

Enabling Growth in the New Anglia Advanced Manufacturing & Engineering Sector through Skills Development 2018-‘25

**New Anglia LEP Sector Skills Plan – Advanced
Manufacturing & Engineering
January 2018**

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Background Context

The Advanced Manufacturing and Engineering (AME) Sector Skills Plan has been developed by the AME sector in Norfolk and Suffolk, working alongside the New Anglia Local Enterprise Partnership, the New Anglia Skills Board and supported by SkillsReach.

SkillsReach was contracted to facilitate and prepare eight sector skills plans for the New Anglia LEP priority sectors. The project was commissioned by the Education and Skills Funding Agency, in partnership with New Anglia LEP, and funded through the European Social Fund. Each Sector Skills plan and supporting Data Pack has been developed in collaboration with local employers and other stakeholders.

The Advanced Manufacturing and Engineering Sector Skills Plan has been developed in partnership with the New Anglia Advanced Manufacturing and Engineering (NAAME) sector group, the lead organisation taking forward the further development and implementation of this plan in conjunction with New Anglia LEP, local education institutions and other stakeholders and key sector champions.

The New Anglia Skills Board places employers at the centre of decision making on skills in Norfolk and Suffolk to ensure the skills system becomes more responsive to the needs of employers, and the future economy.

NAAME's Sector Growth Strategy¹ (2017) focused on six areas to drive sector growth:

- Financially backing the sectors as drivers of economic growth;
- Embed supply chains and knowledge locally;
- Bring together businesses in special interest groups;
- Improve the infrastructure across Norfolk and Suffolk;
- Increase the engagement between schools and businesses;
- Focus on New Anglia's emerging sub-sectors.

SkillsReach is an established East of England-based strategic skills consultancy with an associate project team with extensive experience of developing skills plans.

¹ Hethel Innovation, NAAME Sector Group (2017), Norfolk and Suffolk Sector Growth Strategy: Advanced Manufacturing and Engineering

Executive Summary

Advanced Manufacturing and Engineering (AME) is a large and dynamic sector in the New Anglia economy and one that the area wishes to prioritise given the high skilled, high wage profile of the sector.

The sector is, however, facing significant challenges in meeting its future workforce and skills needs and expected changes in the industry are likely to exacerbate this challenge. Notably the engineering and manufacturing sectors are on the cusp of widespread adoption of new technology, often called Industry 4.0 or the 4th Industrial Revolution, through which traditional engineering is becoming intimately entwined with sensors, automation and ICT.

These changes in the context for the industry are an enormous opportunity and one which we know will change the skills we need, probably ultimately in ways we have not yet even considered. As with earlier industrial revolutions the prize is economic growth, better and safer working conditions and enhanced life opportunities, but Norfolk and Suffolk are not alone in the race to adopt this new technology.

The skills that our existing workforce have and continue to develop will help us lead this process of change, but we also need to attract many more young people by helping to describe clearly how a career in our industry is dynamic and has real prospects. If we are right about Industry 4.0 these prospects will not only be in the traditional AME sector, the skills we have in manufacturing and engineering will also be enablers of change right across the economy, from health care to transport to food production and science.

We propose to work on four supplementary areas to support the focus on Industry 4.0:

- Careers of the Future to ensure the sector projects its career opportunities effectively;
- Developing AME Course Provision to ensure courses meet changing employer needs;
- Physical Facility Development to ensure we increase the capacity for training;
- Tutor Development to increase the supply of tutors to train more people in AME skills.

Every sector will need our support to embrace the opportunities automation and ICT can bring and will need to draw on skills in advanced manufacturing and engineering. The task before us is therefore a once in a generation opportunity to rethink our skills system, with employers working with education and skills providers to rise to the opportunity.

The New Anglia Advanced Manufacturing and Engineering (NAAME) sector group is pleased to be helping to drive this agenda and look forward to working with you so that together we can meet the future skills needs of the industry.

NAAME sector group, January 2018

Acknowledgements

The New Anglia LEP wish to thank the employers, providers and stakeholders who contributed to the plan by attending events, being interviewed or by making referrals to employers and organisations in the sector. The sector skills plan was developed in 2017/18 by SkillsReach.

Overview of the Advanced Manufacturing and Engineering Sector

In total the *Advanced Manufacturing and Engineering* (AME) sector currently employs 84,500 people in the New Anglia area, approximately 11% of the workforce. Employment in the sector has fallen by three per cent since 2010 (-3,100 jobs).

The inclusion of food manufacturing within the defined sector means that the sub sectors of 'Processing and preserving of poultry meat' and 'Production of meat and poultry meat products' are the first and third largest with 4,600 and 3,200 workers respectively². In second place is the sub sector 'Other engineering activities' with 4,500 workers.

In terms of Gross Value Added (GVA) the sector in 2015 was worth approximately £5.1bn to the LEP area, which equates to just over 14% of the total New Anglia economy. This is an increase of £745m on 2010 (+17%) but does mask a drop in GVA between 2014 and 2015 of just over £60m.

The higher share of GVA (14%) compared to workforce (11%) shows that the sector has a higher per capita GVA than the economy as a whole, which given full or very close to full employment in the LEP areas suggests that a focus on growing this sector would allow the economy to expand even without additional net employees in the LEP area. The GVA per capita employed is £60,355.

In 2016 there were 6,040 AME enterprises operating in the New Anglia area, or 10% of all enterprises. Since 2010 the number of Advanced Manufacturing and Engineering enterprises has increased by 425, or around 8%, which is below the total New Anglia rate of growth for enterprises of just over 9%.

Given the smaller share of enterprises (10%) than share of the workforce (11%) or contribution to GVA (14%), the data suggests that enterprises in the sector are both larger and more productive than the average for all enterprises in the LEP area.

The growth in New Anglia AME sector GVA since 2010 is higher than national and regional averages of +15%, higher than Greater Lincolnshire LEP (+1%) and South East LEP (-2%), but below Greater Cambridge & Greater Peterborough LEP (+27%).

Nationally, employment in the sector grew 3%, whilst South East LEP has seen a decrease of -6% since 2010. Greater Cambridge and Greater Peterborough LEP AME employment increased in line with nationally trends and Greater Lincolnshire had an increase of +10%.

The Suffolk Limited report (2017)³ includes 10 manufacturing businesses in its top 100 Suffolk companies employing 2,000 staff (excluding the largest employers such as Greene King). These companies showed a year on year growth of +24% for turnover and +53% for operating profit, showing that this mid-tier of medium and larger companies are seeing strong growth, with this sector growing faster than the average for all companies in Suffolk.

² The food processing sector was covered in more depth in the New Anglia AgriFood Tech Sector Skills Plan developed by the LEP in 2017

³ Grant Thornton, Birketts (2017), Suffolk Limited 2017: Growth in Interesting Times

The AME industry is diverse and includes technology providers, underpinning R&D centres and innovative companies, but in addition many specialist engineers and manufacturing trained staff are employed directly in businesses which make, service or install a wide range of other products or services. The manufacturing sector is increasingly high tech and across many industries advanced manufacturing principles are now being applied, including in:

| | |
|---|---------------------|
| Automotive, trailers and vehicles | Boatbuilding |
| Aerospace | Bio-economy |
| Robotics, automation, ICT equipment | Health equipment |
| Chemicals | Construction |
| Energy, oil and gas | Offshore and marine |
| Agrifood automation (Norfolk and Suffolk SME base strong) | |

Engineering is both a sector in its own right and a source of skills for many other companies in virtually every sector given the pervasive use of engineering in virtually every workplace.

Defining the Scope

The adopted scope is:

| | |
|---|---------------------------|
| Engineering companies | Manufacturing companies |
| Technology suppliers | R&D centres and providers |
| Engineering and manufacturing consultants | Training providers |

Many larger manufacturers and service sector companies also have in house engineering capability e.g. most food companies have an in house engineering team as well as employing external contractors, the same is true in logistics and other similar sectors.

Over 30% of the top 100 companies (by sales) in Norfolk and Suffolk⁴ are in the manufacturing and engineering sector, with over 60% of the total turnover being in food manufacturing. This focus on larger employers also means the sector is likely to be a major contributor to the Apprenticeship Levy with work by SkillsReach (2017) suggesting that 21% of the levy in New Anglia, circa £10.5m, will be paid by advanced manufacturing with a further 24% in the agrifood tech sector (£12m), much of which relates to larger food manufacturing companies.

As well as larger employers the AME sector includes a large number of SMEs as manufacturers or as service providers.

Future Growth potential

Major developments in the industry in New Anglia will drive local growth, including notably:

- The continued growth of Hethel Innovation (including Lotus cars - recently acquired by Geely the Chinese owner of Volvo and associated companies);

⁴ EDP and EADT (2017), top 100 companies

- The development of the A11 technology corridor to Cambridge focused on the AME sector is a core part of the economic development agenda for the Councils on the route;
- The Norwich Aviation Academy;
- Investment by the MOD in new engineering capacity, for example the confirmation of RAF Marham as a long term strategic base for strike aircraft including its Engineering & Logistics Wing (ELW);
- The potential development of Sizewell C in Suffolk could lead to further substantial growth of the sector in the New Anglia area in the medium to long term.

The energy, logistics and construction sectors are also witnessing steady growth, much of which is increasingly using AME technologies and expertise.

The perception of consultees was that the sector is currently seeing slow but steady growth with new regulations, market needs or technology driving a need to upgrade existing equipment e.g. new refrigeration regulations in 2020.

In other parts of the industry the use of new machines, such as CNC lathes, which typically cost £200-400,000 and require high levels of ICT skills as well as engineering skills, will continue to change the sector and lead to higher productivity and growth. However, consultees were concerned that the UK is 'behind the curve' and has been slow to adopt these types of new systems and equipment compared to other countries.

Sector Definition

The sector definition applied to the recent New Anglia LEP Economic Strategy Evidence Base, and reproduced here, encompasses all manufacturing activity in the area, as opposed to highlighting only the '*advanced*' elements and engineering. The rationale, endorsed by consultees is that all manufacturing now has to be 'advanced' if it is to be competitive⁵.

This wide definition means that there are sizeable overlaps between the AME sector and AgriFood Tech (food and drink manufacturing), Digital Tech (printing and publishing), Life Sciences & The Bio-Economy (Manufacture of pharmaceuticals; precision instruments), Transport & Logistics (Repair and maintenance of lorries, ships, aircraft etc.), and Tourism & Culture (Manufacture of Jewellery, musical instruments, games etc.).

To help identify the breadth of the sector, its major sub-sectors and constituent companies, Hethel Innovation (2017) has developed sector reports for High Value Manufacturing and Engineering⁶ which show how vibrant and diverse the AME sector is in New Anglia. These reports will support sector growth and networking programmes run by NAAME.

⁵ The only exception would be the limited niche market for handmade, traditional products which make a virtue and marketing proposition from not using modern automated or highly technical production methods. Whilst there is a growing market for these speciality products, consultees felt that they would remain a niche market with a low overall percentage market share

⁶ Hethel Innovation (2017), Network Development Reports for High Value Manufacturing and Advanced Engineering: precision engineering; automotive sector; advanced materials – composites; electronics sector

Skills & Workforce Supply

Analysis of LEP level results for the 'Manufacturing' sector from the UKCES Employer Skills Survey 2015 shows that the 'Manufacturing' sector was more likely to report skills shortage vacancies (28%) as a proportion of all vacancies than both the New Anglia all sector (19%) and national (23%) averages. Evidence suggests that, as consultees reported, productivity is improving but there is uncertainty about future workforce size.

In total, 6,820 learning aims related to the AME sector were delivered to New Anglia residents in 2012/13, 8.5% of all learning aims delivered in New Anglia, compared to 5.8% for the AME sector nationally. Since 2010/11, there has been an 18% increase in the number of AME learning aims delivered to New Anglia residents. This contrasts with a national decrease of 3%, which suggests that the sector locally is bucking the national trend and trying to ensure that future workforce skills needs are met.

Analysis of data sourced from the Department for Education's Further Education data library based on the Sector Lead Bodies identified as being the most relevant to the AME sector: Process Manufacturing; and Science, Engineering & Manufacturing, shows that the majority of these learning aims (5,360 or 79%) achieved by New Anglia residents were delivered by New Anglia based providers. This is slightly more than the average for New Anglia across all sectors (75%) suggesting the sector is relatively well supported by local skills providers.

Provision of Advanced Manufacturing & Engineering learning aims by New Anglia providers to New Anglia residents has increased, with growth strongest in 'Process & Manufacturing' at +54%, though the majority of learning aims are still delivered under 'Science, Engineering & Manufacturing Technologies' with 3,110 registrations.

In 2015/16 there were 1,810 starts in 'Engineering and Manufacturing Technologies' apprenticeships in New Anglia, 13% of all apprenticeship starts in the area. Growth over time in 'Engineering and Manufacturing Technologies' apprenticeship starts is below that of regional and national comparators, and that of growth in the number of apprenticeship starts overall. Data on apprenticeship participation by sector provides a slightly different perspective with the Manufacturing sector accounting for 8.4% (2,580) of all apprenticeships in 2014/15, which is lower than the level of employment in the sector at 11%.

Despite recent growth in participation rates locally, 22% of manufacturing employers in New Anglia reported having staff that were not fully proficient in 2015, compared to an average of 14% nationally, suggesting that further growth in investment in staff training is needed. This is confirmed by the fact that staff not fully proficient as a percentage of employment in the sector was 5%, above the New Anglia average of 3% but in line with regional and national rates. The data points to staff not being fully proficient as an issue particularly for smaller employers.

UKCES data and the East of England Forecasting Model suggest that the sector is projected to decline in employment between 2014 and 2024 by circa 10% (approximately 8,000 jobs). However, this projected decline is not reflected by local employers who, subject to continued favourable business conditions and workforce supply, expected slow but steady growth.

Even if the sector does see an overall decline in employment, there will still be growth areas within the sector with around 7,000 new jobs forecast over this period. In addition, replacement demand is expected to be somewhere in the region of 30,000 jobs.

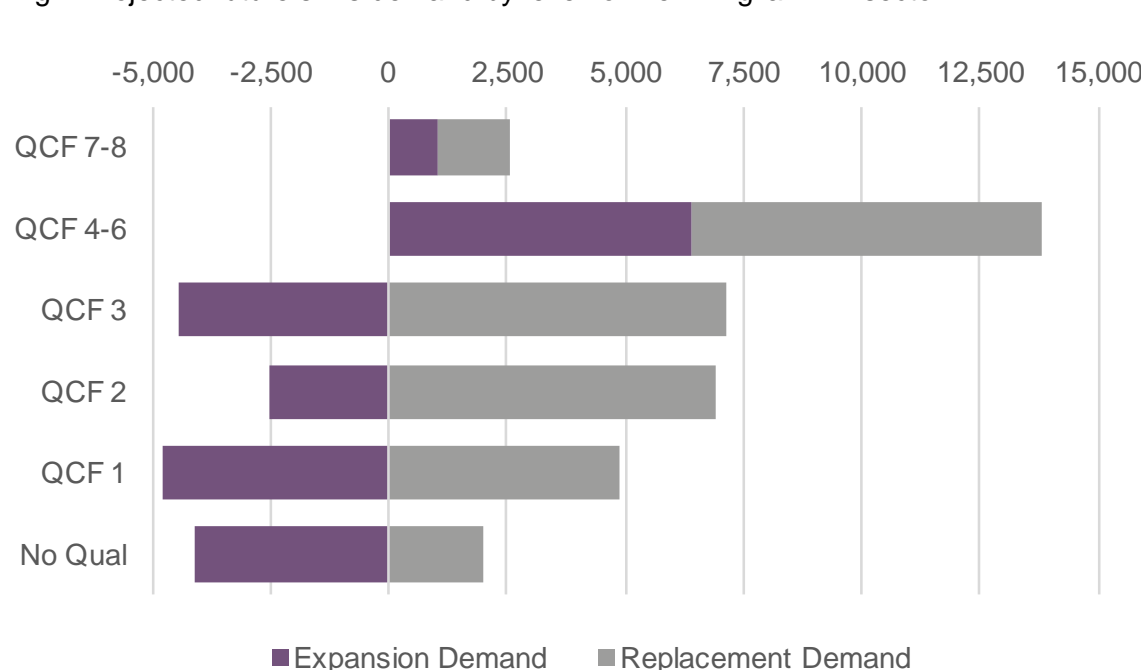
This suggests a net requirement for new staff in the sector at 37,000 over the decade from 2014-2024. New jobs creation (expansion demand) will be primarily in roles requiring degree level skills and higher (Level 4 and above) with job losses in lower skilled roles.

