-scale need for a broad range of high-value skills and disciplines, including engineering, science, project management, production, service, training and finance. Current skills issues are having an impact on growth within the aerospace sector, with above average levels of hard-to-fill vacancies, difficulty retaining staff and employees with technical skills gaps.

Significant commercial opportunities exist for the UK aerospace sector globally. Next generation aircraft will require radically different shapes and airframe technologies to unlock performance, cost and weight improvements demanded by the market. Development of product and process technologies and the relevant skills required to do this will be crucial to securing future market share.

The UK Automotive sector

Employment and output in the automotive sector fell rapidly during the recession. However, in recent times recovery has been quick and growth has been rapid. Global vehicle manufacturers have invested over £6 billion in the UK between 2010 and 2012. The UK is the fourth largest vehicle producer in Europe, making 1.6 million vehicles in 2012.

The attractiveness of the UK's automotive sector is underpinned by four key characteristics; economic environment, labour (costs, productivity and flexibility), skills base and R&D capabilities and support.

There are expected to be four main areas for technology development in the near future; more efficient Internal Combustion (IC) engines, energy storage, lightweight structures and powertrains and power electronics. This technology change offers the UK an opportunity to create tomorrow's vehicles, increase market share and create new supply chain companies.

At this moment in time most repetitive tasks have been automated, the product has become highly complex and manufacturing processes now require different skill sets. Skills issues have constrained the recent growth within the automotive sector with above average levels of hard-to-fill vacancies, difficulty retaining staff and technical skills gaps. The proportion of automotive establishments that trained was also below that of companies that trained across the whole economy.

The global automotive industry is forecast to grow significantly in the next few years with a strengthening trend towards premium vehicles in line with middle class income growth in developing nations. A global shift to ultra-low emission propulsion systems, low carbon technologies will present significant opportunities for UK automotive companies.

A move to new markets and increased focus on innovation will increase the demand for new higher-level technical skills, innovation in product design, the capacity to apply existing skills and the strategic management skills required to identify and capture these new markets.

Additive Manufacturing

Additive Manufacturing (AM) is a term used to describe the manufacture of products using digitally controlled machine tools and is often termed 3D printing. The approach differs from traditional manufacturing in that all Additive Manufacturing processes use a layer-by-layer approach to build up components rather than through machining from solid, moulding or casting.

Additive Manufacturing is of major strategic importance within the aerospace sector, with the UK perceived as very good at R&D but less effective than some other countries in translating this technology into production. The aerospace sector is adopting Additive Manufacturing technology at a rapid rate and is expected to be a major driver in the commercialisation of Additive Manufacturing processes over the next five years.

Within the UK automotive sector, the focus is on the manufacture of ‘live parts’ for high-end motorsport prototypes or tooling. For high volume car manufacturing, cost reduction is a key driver, so the price of Additive Manufacturing components is currently inhibiting wider adoption. Additive Manufacturing alongside improvements in technologies such as rapid CNC machining are starting to play a major role in the shift from rapid prototyping to rapid manufacturing, with major automotive OEMs all showing interest in this area.

The Additive Manufacturing workforce within aerospace is relatively small and is focussed predominantly on R&D functions, with the need for a range of highly specialist, highly qualified staff representing different aspects of the value chain.

Those employed directly in the adoption and/or development of Additive Manufacturing technologies within automotive tend to mainly be time served/recently qualified apprentices with CAD and rapid machine skills, operatives with 'traditional' engineering skills, assembly staff, production quality staff and a small number of highly qualified engineering staff.

Different skill requirements exist for the various parts of the Additive Manufacturing supply chain such as bureaus, powder supply, management and analysis and finishing.

There are a wide range of current recruitment problems within Additive Manufacturing companies including people with experience in Additive Manufacturing, Process Design Engineers, CAD software developers and engineers, project management staff, and apprenticed toolmakers.

It is expected that there will be an increased demand for Engineers to support the automation of Additive Manufacturing processes. Currently, highly qualified people outweigh those at technician/operative level. As Additive Manufacturing becomes more mainstream, a considerable flattening of the workforce profile is expected. Volume manufacturing will require experienced production staff, retraining of existing staff and some increase in machine operatives.

The most significant impact of Additive Manufacturing technology on future employment within both the aerospace and automotive sectors is expected to be with the supply chain rather than directly within OEMs. Within the Additive Manufacturing supply chain there is expected to be an increased demand for those responsible for making, operating and maintaining Additive Manufacturing machines, powder suppliers and finishing companies.

A lack of Additive Manufacturing training courses means that employers tend to train in house and on the job. Specific demand exists for training in design for manufacture using Additive Manufacturing technology and powder management and sampling. External training opportunities are offered by some Additive Manufacturing bureaus (mainly to their own customers), while some machine operation training is undertaken by OEMs. An increased demand for technician level training has led some employers to explore the possible development of an Additive Manufacturing apprenticeship framework. In terms of Higher Education, there are calls for greater CAD experience and Additive Manufacturing modules within degrees as well as higher level Additive Manufacturing courses.

Composites

Occupations identified as part of the aerospace and automotive composite workforce include higher level occupations/specialists including research and development, Quality and Business Management; Engineering staff including Process, Plant, Production, Product, Project, Stress, Maintenance and CAD Engineers; Technical staff including Lab Technicians, CNC machinists and Non Destructive and Destructive Testing staff; and operational staff including Fitters and Laminators

Although high growth is expected in the demand for composites within the UK aerospace and automotive sectors, there is expected to be a shortage of necessary skills at nearly all levels from operator, craft, technician, professional and management roles. Higher level technical skills will in particular be at a premium as these are the roles that are also in high demand from other sectors within Advanced Manufacturing.

