

POLYMER COMPOSITES SECTOR UK SKILLS

NATIONAL COMPOSITES NETWORK

September 2009

Polymer Composites Sector – UK Skills

1 Background

The polymer composites sector is central to the UK economy and to meeting demand from a wide range of major industrial sectors, in particular wind energy and energy conservation. A skilled workforce is therefore essential for UK companies wishing to compete in globally competitive sectors using composite materials. The continued procurement of high value-added composite activities in the UK will depend on the recruitment and retention of skilled composite engineers, technicians and designers. Retraining will be required in companies that have gained expertise in manufacturing using metals but are now increasingly using composite materials. Overall, investment in skills is among the most important that manufacturers can make, and meeting the skills needs of companies and potential investors is central to the UK's long term composite ambitions.

2 Current situation

The National Composites Network (NCN)¹ Skills and Education Working Group has been collaborating with a number of companies and organisations for over 2 years in order to address the UK's composite skills requirements. It estimates that there are around 1000 companies in the UK, manufacturing composite parts with around 1500 companies supporting them in terms of services and equipment. It understands that European competitors have invested heavily in technology centres and clusters which provide skills training for a large number of composites employees and graduates. For example IDA (Industrial Development Agency) Ireland and Enterprise Ireland are looking to establish a Composites Competence Centre with a long-term funding commitment from the State of up to €1m per year for up to five years. This will be an independent collaborative entity which is established and led by industry with the key objective of achieving competitive advantage for industry in Ireland by accessing the innovative capacity of the research community.

As a result of its work outlined above, the NCN Skills and Education Group has made a number of findings and identified the following issues.

3 Demand Side Issues

- 3.1 The UK polymer composites industry consists of a diverse and fragmented collection of markets and mainly small companies which do not necessarily feel themselves to be part of a composites industry but rather associate themselves with the markets they serve. It is at the leading edge of materials technology and advanced manufacturing processes but it is clear from various

¹ The National Composites Network is a Knowledge Transfer Network jointly funded by government and industry, covering the UK Composites industry and its supply chain. It is a Company Limited by Guarantee, with a Board drawn from organisations with prominent composites interests.

recent research reports² that meeting the needs of existing business delivery, let alone future growth, is being constrained by skills gaps and shortages.

- 3.2 The dispersed nature of the industry and the lack of a standard industrial classification has resulted in a fragmented approach to the collection of data and meeting the skills needs of this growing industry. This is illustrated in part by the fact that a number of Sector Skills Councils, led by Cogent and Semta (Science, Engineering and Manufacturing Technologies) play a role in addressing its skills needs.
- 3.3 Staff trained or experienced in composite technology are difficult to attract and retain, both in the UK and internationally. Skills gaps and shortages apply at all levels in the industry and across the UK. The research referred to above identifies particular shortages of:
- Leaders and managers with commercial awareness and business skills to exploit new products, markets and technologies
 - materials scientists
 - qualified engineers, technicians and supervisors that understand composite materials and associated design and manufacturing processes
 - skilled operatives, eg laminators.
- 3.4 Skills gaps are equally prevalent, with few companies investing in upskilling programmes, preferring in many cases to rely on supplier training, buying-in contractor skills to cover short term skills deficiencies or recruiting from Eastern Europe for shop-floor operatives and Western Europe for composites engineering graduates and materials science graduates.
- 3.5 NCN has found consistently that employers express a need for training at each and every composites skills meeting. However, when training is offered, this need rarely translates into sufficient demand to justify establishing courses, particularly qualification-based courses, and investing in equipment. This is perceived to be for the following reasons:
- there are no established career pathways linked to qualifications and not a culture of formal training in the industry
 - the composites content of recognised qualifications is contained in units subsumed within general qualifications and therefore not explicit nor readily accessible

²UK Polymer Composites Sector, Foresight & Competitive Analysis 2001; A Sector Skills Agreement for the Cogent Sector 2007, NCN Foresight Report 2007; East of England Polymer Composites Research Project 2007, Materials UK Education and Skills Review 2008

- companies are not motivated by funding solely linked to qualifications, particularly where these are seen as only recognising existing skills rather than gaining new, job-centred ones
- large companies arrange training for themselves, usually in-house
- there is a fear that if a company trains an already scarce resource, they will be attractive to a competitor
- there are no qualification standards required to be able to produce a composite part (anyone can make a safety critical component without any formal qualification).
- the industry is dominated by SMEs who in general prefer training that is job specific rather than generic, delivered in-house rather than at an off-site facility and supported by external grant funding.