Despite the overall projected decline in job numbers there will still be growth areas within the sector with around 7,000 new jobs at Level 4 to 6 (HE to First degree level) and above (figure 1) and a projected small increase in the number of post graduate level roles, with in total over 7,500 additional jobs created in the AME sector for those with L4+ qualifications.

In contrast at L3 and below the number of employees is projected to fall, with an overall fall of over 15,000 job roles at this level. This is consistent with feedback from consultees, who universally predicted a continued need to upskill the workforce as new technology drives the sector forward.

At the same time, there will be a significant number of existing jobs to replace as people leave the sector workforce. The replacement demand at both ends of the skills range, for those staff with no qualifications/level 1 and at the other end levels 7-8 are very modest. Most replacement demand is focused on levels 2-6, with the demand for L2, L3 and L4-6 all fairly even.

Fig 1 Projected future skills demand by level for New Anglia AME sector



Advanced Manufacturing & Engineering Skills Supply and Demand

As with the overall workforce in New Anglia, the AME workforce is becoming more highly skilled as analysis of 2001 and 2011 Census data shows (figure 2). However, in terms of the shift in qualification levels, New Anglia still lags behind regional and national averages for the AME sector. Nonetheless, the demand for L3 or L4+ skills increased from 19% to 32% over the decade to 2011 and consultees reported that they believed it has continued to grow since 2011 and will do so in future. This trend can be seen in changes in qualifications in the sector between 2001 and 2011 (figure 2).

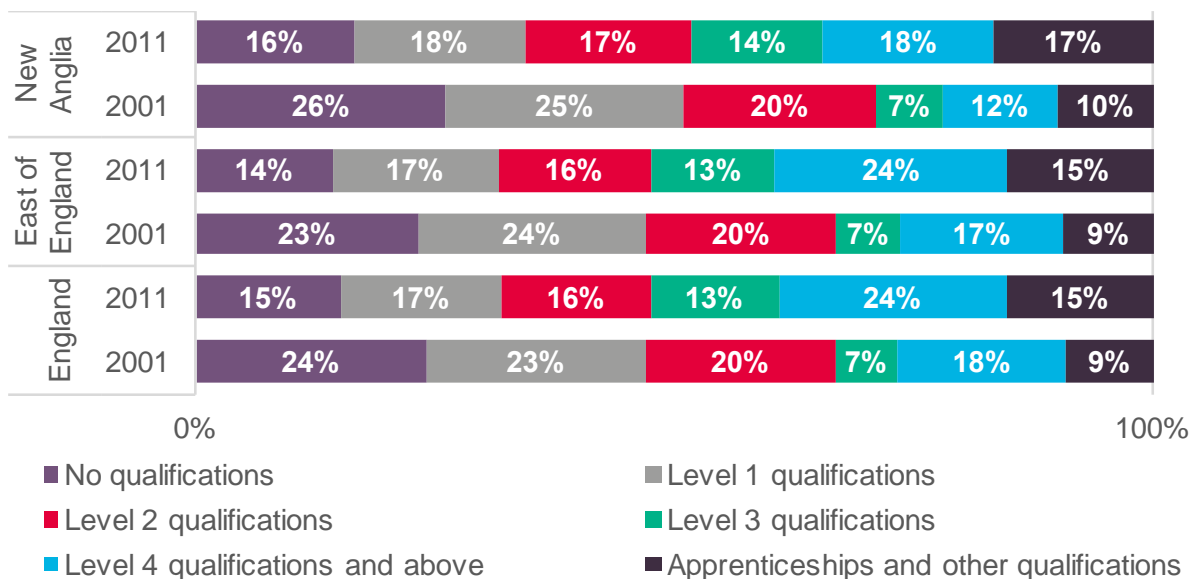
The trend in the qualifications profile in New Anglia (figure 2) shows that the industry has been managing this change to higher qualifications for many years which should help to meet the anticipated future demands (figure 1).

UKCES (2015)⁷ found that New Anglia manufacturers on average are marginally less likely to have vacancies than local, regional and national averages. However, companies with vacancies are much more likely to report these as being Skills Shortage Vacancies (SSVs).

The AME sector's performance against training measures (such as the provision of training in the last year, and on-the-job training) shows that it is either broadly in line or above local, regional and national averages for all indicators compared to other sectors, apart from online or e-learning training. Similarly, training days per trainee and trainee days per staff, are both much higher than all comparators.

Manufacturing employers are also less likely to report underutilised staff than local, regional, and national averages for all sectors, 21% compared to 25%, 25%, and 30% respectively.

Fig 2. Qualification profile in the AME sector



⁷ UKCES (2015), Employer Skills Survey 2015

Opportunities and Challenges

Employers and consultees identified a wide range of key workforce and skills challenges which need to be addressed to facilitate future growth of the AME sector, including:

Workforce supply:

- Recruitment of experienced staff (30+age group) is generally done through national advertising using recruitment agents as there is a lack of local supply and this is not expected to change as employers want to attract the best talent available nationally. One specific challenge noted by employers was the hourglass age profile of the workforce, with a noticeable gap in many companies workforce in mid career staff what one consultee called a 'missing generation', and a problem despite a recent increase in recruitment at younger ages that as the older workforce retires the next generation (30-45 age group) who would be expected to replace them is missing.
- Specialist CPD for the existing workforce is also a national market as there is not enough local demand to offer courses in all areas given the multitude of different specialist skills needed across the AME sector. The demand for CPD is expected to grow given the speed of change in the industry and the technology the AME sector is using. Consultees also reported a frustration that in their view there were no programmes in place for older experienced people to retrain / gain skills to help fill the gaps in industry workforce supply.
- Some work e.g. engineering design work, is being contracted out of the region or UK to access specialist skills available globally. This is the reality of modern global supply chains and it is important for New Anglia to be clear on which parts of the industry to focus local skills initiatives on as the area cannot lead on all areas and, as a consequence, to accept that for some other skills it may be preferable to work with global centres of expertise.
- Many staff, estimated across the engineering sector at 10-11%, come from other EU states and this is creating additional uncertainty for the future given the likely restrictions employers expect after Brexit. Many agencies which help to fill short term gaps in workforce supply have a much higher % of their workers drawn from overseas and in 2017 have started to struggle to meet company needs.

Current course provision:

- Some sub-sectors within AME don't have appropriate apprenticeship provision e.g. ventilation engineering.
- There is also a more general concern that the apprenticeship frameworks are very rigid, overly prescriptive and don't meet the needs of many companies in the sector. Feedback shows that in this sector both providers and employers are frustrated by the inability to flex course content to meet employer needs, with employers saying that this means they are not able to use government endorsed training to meet their needs. They believe that as the system changes to one in which employers are expected to pay more of the cost of the training provided that this must change so that the customer receives what they want to pay for.
- Current FE course funding mechanisms are overly prescriptive and are stopping new full time provision which responds to challenges such as Industry 4.0, because the current funded frameworks don't allow students to combine aspects of engineering, ICT and

electronics which are needed to meet this. This requires new standards and frameworks which are aligned with emerging industry needs or the freedom locally to adapt a light touch national framework to meet local employers' needs.

- Similar development needs to happen in specialist AME areas such as the Aviation sector to ensure that courses at IAAAN are fully compatible with both funding models and industry needs. In most cases this challenge requires more flexible funding.
- There is also a perception that education exit points don't meet industry needs and expectations, whether at school or University/College level. Key challenges exist in relation to technical and employability skills of those entering the industry. Employers reported that even graduates or post graduates need to be viewed as 'trainees' for 3-4 years when they arrive in a company, as in most cases they lack the practical and commercial skills needed and are not 'job ready'.
- There is also a need for clearer pathways for engineering / manufacturing career progression through vocational progression and from FE to HE, as well as academic routes. Several employers and national representative bodies, however, view the current apprenticeships as much weaker than traditional courses as they are shorter, less comprehensive and thus don't in their view equip students with the skills needed. Employers who visit schools to 'sell' the apprenticeship offer also reported concerns that they find most pupils and staff don't see apprenticeships as the preferred route post school and this makes it hard to attract the best young people.
- Some businesses reported that they have moved provider (within the region mainly) due to problems with the quality of provision and because they were sent students who did not meet industry needs.
- There is a need for both core generic skills and in company expertise (given the diversity and very specialist nature of most companies in the AME sector), with employers recognising that they have a key role to play in the more specific company focused skills, but in many cases frustrated at the lack of generic skills amongst students and new recruits. The generic skills which employers require include: control systems, digital, programming, servos/motors, fluid dynamics, new materials, additive manufacturing, energy efficiency, communications and STEM foundations. Engineers also need to develop basic hand skills to use tools and to have dexterity.
- Some employers also reported that they were so confused or concerned by the way the apprenticeship was working that they had decided to ignore the (new) apprenticeship system and to recruit their own apprentices, outside the system, and deliver their own training without trying to secure funding through the levy.
- Overall though employers still felt that the current focus on apprenticeships, whilst welcome, had come too late and that it was now imperative for everyone in industry and government to come together to recruit and train more apprentices. There was also widespread support amongst consultees for the development of degree apprenticeships, but a recognition that awareness amongst young people and their families was still too low and many still viewed apprenticeships as of less value than the academic route of 'A' levels followed by a degree.
- Concerns were also expressed by both individual employers and sector bodies that the new apprenticeship funding model was not working very well. The main concerns are that the restrictions within the system make it very hard to access the levy funds because in many cases the standards are not ready, providers are not ready or employers are having problems accessing the online system. As a result it was felt that many

employers had decided to shelve plans for apprentices until system challenges have been resolved.

- Employers are also concerned that the current set of apprenticeship frameworks still have significant gaps and this leaves many employers unable to access appropriate provision to meet their needs.

Industry and stakeholder views on the responsiveness of skills provision:

- The 'stop/start' nature and complexity of skills funding and initiatives is a major problem in retaining AME employer commitment and interest in skills programmes. More stability and longer term commitment of government funding in the system would give employers the confidence to invest alongside the public sector. Other employers pleaded for government to 'stop changing / messing around with what's going on in schools, i.e. the exam results are no longer A, B, C etc and are now 1, 2, 3 etc... nobody has informed employers what the grade systems equate to so how on earth do we know.'
- The ageing workforce and major new developments, such as the potential Sizewell C plant, means that there are growing concerns about the security of future workforce supply locally as new demands for staff and skills compete with existing employers.
- The skills supply for some substantive sectors, e.g. polymers, is currently lacking and is not addressing market needs (although there is some limited national provision, this is not sufficient to support the sector's growth potential).
- Networking is poor both between education providers and business and between businesses themselves in the AME sector. The business community needs to do more to support each other and promote the sector as a career of choice.
- The importance of 'REAL' Work Experience to inspire young people and its perceived current dysfunctional nature from an employer perspective, means the sector is finding it hard to attract the next generation it needs to support its growth aspirations.
- There is lots of potential locally to address these concerns, with some innovative ideas progressing such as Institute of Technology (IoT) and the Institute of Productivity, but these need to ensure they are delivered in ways which are responsive to industry needs.

Interestingly though one consultee noted that there was also a problem with some employers not releasing staff for training even when this was provided free by component suppliers: *'I am observing widely that (electronics) vendors can't give away valuable technical training in the UK. In Europe they can fill a classroom, in the Far East a lecture hall, in the UK if they don't cancel the event it is virtually a one to one session'.*

College and University facilities and staffing:

- There are recognised major challenges in relation to the level of skills and industry awareness amongst teachers and lecturers given the speed of change in the industry and the recognised challenges of recruiting teaching staff in AME disciplines.
- More broadly there is a problem in recruiting the lecturers and teachers needed in technical and engineering disciplines. The feedback from providers is that this problem is becoming acute in some areas due to rising salaries in the commercial sector that educational providers cannot compete with. There is also a recognition that this problem may well be exacerbated by the need to deliver more higher level provision and to embrace new topics, such as Industry 4.0, which require multi-skilled tutors who can combine expertise in engineering with ICT.

- Some employers find it hard to engage with Colleges as course planning is poor or late, making it hard for employees and learners to fit the course around work. Others noted that they now, for example for mechanical apprentices, use national EEF provision in Birmingham due to a perception that local provision is of poorer quality. Other employers noted that they were working with national providers e.g. Loughborough University to develop chemical engineers due to lack of suitable local provision.
- Employers recognised that Colleges faced problems accessing modern equipment for training and a significant number said that they would be willing to work with providers to address this challenge by sharing facilities. In a few cases this was seen as working well e.g. International Aviation Academy Norwich, but there was a general feeling that this could usefully be extended to other areas.

Specific areas with skills gaps identified by local employers included:

- Electrical, instrumentation and control engineers where technicians are hard to find and experienced engineers (graduate level) are very scarce leading to many companies poaching from each other;
- Mechanical engineers and mechanical engineering companies are both in short supply so it is hard to obtain the skills needed even if you try to sub-contract the work;
- Composites engineers are in short supply in a sub-sector with good growth potential and a strong local sector in New Anglia;
- Embedded software which enables small devices to support the Internet of Things (IoT) by coding and communications via USB, Ethernet and radio – this requires a combination of engineering and computing skills;
- Chemical engineers and organic chemists, because whilst there are 'lots of graduate chemists available [there are] few with knowledge of organic chemistry synthesis';
- Ventilation systems, not least due to forthcoming regulatory changes which will increase demand in this sector;
- The rapid growth in additive manufacturing and 3D printing which will impact across all of manufacturing and potentially in major new markets such as building.

Regional connectivity with neighbouring areas and national provision:

- Consultees were keen to stress that the AME sector is not constrained by LEP boundaries and many businesses and supplier/client relationships cross over LEP boundaries.
- Similarly staff and education provision crosses these boundaries, with notable AME training providers in the West of the region, e.g. College of West Anglia and West Suffolk College, having strong links into Cambridgeshire through their provision and student and employer base. These linkages also include the need to link with national provision such as the Institute for Manufacturing (IfM) and Welding Institute both of which are just outside New Anglia.
- In developing the New Anglia plan it is therefore important to ensure that opportunities to collaborate with other areas are taken.

National and Regional Reports

The feedback from New Anglia employers and stakeholders is broadly consistent with national and regional reports on the challenges and opportunities in the AME sector. Notable recent national and international reports which deal with this sector include:

The **Industrial Strategy** (2017)⁸ sets out how the government see the UK economy changing and how the UK needs to prepare itself for the future, not least due to the need to make the UK more competitive to drive exports and trade post Brexit. There is a strong focus on people within the strategy and the need to address perceived weaknesses in the skills system to ensure that people are equipped with the skills needed to gain and retain productive jobs which also help drive economic growth. As part of this it promotes apprenticeships, investment in technical education and a major focus on STEM skills to address the shortages of technical skills in AME and related sectors.

The **Technology Industry Futures Report**⁹ in spring 2017 was an update of the original papers from 2010 and 2012 and was released on the same day as the Industrial Strategy Green Paper. It received over 1,000 responses, held 7 round table consultations and reviewed over 50 technologies and 100 articles. Its main conclusion was that the largest change since 2012 was the convergence and interaction between different technologies into new products and services which defy traditional sectoral boundaries. Amongst its recommendations was a need for government to work with industry to act as a 'skills planner – prepare for growing demand for worker with multi-disciplinary technical skills, and mitigate the impact of robots and machine learning replacing unskilled and graduate-level roles'.

The **Made Smarter Review**¹⁰ (developed as part of the Industrial Digitalisation Review) was published in autumn 2017 and considered how digital technologies in all their forms (e.g. robotics and automation, AI, VR etc.) will impact UK industry. It estimated that embracing the transformative power of digitalisation has the potential to increase UK GVA by £455bn (cumulative) over the next decade by improving productivity, reducing waste and developing new markets. The review included a cross cutting theme of skills, which was a recurrent theme in all the consultations held to produce the review. The parallel development (not yet approved or published) of the Robotics and Autonomous Systems (RAS) sector deal proposal has estimated that RAS could lead to a long term increase in employment of 7% and be worth an additional 15% of GVA or £218billion per annum.

The **Impact of AI in UK Constituencies**¹¹ (2017) looked at where in the UK would be most affected by automation, with the South West Norfolk and Suffolk Coastal constituencies predicted to be the most affected in New Anglia as they have more staff in low skill jobs which are likely to be automated. The study found that between 22-39% of the workforce of every constituency would be affected by automation argued that: 'UK government should: develop smart, targeted strategies to address future job displacement The importance of targeting these interventions to those at most risk cannot be overemphasised. Such

⁸ HMG (November 2017), Industrial Strategy: Building a Britain Fit for the Future,

⁹ Government Office for Science (2017), Technology Industry Futures

¹⁰ HMG (2017), Made Smarter Review

¹¹ Future Advocacy (2017), The Impact of AI in UK Constituencies

interventions could include supporting businesses to retrain employees and providing financial and psychological support to people impacted.'

