

The Future of Higher Vocational Education

Advanced apprenticeships –
Uniting universities and industry in
manufacturing the UK's economic future

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Britain faces a stark choice: a race to the bottom in skills and wages or a race for the top in the demanding 21st century economy. Britain must not join the race to the bottom. Our goal is to transform the opportunities available to young people through efforts to develop a high skill, high productivity economy.

'A route-map to Labour's revolution in apprenticeships'
Chris Husbands, Director of the Institute for Education and chair of Labour's Skills Taskforce
New Statesman – 15 October 2013

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Introduction



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In July 2014, the Labour leader Ed Miliband MP addressed the Sutton Trust on the subject of vocational education, and opportunities for what he called 'the forgotten 50%'.

He said that a Labour government would introduce new technical degrees to meet the demand for hundreds of thousands of STEM (science, technology, engineering and mathematics) technicians needed for infrastructure projects such as the new high speed rail line and the Thames Tideway.

While Britain had a strong track record on providing world class academic degrees in engineering and maths, the Labour leader said he believed Britain lags behind Germany which has a highly developed vocational system. Expanding on his premise that 'the academic route does not work for everyone', Ed Miliband said that although the UK currently had 100,000 people on Level 3 apprenticeships, this figure needed to be increased to 200,000 or 300,000. Along with the introduction of a technical baccalaureate, enhanced apprenticeships and new technical degrees – designed with industry – would be Labour's priority for the expansion of university places.

Labour is not alone in calling for a new focus on a rebalanced economy, growth and skills. Business Secretary Vince Cable has called for degree-level apprenticeships to become 'the new norm'. He has announced the creation of a new generation of National Colleges: specialised institutions, acting as national centres of expertise in key areas of the economy, employer-focused, and combining academic knowledge with practical application.¹ Again, former Minister for Skills and Enterprise Matthew Hancock encouraged employers to work with training providers to design high-quality courses that will deliver the skills they want, "a new social contract, with the taxpayer, employers and apprentices working in partnership to secure Britain's economic future."²

Yet while politicians and policy makers promote more high-quality technical education and greater access for those who are currently not acquiring the right skills for industry and employment, there are still nagging doubts.

- How can providers be sure that they are offering the education which industry actually wants? Do we need to change our degree structure?
- In doing so, how will we guarantee both quality and the opportunity of progression for young people?
- What opportunities can be created for young people for whom the idea of fees and debt would be enough to put them off higher education?
- And how can we challenge a persistent culture which privileges traditional academia over 'blue-collar' vocational education?

The answers to these questions go far wider than universities. Negative attitudes to technical education must be challenged at school and in our wider culture. Vocational education has for too long been forced to sit at the back of the educational bus.

There is no need for us to duplicate the high quality provision of vocational education that already exists in the further education and higher education sectors. But research intensive universities do have a very specific responsibility and opportunity to make a difference, and to help provide the very highest quality technical and vocational education which can in no way be counted as second class. By combining with our most progressive and globally-renowned companies, the UK's internationally-respected universities have the potential to deliver something new and aspirational: an elite vocational education with the potential to change minds, lives and our economy.

¹ V. Cable, 11 December 2014, Cable: new generation of National Colleges will lead revolution in hi-tech skills. www.gov.uk/government/news/cable-new-generation-of-national-colleges-will-lead-revolution-in-hi-tech-skills

² M. Hancock, 7 July 2014, Mathew Hancock's speech on a skills revolution. www.gov.uk/government/speeches/mathew-hancocks-speech-on-a-skills-revolution

³ World Bank (2015), Manufacturing, value added (% of GDP). <http://data.worldbank.org/indicator/NV.IND.MANF.ZS/countries/1W-DE-GB?display=graph> (Accessed on 23 January 2015)

Challenging stereotypes of vocational education

This report draws on the experiences of Warwick and Sheffield not only because we know these institutions best but also because we believe we are doing something new. We do not take the credit for this alone, however. Our industrial partners made clear to us that we needed to challenge stereotypes and be prepared to go to places that research-intensive universities do not always venture, and this message was reinforced by inspiring colleagues who have been courageous in breaking new ground and, in the process, developing new forms of university-industry partnership.

Today these same partners and colleagues are telling us that we need to go further, and to their voices are added those of young people themselves, as well as their teachers and families. All are making clear to us that vocational education should not be restricted to FE colleges or in-house training, and that a purely twin-track approach may limit the very young people it aims to support. Elite apprenticeships and the opportunity for progression through co-designed higher vocational degrees within the UK's leading universities can and do challenge the negative stereotypes of technical education by offering quality and rigour in a unique context. They give young people the possibility of aspiring to University without turning their back on a vocational route.