4 Supply Side Issues

- 4.1 The pace of technological change in the industry is such that it is difficult for the supply side to keep pace in terms of teacher and curriculum development and state of the art equipment.
- 4.2 Provision tends to serve individual sub-sectors eg marine, aerospace and as a consequence lacks coherence. There are qualifications and training courses serving the industry but with gaps and duplication and no coherent framework linked to career pathways. Employers are generally unaware of the qualifications, training provision or potential funding streams that do exist currently.
- 4.3 Many of the training courses on offer are not based on national occupational standards or accredited to recognised qualifications so the employer is unable to access public sector funding for the training. Moreover it means that companies have no way of assessing the competency of an individual against an industry standard so either further training is offered at additional cost or the company's productivity suffers.
- 4.4 There is a lack of quality training provision with few Colleges or Centres having the expertise or equipment to deliver off the job training. There are a few geographically dispersed commercial training providers who are able to deliver the modular, bite-sized, 'just in time' upskilling that SMEs largely favour. However, much of this type of training is not eligible for public sector funding which does not generally support the delivery of modules or part qualifications.
- 4.5 Few companies recruit school leavers and able young people are not attracted to higher level courses which has led to a decline in university materials science and engineering courses (see below).

These factors are already contributing to a shortage of graduates and apprentices with severe implications for the design, production and management capabilities of the industry in the future, particularly in the light of current gaps and shortages outlined above.

5 Opportunities

- 5.1 The polymer composites sector is growing and critical to all aspects of everyday life. It is essential that focus and coherence is brought to bear on the disparate qualifications, skills initiatives and training provision currently available to the industry. Both Cogent and SEMTA have relevant national occupational standards and qualifications (see Annex 1) which, subject to review and rationalisation, could provide a coherent and progressive framework of work-based qualifications linked to recognised career pathways.
- 5.2 Both Cogent and SEMTA have National Skills Academies whose remit is to work with training providers to ensure that their provision is fit for purpose and employer-facing. A coordinated approach to building provider capacity on the part of the two academies would help to create a quality-assured UK-wide provider network for the industry. In addition, Cogent and SEMTA both have Sector Compacts which are national agreements with the Learning and Skills Council (LSC) to direct funding to their respective footprints for specified qualifications (eg NVQs) and Management and Leadership training. This offers real opportunities to companies, particularly SMEs to access either full or partial funding for training linked to NVQ qualifications. Management and leadership training does not have to be linked to a qualification.
- 5.3 The new Diploma in Manufacturing and Product Design provides an opportunity to raise awareness and support the teaching in schools of polymer composite materials and technology and related career opportunities. It is essential that more young people are encouraged to undertake Apprenticeships in Polymer Composites Design and Manufacture. For this a Technical Certificate specific to polymer composites will need to be developed and the capacity of training providers will need to be enhanced so that they have the capacity to support the delivery of Apprenticeship programmes.
- 5.4 Foundation Degrees are modular, work-based qualifications equivalent to the first two years of an Honours degree. The Cogent FD in Polymer Technology will have a composite pathway and the uptake of such qualifications has the potential to assist employers to fill their higher level skills gaps.
- 5.5 Both Cogent and SEMTA and other organisations have developed products and services which could be promoted and made

available to the industry, eg ASET (assessment of employer-based training), for the purposes of accrediting it and linking it to a national qualification. There is an opportunity to develop a coherent offer or set of offers to the industry but this will require a concerted and joined up approach on the part of all interested parties.