In **Jobs Lost, Jobs Gained** (2017)¹², McKinsey & Company argues that globally they expect 15% (midpoint estimate) of current jobs will be lost to automation, but that the proportion varies widely between countries and industries, with on balance more jobs likely to be affected in countries and industries where industry is more developed and wages are higher (such as the UK). They expect the overall economy and the demand for workers to grow due to economic growth, but as with other reports argue that these changes 'will challenge current education and workforce training models, as well as business approaches to skill-building'. They suggest that the change seen in the economy could be faster and more profound than in previous industrial revolutions and require major skills initiatives.

Many of the same themes have been picked up by the Engineering Employers Federation (EEF) in a series of recent reports including:

- In **An Up-Skill Battle**¹³ EEF (2016) reported that 'we will struggle to find a sufficient number of candidates to satisfy the demands of our sector, and too many candidates lack the skills that manufacturers need'. The report identifies that 49% of employers in the sector already think UK productivity is lagging our competitors and recommends that greater focus on both management skills and technical, production skills are needed to address this. This report also argues for supporting more young people to take apprentices and for 'an integrated approach to skills, both vocational and academic, which has so far eluded the UK' and worries that with 'devolution of skills national and regionally, skills policy will in the future become more fragmented and less effective. This must, at all costs, be prevented'.
- In a presentation in September 2017 the EEF¹⁴ predicted the development of an 'hourglass' economy for skills in the industry with a growth in higher skilled jobs at expense of those in the 'middle', and predicted that 54% of all jobs in the engineering sector would need L4+ skills by 2024. They also highlighted that 76% of engineering employers employed at least one migrant, with the current workforce comprising 87% UK nationals, 11% from other EU states and 2% from outside the EU. It also noted that employers had already seen a reduction in job applications from EU nationals and an increase in EU nationals leaving their jobs.
- In **Britain and the EU: Manufacturing an orderly exit**¹⁵ (2016) EEF argued for a focus on four themes to help the AME sector respond to Brexit: ensuring access to key markets in the EU; ensuring regulatory certainty; supporting domestic investment; and, 'addressing the UK skills gap, calling for the Government to maintain the current skills base and a new immigration policy, which enables employers to access much needed skills'.

¹² McKinsey Global Institute (December 2017), *Jobs Lost, Jobs Gained: Workforce Transitions in a Time of Automation*

¹³ EEF (2016), *An Up-Skill Battle: EEF Skills Report 2016*

¹⁴ EEF (15th September 2017), Richard Halstead, *State of UK Manufacturing and Brexit*, Greater Lincolnshire Manufacturing Conference

¹⁵ EEF (2016), *Britain and the EU: Manufacturing an orderly exit*

- In the **Manufacturing Outlook 2017 Q3**¹⁶ the EEF reported that the sector was growing well, with the balance of manufacturers reporting growth in Q3 running at: +34% for output; +22% for UK orders; +33% for export orders; +25% for employment and +15% for investment. However, the survey also found most manufacturers were markedly less optimistic for the economy in 2018 given the uncertainty over Brexit.
- In **The 4th Industrial Revolution: a primer for manufacturers**¹⁷ the EEF reported that 80% of manufacturers thought that the 4th Industrial Revolution would be a reality for their business before 2025, but only 11% thought that the UK manufacturing sector was currently geared up to respond. 50% of manufacturers surveyed thought that their need for IT and software skills would increase over the next 3 years, and the report also concluded that 'great leaders are needed for this to be a revolution'.

The EEF has also conducted surveys of its members in relation to the apprenticeship levy¹⁸, with the key results from those surveyed being:

- 35% will pay the levy as a single employer with a wage bill of over £3m and a further 46% of companies will pay the levy as part of a group of companies;
- 5 in 10 manufacturers said they needed help to understand the levy system and 56% wanted help to find the right apprentice and 6 in 10 wanted more information on the range of apprenticeships on offer;
- Manufacturers universally felt that they could not pass the cost of the levy onto their customers and 33% expected to cut other parts of their training budget to fund the levy;
- 46% expected to increase their engineering apprenticeship training and 47% expected to convert existing training into apprenticeships;
- 75% of employers did not expect to get back what they pay into the apprenticeship levy, 34% see no benefits in the new levy system and 6 in 10 are concerned about how to absorb the cost pressures created by the levy.

Whilst this shows that the levy may lead to changes in behaviour, welcomed by some local employers to address the problem of free riders in the training system (those who recruit staff trained by other employers), the national picture also shows that along with most local employers they are still unsure of how the levy will work in the AME sector and want help to understand its implementation.

Locally feedback from employers was consistent with this EEF analysis in that many local companies reported they were still uncertain about how the levy system worked and many felt that the current approved apprenticeship frameworks did not meet their needs. In the short term this has reduced their willingness to take on apprentices, but they believe apprenticeships are the best type of provision and hope that numbers will increase again once the new systems bed in and new frameworks are approved. For larger employers the ability to share their levy with smaller companies in their supply chain has not been communicated well to employers most of whom were not aware this would be possible.

¹⁶ EEF (2017), Manufacturing Outlook 2017 Q3

¹⁷ EEF (2016), The 4th Industrial Revolution: a primer for manufacturers

¹⁸ EEF (May 2017), Ready, Steady, Apprenticeship Levy

Engineering UK¹⁹ has also identified that:

- The sector employs 19% of the workforce (5.7million employees), but has significant challenges in terms of skills gaps with engineering being in 15 out of 32 categories identified by the Migration Advisory Committee as open for skilled migration.
- The industry expects to need 186,000 new recruits each year to 2024 and is seeing increased interest in the sector with the highest number of apprentice starts for 10 years at 108,000 and a 5% rise in Higher Education applicants in 2015/16. It also reported that 96% of teachers would recommend engineering careers and 51% of 11-16 year olds would consider a career in engineering.
- However, they also identified that a big gender gap remains, which appears to occur primarily at ages 16-21, because whilst 49% of candidates for GCSE physics are female, this falls to 22% for 'A' level physics, 15% for undergraduate engineering and technology, only 7% of engineering apprentices, resulting in only 13% of engineering jobs being held by females. This gender issue is also apparent from other work by Engineering UK which shows that whilst 85% of dads would recommend a career in engineering this falls to only 67% of mums.

This work suggests as corroborated by local employers that there needs to be more focus on careers advice and guidance as whilst in general support for careers in the sector is high, this is not translated through into applications for training by young people.

Regionally the **Science and Innovation Audit (SIA) for the East of England (2017)**²⁰ identified four sectors as being particular strengths of the region: life sciences; agritech; ICT; advanced manufacturing and materials. However, the real focus of the SIA was on the overlaps between these four themes and how, by using technology from one of them, growth in other sectors could be accelerated (this mirrors the central conclusion of the Technology and Innovation Futures report 2017 above). This calls for inter-disciplinary skills and for example the chapter summary for advanced manufacturing and materials states that: "The AM&M sector is in the process of being transformed – particularly through digitalisation (Industry 4.0)'

The SIA executive summary also identified digital and ICT skills as being central to the delivery of all four themes and regional growth, stating that: 'There is an overarching requirement to address major issues relating to skills – particularly those relating to data science and computer science. The Audit found shortages across all four Themes – and the scale of the problem is such that unless addressed, it will stymie business growth across the East of England.' Under the section on overarching technology trends, the SIA notes that 'Intelligent manufacturing, otherwise known as Industry 4.0 involves pervasive digitalisation...'. These statements are consistent with feedback from local AME employers who are witnessing at first hand the changes being brought about by digitalisation and the challenges of finding the mix of engineering and ICT skills – ICT for real World problems as some employers described it – that are needed to address this change.

¹⁹ Engineering UK (2017), The State of Engineering: Key Facts 2017

²⁰ BEIS (2017), East of England Science and Innovation Audit

A number of sectoral reports for end users of AME skills, e.g. agrifood, have also clearly identified the growing need for AME skills to support their growth. Areas such as automation, robotics and control systems are growing in importance across industry. Campden for example have identified that new 'Skills and knowledge are needed including Uses of technology, 'integrated data' and artificial intelligence (e.g. web, Internet of Things, remote sensing, social media) to monitor and manage agricultural products'²¹. The EFRA select committee (2017) also reviewed the need for labour in the food chain and reported that the government sees the need for 'greater automation and mechanisation of the sector' to help meet future labour supply challenges²².

Conclusions

What unites all the national and international reports is a belief, borne out by many local employers, that the AME sector is on the verge of major change, which in its speed and all pervasive nature will be as significant as any of the earlier Industrial Revolutions and thus worthy of the term the 4th Industrial Revolution, or Industry 4.0.

However, the potential is that the changes unleashed by Industry 4.0 will affect virtually every other major sector as automation, the internet of things and robotics replace many existing jobs.

Whilst the AME sector could be the major beneficiary of this change, consultees were keen to point out that increasing the supply of skills in engineering and linked enabling disciplines, such as ICT, will determine whether New Anglia can gain from this process of change.

With the demand for the engineering, automation and digital skills needed increasing across all sectors and not just in those companies in the AME sector directly, employers were also concerned that they will face increased competition for skills and thus not be able to benefit from these changes which are global in nature.

Failure to act on the skills needed by Industry 4.0 would lead to loss of employment in many other sectors which will invest in new technology, but which will buy this technology from AME suppliers in other regions, without the area seeing the gains which could be delivered within the AME sector locally if it is able to meet these needs.

Addressing these challenges is not easy and requires a commitment from employers and government to work together on strategic challenges such as how to address the gender imbalance in engineering, secure the skills needed for Industry 4.0, both through new entrants and retraining and to ensure that engineering and manufacturing skills are available both within the AME sector and to other employers who need them.

²¹ Campden, Scientific and technical needs of the food and drink supply chain 2018-2020

²² EFRA Select Committee (2017), Feeding the nation: labour constraints, Seventh Report of Session 2016–17

The AME Sector Skills Plan

The AME sector skills plan will balance partnership development to help the AME sector act collectively, with shorter term locally responsive actions to meet immediate challenges and longer term strategic and often larger scale development of new centres and programmes to meet the long term workforce and skills needs of the sector.

Priorities for Action

The analysis of need from the consultations and reports on the advanced manufacturing and engineering industry, shows that the AME sector faces a series of current and future challenges in sourcing the workforce and skills needed to support both current operations and to deliver growth.

However, there was also clear evidence that local employers are very aware of the challenges facing the industry and many are willing to actively work with other employers and stakeholders to address future skills supply issues.

The priority actions set out in the plan are designed to address a set of strategic objectives proposed by employers:

- The need to **mobilise industry leadership** in helping meet future workforce and skills supply challenges and in ensuring that providers have clear guidance on the skills needed – there was agreement that the scale and complexity of the challenge means that training providers and government cannot meet the industry's needs without the active leadership, input, guidance and support of employers;
- The need to **rise to the challenges and opportunities afforded by Industry 4.0** as the lines between engineering and digital technologies blur to deliver smarter, more productive manufacturing processes;
- A strategic imperative to **plan for major projects or programmes in advance** which will increase the demand for AME skills e.g. the potential development of Sizewell C would help grow the local AME sector substantially, but unless this is managed could in the process 'poach' staff from other AME employers in the region;
- The pressing need to **build on and co-ordinate careers advice and guidance** so that more young people, at every age from primary to post graduate level, consider a career in the AME sector, with a particular focus needed in attracting females to an industry which is still male dominated;
- A need to focus more on **applied skills development** so that apprentices and students gain the real world work experience needed to be useful members of the team in AME sector companies from day one, including by developing new applied HE provision;
- The need to ensure that training programmes have access to **modern facilities and equipment to support new curriculum areas such as Industry 4.0**, in most cases by working with industry to meet this need rather than trying to create all the facilities needed in educational centres which will rapidly be out of date;
- The need to **increase the supply of tutors with first-hand experience of the latest technology** and how it is applied in the workplace, so that students and trainees are equipped with the skills needed by employers.

Need for a Step Change

Throughout the consultation process it was clear that employers and providers shared a view that the demand for AME skills was likely to see a step change in three important ways:

- **Total demand** - the total demand for AME skills will increase as the use of automation and robotics, self-driving vehicles and other similar developments advance;
- **New Skills and Combinations of Skills** - the nature of the skills needed will change quickly as technology advances and boundaries between disciplines become blurred;
- **Diversify into new sectors** – as the demand for AME solutions moves into new sectors (e.g. health care) and affect the demand for skills and employees with AME skills across many other industries.

Consultees felt that incremental, organic growth of training and skills provision was likely to mean that the current shortage of AME skills becomes a crisis and constrains future growth of the sector.

Addressing this required a step change in three areas:

- Employers need to work together as they are all facing similar challenges and, by pooling their demand, can make it much more viable for education and training providers to be able to respond to their needs. This is true of both their need for new recruits as well as the pressing need for more CPD as skill requirements change.
- Providers need to work together to create clear progression routes, attract new talent to the provision and to ensure that collectively the shortfall in skills for the growth of the industry can be addressed.
- Funders and strategic bodies including funding bodies, the LEP and Councils need to agree an investment strategy to support the employer and provider base in delivering the step change in employer engagement and provider response needed.

There is a need to change the national funding rules, standards and frameworks to make them fit for purpose, so that they are much less prescriptive to enable employers and providers to work together to ensure provision meets market needs. The current frameworks and standards are dated, have significant gaps and are frustrating the development of courses which meet emerging needs which will grow the AME economy e.g. Industry 4.0.

One area in which more collaboration is needed is in bringing together major investment programmes in AME skills and knowledge provision, including:

- Institutes of Technology;
- The Institute of Productivity;
- Major investment programmes in AME being delivered by providers including UEA, West Suffolk Colleges, East Coast College, College of West Anglia, City College Norwich and Easton and Otley College.

Whilst recognising that each of these developments are separate and will have to ensure they have a viable business plan, by working together real synergies which could benefit students (e.g. progression pathways) and employers (e.g. access to new skills) could be unlocked, which in turn would support economic growth and the viability of all the individual developments.

AME Sector Skills Plan Delivery

The delivery of the sector skills plan should be led and supported by industry. The New Anglia Advanced Manufacturing and Engineering (NAAME) sector group has a key role to play in providing this sector leadership.

To give focus to the skills aspects of AME sector development a Skills Group should be established to advise on skills development for the sector in Norfolk and Suffolk. The Skills Group should report to both the NAAME Board and LEP Skills Board to ensure that it both draws on the needs of the industry and informs skills investment and planning by the LEP.

In developing the AME Skills Group an emphasis will be placed on promoting collaboration and joint working between:

- Employers to identify common issues which need to be addressed and to identify ways in which they can pool their resources to secure the future workforce needed;
- Employers (either individually or collectively) and education and training providers on areas including the promotion of AME careers, the development of new or enhanced programmes, securing the specialist staff and facilities to train the workforce;
- AME employers/training providers and funding (ESFA, HEFCE etc.) or economic development bodies (Councils and the LEP), to ensure that public sector resources are aligned with industry needs given the magnitude of change which is anticipated in the skills needs of the sector in the next decade and beyond.

The collaboration and joint working proposed between employers and the education and training system will focus on both short term actions at sub-sector or local level, as well longer term more strategic programmes. The role of the AME Skills Group will in most cases be confined to supporting projects led by employers and/or training providers, but for larger projects the Skills Group will ensure that at least one of its members takes an oversight role in projects it sponsors to ensure that the lessons learnt are disseminated.

Whilst it is expected that the Skills Group will develop its own rolling project plan, with ongoing input from employers and providers, five initial skills interventions are proposed to address the agreed strategic objectives:

1. **Industry 4.0 Challenge Programme** working across the AME and digital tech sectors in New Anglia to ensure that the New Anglia AME sector has the skills needed to deliver new manufacturing and engineering technologies;
2. **Careers of the Future Programme** to ensure that the sector projects the career opportunities in AME effectively, both to school age and older students;
3. **Developing AME Course Provision** to ensure that courses meet changing employer needs and that this is supported by government funding frameworks;
4. **Physical Facility Development Programme** by identifying opportunities to share resources between industry and training providers and to create new or enhanced physical facilities and training centres;
5. **Tutor Development Programme** to increase the supply of tutors, full and part time, to help deliver the skills development needed by the AME sector.