At the National Summit on Apprenticeships and Higher Vocational Education held at The University of Sheffield in June 2014, the Director of Global Manufacturing at Rolls-Royce Hamid Mughal said that the apprentices he saw developing their skills in an environment of world-leading collaboration between top UK research institutions and industry would create not only more efficient manufacturing processes, but also 'a new kind of engineer'.

Advanced manufacturing education – producing 'a new kind of engineer'

Vocational education does not have to be a poor relation of traditional academia, and subjects such as engineering and science fail to offer industry all that it needs from graduates if a high-quality vocational education is absent from our leading universities. Medicine, law and architecture are vocational subjects already taught in our leading universities. The needs of industry and the desire for the UK to play a full role in the global economy, not to mention manufacturing here in the UK the key elements of our own energy and transport infrastructure, demand that a vocational approach to science, technology and engineering should be seen in exactly the same light.

When understood in the context of the UK's future within the global market place, national policy needs to reinforce a culture in which the highest standards of vocational education are a route of first choice for talented young people. Such an education cannot and must not stop at undergraduate degree level. There is no reason to think that the most able apprentices should not be able to progress through well-designed degrees into postgraduate study and on to PhDs or MBAs, or diversify into areas such as commercial law where a deeper understanding of the nature of high-value manufacturing will offer a unique

business advantage. The industrial leaders and world-class engineers of the future will also come through vocational routes in our very best universities, drawing on an education which unites traditional academic strengths with the latest industrial practice.

If the UK wishes to rebalance its economy, and move the UK's manufacturing base from 10% of GDP at the moment to the 22% of GDP found in Germany, it needs more high-quality engineers of the kind that industry craves.³ The expansion of UK companies and inward investment from overseas simply will not happen without it.

What is more, this education will be funded by employers who ensure that the young people who graduate from these degrees will have experienced the dream of true access – a high quality relevant education leading to excellent employment in which the student gains industrial experience without incurring large debts.

The following report offers a personal reflection on the current challenges facing technical and vocational education in the UK, and draws on the experiences of our own institutions in designing high-quality apprenticeships with some of the world's leading companies – companies like Boeing, Rolls-Royce and Jaguar Land-Rover. It also makes seven recommendations for change, and proposes a pilot programme which we believe would demonstrate what is possible and necessary to signal change.

We believe that the Universities of Warwick and Sheffield are leading the way within research-intensive higher education, creating a new form of higher-level technical university education. The task now is for politicians to embrace the potential of what industry believes is a key to transforming the UK's vocational offer, and to make sure that more of the elite universities do the same.

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If I was 16 years old and I was given a hundred choices for careers, I would choose [this option] every time. You cannot ask for a better environment for tomorrow's engineers to create the complex, customer-oriented values and solutions for industry, the economy and for the UK than this environment.

Time for change

The debate about higher vocational education raises important questions. Who are our universities for? What do young people need and want? What does the UK economy need? What do employers need if industry is to compete around the globe?

In addition to important measures being taken to address STEM education in schools and to encourage far greater engagement with employers, there is a real need to provide high-quality vocational education deeply embedded in the cutting-edge research and development taking place in UK universities in partnership with industry. In this environment, apprentices and students will directly benefit companies by transferring experience in the latest technologies using state-of-the-art equipment into sponsoring companies.

Such young people are then also exposed to routes into higher education which blend technical skills with genuinely research-led teaching, providing new forms of progression without limits in either aspiration or attainment. But perhaps most persuasive of all to the young people themselves is the fact that they can access this excellent education with its associated employment without incurring fees or the debts often associated with university education. Apprenticeship and University costs are covered by sponsoring companies who employ apprentices through higher vocational education to degree level and beyond.

A vision of industrially-relevant higher vocational education

- In addition to developing technical and vocational education within schools and colleges, the UK needs to support a growing manufacturing sector by investing in the highest quality vocational education based in a series of elite universities.
- Apprenticeships and degree routes should grow out of the existing strengths of research-intensive universities in partnership with key industries and already embedded in city and regional growth strategies which are vital to a stronger UK, not purely dependent on the financial sector and service industries based in London and the South East.
- The natural home for such a new generation of university vocational provision would be National Centres of Excellence which already focus on close partnerships between industry and our world-leading universities. In this progressive environment, apprentices and students sponsored by industry would access training and qualifications which carried the assured quality of our leading universities supported by business who would be full partners

in course design and work-place based projects with direct commercial benefit.

- These new centres would be designated as Royal Technology Centres, in order to underline their status.