6 University Composites Skills Provision

6.1 Higher education provision for composites is very limited and the overall decline in Materials Science and Engineering undergraduate courses in the UK is particularly worrying in the light of the above skills shortages. This situation is unlikely to improve unless there is a sector attraction strategy which seeks to impact on the 14-19 curriculum and careers advice in order to increase demand for higher level skills provision. However, the Government will shortly publish a new Higher Education Framework that will set out how higher education in England will take 'a more active approach to building British competitive strengths through higher skills levels, research and knowledge transfer'. It is to be hoped that this will present new opportunities for capacity building in respect of polymer composites in the higher education sector.

6.2 Undergraduate courses.

Employers need composites graduates. However at undergraduate level, composites courses within academia are seen as too specialist for 18 year olds.

Many Universities have Composites Modules embedded into their Materials Science or Engineering Degrees, however the University of Plymouth is the only University where 'Composites' appears in the Course Title. Their BEng (Hons) Composite Materials Engineering was renamed as BEng (Hons) Mechanical Engineering with Composites. The name was changed as a result of market research and has resulted in the recruitment of higher student numbers. The University of Plymouth's graduate destination information reveals that almost all of the 106 graduates from the UK in the period 1991 to 2009 remained in the UK and were employed by composite companies or composite supply chain companies which may reflect the 'hands on' nature of the course.

6.3 Postgraduate courses

At MSc level, Composite Materials by Research exists at Manchester University. An MSc course also exists in composites at Imperial College London (which currently has 25 students) which is filled mainly with non UK nationals. Both the Universities of Cranfield and Surrey have an MSc in Advanced Materials and the University of Plymouth has an MSc in Mechanical Engineering with composites content.

At PhD level there is significant activity. The University Research sector seems to be thriving. The following UK Universities offer PhD programmes in Composite Materials: Cranfield University, Imperial College, Oxford Brookes University, Queen Mary University of London, University of Bath, University of Bristol, University of Cambridge University of Exeter, University of Loughborough, University of Manchester/UMIST, University of Newcastle upon Tyne, University of Nottingham, University of Oxford, University of Plymouth, University of Sheffield, University of Southampton, University of Strathclyde, University of Surrey, University of Ulster and the University of Warwick.

Many PhD graduates remain in universities and go on to undertake post doctoral training. Where they go into industry they do not always find their skills are suitable. Additionally, some of the students that seek employment are non EU nationals for whom work permits are subsequently required. The EPSRC Centre for Doctoral Training at Bristol University is designed to tackle this gap with 10 funded Engineering Doctorates.

7 Future Requirements

The NCN Skills Group has identified a number of trends and future training requirements. These are:

7.1 Specific training requirements

- In the short term existing processing techniques of hand laminating, infusion (vacuum forming) and prepreg lay up, need training support
- In the medium term, the more advanced industries will have to be trained for automation whereas the lower tech companies will adopt infusion/prepreg
- In the long term, all industries will have to adopt automation and the skills associated with that

7.2 Engineering Skills

- The EngD scheme is welcomed and further such initiatives are encouraged
- Skills based around composite automation need to be developed
- An understanding of Composite physical properties is required
- Technology Strategy Board (and similar state) funding in Technology Programmes helps in on-the-job 'training' of Composite Engineers and is not to be underestimated – this needs to continue
- Formal UK Training provision for all but the highest level is lacking

- An opportunity exists to co ordinate the funding and activity nationally rather than regionally

7.3 Professional Accreditation

The Engineering Council through the professional institutions offers professional registration as Engineering Technician (Eng Tech), Incorporated Engineer (IEng) or Chartered Engineer (CEng). Given that safety critical components are made of composites, it would be appropriate for personnel to be required to register within this system and for employers to seek that level of commitment.

8 Conclusions

The provision of skills and training for composites in the UK is disjointed. This is true for both industrial and academic provision. To help address this the knowledge and expertise that are developed in large companies using composite materials needs to be transferred down the supply chain to the ultimate manufacturer whilst recognising that industry needs to operate in an accredited quality scheme. Accreditation of training linked to qualifications in the new Qualifications and Credit Framework (QCF) is required which links the Sector Skills Councils and the UK skills agencies with trade bodies and key industry players.