It was also recommended that there is a key role for the Skills Group in advocating with employers that the sector should take a more proactive approach to promoting the industry as a career of choice. Whilst it is recognised that some employers are very active on skills

and careers issues, consultees reported frustration that many other employers in the sector still see the challenge as one for others e.g. Colleges or national sector bodies, to address. A sector based group which championed careers promotion and brought employers together in New Anglia to help the whole sector work with providers to ensure provision meets its needs was therefore seen as potentially very beneficial to the growth of the whole industry.

Local and Regional Level Action

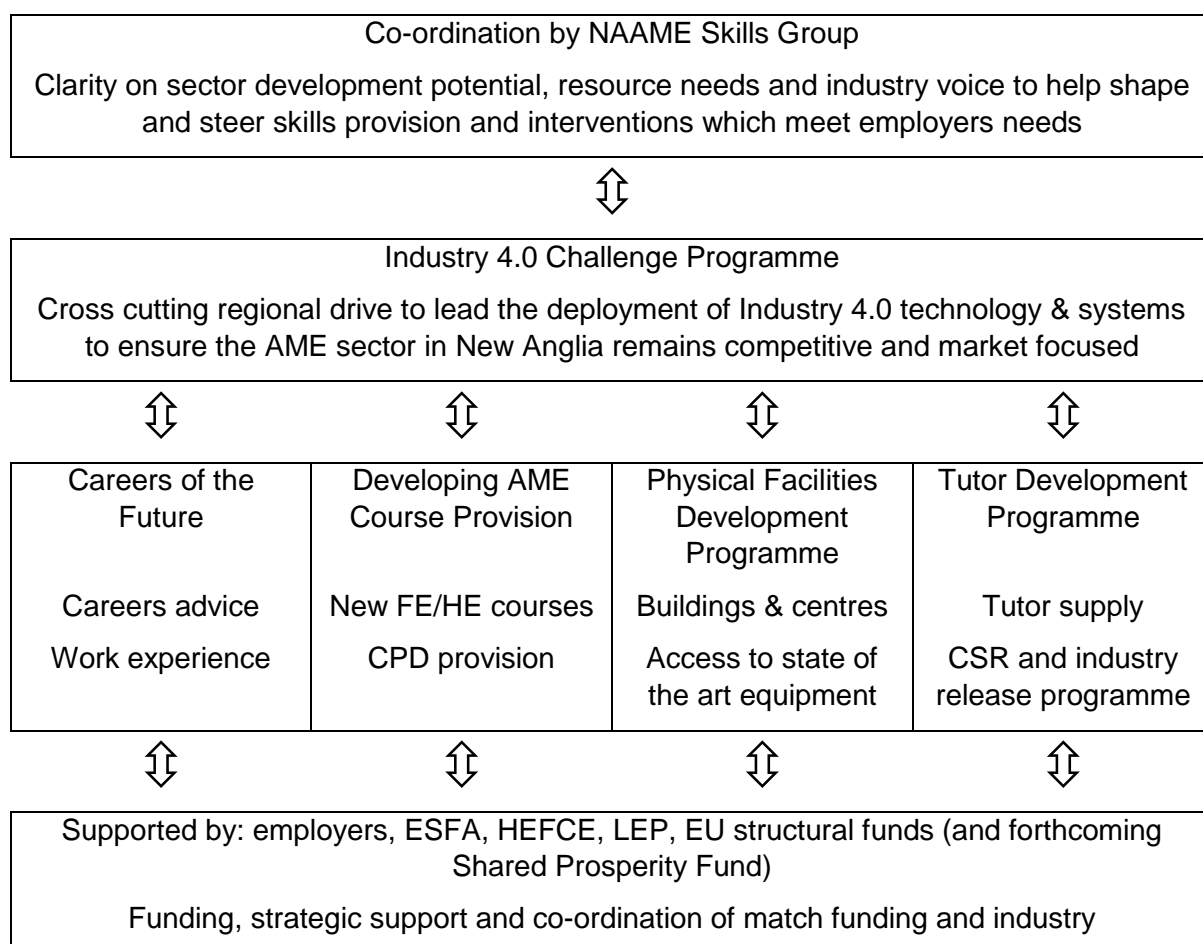
Whilst most of the proposed actions are focused on the New Anglia level, given the scale and diversity of the AME sector, consultees were also clear that leadership at the sub-sector and/or local geographic level was also needed for some of the proposed interventions.

Delivery of the region wide plan should build on successful local initiatives, seek to fill gaps where these exist and drive forward a coordinated regional response.

Consultees also strongly supported working with other sectors which need AME skills e.g. ports and logistics, energy, agrifood tech, given the shared challenges. This could encompass both sharing course provision as well as promoting 'technology' intensify careers and potentially longer term ambitions such as a Science Centre to promote STEM careers.

Strategic Overview of the proposed skills interventions

The relationship between these interventions is:



Proposed Skills Interventions

| Intervention 1 – Industry 4.0 Challenge Programme |
|--|
| <p>Rationale: Industry 4.0 and the Internet of Things (IoT) are predicted to advance very rapidly in the AME sector in the next 5 years and, unless the sector addresses the skills challenges this creates, there is a real risk that it will reduce the competitiveness of the local AME sector. Similar challenges in relation to digital skills were identified in the Life Sciences and Bio-economy and AgriFood Tech sector skills plans and addressed in the ICT and Digital skills plan, and the opportunity should be taken to work across these sectors to identify common actions which can be taken.</p> |
| <p>Action to be Taken: the challenges and opportunities arising from Industry 4.0 will affect every aspect of the AME sector and many of the end users the sector supports. It is also a broad challenge and will require substantial investment over an extended period of time from both industry and the public sector. Proposed actions include:</p> <ul style="list-style-type: none"> • Developing the Institute of Productivity to lead work on the automation agenda for Norfolk and Suffolk to ensure that the manufacturing sector can embrace new more efficient production processes with a strong emphasis on CPD. It is critical to align this with the proposed Institute of Technology and investments being made by Colleges and Universities • Ensuring that New Anglia develops links to sector deals which are focused on these challenges and builds Industry 4.0 into the Local Industrial Strategy; • Promote the uptake of Knowledge Transfer Partnerships (KTPs) and innovation funding which draw on and develop new higher level skills in Industry 4.0 in New Anglia AME sector companies; • Developing challenge led tasks on coding, data analysis and automation to use with young people based on Advanced Manufacturing and Engineering problems which can be used with schools, Colleges and projects such as Stepintotech. |
| <p>Leadership: this action needs to link end user demand from employers represented by NAAME with the ICT/Digital sector (via TechEast) and the Institute of Productivity to develop a large programme led by industry and key stakeholders.</p> |
| <p>When: this action is critical to the AME sector's future and so a programme should be developed and launched by summer 2018 and inform the implementation plans for the New Anglia Economic Strategy.</p> |
| <p>Resources and support: the proposed Industry 4.0 challenge programme should work with the LEP to identify a substantial medium to long term investment package which prepares New Anglia for the challenges and opportunities of Industry 4.0. The objectives of this programme, CPD, knowledge led growth, innovation and competitiveness, align well with the New Anglia Economic Strategy, the UK and Local Industrial Strategy, and the LEP should work with employers and providers to develop proposals for major bids to national programmes and the forthcoming Shared Prosperity Fund.</p> |

Intervention 2 – Careers of the Future Programme

Rationale: the AME sector is facing major challenges with staff supply and needs to attract more applicants, including those from non-traditional backgrounds, by co-ordinating the projects and initiatives working on this challenge locally, regionally and nationally.

Action to be Taken: promoting the AME sector as a career of choice requires actions by employers, regional and national sector programmes and providers to be co-ordinated into one comprehensive offer. The programme should target all ages and backgrounds, with a focus on: 9-18 age group as they make career choices; female students who are under-represented in AME; and, explaining career paths and salaries in the AME sector to students and parents. The successful Opito scheme in the energy industry was a model which consultees supported. The coordination of careers advice should:

- Embrace and build on the work being undertaken by specialist local programmes such as Stepintotech, which works with young people on digital and engineering challenges and Beacon East and Cambridge Launchpad both of which support business education partnerships and work on careers advice;
- Promote case studies of early career AME sector workers who have good jobs, career prospects and salaries to dispel misconceptions about the sector;
- Align industry and learning provider investment with regional and national programmes run for STEM and by engineering sector bodies, with employers keen to see a 'reboot' of the STEM ambassador scheme which they feel is effective when delivered;
- Influence school curriculum delivery by promoting examples of new technology which can be linked to curriculum content e.g. ICT and digital or physics and maths;
- Support delivery by employers and Enterprise Advisors at the local level by providing them with the support and development needed to work effectively with schools.

The provision of work experience also needs improving to help ensure that young people are both given meaningful experience of the AME sector and then supported, through careers advice, to understand how to move forward with an AME career. Employers are keen to see Norfolk schools adopt the more flexible approach to work experience seen in Suffolk to ensure that more employers can support work experience for more students. It is also vital that barriers to work experience such as H&S or the perception in some schools that it is challenging to offer work experience in the AME sector is addressed.

Leadership: the NAAME sector body should take ownership of this programme and through its Skills Group champion the delivery of future careers advice to the sector.

When: the careers of the future programme should be established by 1st September 2018.

Resources and support: resource needs for co-ordination are comparatively modest but it is important that a central resource, guaranteed for 3-5 years is secured to help co-ordinate careers delivery. The majority of resources needed for delivery are already in place, through regional programmes (e.g. icanbea, Enterprise Advisor Network) and nationally (e.g. EEF, tomorrowseengineers.org.uk, access IET provision). In addition many businesses in the sector work with schools and FE/HE to promote the industry.

Intervention 3 – Developing AME Course Provision

Rationale: progression from FE to HE courses in the AME sector needs to be improved to meet the large predicted increase in the demand for L4-6 qualified job. The existing workforce will also need to undertake further training as the development of Industry 4.0 changes the nature of many roles in the sector. Both challenges require new and developed course provision which is more flexible to meet employer and students' needs.

Action to be Taken: to facilitate improved rates of progression from age 13-14 to further and higher education in the AME sector courses must meet both students' and employers needs through combining practical and theoretical knowledge, with a focus on the application of skills. In addition to action locally the sector must engage with national funders, via the LEP and sector bodies, to promote more flexible national standards and frameworks which allow local providers and employers to work together to design courses which meet market needs. The focus for new course development includes:

- Development of progression pathways from existing FE full time courses to HE;
- New course types including developing Higher Apprenticeships with employers to meet the gap in applied higher level skills development in the AME sector;
- Course development also needs to facilitate FE courses which allow engineering and ICT to be combined to meet the need for Industry 4.0 provision;
- New modes of delivery which are responsive to industry needs e.g. short block release, use of blended learning or seasonal provision which allows students to work as a part of their company team whilst learning at the same time on a flexible basis;
- Filling gaps in current course provision e.g. applied engineering design to ensure that employers have access to engineers who can design and prototype new technology;
- Working with schools and FE providers to develop progression routes from STEM subjects into the AME sector, by linking to 'T' Level developments as these are developed over the next few years.

Training providers and industry also need to work collaboratively to develop specific courses or modules/units to equip the existing workforce for new challenges, such as Industry 4.0, through CPD courses which help employers develop new skills.

Leadership: the industry, led by NAAME, will work with Colleges and Universities to develop new models of course provision which are responsive and flexible to industry needs and which attract non-traditional entrants.

When: the development of new courses is an ongoing process, but given the rapid increase anticipated in technology linked to Industry 4.0, it is vital that new provision in this area is developed in time for delivery in 2018 or 2019.

Resources and support: the resources required are mainly a commitment by Colleges and Universities in conjunction with industry partners to develop new courses and technical training programmes. As well as influencing the design of the new Shared Prosperity Fund (with the LEP), the AME sector must work with national funding bodies to argue for a more flexible set of standards and frameworks which meet industry needs.

Intervention 4 – Physical Facility Development Programme

Rationale: the AME sector is seeing rapid changes in the technology used and ensuring access to modern state of the art training facilities and equipment is essential to meet future skills needs. Training providers can struggle to afford the large investment and re-investment needed and therefore training providers and industry should work together.

Action to be Taken: providers, employers and the LEP should work together to identify and fill gaps in physical training facilities in the region under the framework a strategic investment plan which aligns physical facility and staff development. A clear business plan will be required for each development which reviews existing provision (inside and outside the LEP area) and the business case. The following initiatives were identified as being desirable as part of an overall strategic investment plan for AME sector skills:

- The Institute of Technology and Institute of Productivity would both help position New Anglia's AME sector for Industry 4.0, but need to be aligned with other proposed developments e.g. CCN/Easton & Otley College proposal for an applied HE centre;
- Further investment in the International Aviation Academy Norwich (IAAN) which is meeting a UK wide need, but which needs further investment to fulfil its potential;
- Building on existing Skills Deal projects once these are proven to work (appendix C);
- Develop additional UTC provision to create additional applied AME routes for young people, including the potential for a Felixstowe UTC for the logistics and AME sectors.

Access to state of the art equipment is essential so that trainees are taught how to use the latest technology and can in turn help to facilitate its introduction into companies. This will:

- Require new arrangements between training providers and industry and training providers may need to be flexible to fit around machine availability;
- Need new commercial models (of the type pioneered for example by IAAN or CoWA with Cooper Roller Bearings) to deliver collaborative provision.

To address these challenges a short term project, potentially supported by the Skills Deal, to promote model agreement(s) and proven collaborative working methods is needed along with a register of equipment which industry could make available to providers..

Leadership: development of new facilities will be led by providers, but in doing so they will work with the NAAME sector group, local business groups and employers.

When: developing new training centres is inevitably time consuming, but the aim should be to address specific modest scale needs during 2018 (possibly with LEP support), with larger developments (e.g. a new UTC in Felixstowe or applied HE Centre) having business plans in place by 2020. The proposed development of models to share equipment between providers and industry should be in place by autumn 2018.

Resources and support: co-ordinating access to industry owned facilities is a revenue cost and commercial deal which once established should be self-financing. Larger developments of new facilities will be required to develop business plans which are then funded by a combination of the providers, industry partners and public sector funds.

Intervention 5 – Tutor Development Programme

Rationale: delivery of training to the AME sector is being constrained by the lack of tutors available to teach the subject and a perception amongst employers that many current tutors have outdated technical skills which are not at the cutting edge of industry practice. With commercial salaries typically substantially higher than those paid in (especially further) education, addressing this shortfall and securing tutors at the level needed will require new thinking and collaboration between employers and training providers.

Action to be Taken: there is a need to address the shortfall in and the skills available within the pool of trainers and lecturers in the AME sector by recruiting and training more tutors. The proposed programme would be structured to explore the potential to:

- Develop multifunctional roles for experienced, older or semi-retired staff in industry who could be used to tutor younger staff (whilst admin was dealt with by full time training professionals employed by Colleges);
- Develop tutor exchange programmes to upgrade skills whereby tutors undertake placements with employers or a short term job swap into industry;
- Recognise industry experience as an alternative to formal teaching qualifications, to help broaden the pool of potential tutors available to the AME sector, with a focus on those who can inspire students and lead practical skills training;
- Develop CSR programmes which link larger AME employers with training providers to support provision with experienced and skilled staff input, even if only a 'guest lecture' basis or by hosting training events on their premises;
- Utilise seasonality in employer staff needs (e.g. aerospace winter peak and agrifood summer peaks), to identify staff who could work for part of the year in industry and part of the year in a training role.

The same need in relation to engineering tutors was identified in the Agrifood Tech sector skills plan and the potential for collaborative working with this sector should be explored.

The potential to pay higher salaries to attract tutors through using full cost recovery courses for industry should also be explored.

Leadership: industry and training providers need to work together to address this challenge, through identifying potential tutors, helping them to be trained to undertake a tutor role and supported in doing so. There is a role for the proposed NAAME skills group to promote this programme.

When: a programme to develop an increased supply of new trainers and lecturers should be developed by January 2019.

Resources and support: the potential for ESF and similar funding should be explored to support this need, possibly building on the *Industry Educator Model* developed by Bishop Grosseteste University in Lincolnshire using ESF funding.

Appendix A – Sector Skills Plan Development Process

The development process for the Advanced Manufacturing and Engineering (AME) Sector Skills Plan was overseen by a task and finish group, which met in November 2017 and January 2018. The final plan was also presented to the New Anglia Advanced Manufacturing and Engineering (NAAME) conference on 15th February 2018 where a break out group on skills was held.