The benefits

The benefits of this approach are clear. The opportunity to create world-leading centres inspired by a culture of research and commercial innovation would allow students to access the highest quality vocational education. Furthermore, the opportunity to enter this education from an apprenticeship route would also dramatically increase participation for students from backgrounds where there is no tradition of higher education, or where fees and debt are seen as a barrier to entry.

For the tax-payer too, this model allows for costs to be shared with industry, while a student who comes through an apprenticeship route onto a vocational degree graduates with seven years' industrial experience and no debt. And what is more, the UK will gain a cohort of graduates already highly valuable to industry and national competitiveness, with a greater focus on how ideas can be translated into economic value.

National Colleges linked to our leading universities and industry

The new wave of employer-led National Colleges recently announced by the Government will provide a focus of world-leading university-business collaboration in key areas for translation in the economy.⁴ In addition to centres focusing on aerospace, automotive engineering and manufacture, the UK already has dedicated university-industrial collaborations in such vital areas as civil nuclear energy, rail, medical technologies and bio-tec, while Coventry and Sheffield will jointly provide the headquarters of the new National College for Advanced Manufacturing. As a context for vocational training of the very highest level, such an environment will offer those who take this route an education which would be second to none in the world.

⁴ V. Cable, 11 December 2014, Cable: new generation of National Colleges will lead revolution in hi-tech skills. <https://www.gov.uk/government/news/cable-new-generation-of-national-colleges-will-lead-revolution-in-hi-tech-skills>





Facts and figures

The UK requires 830,000 new engineers over the next 8 years purely to replace workers reaching retirement, professionals who will require deep understanding of the nature and potential of emerging technology.⁵

In the civil nuclear energy industry more than two-thirds of skilled workers will retire in the next decade.⁶

31 per cent of high-tech manufacturing firms import labour from overseas due to the skills shortage.⁷

Average UK student debt for students graduating under the new tuition fee system is expected to be £44,035 (in 2014 prices).⁸

There are over three-quarters of a million young people unemployed in the UK.⁹

The UK clearly needs more skilled engineers, but what kind? Certainly, our world-leading Faculties of Engineering are doing an excellent job producing traditional civil, chemical, electrical and systems engineers of the highest standard. And we need more. Finding routes from vocational qualifications to existing engineering degrees is a task in itself.

But we also need something more again, a vocational route and degree level offer which is, as Ed Miliband has proposed, co-designed with industry itself. For this, we cannot simply look to another country for an existing model: the UK needs to innovate and respond to the demands of business and the economy with something which will also be of great value to young people.

The proposals are currently at the drafting stage, but work by Professor Keith Ridgway who co-founded The University of Sheffield's Advanced Manufacturing Research Centre is once again at the cutting edge. (A sample of his proposed new manufacturing degree is found in Appendix 1.)

The skills mismatch

According to the IPPR's 2014 report, Winning the global race? jobs, skills and the importance of vocational education, over the coming decade a large number of jobs will be created in sectors that tend to rely on vocational education and qualifications yet there is a mismatch between the skills and qualifications needed by employers, and those held by the workforce.¹⁰ Thirty-nine per cent of vacancies in skilled trades are caused by skills shortages, and there are emerging shortages in areas such as health and care professionals.¹¹ The IPPR's conclusion is clear:

"In light of these findings, it is clear that Britain needs stronger and better-quality vocational education, coupled with new business models that make better use of workforce

skills and enable companies to move up the value chain to take advantage. This will require employers to engage in a more meaningful way in vocational education and skills development than they do currently."¹²

The demand for apprenticeships from young people

Demand for apprenticeships from young people far outstrips supply. According to the National Apprenticeship Service, more than 1.4 million online applicants competed for vacancies in 2013. There were close to 129,000 vacancies posted online in 2012/13, up 27% on the previous year. This represents an average of 11 applicants per apprenticeship. In some job areas young people were competing with over 30 applicants for every place.¹³

5 V. Cable, 23 April 2014, 830,000 new engineers over the next 8 years. <https://www.gov.uk/government/speeches/where-next-for-further-and-higher-education>

6 V. Cable, 23 April 2014, 830,000 new engineers over the next 8 years. <https://www.gov.uk/government/speeches/where-next-for-further-and-higher-education>

7 T. Hunt, Speech to ASCL Conference, <http://www.ascl.org.uk/download/922B44BF-326F-483A-AE484FE5F0BB4F2B.html>

8 C. Crawford and W. Jin, IFS Report R93, Payback Time? Student debt and loan repayments: what will the 2012 reforms mean for graduates? <http://www.suttontrust.com/wp-content/uploads/2014/04/payback-time-report.pdf> (p.21)