Within Universities there is an extensive composites science and technology base but expertise gained there often is not utilised in the UK as many researchers return to other countries. UK industry is keen to utilise this pool but are often unable to, due to the cost and operational priorities.

9 Recommendations

Within the next 2 months:

- 1 Create a Partnership Agreement between Cogent and SEMTA for the purpose of developing a coherent skills strategy for the Polymer Composites Sector
- 2 Set up a representative group of composite employers to lead the development of the skills strategy
- 3 Set up a Task and Finish Group, chaired by an employer who has a good understanding of the industry's skills requirements to develop an action plan which includes:

Short Term (to be completed within 12 months)

- 3.1 the development of agreed career pathways for the composites industry in consultation with employers

- 3.2 a review of current national occupational standards and the suite of Cogent and SEMTA qualifications relevant to the industry with a view to creating a coherent framework of standards and qualifications linked to agreed career pathways
- 3.3 consultation with employers on the development of a technical certificate and work-based pathways for a composites specific apprenticeship
- 3.4 completion of the Advanced Composites Technology Programme for Polymer Composite Industries (developed with the marine industry in the South East region and funded by SEEDA) and mapping of its underpinning competences to national occupational standards with a view to it being accredited as a formal qualification and included in the QCF
- 3.5 A review of current training provision in order to identify gaps and to ensure that training provision is fit for purpose and accessible to the industry UK-wide. This will involve consultation with employers and trade bodies to agree training priorities and how it should be delivered and funded.

Medium Term (ongoing over next 2/3 years)

- 3.6 the development of a sector attraction strategy building on the 14-19 Diplomas in Manufacturing and Product Design/Engineering and Apprenticeships
- 3.7 Establish a Higher Education Forum for Polymer Composites chaired by a senior employer to:
 - address student recruitment, curriculum content, marketing and promotion, industry placements and entry to employment
 - investigate how better the UK's science research and technology base can be better exploited for the benefit of the industry.

10 Progress Summary

A meeting to discuss the foregoing skills strategy was convened and chaired by NCN on 11 September 2009. The meeting was attended by representatives of NCN, Cogent and Semta sector skills councils, the South West Development Agency, the Department for Business, Innovation and Skills (BIS), UK Trade and Investment and the Department of Energy and Climate Change (DECC). The recommendations and content of the skills strategy were discussed and agreed. The group will meet again on 13 January 2010 to review progress.

Appendix 1- Qualifications offered by Cogent and SEMTA relevant to the Polymer Composites Sector

Organisation	Qualification	NVQ Level	Comments
COGENT	Apprenticeship Advanced Apprenticeship in Polymer Processing and Related Operations (PPRO) (Framework 111)	Level 2 Level 3	Knowledge based element ie Technical Certificate: Edexcel BTEC National Certificate in Manufacturing Engineering is generic with 1 or 2 units relevant to polymer composites Competence based element eg NVQ Levels 2 + 3 (PPRO) are generic and material would need to be written by the provider for use in a composite processing environment
	NVQs in Polymer Processing and Related Operations	Level 2 Level 3	These are generic work-based qualifications with some units that could be customised by the training provider for use in a composite work-based environment by the writing of specialised units. The NOS (National Occupational Standards) underpinning these qualifications will be reviewed between Autumn 09 and Spring 10
	Gold Standard Qualifications (QCF - Qualifications and Credit Framework)	Level 2 Level 3	These are new slimmer modular qualifications that have been developed by Cogent arising from its Sector Skills Agreement (SSA) research and resultant Sector Qualification Strategy (SQS). They are now available on the new Qualifications and Credit Framework (QCF) and can be funded eg by LSC Train to Gain funding.