The development of the plan was also informed by a meeting held by Greater Norwich Manufacturing Group in December 2017 and a series of meetings with the LEP.

In addition to this sector skills plan document, a supporting datapack has been produced which outlines the current workforce in the sector, trends in its skills levels and how the local AME sector in New Anglia compares with other areas.

This datapack also reports on the underlying socio-economic context for the AME sector locally and reports on projected changes in future skills needs and current student numbers. The datapack is presented as a separate document and provides the data to underpin many of the comments made in the sector plan and should be used as a reference source which is read in conjunction with the plan.

At the events and through one to one consultations with employers and stakeholders the key questions posed were:

Question 1 – Current and Future Skills Supply and Demand

What are the key skills issues facing the Advanced Manufacturing and Engineering (AME) Sector in New Anglia?

This could include for example:

- Workforce supply or demographics
- Labour supply
- New technology
- Recruitment and retention
- Nature of training and education provided (courses and providers)

Question 2 – Proposed Skills Actions

What are the key 3-4 actions which are needed to address anticipated skills & workforce challenges in the Advanced Manufacturing & Engineering Sector in the next 5 years?

This could include for example:

- New provision by Schools, Colleges or Universities
- New centres for training or education
- New models of delivery e.g. Higher Apprenticeships
- Groups of employers working together to procure training and skills development
- Careers advice and guidance
- New funding models
- Workforce development programmes

We are interested in both short term quick wins, as well as longer term more strategic interventions. In every case industry will need to help take the lead, steer and deliver the interventions, so what are employers prepared to invest in alongside the public sector?

Supplementary Questions

Question 3 – Consultees

- Who do you think we should be consulting in the sector in relation to future skills challenges?
- Could you supply contact details for key people who are interested in this topic and who are not here today

Question 4 – Reports on the AME industry and the sector's skills needs

- What other reports should we be consulting?
- We are particularly interested in: local and regional reports on the sector and its future development; reports specifically focused on the skills challenges in the sector

Consultees

A series of key informant interviews were conducted with a mix of employers, sector skills providers and representative bodies. In total over 50 consultees were interviewed in depth and/or attended the task and finish meetings held or provided other direct input which has informed the plan (presentations at events, referrals, links to reports). These consultees included:

1. Alex Barrett, Rocollec and Institute of Engineering and Technology (Anglian Coastal Local Network)
2. Alex Hayes, Norwich UTC
3. Alice Reeve, Hethel Innovation
4. Andrew Chappel, City College Norwich
5. Andrew Whilding, Institute of Productivity & UEA Engineering
6. Andy Rice, Cambridge Launchpad Programme
7. Cheryl Willis, Suffolk Coastal and Waveney District Councils Economic Development
8. Chris Moore, City College Norwich
9. Claire Riseborough, Step into Tech
10. Craig Fisher, Engineering UK
11. Darryl James, Felixstowe Academy
12. Dave Munro, UCP Zeller Plastik UK
13. David Henley, Easton and Otley College
14. David Pomfret, College of West Anglia
15. Ed Rose, City College Norwich
16. Gary Jefferson, West Suffolk College
17. Greg Shepherd, GT Bunning Ltd
18. Ian Nicol, National STEM manager, Career Ready
19. Jason Chapman, Dereham Neatherd High School
20. Joe Rahman, M&H Plastics
21. Jonathan Prynn, Philips Avent
22. Louise Collins, Norfolk County Council

23. Mark Bruhin, Beacon East
24. Matt Looker, NAAME sector group
25. Mike Wilson, ABB UK
26. Miranda Hayward, Cooper Roller Bearings, Kaydon part of the SKF Group
27. Nick Armstrong, Easton and Otley College
28. Nick Pull, Pitkin and Ruddock Ltd
29. Nova Fairbank, Norfolk Chamber of Commerce
30. Paul Harrison, Borough Council of Kings Lynn and West Norfolk
31. Paul Moore, Lynn Moore Engineering
32. Paul Smith, CoWA
33. Peter Devonish, Mid Norfolk Academy Trust, Dereham Neatherd High School
34. Peter van Der Horst, KLM Engineering UK Limited
35. Ray Goodman, Easton and Otley College
36. Richard Bridgman, Warren Services
37. Richard Pace, Norwich Airport
38. Richard Seager, Thurne-Middleby Ltd
39. Robert Campbell, Breckland Council
40. Robert Fawkner, Trox UK
41. Sarah Kelf, M&H Plastics
42. Simon Coward, Hethel Innovation
43. Simon Rainger, Textron (including Ransomes)
44. Simon Rhodes, City College Norwich
45. Stephen Scowen, Broadland Council
46. Sue Allott, Philips Avent
47. Sue Foster, Thurne-Middleby Ltd
48. Tim Green, Briar Chemicals
49. Tim Mills, Breckland Council
50. Verity Davidge, Engineering Employers Federation
51. Wayne Thorpe, Padgate Services Ltd
52. Will Tait, NAAME sector group
53. William Bridgman, Warren Services

The consultation process has also included reviewing the feedback collected from other key sectors of the New Anglia economy for which sector skills plans have been developed on the engineering and/or manufacturing skills supply challenges in their sectors, including the plans for: AgriFood Tech; Life Sciences and the Bio-economy; Ports and Logistics; Energy.

Additional input, advice and guidance was received from a further 12 officers of the LEP and County Councils:

- New Anglia LEP: Chris Starkie, Lisa Roberts, Natasha Waller, Alex Frost, Linn Clabburn
- Norfolk County Council: Vince Muspratt, David Dukes, Eve Cronin, Lisa French
- Suffolk County Council: Judith Mobbs, Michael Gray, Jasmine Joolia

Appendix B – Summary of DataPack & Other Sector Intelligence

Advanced Manufacturing & Engineering in New Anglia

In terms of Gross Value Added (GVA) in 2015 the sector was worth approximately £5.12bn, which equates to just over 14 per cent of the total New Anglia economy. This is an increase of £745m on 2010 (17 per cent), in line with growth across the whole economy, but does mask a drop in GVA between 2014 and 2015 of just over £60m (latest data available).

In total, the sector currently employs 84,500 people, which is approximately 11 per cent of the workforce. Employment numbers in 2015 are over 3,000 less than they were in 2010 (a fall of three per cent). Over the same period employment across New Anglia grew by seven per cent.

When looking at sub sectors the inclusion of food manufacturing means that the sub sectors of 'Processing and preserving of poultry meat' and 'Production of meat and poultry meat products' are the first and third largest with 4,600 and 3,200 workers respectively. In second place is the sub sector 'Other engineering activities' with 4,500 workers. It is worth noting that three out of the top five largest sub sectors have all experienced drops in employment between 2010 and 2015.

With regards to the structure of employment, then the Advanced Manufacturing & Engineering sector is much more geared towards full-time employment. 80 per cent of employment in the sector is full-time compared to 57 per cent across the whole economy.

In terms of enterprise numbers, as of 2016 there were 6,040 Advanced Manufacturing & Engineering enterprises operating in the New Anglia area, or ten per cent of all enterprises. Since 2010 the number of Advanced Manufacturing & Engineering enterprises has increased by 425, or eight per cent, in line with the total New Anglia rate of growth. However, this growth rate is below that seen across all New Anglia enterprises, and below regional and national growth rates for the sector (11 and 15 per cent respectively).

New Anglia Economic Strategy text on Advanced Manufacturing²³:

Sector introduction (page 14):

ADVANCED MANUFACTURING AND ENGINEERING

With several sector specific clusters of national expertise in automotive, civil aviation, composites and pharmaceuticals, manufacturing and engineering in Norfolk and Suffolk supports a number of key sectors. The advanced manufacturing and engineering sector in Norfolk and Suffolk reflects the area's diverse economic strengths. The sector links into the supply chain of specialisms such as agriculture and food production, civil aviation, transport, pharmaceuticals and energy. Hethel Engineering Centre is the regional hub for innovation and technology and has the potential to expand to meet the demand for incubation space in this growing sector. Businesses are working together with UEA, through the New Anglia Advanced Manufacturing Engineering sector group, to develop a new Institute for Productivity. This will build on UEA's expertise in business education and engineering. There are several specialist advanced manufacturing and engineering companies in the area, including: Lotus (Hethel), a class-leading manufacturer of sports cars; Multimatic (Thetford), a specialist in vehicle dynamics; and Philips AVENT (Glemsford), producing infant feed and health accessories.

²³ New Anglia (2017), The East: Norfolk and Suffolk Economic Strategy - A Strategy for Growth and Opportunity

Skills section (pages 20-21):

DRIVING INCLUSION AND SKILLS Our people, whether in traditional careers, micro businesses, arts and culture or supporting others in the community are central to all our ambitions and goals. We want to raise and support aspiration across all ages. Good progress has been made in raising skill levels, but we want to go further and faster, particularly for those already in work. We will help our young people set their ambitions high and understand the exciting local careers available to them.

Our area is one of significant economic opportunity, with high levels of employment. We will give people the information they need to know to make informed decisions on the skills, capabilities and opportunities they need to succeed. We will encourage businesses to invest in and providers to respond quickly to, the long term needs of people and businesses.

We will design our actions and investment so that they enable growth that directly supports wider community benefits, including wellbeing, health and care.

TOGETHER WE WILL:

- Through the development of sector skills plans produce clear statements about the skills businesses need now and in the future, to influence providers, business investment and personal choices by new students and those already in the workforce.
- Develop an integrated skills offer for businesses across Norfolk and Suffolk, to make it easier for them to navigate and access the initiatives and provision that are available. We will focus particularly on the long term development of technical skills in our existing workforce.
- Prioritise capital investment on provision that will deliver the future skills our sectors and workforce need. Taking a commissioning approach and being clear about what must be provided. We will use Skill Deals programme to drive innovation aligned to local economic need.
- Prioritise leadership support for our entrepreneurs and those in new high growth businesses, through further accelerator support, business mentorship. Providing the ecosystem that new entrepreneurs need to succeed.
- Deliver the Youth Pledge for all our young people, providing an integrated offer that shows and inspires young people about the opportunities that exist and provides support to enable them to access them, including support into employment.
- Step up our efforts to promote and support the delivery of high quality apprenticeships providing clear entry routes into our focus sectors, directly produce the skills and capabilities our economy needs – including higher level technical skills through degree and higher level apprenticeships.
- Work with Government to establish an Institute of Technology that builds on our strengths and meets the increasing need for higher level technical skills in key areas such as energy, engineering and manufacturing.
- Grow the number of Enterprise Advisers and the number of schools that are engaged. Further strengthening the link between the business and education community in order to drive young peoples' aspirations and work readiness in line with the requirements of the local economy.

Youth Pledge Every young person (16-24) in Norfolk and Suffolk will get the personal support they need to get an apprenticeship, training, work experience or a job within 3 months of leaving education or employment.

- Expand the education pipeline within our Primary and Secondary Schools, by engaging children in Science, Technology and Engineering skill development within their curriculum to prepare them as the region's future workforce.
- Develop new approaches and remove barriers to getting people back into work, especially for those furthest from the jobs market and provide support for all into sustained employment. This will include our pilot work and health programmes, the delivery of high quality basic skills training in English, Mathematics and ICT and the development of pathways for young people and adults with special educational needs and disabilities (SEND) to move into supported employment. And developing opportunities to capitalise on the skills, knowledge and experience that the over 65's population offer. Our ambition is to extend the principles behind our integrated approach for young people and the Youth Pledge to adults.

"Driving skills and high quality employment is fundamental to our goals to create a more inclusive economy, with improving wage levels, living standards and attainment."

INTERNATIONAL AVIATION ACADEMY – NORWICH

We have the world's first Aviation Academy in Norwich.

This will work in partnership with providers and industry to provide pathways for young people through to careers in all aspects of the aviation industry, which is facing a global skills shortage. This offer will be extended to ages 8-18 to embed skills into the academic learning process with a linked FE and HE route for students

New Anglia website text on Advanced Manufacturing Sector²⁴:

We are home to several advanced manufacturing clusters, including automotive, civil aviation, composites and pharmaceuticals. Manufacturing and engineering in Norfolk and Suffolk supports a number of key sectors.

The advanced manufacturing sector in Norfolk and Suffolk is a reflection of the area's diverse economic strengths. Advanced manufacturing strengths include civil aviation, pharmaceuticals and energy supply chains. Hethel Engineering Centre is the regional hub for innovation and technology and is expanding to meet the demand for incubation space in this growing sector.

There are several specialist advanced manufacturing companies in the area, including: Lotus, a class-leading manufacturer of sports cars; Multimatic, a specialist in vehicle dynamics; and Sanofi, a leader in biotechnology and pharmaceuticals.

The manufacturing and engineering industry is changing: with a shift away from metal to composite materials; a focus on renewables and biological substances; industrial biotechnology and plastic electronics; and new aerospace technologies. Suffolk and Norfolk have already established itself as a centre of excellence within these areas and we have both large employers and concentrations of smaller businesses across Suffolk and Norfolk, all making their mark as experts and innovators.

²⁴ New Anglia (2018), <https://newanglia.co.uk/project/advanced-manufacturing/>

Our Sector Group

New Anglia Advanced Manufacturing and Engineering (NAAME) provides a business-led voice and secures income to deliver business support programmes, pilot innovation programmes and support for business start-ups. The group works with the LEP on skills and innovation projects.

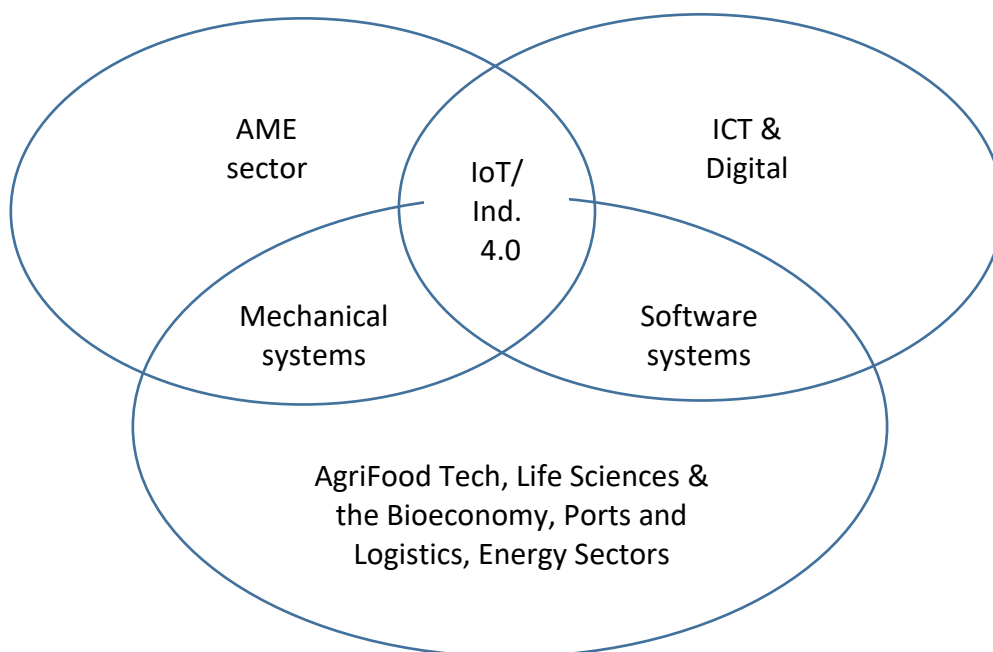
By bringing businesses together, NAAME aims to improve facilities, raise attainment and aspiration and encourage inward investment.

Links to Other Sector Skills Plans

The AME sector has a major overlap with other key sectors of the New Anglia economy including in particular the traditional use of mechanical systems built by engineers and supplied by AME companies to 'end users' in the agrifood tech, life sciences and the bio-economy, ports and logistic and energy sectors. These 'end user' sectors have also traditionally drawn on expertise from the ICT and digital sector through the supply of software systems.

Evidence from the consultations for the sector skills plan and other reports, however, suggest that the area which is now expanding rapidly is the area in which engineering and manufacturing, enabled by ICT and digital systems creates new processes used by these 'end user' sectors – the concept behind Industry 4.0 or the Internet of things – as illustrated below:

Fig 1 Relationship between the AME, ICT/digital and 'end user' sectors



Future skills investment for the Advanced Manufacturing and Engineering will therefore need to link closely with skills investment in other New Anglia key sectors which are developing sector skills plans including:

- AgriFood tech – as the largest manufacturing sector in New Anglia (and nationally) the agrifood sector is a major user of engineering. As the food chain embraces automation and digitalisation to address major labour cost pressures, constraints on labour supply and the relentless drive for competitiveness, the industry will need to work closely with the AME sector. Many agrifood tech companies, particularly large ones, directly employ

specialist staff with AME sector skills to provide in house expertise to design, construct, install and maintain mechanical and control systems.