9 J.M. Davies and D. Hough, 17 December 2014, Youth Unemployment Statistics. <http://www.parliament.uk/business/publications/research/briefing-papers/SN05871/youth-unemployment-statistics>

10 J. Clifton, S. Thomson, and C., June 2014, Thorley. Winning the Global Race? jobs, skills and the importance of vocational education. http://www.ippr.org/assets/media/publications/pdf/winning-global-race_June2014.pdf

11 J. Clifton, S. Thomson, and C., June 2014, Thorley. Winning the Global Race? jobs, skills and the importance of vocational education. Available at: http://www.ippr.org/assets/media/publications/pdf/winning-global-race_June2014.pdf (p.9)

12 J. Clifton, S. Thomson, and C., June 2014, Thorley. Winning the Global Race? jobs, skills and the importance of vocational education. http://www.ippr.org/assets/media/publications/pdf/winning-global-race_June2014.pdf (p.7)

13 National Apprenticeship Service, 17 February 2014, Online Apprenticeship applications increase by a third. <http://nas.apprenticeships.org.uk/news-media/latest-news/article358.aspx>

Changing the culture

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65% of teachers would not advise a higher achiever to do an apprenticeship.

Pearson UK poll for the Sutton Trust
July 2014¹⁴

As early as Year 8, children are being asked within schools to think about how they would answer the question, ‘Do you want to go to university?’ And it is not just young people and schools who are asked and seek to answer this question. Parents too wonder about whether or not their child should go to university, in some cases balancing concerns about debt with thoughts about investment in future success or the social access that they believe university will give to the professions and the middle class.

But why is academia continually seen as a contrast to vocational education? Subjects such as medicine, architecture and law – often held in high regard within universities – are vocational subjects leading to University degrees but also to professional status and accreditation. So why should vocational education be pitched as primarily for ‘the forgotten 50%’ or those who teachers and pupils themselves believe cannot make it to university?

The binary divide in UK Higher Education between vocational and academic routes is damaging to young people and to the UK’s prospects. What would change this? Parity of esteem is increasingly being addressed by those apprenticeship and vocational routes which lead to highly desirable employment or where training is seen to be of an excellent quality.

Differentiating on grounds of quality

Leading companies are already beginning to differentiate on grounds of quality. Barclays employs over 1,000 apprentices who, it says, “benefit from invaluable work experience, an extremely competitive salary and extensive support to develop valuable skills and work towards a QCF qualification on the job” – anecdotally, Barclays apprenticeship designers report that apprentices are outperforming graduate entrants on all metrics and are used to mentor new graduate trainees.

BBC journalism apprentices have as many as 2,000 applications for just 10 places. But according to Tony Hall, Director General of the BBC, the scope for apprenticeships at the BBC goes beyond journalism to degree-level qualifications in business and technical areas. Apprenticeships exist in creative content but also in areas such as trainee solicitors in the organisation’s legal team. A three-year apprenticeship in technology is “a really stretching qualification we designed as an industry – the BBC, ITV, Ch4, Arqiva and Red Bee Media all working together” and the organisation is working with Pearson College to develop the next generation of production managers – a critical skills gap.¹⁶ The BBC have set a target of 1% of its employees as apprentices, working with organisations such as Job Centres and the Stephen Lawrence Trust to diversify the BBC workforce and identify talent from all backgrounds.¹⁷

“Our objective should be a better skill base for the British economy. For this, the total number of apprentices matters little, but the quality of skills training each receives matters a great deal. Young people know this, which is why the best apprenticeships are massively oversubscribed. We need better integration of higher and technical education, even if that means less apprentices overall. If we get our very best institutions involved in delivering vocational education, this would help companies give young workers a technical skills training comparable to the best in the world.”

Professor Lord Kumar Bhattacharyya, Former LUCAS apprentice and Chair of the Warwick Manufacturing Group – ‘Quality not quantity key for training apprentices’, Birmingham Post – July 2014

“Our apprentices are working right at the heart of our production, engineering and business teams. And, they’re doing incredibly well. The young talent emerging

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There’s still a lingering view in this country that apprenticeships are for people who don’t make it to university. This is wrong, and it would be met with bewilderment in other countries. We should be clear that there are degree- and masters-level apprenticeships, which are just as rigorous as degrees studied in the traditional way – and deliver equally good (or better) career prospects.

Cambridge Public Policy Lecture – What next for further and higher education?
Secretary of State for Business, Vince Cable MP
April 2014¹⁵

from our latest production scheme was so impressive – that all of them went straight into jobs. They’ve now got their foot on the first run of the career ladder – competing head-to-head with graduates. So the quality is exceptional!