			These are based on a selection of existing NOS which although still generic are more relevant to a polymer composite processing environment eg <i>Produce Products using hand-based operations with polymer processing & related environments</i>
	Advanced Composites Technology Programme	Level 3 to 4 NVQ equivalent	<p>This is a modular programme developed in direct response to employers using polymer composite processes and materials in the marine sector in the South East of England. It covers all the competences required of polymer composite process technicians and engineers, team leaders, supervisors and repair and refurbishment engineers.</p> <p>The programme is still in development with some modules remaining to be written. It is not based on NOS and is not currently an accredited qualification. It is currently only being offered in the South East Region where it was originally developed and funded.</p>
	Foundation Degree in Polymer Technology	Levels 4 + 5	Developed by Cogent with Colleges and Higher Education Institutions. When fully developed it will have a composites pathway which will mean that a work-based qualification route will be available from Level 2 through to Level 5 (equivalent to first 2 years of an Honours Degree).

<p>SEMTA</p>	<p>Young Apprenticeship 14 to 16 program: Apprentices may opt to follow the performing Engineering Operations (PEO) NVQ Level 2 qualification and have the opportunity to complete the following optional units amongst many other units: <i>Producing composite mouldings:</i> - <i>Using wet-lay up techniques</i> - <i>Using pre-preg laminating techniques</i> - <i>Using resin infusion techniques</i></p>	<p>Level 2</p>	<p>As these units are part of the PEO qualification which is broad-based, it is unlikely that a FE College would have the expertise and equipment to deliver all of these optional units.</p>
	<p>Engineering Apprenticeship (framework 106) Apprentices can either follow the above PEO NVQ Level 2 as the main competence element which can be delivered by a provider eg college or a job specific NVQ (see below Materials Processing and Finishing NVQ Level 2 and Mechanical Manufacturing Engineering NVQ Level 2) which must be delivered in the work-place. If they select the latter route the Framework specifies that they must also complete the mandatory units from the PEO.</p>	<p>Level 2</p>	<p>The above issue applies for this Framework if they follow the PEO route.</p> <p>This Apprenticeship contains units that are specific to polymer composite processing. However, the main area of concern is the lack of an appropriate Technical Certificate relevant to polymer composites to provide the knowledge-based element of the Framework.</p>
	<p>Engineering Apprenticeship (framework 106) Apprentices following this Advanced Apprenticeship program must complete</p>	<p>Level 3</p>	<p>The Advanced Apprenticeship provides a range of pathways relevant to the application of polymer composite manufacture and</p>

	<p>PEO NVQ Level 2 to meet the Additional Employer Requirements (AER) of the Framework. This may include the polymer composite units listed above for the Young Apprenticeship programme.</p> <p>On completion of the AER the Apprentice will progress to Level 3 Job specific NVQs</p> <p>In Automotive Engineering, Aeronautical Engineering, Mechanical Manufacturing Engineering, Marine Engineering all of which contain polymer composite specific units.</p>		<p>processing in a number of different industry sectors eg automotive, aeronautical, marine. Each of these pathways contain units that are specific to polymer composite processing (see below).</p> <p>As above, the main area of concern is the lack of an appropriate Technical Certificate relevant to polymer composites to provide the knowledge-based element of the Framework.</p>
	<p>Performing Engineering Operations NVQ</p> <p>Contains 4 units specific to polymer composite processing</p>	Level 2	This NVQ is designed for delivery in a College or Training Centre.
	<p>Materials Processing and Finishing NVQ</p> <p>Contains 10 units specific to polymer composite processing</p>	Level 2	Must be delivered in the workplace
	<p>Mechanical Manufacturing Engineering contains 10 units specific to polymer composites processing including repair to composite moulding</p>	Level 2	Must be delivered in the workplace
	<p>Automotive Engineering NVQ</p> <p>Contains 10 units specific to polymer composite processing in an automotive workplace</p>	Level 3	Must be delivered in the workplace
	<p>Aeronautical Engineering NVQ</p> <p>Contains 9 units specific to polymer composite processing in an</p>	Level 3	Must be delivered in the workplace

	aeronautical workplace		
	Mechanical Manufacturing Engineering Contains 8 units specific to polymer composite processing	Level 3	Must be delivered in the workplace
	Marine Engineering Contains 9 units specific to polymer composite processing in a marine workplace	Level 3	Must be delivered in the workplace