- Life sciences and bio-economy in New Anglia have traditionally been focused on research and development and a relatively small number of very sophisticated manufacturing companies utilising high end AME skills. However, as noted in the adopted Life Sciences and Bio-economy Sector Skills Plan for New Anglia, this sector is believed to have significant growth potential if it can commercialise more of the science base to manufacture products which support the growth of the bio-economy. To do this it was recognised that the Life Sciences and Bio-economy sector needed to draw on AME skills and to work collaboratively with AME sector companies.
- Ports and logistics - the LEP's large logistics industry is keen to invest in new more efficient technology, but is reporting a major challenge in the supply of engineers to facilitate growth. The freight, storage (including cool chain and ambient) and supply chain infrastructure is a major user of vehicles, mechanical and control systems which are designed, supplied and serviced by the AME sector. The ports and logistics sector expects to invest more in automation both to address staff supply challenges and as new systems, such as autonomous vehicles and automated warehousing are rolled out across the industry, with the next decade predicted to see major changes in the industry in this respect.
- ICT and digital – as noted above all feedback suggests that there is increasing collaboration between the AME and ICT and digital sectors, with for both sectors the largest growth sector being the 'cross-over' between the two sectors which is emerging as Industry 4.0 / the Internet of Things (IoT). All consultees expected this to continue and regarded the need to invest more in ICT and digital training and to ensure that ICT training met the needs of real World applications in the AME sector as essential to the growth of the AME sector in the next decade. Consultees stressed that employees who had skills drawn from both sectors were in particular demand and could command higher salaries in dynamic, fast moving careers as the AME sector adopted Industry 4.0.
- Energy - renewables, oil and gas are large sectors which create major demand for advanced engineering solutions in the New Anglia area. With major future growth of, in particular, offshore wind predicted, as well as new technology in oil and gas and ongoing decommissioning work of older fields in the North Sea, the expectation is that the demand for engineering and advanced manufacturing skills will remain. Subject to funding and approvals being secured, the energy sector could also in the next two decades see the development of the region's largest engineering project at Sizewell C. If this development occurs it is alone expected to create demand for 15,000 construction and engineering staff over an extended period of time.

Appendix C - Current Skills and Training Provision for AME

The range of education and training provision for the AME sector is very broad and includes provision in schools (primarily careers advice and projects), further and higher education as well as industry led training and projects funded by the New Anglia Skills Deal programme.

The listing below is not exhaustive, but is intended to give an overview of the range of provision available in Norfolk and Suffolk or accessed by companies there.

Schools

There is a wide range of teaching and careers support available for schools in relation to engineering, with major national programmes run by organisations including The Institution of Engineering and Technology (IET)²⁵ which (working with Tomorrow's Engineers) links to a wide range of programmes such as:

- IET Faraday teaching resources for KS3-5
- IET Faraday Challenge days KS3
- IET Stem ambassadors
- IET First Lego League KS2-4
- Arkwright Engineering Scholarships
- E3 Academy for electrical engineering courses at selected Universities
- Engineering (up to £15,000 per project) and School (up to £500 per school) grant schemes to promote engineering

In addition to national programmes the region also has a number of programmes focused on STEM careers advice, guidance and experience including:

- Step into Tech – a social enterprise based in Norfolk focused on coding and STEM provision for young people;
- The Dudgeon STEM programme targeted at the 12-16 age group and supported by the Dudgeon Offshore Wind Farm provides grants for STEM related courses and projects

Further and Higher Education

UEA has developed an Engineering School with a particular focus on the energy, automotive, aerospace and mechanical and manufacturing sectors. UEA offers:

- BEng Engineering
- MEng Engineering
- BEng Energy Engineering with Environmental Management
- BEng Energy Engineering
- MEng Energy Engineering
- BEng Engineering with a Year in Industry
- MSc Energy Engineering with Environmental Management

UoS offers:

- HNC/HND Mechanical Engineering

College provision in engineering and manufacturing across the LEP area, includes:

City College Norwich:

- L2 Aviation Engineering IAA;

²⁵ IET (2015), IET Education for Science, Design & Technology, Engineering, Maths and Computing

- L3 Access to HE engineering;
- L2 Apprenticeship Electrical Engineering;
- L3 Apprenticeship Engineering Maintenance;
- L2 and L3 Apprenticeships in Fabrication and Welding;
- L2 Apprenticeship in Mechanical Engineering;
- L3 Apprenticeship in Mechanical Manufacture Engineering;
- BSc (Hons) Professional Aviation Engineering Practice;
- HND Electrical/Electronic Engineering;
- HND Mechanical Engineering;
- L3 diploma Mechanical Engineering;
- L2 and L3 diploma in Electrical Installations;
- L2 CNC machining;
- L3 Electrical Installation/Maintenance Apprenticeship;
- L1 diploma in Engineering;
- L2 diploma Electrical Installation;
- L2 diploma in Engineering;
- L3 diploma in Electrical Installation;
- L2 Motor Vehicle Service and Maintenance Technician Apprenticeship;
- Access to HE: Engineering

College of West Anglia:

- Autocad 2012 Introduction (CAD 1)
- Autocad Level 2 City & Guilds Award in 2D Computer Aided Design 7579-02 (CAD 2)
- Autocad Level 3 City & Guilds Award in 2D CAD 7579-03
- Level 3 (CAD 3) Bridge to Motor Vehicle - Entry Level; Business Improvement Techniques
- Level 2 (NVQ Diploma) (Workplace)
- Business Improvement Techniques - Level 3 (NVQ Diploma) (Workplace);
- Civil Engineering - Level 4 (HNC)
- Electrical and Electronic Engineering - Level 4 (HNC)
- Electrical Fault Finding Techniques (EFF 1 and 2) - Bespoke
- Electrical Installation - Practical Skills - Level 2
- Electrical Maintenance Refresher for Maintenance Engineers - Bespoke
- Electrical Skills Assessment - Bespoke
- Electricity at Work Regulations 1989 - Bespoke
- Electrotechnical Installation - Apprenticeship (Advanced) - Level 3
- Engineering (Improving Operational Performance) - Apprenticeship (Intermediate) - Level 2
- Engineering - Level 2 (Extended Certificate)
- Engineering - Level 3 - Extended Diploma
- Engineering - Level 3 - Extended Diploma - Anglian Water @One Alliance
- Engineering Maintenance: Food and Drink - Apprenticeship (Advanced) - Level 3
- Engineering Manufacture (Fabrication & Welding) - Apprenticeship (Advanced) - Level 3
- Engineering Manufacture (Mechanical Production, Maintenance, Technical Support and Electrical/Electronic) - Apprenticeship (Advanced) - Level 3
- Engineering Manufacture (Mechanical Production, Maintenance, Technical Support and Electrical/Electronic) - Apprenticeship (Advanced) - Level 3
- Engineering Skills - Intermediate - Level 2; Engineering Skills - Level 1 (Diploma)

- Fundamental Maintenance Skills for Production Maintenance Engineers - Bespoke
- Fundamental Workshop and Machine Shop Safety - Bespoke
- Hydraulic Systems Maintenance Skills - Bespoke ; Industrial Automation Programmable Logic Controllers (PLC 1)
- Industrial Automation Programmable Logic Controllers (PLC 2)
- Industrial Electrical Maintenance Skills for Maintenance Engineers (City & Guilds 2323)
- Introduction to Welding - Part-time
- Level 3 Award in the Initial Verification and Certification of Electrical Installations (City & Guilds 2394-01)
- Level 3 Award in the Periodic Inspection, Testing and Certification of Electrical Installations (City & Guilds 2395-01)
- Mechanical Engineering - Level 4 (HNC)
- Motor Vehicle - Service and Repair - Level 1
- Motor Vehicle - Service and Repair - Level 2
- Motor Vehicle - Service and Repair - Level 3
- Motor Vehicle Maintenance and Repair - Apprenticeship (Advanced) - Level 3
- Motor Vehicle Maintenance and Repair - Apprenticeship (Intermediate) - Level 2
- Motorsport - Level 2
- Motorsport - Level 3
- Petrol Driven Cut-off Saws
- Pneumatic Systems Maintenance Skills - Bespoke
- Portable Appliance Testing Code of Practice for In-Service Inspection & Testing of Electrical Equipment - City & Guilds 2377
- Safety in the Use of Abrasive Wheels - Provision and Use of Work Equipment Regulations (PUWER 1998) HSE - HSG 17
- Unvented Hot Water Storage Systems
- Vehicle Body and Paint Operations - Level 2 (Diploma)
- Vehicle Body and Paint Operations - Level 3 (Diploma)

East Coast College:

- Motor Vehicle Maintenance Level 1
- Motor Vehicle Maintenance Level 2
- Electrical Engineering Skills
- Engineering Skills
- EAL Extended Diploma in Engineering Technologies
- Mechanical Engineering Skills – Manufacturing/Machining
- Pre-Apprenticeship Engineering
- Extended Diploma in Mechanical Manufacturing Engineering
- Diploma in Performing Engineering Operations
- Extended Diploma in Engineering Maintenance and installation
- Engineering – Welding & Fabrication L2
- Engineering – Welding & Fabrication L3
- Energy L3
- Energy Skills
- Award in Computer Aided Design and Manufacturing
- HNC/D Engineering
- 90 Credit in Engineering
- Extended Diploma in Engineering

- Diploma in Operations and Maintenance Engineering
- Principles of Engineering Maintenance, Installation and Commissioning
- Mechanical Engineering Skills – Manufacturing/Machining
- Motor Vehicle Maintenance Level 1
- Motor Vehicle Maintenance Level 2
- Motor Vehicle Maintenance L3
- HNC/D Engineering
- Higher National Certificate in Operations Engineering
- Welding and Fabrication Level 1
- Welding Evening Classes
- Engineering – Welding & Fabrication L2
- Engineering – Welding & Fabrication L3

East Norfolk Vllth form College:

- Engineering (single) BTEC L3

Easton and Otley College:

- L2 diploma in land based engineering;
- L3 extended diploma in agricultural engineering;
- Apprenticeship land based service engineer; apprenticeship land based service engineer technician; heavy vehicle service and maintenance technician; light vehicle service and maintenance technician;
- L1 diploma in vehicle maintenance;
- L1 IMI diploma in service and maintenance engineering;
- L2 certificate in fabrication and welding;
- L2 diploma in light motor vehicle maintenance and repair principles;
- L3 diploma in light vehicle maintenance and repair principles

Suffolk New College:

- EAL Diploma in Performing Engineering Operations;
- EAL L2 Diploma in Fabrication and Welding Engineering Technology;
- IMI entry level Diploma for the introduction to vehicle technology;
- IMIA L1 Diploma in Vehicle Maintenance;
- IMIA L2 Diploma in Vehicle Accident Repair Principles and Paint Operations;
- IMIA L2 Diploma in Vehicle Maintenance Repair Light Vehicle;
- IMIA L3 Diploma in Vehicle Accident Repair Principles and Paint Operations;
- IMIA L3 Diploma in Vehicle Maintenance Repair Light Vehicle;
- CAVA Access to HE IT & Electronics;
- FdSc Civil Engineering and BSc (Hons) Civil Engineering (Progression Route) with University of Suffolk

West Suffolk College:

- L2 engineering diploma
- L3 engineering extended diploma
- Progression to automotive engineering
- Electrical and Electronic Engineering - Advanced Apprenticeship
- Engineering Technical Support - Advanced Apprenticeship
- Fabrication and Welding - Advanced Apprenticeship
- Fabrication and Welding Engineering - Intermediate Apprenticeship

- Installation Electrician/Maintenance Electrician Level 3
- Maintenance and Operations Engineering Technician Level 3
- Mechanical Manufacturing Engineering - Advanced Apprenticeship
- Motor Vehicle Service and Maintenance Technician Level 3
- Performing Engineering Operations - Intermediate Apprenticeship
- City and Guilds 2391-52 Combined Inspection and Testing
- Introduction to Welding
- Electrical Electronic Engineering Diploma Level 3 Part Time
- Mechanical Engineering Diploma Level 3 Part Time
- FDEng Mechanical Engineering
- HNC Mechanical Engineering
- HND Mechanical Engineering
- BEng(Hons) Mechanical Engineering (progression route)
- FDEng Electrical Engineering
- HNC Electrical Engineering
- HND Electrical Engineering
- BEng(Hons) Electrical Engineering (progression route)
- FDEng Electronic Engineering
- BEng(Hons) Electronic Engineering (progression route)

Consultees also reported accessing specialist national training provision in AME primarily at University level e.g. at Loughborough and other universities which specialise in the sector.

Industry Led Provision

As noted by many consultees, the specialist nature of many employers in the AME sector means they also utilise national training expertise, from Colleges, Universities, private sector providers and trade bodies. For example the Engineering Employers Federation (EEF) provides a range of tailored industry courses through programmes such as its 'Lean Academy'²⁶. EEF also provides courses on leadership and management (accredited by ILM and CMI) at every level from team leaders to senior executives and, for primarily for engineering companies provides in depth specialist support and consultancy on HR issues.

The International Aviation Academy Norwich (IAAN at Norwich Airport is a joint venture between local partners and the Aviation Skills Partnership, with IAAN promotion stating that:

'IAAN is the first of Aviation Skills Partnership's (ASP's) skills academies. It is a unique collaboration of employers, trainers, educators, funding bodies, government, industry and, of course, students and delegates. As more are opened across the country, access to expertise and resources will grow even further. We will provide students with a comprehensive, cutting edge, and hands-on training, unrivalled anywhere.

The International Aviation Academy – Norwich (IAAN) is a brand-new, purpose-built training academy that will create the next generation of aviation professionals. We offer training across all six of the Aviation Skills Partnership's areas of aviation:

²⁶ EEF (2017), Achieve Sustainable Business Growth: productivity improvement support



- **Professional Pilot**
- **Operations**
- **Air Traffic Control**
- **Cabin Crew**
- **Airport Operations**
- **Aviation Engineering and more...**

We have created a unique and original real world learning environment that will truly allow our students to experience the aviation industry. Our facilities include a full size operational aeroplane for unrivalled accuracy in our aviation simulations, we also have a helicopter arriving in due course. We will welcome a broad range of local, national and international students and delegates, and will raise the standards of learning within the aviation industry.

One of the mainstream programmes within the Academy will see up to 80 new aviation engineers being trained per year. They will start training at the age of 16. Across this and other courses, we expect a typical year to see 450 people being trained for local, national and international aviation jobs.

The Aviation Engineering courses at the Academy are from Level 2 through to BSc Professional Aviation Engineering Practice in conjunction with Norwich City College and KLM UK Engineering.

We will also connect with the local schools, colleges and universities, creating opportunities for children as young as 8 to link with the academy.'

New Anglia Skills Deal Programme

The programme has seen good interest from the AME sector in accessing skills deal funding. Projects which relate to the AME sector as at December 2017 included:

| Project Title/Status | Description |
|---|---|
| Welding and Fabrication Centre Applicant: Ransomes Jacobsen / Suffolk New College Approved Funding: £150,000 Match: £357,473 | A new welding and fabrication for training in Suffolk which opened in autumn 2017. Skills Deal funding will be used to support the training and other revenue costs to establish the centre in its first two years. Proposal includes: <ul style="list-style-type: none"> • 283 people trained or re-skilled in welding and fabrication • 70 regional firms engaged • 30 new jobs including apprenticeships • Specialist training provision that will continue beyond the two years of the proposal A new Welding and Fabrication centre was launched at Suffolk New College in March, incorporating a virtual training facility. Delivery of provision has begun. 30 participants have been trained to date. |

| | |
|--|---|
| <p>Enhanced Engineering Facilities</p> <p>Applicant: Hi-Precision Ltd./ Suffolk New College</p> <p>Approved Funding: £140,000</p> <p>Match: £140,000</p> | <p>A project that provides enhanced engineering facilities at Suffolk New College which will allow, for the first time, the ability to offer training in the manufacture of bespoke machinery parts. Employers are currently having to access training out of the area.</p> <p>The application is currently subject to "Due Diligence".</p> <p>Proposal includes:</p> <ul style="list-style-type: none"> • Enhanced engineering facilities • 10 Advanced Apprenticeships in Engineering Manufacture • 32 Awards & Diplomas in Engineering and Engineering Manufacture |
| <p>Training for students and employees in specialist skills - Industry 4.0 & Automation</p> <p>Applicant: Warren Services/ West Suffolk College</p> <p>Approved December 2017 subject to due diligence</p> <p>Funding: £150,000</p> <p>Match: £150,000</p> | <p>A project that provides an industry 4.0 training centre for the region with associated training courses for students preparing to enter the employment market and employers looking to upskill adult staff and implement new and advanced manufacturing processes to help thier businesses stay up to date with international advances.</p> <p>The application is currently subject to consideration of "Expression of Interest".</p> <p>Proposal includes:</p> <ul style="list-style-type: none"> • Development of Industry 4.0 based modules for students and employees to study • 80 full time level 3 engineering students • 50 part time HNC/D Engineering Students • 100 Engineering Apprentices • 25 SME's employees • 20 Adults wishing to retrain/gain employment in the industry |

The AME sector thus has three (subject to due diligence) approved projects out of seven across all sectors. A further two projects related to the AME sector have been invited to submit full applications following expressions of interest.