“We want to find people with real potential – and develop it to the full. Our apprentices offer something that’s different, that’s energising – something that will make our programmes bolder, and better. There are few things more important to our future than embracing this talent. It’s business critical because our industry thrives on creativity.”

Tony Hall, Director General of the BBC, ‘You’re Hired’ speech – March 2014¹⁸

When brands such as Rolls-Royce, Jaguar Land Rover, the BBC or Barclays associate themselves with universities in courses which are co-designed and sponsored by those employers, the power to change perceptions is enormous. When this endorsement is accompanied by excellent attainment at university level, including progression to postgraduate study, the potential for early international experience, a strong record of employment and skills, as well as the opportunity to develop enhanced abilities in areas such as making presentations, project management, event organisation and public speaking, it is no surprise that graduate employment and earnings compare very favourably with those pursuing more traditional routes.

Employers, though, also focus on the benefits which accrue even before apprentices and sponsored students complete their study. Knowledge gained in a high-quality research-led environment is transferred into sponsoring companies from day one. This process is enhanced by an intensive focus on teaching and contact with trainers who themselves are familiar with industrial practice, a culture of work is established from the beginning, and students who are also employees develop a relationship of confidence and familiarity with a commercial culture.

So is the job done by these few trailblazers? Can it be scaled up?

The challenge is to ensure that this kind of innovation does not remain the preserve of those few institutions who operate at scale. Universities and policy makers should learn from the best and ensure that it is open to individuals from all backgrounds and to high-tech SMEs as well as global corporations.

¹⁴ I. Nash, July 2014, Higher Ambitions Summit: Rapporteur Report. <http://www.suttontrust.com/wp-content/uploads/2014/08/higher-ambitions-report-final.pdf> (p.6)

¹⁵ V. Cable, April 2014, Where next for further and higher education? <https://www.gov.uk/government/speeches/where-next-for-further-and-higher-education>

¹⁶ T. Hall, March 2014, Speech given by Tony Hall, BBC Director-General, at the ‘You’re Hired’ apprenticeship event. <http://www.bbc.co.uk/mediacentre/speeches/2014/dg-youre-hired>

¹⁷ BBC, March 2014, Tony Hall announces new BBC apprenticeship schemes. <http://www.bbc.co.uk/mediacentre/latestnews/2014/apprenticeship-schemes.html>

¹⁸ <http://www.bbc.co.uk/mediacentre/speeches/2014/dg-youre-hired>

Challenges to research-intensive universities

A new partnership between industry and universities

In Warwick and Sheffield we have found that we simply had to become fully involved in industry-led research and high-level vocational education. Yet for this to be the case more widely, research-intensive universities need not only to take a new approach to vocational education, but also to how they work with companies. Old divisions between pure and applied need to be challenged in an environment where the factory and the laboratory are one and the same. University research must move onto the shop floor and academics need to embrace a culture in which they not only engage with industry but in which industry helps frame the questions which lead to collaborative research in world-leading shared facilities.

This is already taking place in the UK's High Value Manufacturing CATAPULTs – centres of rapid translation between university research and industry. Vocational education set in such a context owes as much to the culture of the Fraunhofer Academy in Germany and MIT in the United States as to the traditional academic route within UK Higher Education. It has the potential to create the kind of rounded engineers, deeply embedded in the best of British research and development, which companies want and who will up-skill them from the beginning as they transfer knowledge and create the skills we need to power the UK economy.

The Prime Minister David Cameron has said, "I want it to be the new norm for young people to either go to university or into an apprenticeship."¹⁹ But an either or approach to technical education will not give the UK the research-rich skills it so desperately needs in the scientists, engineers and technicians of the future.

Admissions criteria

University rankings are currently assessed by metrics which include admissions criteria or 'tariff', not only outcome. Top-ranked universities will therefore need to find ways to adjust to the rise of BTECs (British Technology and Education Council qualifications) – the proportion of the 18 year old population in England who entered higher education and held BTEC qualifications increased to 6.7 per cent in 2014, the highest level recorded and more than twice the proportion in 2008 – and to find ways of judging by outcomes rather than entry levels.²⁰

This is particularly important for widening participation and routes into higher vocational education. As Mary Curnock-Cook told Research Fortnight,

"Taking into account the shrinking population, it is estimated that in just five years' time, there could be 10,000 fewer English 19-year-olds with A-levels and over 20,000 more English 19-year-olds holding vocational... qualifications such as BTEC."²¹