The range of skill requirements within the composite workforce is also likely to change over time. The increasing use of composites will create a demand for more R&D related roles such as scientists and test engineers. The creation of new design options will lead to an increased requirement for Design Engineers and people with higher level CAD skills. The move into new products and design using composites will also require Project Engineers at all levels and new Business Development Managers. As processes become more automated it is expected that there will be a growing need for multi-skilled craft and technician level workers with both CNC and composite experience and Maintenance Engineers to keep plant running at optimum levels. Currently the skills requirements for aerospace are much clearer than for the automotive sector. The fundamental question for the automotive sector is whether the high volume automotive manufacturers will embrace the use of composites in the near future.

Training provision appears to have been driven largely by major aerospace employers, together with some other major composite supply chain players. Strong links with both FE and HE have been vital for those companies developing their own composite training programmes. For SMEs this is much harder and it is clear that major weaknesses remain in relation to access to appropriate composite provision for such employers and their respective employees.

Plastic Electronics

The multidisciplinary nature of Plastic Electronics that is required to both develop and exploit the core technologies involved is widely acknowledged, with a high proportion of highly qualified Chemists, Physicists, Material Scientists, Electronic and other Engineers employed and those with experience in the semiconductor, display or printing industries.

The Plastic Electronics workforce is typically highly qualified, at least in part linked to the high proportion of Research and Development staff, with a preponderance of those with PhDs.

When recruiting those with experience in Plastic Electronics there is a relatively small pool of key companies and academic institutions in the UK from which to potentially recruit, so it is clear that use of existing networks is very important.

A number of those companies interviewed are only able to source the skills they require by relying heavily on recruitment outside the UK.

There are a number of factors that may constrain direct employment growth in the UK within Plastic Electronic companies, including the prevalence of technology licensing business models; the propensity for Plastic Electronics companies to be bought out in the future and the location of a high proportion of production overseas.

As Plastic Electronic technologies mature and are increasingly applied within commercial production, an increase in core Research and Development staff comprising highly qualified Chemists, Physicists, Material Scientists, Electronic and other Engineers is likely, together with an increased proportion of those involved in process development and production, including Process and other Engineers and those with relevant industry experience within the semiconductor, display or printing industries and operative staff.

Training undertaken by companies interviewed tends to be mainly ‘in house’ combined with use of specialist conferences/events accessed via academic networks. There appears to be significant support for the development of an appropriate apprenticeship framework to support the Plastic Electronics sector, some support for Masters level provision, possibly on a modular level, but views on the need for specialised course provision at degree level amongst those interviewed are mixed.

Conclusions

For the aerospace sector both Additive Manufacturing and Composites have been identified as of major strategic importance while the current application of Plastic Electronics is much less clear, although it could be very significant in the future.

The use of Composites and Additive Manufacturing within the general automotive sector in the UK remains relatively limited due to the cost of investing in the technology, except in 'high end' automotive activities where cost is less of an issue. Commercialised Plastic Electronics applications within the automotive sector are expected to occur by 2020.

Although growing rapidly the scale of Additive Manufacturing activity in the UK is currently at a far lower level than Composites. Both the aerospace and to a lesser extent the automotive sector is a major contributor to both Composites annual production revenue and added value. The overall scale of Plastic Electronics activity in the UK is currently of a significantly lower order.

Growth in employment in relation to all three technologies implies a changing shape in demand for skills. However, with respect to all three technologies skill shortages pose significant threats to future UK employment growth if not tackled. Wide ranging recruitment difficulties are already reported in relation to recruitment of both Composites and Additive Manufacturing staff. In the case of Plastic Electronics companies a number of companies are only able to source the skills required by relying heavily on recruitment of non UK graduates.

Training provision within the UK remains largely fragmented in relation to all three technologies. Large Composites companies have been developing their own training programmes as they have the resources to underpin the development of this provision and the influence to drive change within local training providers. For SMEs this is not possible and this may constrain growth in the supply chain.

There is a general lack of Additive Manufacturing training available. The training that is undertaken tends to be on the job and in house, with expertise currently concentrated within those employers, such as specialist Additive Manufacturing Bureaus, certain aerospace and automotive OEMs and Tier 1 manufacturers.

Training undertaken by Plastic Electronics companies interviewed also tends to be mainly ‘in house’ combined with use of specialist conferences/events accessed via academic networks.

In terms of higher education, it was commented that there needs to be more initiatives that bring Composites provision closer to industry. There appears to be potential scope for Additive Manufacturing modules within relevant degree courses and higher level Additive Manufacturing courses. With respect to Plastic Electronics there is some support for Masters level provision, possibly on a modular level, but views on the need for specialised course provision at degree level amongst those interviewed was mixed.

With respect to Apprenticeships, there was some support expressed by those interviewed for the development of Additive Manufacturing and Plastic Electronics frameworks, in line with the recently launched Semta Apprenticeship Framework for the composites workforce.

At present, although some mapping of these technologies has been undertaken, very little is still known of the size and profile of these companies and the associated supply chain workforce in different localities. This means it is very difficult to assess training needs at a local level and start to address other supply chain support issues.

Evidence Reports present detailed findings of the research produced by the UK Commission for Employment and Skills. The reports contribute to the accumulation of knowledge and intelligence on skills and employment issues through the review of existing evidence or through primary research.

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