Task and Finish Groups

In addition to the feedback from individual consultees and attendance at other events, the process to develop the plan included two dedicated larger consultation events on 15th November and 22nd January, a summary of which is recorded below.

Meeting summary from Task and Finish Group at Hethel Engineering on 15th November 2017

Sector profile

The perception is that the sector is seeing slow but steady growth with new regulations, market needs or technology driving a need to upgrade existing equipment e.g. new refrigeration regulations due in 2020 will lead to major changes in skills needs.

New machines, such as CNC lathes, are typically £2-400k and require high levels of ICT skills as well as engineering skills. A feeling was expressed that the UK is behind the curve and has been slow to adopt these types of equipment compared to other countries.

Workforce and Skills Issues

A wide range of issues were discussed including:

Workforce supply:

- Recruitment of experienced staff (30+age group) is generally done through national advertising using recruitment agents as there is a lack of local supply.
- Specialist CPD is also a national market as there is not enough local demand to offer courses in all areas.
- The demand for CPD is growing given the speed of change in the industry and the technology it is using.
- Some work e.g. engineering design work, is being contracted out of the region or UK to access specialist skills. This is the reality of modern global supply chains and it is important for New Anglia to be clear on what we can do well locally and accept that for some other skills it may be preferable to work with global centres of expertise.

Industry and stakeholder responsiveness:

- The Stop/Start nature and complexity of skills / careers initiatives is a major problem in retaining industry commitment and interest in skills programmes.
- The ageing workforce and major new developments, such as the potential Sizewell plant, means that there are growing concerns about future workforce supply.
- The skills supply for some substantive sectors, e.g. polymers, is currently lacking and is not addressing market needs (there is some limited national provision).
- Networking is poor both between education providers and business and between businesses themselves. The business community needs to do more to support each other and promote the sector as a career of choice.
- The importance of 'REAL' Work Experience to inspire young people and its current dysfunctional nature from an employer perspective means the sector is finding it hard to attract the next generation.

- There is lots of potential locally with some innovative ideas progressing such as the Institute of Technology (IoT) bid and the Institute of Productivity concept, but these need to ensure they deliver for industry.

Current course provision:

- Some sectors don't have appropriate apprenticeship provision e.g. ventilation engineering. A general concern that the frameworks are very rigid and don't meet the needs of many companies.
- Education exit points don't meet industry needs and expectations, whether at school or University/College level. Key challenges exist in relation to technical and employability skills of those entering the industry.
- There is a need for clearer pathways for engineering / manufacturing career progression through vocational progression as well academic routes.
- Even graduates or post graduates need to be viewed as 'trainees' for 3-4 years when they arrive in a company as in most cases they lack the practical and commercial skills needed and are not 'job ready'.
- Some businesses have moved provider (within the region) due to problems with the quality of provision and because they were sent students who did not meet industry needs.
- There is a need for both core generic skills and in company expertise (given the diversity and very specialist nature of most companies in the AME sector). Generic skills include: control systems, digital, programming, servos/motors, fluid dynamics, new materials, additive manufacturing, energy efficiency, communications and STEM foundations. Engineers also need to develop basic hand skills to use tools and to have dexterity.

College and University facilities and staffing:

- Major challenges in relation to the level of skills and industry awareness amongst teachers and lecturers. More broadly there is a problem in recruiting the lecturers and teachers needed in technical and engineering disciplines.
- Some employers find it hard to engage with Colleges as course planning is poor or late, meaning date and room changes which makes it hard to fit around work.

Potential Solutions

The discussion identified one overarching need: the need to improve networking and collaboration between industry and training providers. It was felt that this must focus on:

- Two way communication so that industry can help support training providers and vice versa, so that education and skills providers deliver what is needed by employers.
- Building connectivity / collaborations through employer networks at a local level, but also to scale these up at regional level e.g. NAAME cluster developments. Improved connections can help deliver new on-site learning space / shared CPD to support competency development / broader business / skills collaborations / retaining local skilled staff in area / shared commissioning of training / apprenticeships (especially Levy - payers - including using the new supply chain flexibility of 10%)
- Mapping existing initiatives and seeking to present these coherently to employers. This needs to embrace new activities such as the proposed Institute of Technology (IOT) and

Institute of Productivity (IOP) to ensure they are connected to and add real value to the AME sector.

In the longer Term there is a desire to strengthen skills governance with a region-wide steering group - probably via NAAME - backed up by local clusters which also need strengthening

In parallel to and supported by improved links between employers and training providers, a number of key areas for action were identified:

1. Careers

- Improved careers advice is needed at school and College/University level, to explain the breadth to careers in AME – this needs supporting by businesses more so that there is a clear pull in the system.
- STEM clubs in schools and a reboot of the STEM Ambassador scheme (perceived as successful) are seen as really useful ways to grow the AME workforce supply.
- There is a need to address low awareness of initiatives such as Icanbea / the Skills Pledge both amongst employers and other stakeholders.

2. Work Experience

- Work experience at school age is critical but currently perceived to be poor quality – it needs to be more flexible so that businesses can offer real experience and students need to be better prepared for it. In Norfolk there tend to be set weeks for work experience which often don't fit with businesses, whereas Suffolk is more flexible and this approach needs extending to Norfolk to fit with employers.
- Schools often lack engineering work experience opportunities due to real or perceived barriers and this means most students do work experience in other sectors (40% school students at a represented school went into retail this year). The industry and schools need to work together to correct this.
- There is a need to tackle the pre and post 16 work experience offer to improve its utility / accessibility and reduce its bureaucracy for employers in areas such as H&S / DBS etc.

3. Types of provision

- Higher Apprenticeships are a good development and could address many of the current weaknesses of graduates not being work ready and open up the sector to new students, but they need more support and development.
- There is a need across all provision to increase the supply of ICT skills to enable modern next generation (Ind 4.0) manufacturing through the development of programming skills and coding
- There is also a specific skills shortage of engineering design skills in the region which needs to be filled by providers

4. Access to State of the Art Equipment

- The provision of state of the art equipment by businesses to help run training courses e.g. CNC machines, could help to ensure that students are trained on the latest technology. It is recognised that this will require new arrangements between training providers and industry and training provision may need to be more flexible to fit around machine availability, but willingness on both sides could solve these limitations.

Meeting summary from Task and Finish Group at Hethel Engineering on 22nd January 2018

The meeting on 22nd January focused on reviewing the overall conclusions and focus of the draft plan and how the proposed actions could be delivered. This feedback was then used to finalise the sector skills plan.

General Comments:

Consultees were clear that the AME sector faces very real challenges in securing its future workforce. Addressing this requires increased visibility of the sector and its growth and career prospects.

The need for a step change in public/private skills investment is clear, because at present a culture of poaching skills is evident from many employers and the ratcheting up of salaries is in danger of making some companies unviable (and also makes it impossible to recruit tutors given the salaries in industry).

All consultees wanted to see a much more joined up approach, in which clear career paths supported by education and skills progression routes are available. There is a risk that we focus too much on new (young) entrants to the industry, rather than retraining the existing workforce to embrace new technology and improve productivity.

Feedback on recommendations, actions and their deliverability

Overarching: AME sector Skills Group should be established to advise on skills development for the sector in Norfolk and Suffolk

This was felt to be sensible and NAAME was clearly favoured as the body to lead this work, although there are some concerns which need to be addressed (by NAAME and the LEP) about how the sector group and its proposed work on skills is resourced.

A number of companies including Warren Services, M+H Plastics, Thurne Middelby, Trox UK and Lynnmoore Engineering are thought to be keen to support this work.

It was stressed that the group should ensure that it focuses on strategic issues and avoids being seen to dominate good local initiatives which are being taken, for example through the NAAME sub groups like the Greater Norwich Manufacturing Group or the group in West Norfolk coordinated by the Borough Council.

It was felt that the skills group should promote a 'joined up' approach both to identifying the issues and coordinating delivery. Key roles would be to champion regional scale projects and map what is happening.

There is a need to ensure that the group is representative geographically, by company size and by sub-sector given the diversity of the AME sector.

Headline action - Industry 4.0 Challenge Programme working across the AME and digital tech sectors in New Anglia to ensure that the New Anglia AME sector has the skills needed to deliver new manufacturing and engineering technologies

Whilst recognising that Industry 4.0 is not the only challenge, there was widespread support for the focus on this topic and a feeling that it could be pushed even harder in the sector skills plan, given that it will affect all businesses in the AME sector.

It was felt that it should be led by the proposed skills group with significant employer representation plus providers. Critical to success will be to align investments being made by many providers with the proposed Institute of Technology and the Institute of Productivity

into one comprehensive offer and programme. There is a need to explore how this relates to and could be a major theme in both the development of the Local Industrial Strategy the LEP is leading and the local delivery of the Shared Prosperity Fund.

A view was expressed that industry would certainly need to get involved as it would be as much a pull as a push because of the business necessity, although businesses would primarily rather engage at a project level rather than around the policy development which they saw as a LEP role.

Careers of the Future Programme to ensure that the sector projects the career opportunities in AME effectively, both to school age and older students

There was good support for the need to focus on careers and future workforce supply. It was felt that the skills group should try to provide an oversight of careers / STEM advice.

In delivering a skills theme it was noted that there is a need for more role models, both individuals and businesses. The current model of CEIAG and work experience was seen as very ineffective in terms of promoting opportunities within the AME sector and inspiring young people and there was a view that we need to start earlier at age 9-11.

It was also stressed that the industry is poor at selling itself and many members of the public don't appreciate that the sector is growing, has good careers and high salaries. It was also suggested that the Norwich Cambridge Technology Corridor should be used to help promote AME careers and gather together job adverts so that the sector is shown to be large and vibrant.

Manufacturers need to open their doors for careers events, but need help and advice to address the perceived problems with health and safety and insurance. It was also recognised that transport for young people to access events or work experience run by industry was needed. It was suggested that pop up careers advice stations for AME could be useful in public places and at careers events.

Employers were keen to look at whether any unspent Apprenticeship Levy could be used flexibly to support careers promotion.

There was also support for the idea that New Anglia needs a 'science centre' as a physical beacon to inspire young people (although a recognition that this is a longer term aim due to lack of obvious funding). It would be a collaboration with local businesses who would showcase their businesses and capabilities on a 'rota' basis with school hosting and build on best practice from some large cities in the UK.

Developing AME Course Provision to ensure that courses meet changing employer needs and that this is supported by government funding frameworks

There is real frustration from both providers and employers that current national frameworks and standards are out of date, have gaps and don't allow progression from FE to HE as easily as they should. The diversity of local employer needs and the speed with which topics such as Industry 4.0 are advancing means that fixed standards and frameworks are no longer applicable. Employers would like to see more local devolution so that they can work with providers to design courses which meet real employer needs in a responsive way.

Addressing this was seen as a pressing issue, which needs addressing in the next 1-2 years if the UK is to create the skills needed by Industry 4.0. The need to have courses which combine engineering and IT is central to this challenge.

Industry 4.0 will also create a big demand for cyber security skills, both for employed in house staff with practitioner skills backed up by specialists, but nobody is teaching it at present due to lack of teaching staff as anyone with the skills can earn far more in industry. Initially Industry 4.0 will lead to an increase in the demand for Control Engineers.

There is likely to be four global players providing ICT frameworks for the Internet of Things, end user businesses will mainly access these via operating systems. This means that the challenge will not necessarily be 'coding skills' but rather 'configuration skills' and systems integration and it is critical that these skills are delivered locally (see 'connected enterprise' on a google search).

Physical Facility Development Programme by identifying opportunities to share resources between industry and training providers and to create new or enhanced physical facilities and training centres

It was stressed that physical facilities and tutor supply needs have to be developed in parallel and that shiny new buildings without the staff to deliver courses were a waste of resources. It was felt that too often current competitive funding focused on capital investment without the parallel revenue funding support.

There was very strong support for the idea that New Anglia needed a strategic investment plan for AME skills infrastructure, which should seek to coordinate investment by Colleges, Universities and through programmes such as Institutes of Technology and the Institute of Productivity. However, it was also stressed that this should not be inward looking and only look at facilities inside Norfolk and Suffolk as industry regularly and some local providers (e.g. CoWA, WSC) work across the regional boundary. It is therefore vital to compliment and work with physical facilities in neighbouring counties. In a few specialist areas this approach needs to extend to linking with national specialist centres when it is not economic to provide the facilities needed locally.

Tutor Development Programme to increase the supply of tutors, full and part time, to help deliver the skills development needed by the AME sector

There was a clear recognition that tutor supply is a major problem. Particularly in FE salaries and conditions of employment are widely seen as poor which makes it very hard to attract staff. It was reported that in many cases the students are earning more than those who are being asked to teach them and this leads to many tutors leaving to move to industry. The higher salaries in industry are expected to continue to grow given the demand for AME skills and this will make this problem worse.

It was suggested that unless FE can pay more for staff, potentially by using CPD courses to increase incomes and thus salary rates, it will not be possible to solve this problem. There is some scope to use engineers at the end of their careers (often part time and most do not want to do the paperwork which is required in FE) or guest lecturers as part of CSR programmes, to help provide staff resources, but these do not replace the need for full time younger tutors. All providers are reporting a lack of tutors and a casualization of the workforce which makes course delivery very challenging. Some employers reported that they were happy to help provide CPD for tutors, but the problems of releasing staff from FE Colleges to find time to do this was also noted.

Annex 1 – East of England Science and Innovation Audit (SIA) Extract adapted from the Summary Document²⁷:

1: Introduction

In Autumn 2015, the UK Government announced regional Science and Innovation Audits (SIAs) to catalyse a new approach to regional economic development. SIAs enable local consortia to focus on analysing regional strengths and identify mechanisms to realise their potential. The East of England¹ – defined in relation to four Local Enterprise Partnership geographies² – is home to some of the UK's foremost scientific research strengths and innovation capabilities. These are vested in a dynamic private sector and across world class universities and research organisations. They are being animated through more-or less formal networks (of entrepreneurs, investors and researchers) which are now well established within a distinctive and world class innovation ecosystem.

The East of England defined here is not the same as the (old) Government Office Region with the same name. Some data are only available at the level of GORs and where that is the case, tables/charts/maps are labelled accordingly ² Greater Cambridge Greater Peterborough Enterprise Partnership; Hertfordshire Local Enterprise Partnership; New Anglia Local Enterprise Partnership; and that part of South East Local Enterprise Partnership which is north of the River Thames

The immediate focus of our SIA is four Themes: Life Sciences, Agri-tech, Advanced Materials and Manufacturing (AM&M) and ICT³.

From within these Themes, the region has grown some of the world's most influential businesses – ranging from ARM Holdings and HP Autonomy to MedImmune. It also continues to attract substantial investment in “the next generation” of early stage businesses: it is, for example, estimated that over £500m has been invested in Life Sciences companies on Babraham Research Campus over the last two years alone. In addition, the region is attracting the interest of the corporates. Major recent investors include Huawei, Google, Apple, Microsoft, AstraZeneca and Pfizer.

However our Audit is not just about individual Themes. Instead, it is about the opportunities which are unlocked by processes of convergence. As one of well over 200 stakeholders that contributed to our Science and Innovation Audit explained:

- “I believe the active investors here – who are coming from all over the world – are investing in artificial intelligence, big data software, machine learning and then into the life sciences, bioinformatics and medical technology, and bringing it all together”
- “The focus here, in the universities and in the business communities, on artificial intelligence, machine learning and robotics, combined with genetics and genomics, presents huge possibilities. Connecting that up in a small place like this could be dramatic”

(from: East of England SIA stakeholder consultations, March/April 2017)

²⁷ East of England Science and Innovation Audit Summary: A Science and Innovation Audit Report sponsored by the Department for Business, Energy and Industrial Strategy, 21st September 2017

2: Our Vision

We will build on our position as the leading UK region for science and innovation for the benefit of people within the region, the UK and internationally.