According to the UCAS response to the Ofqual Consultation on New A Level regulatory requirements in January 2014, UCAS data suggests that vocational qualifications, such as BTECs, do not facilitate progression in to Higher Education in the same way as A levels. For every 100 A level students accepted into high tariff institutions in 2013, 3 BTEC applicants were accepted. By comparison, 49 BTEC students were accepted for every 100 A level students at lower tariff institutions. Given that a larger proportion of learners from disadvantaged backgrounds take vocational qualifications than those from more advantaged backgrounds, according to UCAS "care will have to be taken to ensure that any increase in the number of learners studying vocational qualifications does not impact on progress made in relation to widening participation and fair access in recent years."²²

Flexibility

Providing sponsored routes for apprentices to progress to degree level and beyond will mean that universities will need to ensure that part-time and flexible options are available, and that higher level provision is not more of the same of what is already available within Faculties of Engineering. Excellent though this provision is, vocational education will need an industry-inspired curriculum and teaching to continue into degrees and beyond.

A different kind of teaching: trainers as mentors to success

High-quality vocational education also requires a different approach to teaching, with a strong lab-focused approach and deep investment in student success through mentoring. The apprentice-trainer relationship itself is key to raising aspiration, with trainers respected within the University and industry alike as committed teachers with full industrial credibility and experience.

This kind of teaching also lends itself to integration with work placements and projects. Trial pieces and projects encourage those undertaking vocational education to apply what they are learning and evidence their skills in demonstration pieces.

¹⁹ D. Cameron, March 2013, Prime Minister: apprenticeships are central to rebuilding economy <https://www.gov.uk/government/news/prime-minister-apprenticeships-are-central-to-rebuilding-economy>

²⁰ UCAS, 2014 UCAS, 2014 Application Cycle: End of Cycle Report, December 2014. Available at: <https://www.ucas.com/sites/default/files/2014-end-of-cycle-report-dec-14.pdf> (p.58); End of Cycle Report, December 2014. Available at: <https://www.ucas.com/sites/default/files/2014-end-of-cycle-report-dec-14.pdf> (p.58)

²¹ UCAS, July 2014, UCAS submission to the call for evidence to the Commission on Child Poverty and Social Mobility. <http://www.ucas.com/sites/default/files/ucas-submission-to-the-call-for-evidence-to-the-commission-on-child-poverty-and-social-mobility.pdf> (p.4)

²² UCAS (2014). UCAS response to the Ofqual Consultation on New A Level Regulatory Requirements. Available at: <http://www.ucas.com/sites/default/files/ucas-response-to-the-ofqual-consultation-on-a-level-reform.pdf> (p.5)



Universities have an extraordinary potential to enhance economic growth. The full diversity of institutions have a role to play from local SME support and supply chain creation to primary technology leadership and breakthrough invention... The strongest basis for regional economic growth is activity rooted in a sound understanding of a locality's comparative economic advantage.

Encouraging a British Invention Revolution – Review of Universities and Growth

Sir Andrew Witty

Regional drivers

Every city and regional growth plan in the UK includes a focus on developing skills, simply because local companies and inward investors make it clear that without a high-quality workforce able to support expansion or investment, growth stalls.

With a growing focus on the UK's regions, vocational education is even more in the limelight as fundamental to economic regeneration. The City Growth Commission's final report proposes greater regional input into skills budgets.²³ The importance to the regions of appropriate provision which reflects local needs and supports the rebalancing of the economy will also require partnership working with local industry and government.

It is clear that any devolution of responsibility for vocational education to regions (whether in the form of LEPs or local authorities) has the potential to further cement vocational education's status as a second-class citizen. It must therefore be balanced by a high-achieving apprenticeship scheme based in elite universities which can act as a counterweight. Higher vocational education is not a contradiction in terms!

Lessons from history

Politicians, policy makers and universities need to heed the lessons from history. The UK has been debating vocational and technical education since the 1800s. The foundations of red-brick universities such as Sheffield were closely associated with the needs of local industry and the provision of skilled employment opportunities. Indeed, institutions were often founded with the direct support of local business and parents who aspired to opportunity for their children – in Sheffield for example, posters in factories across the city urged workers to make penny donations to support the founding of a University which would bring economic benefits and an education for 'the child of the working man'.²⁴

Later technical and civic institutions were designed to support the economy and industry. However, with the granting of university status to polytechnics, a change in culture followed in which becoming a 'proper university' often meant changing to an emphasis on vocational

education as somehow lower in status. While excellent vocational courses existed and continue to be provided in the new Universities, they had insufficient status in the mind of the nation. This was accompanied by the loss of training and of a strong basis in UK Research and Development within nationalised industries which has never been replaced by academic research and innovation, to the deep detriment of the UK Plc.

In 1965, Tony Crosland – then Secretary of State for Education and Science – warned:

"We shall not survive in this world if we in Britain alone down-grade the non-university professional and technical sector. No other country in the Western world does so... Let us now move away from our snobbish caste-ridden hierarchical obsession with university status."²⁵

Almost 50 years later, vocational education remains the greatest challenge facing education in the UK, and although it has traditionally been the poor relative of higher education, this situation cannot continue. In England, vocational education is confusing for schools, employers and young people – it is spread between too many kinds of providers and many kinds of funding and many kinds of qualification, with no one really responsible for establishing coherent pathways.

While there have been some recent important innovations such as University Technical Colleges and Career Colleges, vocational education still remains the under-funded poor relation of higher education, except when it comes to vocations like law and medicine which were never tainted with the label of trade.

²³ City Growth Commission, October 2014, 'Unleashing Metro Growth: Final Report of the City Growth Commission', <http://www.citygrowthcommission.com/wp-content/uploads/2014/10/City-Growth-Commission-Final-Report.pdf>

²⁴ The University of Sheffield, A truly civic university. <https://www.sheffield.ac.uk/about/the-university-of-the-year/civic-university>

²⁵ T. Crosland, 1956, quoted in V. Cable, April 2014, Where next for further and higher education? <https://www.gov.uk/government/speeches/where-next-for-further-and-higher-education>

Case study 1



The Advanced Manufacturing Research Centre, University of Sheffield

The Nuclear Advanced Manufacturing Research Centre, University of Sheffield

Focus

High-value manufacturing, in particular aerospace and civil nuclear energy

Lead industrial partners

Boeing, Rolls-Royce

Supply chain supporters

Tier 2 members of the AMRC and NAMRC

In 2013, The University of Sheffield welcomed its first cohort of 150 Advanced Apprentices to its purpose built Advanced Manufacturing Research Centre Training Centre. These apprentices, who are employed and funded by their industrial sponsors, reflect the University's awareness that a lack of high-quality vocational education and skills within high-value manufacturing was damaging the ability of its region, and of the UK, to expand its manufacturing base and rebalance its economy. Indeed expansion of the Advanced Manufacturing Park and inward investment from companies keen to move alongside the University's world-leading manufacturing research centre were being put at risk without a parallel investment in growing the highly skilled workforce required for the next generation of high-value manufacturing.

As a partner in the city-region keen to raise attainment and prosperity for local people, the University was also sharply aware of the need amongst the region's young people for alternate routes into Higher Education which provided exceptional potential for employment, the chance to earn-as-you-learn and which removed the prospect of debt after graduation.

A pilot programme began as early as 2006, with initial apprentices fully employed by either the AMRC or partner companies.

Lessons learned formed the foundation of what became the AMRC Training Centre – a bespoke facility designed with partner companies which dramatically expanded the AMRC apprentice offer without damaging the high-value manufacturing context which made it so attractive to industry.

About the Apprenticeships

The University of Sheffield AMRC Advanced Apprentices are employed by manufacturing companies – many of them local SMEs – keen to benefit from the high-quality training in the practical and academic skills that manufacturing companies need to compete globally. Sponsoring companies range from global leaders such as Rolls-Royce and TATA to local high-tech supply-chain companies.

Based in a new 5,500 sq m building alongside the University's National Research Centres into Advanced Manufacturing and Civil Nuclear Energy, the University has agreed progression routes through undergraduate study in Engineering up to doctorate and MBA level. The Centre has particular resonance for local people as it is sited on the former Orgreave Colliery, scene of conflict in the 1980s during the miners' strike and now a symbol of hope and