We will achieve this by accelerating the process of convergence. Already open innovation is a defining feature, but remaining boundaries between disciplines and institutions will dissolve. Researchers, entrepreneurs and investors – and, in Life Sciences, clinicians – will work alongside end users (whether patients, industry or customers) on a daily basis. This will enable and accelerate a process of translation, which will be fuelled – across the piece – through the creative and extensive use of data. The outcomes will be economic impacts of national significance – and societal benefits that will be enjoyed worldwide and will, literally, be life-changing.

3: Our strengths

Our Vision is ambitious. However, it is entirely achievable. Our confidence is founded on the strength of our scientific capabilities and innovation assets. These are impressive when considered individually, but they are outstanding when placed in the context of our innovation ecosystem as a whole. Some of the building blocks within this are set out in the graphic below. But the “blocks” are less important than the “wiring” – literally, what “makes the whole greater than the sum of the parts”.

This is defined, first and foremost, by the people working within and across our innovation ecosystem. These people – whether researchers, entrepreneurs, investors or clinicians – constitute some of the world’s best talent. They are our strongest asset, alongside the people working with and to them.

Beyond this, particular strengths found across our four Themes include:

- **Our ability to both attract and grow talent:** Our universities generate a pool of outstanding graduates and post-graduates, many of whom are quickly employed within our innovation ecosystem, whether by major research-intensive private sector businesses (like GSK and BT); or within small, vibrant start-ups and spin-outs; or as entrepreneurs in their own right. At the same time, our businesses, research institutions, universities and hospitals provide a magnet for talented people from around the world.
- **The strength and depth of our networks:** Cambridge has been described by serial entrepreneur, Andy Richards, as a “low risk place to do high risk things”, mainly because of the nature of our informal and formal networks. Our places – such as Cambridge, Norwich, Colchester, Ipswich and Stevenage – are big enough to bring scale but small enough to ensure a depth of relationships with which large cities cannot compete. These are animated more formally and more broadly through outstanding networking organisations, some of which are now well established (e.g. One Nucleus, Eastern Academic Health Science Network, Cambridge Network, Cambridge Wireless, Agri-Tech East, Cambridge Cleantech) whilst others are quickly emerging (e.g. Tech East, SyncNorwich, Innovation Martlesham). These complement each other and they provide invaluable connectivity across our innovation ecosystem.
- **Our ability to generate and attract investment:** Linked closely to the strength of our networks is the vibrancy of investment processes. Within the East of England, there is a growing body of serial entrepreneurs-cum-investors, who provide both early stage investment and a good deal of wisdom and know-how; effectively, they propagate both knowledge and wealth within the ecosystem. The region has its own cadre of locally-

based angel investors and venture capitalists, and it also attracts a good deal of interest from the London-based investment community. Increasingly, the East of England is a destination for international investment, both through multinational companies (such as Apple, Google, Huawei) and through global investors.

- **Our support for highly innovative early stage business:** Our network of science parks, innovation centres, incubators and accelerators is second to none. It includes locations which are seen as exemplars around the world (e.g. Cambridge Science Park, St John's Innovation Centre, Norwich Research Park, Wellcome Genome Campus, Adastral Park); more recent ventures which have very quickly become recognised parts of the national innovation infrastructure (e.g. Stevenage Bioscience Catalyst, BioPark, Cambridge Biomedical Campus, Rothamsted Centre for Research and Enterprise (RoCRE)); and some very new and exciting ventures which are really still emerging (e.g. University of Essex Knowledge Gateway, University of Suffolk's Waterfront Innovation Centre, and Future Business Centre, Peterborough). In all cases, these are far more than property schemes. They are nurturing business, encouraging open innovation and providing a material input into the region's networking strengths described above.
- **Our industrial "lineage":** The history of our regional economy is not that of a manufacturing powerhouse, founded on 19th century technologies. This makes the region really quite distinctive. Our history in relation to intensive arable agriculture and horticulture, particularly on land that itself had to be reclaimed, conveys something of our ingenuity. Beyond that, our region benefitted from the growth of major knowledge-based businesses in the early 20th Century that have created an enduring legacy in terms of skills and aptitudes – aerospace in Hertfordshire and automotive in Essex are two examples. We have industries which are changing profoundly, but not in the sense of structural decline; restructuring processes are instead premised on knowledge, ideas and connectivity – core features of our innovation ecosystem.
- **Our locational advantages and international outlook:** The East of England abuts London to the south, and our relationships with London are increasingly strong ones. These are evidenced through flows of people, ideas and money – in both directions. They have been accelerated through major – and highly complementary – investments in London. The location of the Francis Crick Institute and Alan Turing Institute are especially notable in relation to our four Themes. The East of England has the physical capacity to commercialise knowledge to a level that London cannot, and this in itself is a substantial asset and strength⁴. In addition, we are well placed in terms of connections to Oxford and the wider Golden Triangle (infrastructure issues notwithstanding); and to the Midlands and North (on the East Coast Mainline, A1(M) and A14 especially). Crucially, we also have an exceptional location for international connectivity, through both ports and airports.
- **Our research assets:** The final piece in our innovation ecosystem relates to the depth and breadth of our research excellence which is, simply, outstanding. The UK Research Councils (BBSRC and MRC especially) and the major charities (notably Wellcome Trust and CRUK) have invested substantially in our research base. We are home to the Sanger Institute, the Babraham Institute, the Laboratory for Molecular Biology (LMB), the Earlham Institute, the National Institute for Agricultural Botany (NIAB), the John Innes Centre, Rothamsted Research and – from 2018 – the Quadram Institute (on Norwich Research Park). Across research fields that are absolutely germane to Life Sciences, Agri-tech and ICT, these are conducting world-leading research that is changing the way disease is understood and data are used, and they are enabling the two to be brought

together to unlock world-changing possibilities. Alongside the research institutes are our universities. The University of Cambridge is consistently among the top 5 on worldwide university rankings and it has a huge depth of research excellence across all four of our Themes. The University of East Anglia, University of Essex, Anglia Ruskin University and University of Hertfordshire also all have world class specialisms, and they have been recognised in these terms in national comparative reviews, such as that conducted by Lord Witty. Finally, we would flag the scale, depth and excellence of the research conducted within our businesses: GSK, BT and Microsoft Research, for example, undertake prolific research, increasingly moulding the innovation ecosystem which surrounds them.

4: Growth opportunities

All four of the Themes which provided the focus for our Science and Innovation Audit are defined around growth opportunities in national and international markets. As “sectors”, all four are relatively large on conventional metrics compared to UK averages, particularly at a sub-regional scale. Considered narrowly as “sectors”, growth prospects are inconsistent. They are strong in Life Sciences, Agri-tech and ICT and more modest in relation to Advanced Materials and Manufacturing – although we consider AM&M to be of foundational importance to the other Themes (even if the pace of investment and growth is slower).

However, we are not identifying “growth opportunities” in linear sectoral terms. Instead, we are seeing them through the lens of our innovation ecosystem and its ability to adapt and respond to societal challenges and imperatives – both those that emerge through the market and those where government, in some capacity, intervenes. These growth opportunities are difficult to define very precisely, but they are real ones – and they are ones for which the East of England is uniquely well equipped because of accelerating processes of convergence within and across our innovation ecosystem.

This means that we can respond to and (to a degree) precipitate five overarching growth processes that are driving market opportunities in the UK and internationally, and which transcend individual technologies and sectors:

- **Cost savings and imperatives relating to productivity:** Among public sector service providers and across the private sector, there is a relentless imperative to reduce input costs. The adoption of robotics in Agri-tech will reduce the requirement for manual labour and the East of England is in the vanguard in terms of quickly-emerging responses. More generally, in the context of population growth worldwide, there is a need for more productive, nutritional and environmentally sensitive crops; new molecular techniques will be vital to achieving this, and through the work of organisations like the John Innes Centre, NIAB, Rothamsted Research and the University of Cambridge, the East of England is tremendously well-placed. In the healthcare domain, there are huge cost pressures of many different forms. In terms of preventing illness, the potential of the microbiome is enormous and – particularly on Norwich Research Park – the region has outstanding (and growing) assets. Future screening programmes could well rely on innovation in the region in the sphere of medical devices; Cambridge-based Owlstone Medical, for example, is developing a breathalyzer for disease with the overall mission of saving 100,000 lives and \$1.5bn in healthcare costs.
- **Precision, stratification and personalisation:** Linked fundamentally to the imperatives for cost savings and efficiency is a raft of different opportunities relating to precision and personalisation. Through Agri-tech, the region is well-placed to apply, and benefit from,

new technologies in precision and smart agriculture, including the application of robotics, sensors and diagnostics to increase the efficiency, speed and precision of applying fertilizers and pesticides, and of harvesting. There are also substantial opportunities in the Life Sciences. Many diseases are much better understood now than they were two decades ago (in part because of the impact of the human genome project in which Cambridge-based scientists played a crucial role) and this is unlocking substantial advances in personalised medicine. Our innovation ecosystem is world leading in this context, partly because it has been able to bring together fundamental medical research (including in relation to cell and gene therapy) with the possibilities of data, the day-to-day interests of clinicians and – increasingly – the potential linked to medical devices. The result is huge advances in stratified and personalised medicine and far more effectively tailored treatments. These are improving health outcomes and they represent a substantial opportunity across global healthcare markets which are growing quickly. There are challenges too – not least regulatory ones – but the region’s innovation ecosystem is uniquely well positioned to respond.

- **Cleaner and resource-efficient solutions:** A third overarching opportunity relates to the imperative for solutions that are environmentally efficient. Again, this manifests itself in many different ways. The East of England is a dry region and innovative Agri-tech businesses are finding ways to reduce the use of water in commercial agriculture and horticulture. The East of England is also a fast growing region and substantial house building is planned. In this context, there is an imperative for far more sustainable building materials and approaches to construction; again, the region has world-leading expertise and solutions are ensconced within the AM&M Theme (through, for example, Hertfordshire-based BRE). Also within AM&M are the region’s substantial capabilities linked to offshore renewable energy. All of these different elements are regional strengths which are genuine assets because of the wider market opportunities linked to them.
- **Disruption:** We consider that there are exciting possibilities linked to disruptive innovation. By its nature this is unpredictable and it will redefine markets, creating substantial opportunities in the process. Our innovation ecosystem has a depth of research excellence and an increasing agility in applying it – through convergence – that will mean that we are uniquely well placed both to initiate disruption and to respond to it. The convergence of Life Sciences with all sorts of data analytics is starting to effect profound changes and the East of England’s innovation ecosystem is leading the way. Numerous examples could be cited – from GSK’s collaboration with Google to, for example, the Centre for Therapeutic Target Validation (CTTV, now called Open Targets), an open innovation consortium based on the Genome Campus at Hinxton which is committed to sharing data across the scientific community.
- **Global profile, confidence and “brands”:** Finally, we consider that there are growth opportunities that present themselves because of the global recognition that our innovation ecosystem has already generated. “Cambridge” is a global “brand” and a substantial asset in these terms. Equally, around the world, investors associate “Adastral Park” and “BT Martlesham” with pioneering research; “Babraham” and “Hinxton” are no longer (just) “villages in rural Cambridgeshire” but global shorthand for pathbreaking Life Sciences research and the lifechanging possibilities it creates; and “Norwich Research Park” and “Stevenage Bioscience Catalyst” are synonymous internationally with research excellence and open innovation. Add to this both key individuals (e.g. Hermann Hauser) and companies (e.g. ARM, GSK and AstraZeneca) and the strength of the region’s brands is simply phenomenal. This is not marketing

spin, but a source of global profile and confidence. And this in itself is creating growth opportunities. Crucially, it represents a further stimulus for the growth of the region's innovation ecosystem.

5: Gap analysis

At the start of the Audit two overarching challenges were, however, identified – commercialisation and collaboration. Through the Audit, these were examined rigorously. Four Theme-specific hypotheses were tested through both primary research and secondary evidence, and in all four cases, the hypotheses were supported. To continue to be world-leading, the challenges must be addressed at the level of the East of England innovation ecosystem as a whole.

Translation and convergence are – by definition – statements of “process”. They are on-going, relentless and demanding, and the bar is set high and rising. The East of England is competing with the most effective ecosystems in the world – some of which are reasonably well known and understood (Silicon Valley, Boston (Massachusetts)) but many of which (particularly those emerging quickly in the Far East) are not. Against this backdrop, there is no room for complacency – or for local politics within the region, or for resourcing squabbles with UK Government. The East of England innovation ecosystem is world-leading, but it needs to continue to evolve rapidly – and it must be empowered and resourced so to do.

In accelerating translation and convergence, there are four main “gaps”. These are defined with a view to the ecosystem's future evolution, not simply its current form.

Unlocking investment in the process of convergence

The investment process is integral to the commercialisation journey and it is, by definition, risky. The innovation ecosystem in the East of England is better than most in terms of early stage investment; Cambridge, in particular, benefits from a vibrant local investor community, and it attracts the interest of investors world-wide. But the challenges are not “solved” and indeed, some are becoming more acute as the process of convergence accelerates.

The issues were noted particularly within the Life Sciences Theme – although they were also observed elsewhere. Open sourcing – and the use of big data – is a major driver of innovation and it is underpinning and accelerating processes of convergence. There are major opportunities relating, for example, to the convergence of clinical patient data, deep/machine learning, communication technology and connected medical and wellness devices, and the region has huge assets and capabilities in this sphere. However, the process of convergence may well not generate intellectual property in a form that can be easily protected through patents. For investors – who may be sector specialists with limited knowledge of convergence interfaces – this creates uncertainty and risk. Solutions need to be found.

Providing skills – particularly relating to data

Across all four Themes, there are major – and similar – skills shortages. The extent and nature of the challenge was summed up by one business consultee from within the AM&M Theme (in this case an automotive business):

- “I would look beyond automotive. What are the most valuable skills going forward? Software skills, data management skills, automation skills, robotics, artificial intelligence, machine learning. Bringing users to new services through a smart compelling

interface... There is a really hard set of computational skills to bring..." East of England SIA stakeholder consultations, March/April 2017

Digital technologies are pervasive. Their application is the essential underpinning of the innovation ecosystem. But without sufficient people who are "educated in real computer science", innovation will falter and business growth will stall. The issues are acute already. Moreover, given the global nature of the higher-level skills pool, the risks linked to Brexit are obvious and immediate.

Enabling co-location and clustering

A third finding which was shared across all Themes surrounded the value – and innovation capacity – that is generated through co-location and clustering. Particularly in Life Sciences, there is much to be gained through physical proximity: silos need to be broken down and scientists from different disciplines need to work alongside clinicians, entrepreneurs, investors and patients on a daily basis. Tacit knowledge needs to be generated and shared, particularly against a backdrop of open innovation. Serendipity needs to be engineered.

These observations need, of course, to be contextualised – and they run up against various constraints. First, whilst much value can be generated through physical clustering, considerations relating to Green Belt are also important. Second – and related – even if land can be found, not everything can or should happen in the same physical space. Wider approaches to collaboration across the innovation ecosystem, some of them virtual, need to be developed.

Nevertheless, insofar as the strength of the East of England's innovation ecosystem rests with localised clusters in which proximity is central to translational processes, those clusters need to be equipped to grow appropriately. Equally, where there is potential for clustering around knowledge-rich assets (and a specific emerging opportunity is the new Quadram Institute in Norwich), appropriate physical provision should be made to unlock a future growth dynamic. The relationship between the innovation ecosystem and "place" is intrinsic and critical. It needs to be recognised fully in these terms such that the ecosystem as a whole can evolve optimally.

Increasing connectivity

Finally, the importance of connectivity must be acknowledged. Across a relatively large geographical region, the innovation ecosystem will not function well if connectivity (both within and beyond it) is poor.

This observation bites at various levels. At the most mundane, it is very important that broadband connectivity is consistently good. Anticipating emerging gaps in relation to the medium-term evolution of the innovation ecosystem, the issue of digital connectivity needs also to be considered at a more profound level. Looking ahead, data will be transformational across Life Sciences, Agri-tech and AM&M, and within the ICT sector itself. Huge volumes of data will need to be generated, captured, stored, protected, transmitted and used. The region needs a digital infrastructure that can cope – and, indeed, it needs a digital infrastructure that can help to realise the full transformative potential.