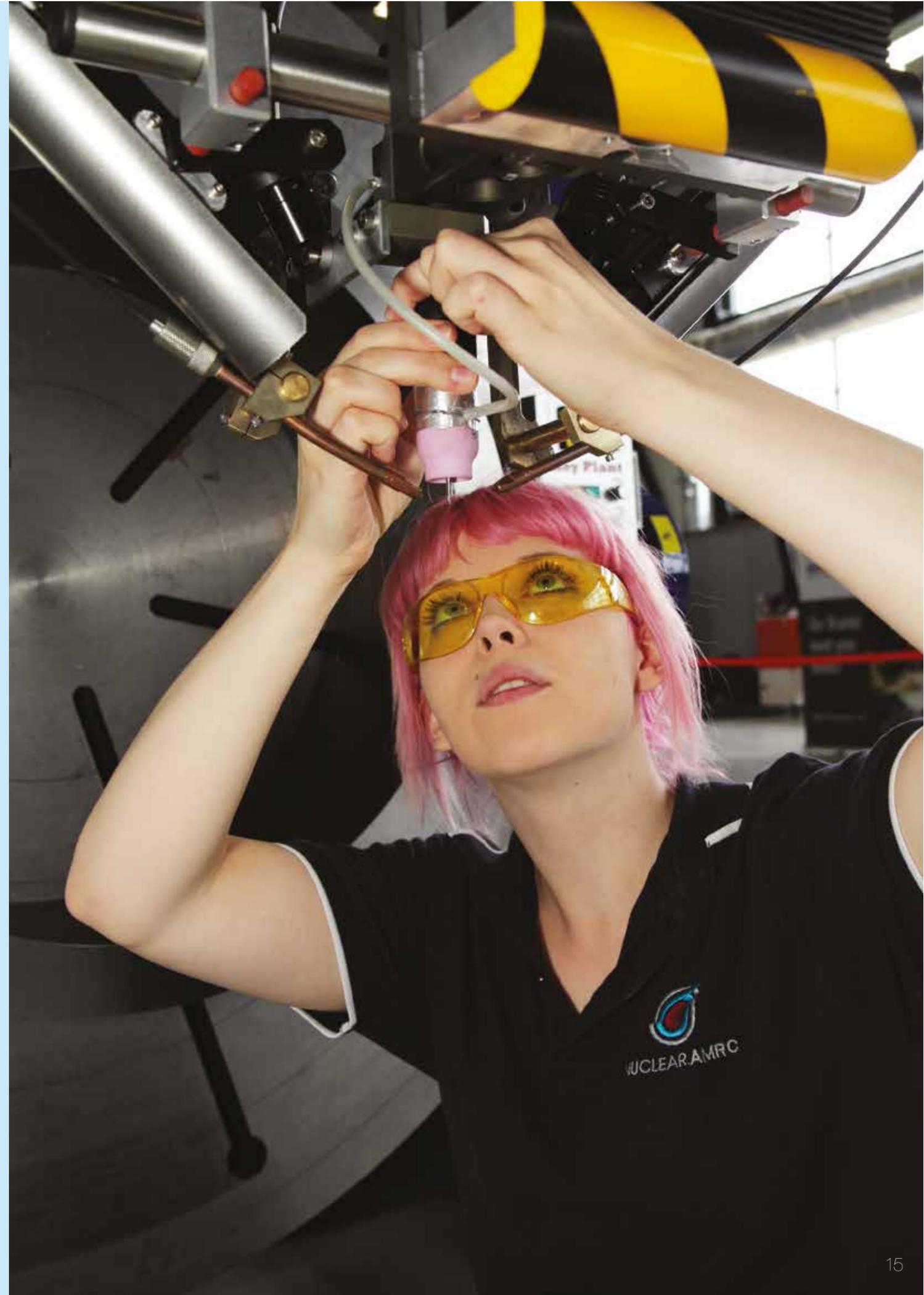
opportunity for the children of communities blighted by the decline of traditional industries.

Allied to two national manufacturing CATAPULT research centres, the Advanced Apprenticeships address the issues of quality and parity of esteem through first-class facilities and truly research-led teaching. The curriculum is directly shaped by research undertaken with partner companies and apprentices access an alternate route into higher education with a focus on the skills and culture so important to employers. The apprenticeships also provide a direct alternative to student loans. An apprentice who progresses through undergraduate degree levels will graduate at 22 with a degree from a leading UK university, 7 years industrial experience and no fee-related debt.



A vision for the future of UK manufacturing – British technology and skills at its best.

Liam Byrne describing his visit to the AMRC Training Centre on Twitter





Case study 2

WMG – University of Warwick

Focus

High-value manufacturing, in particular automotive

Lead industrial partners

Jaguar Land Rover

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Apprentices at Jaguar Land Rover can expect to be earning around £32,000 by the time they finish their course; they also collect a Warwick degree. This kind of programme, including a sponsored degree, has huge advantages both for employers (who gain staff with theoretical as well as practical knowledge tailored to their specific needs) and for individuals (who gain a career-focused degree, earn good money while they study and graduate free without student loans).

Cambridge Public Policy Lecture – What next for further and higher education?
Secretary of State for Business, Vince Cable MP
April 2014

Because of the close relationship between WMG and Jaguar Land Rover (JLR), Warwick University has become closely involved in the education of apprentices. Three main activities are currently being undertaken.

One is a new University Technical College, the WMG Academy for Young Engineers, which opened in September 2014, and offers young people new qualifications based on the real-world skills and experiences needed in the advanced engineering industry. The WMG Academy is focused on a broad base of engineering, with specialist attention given to areas applicable to local employers in the automotive, aerospace and high-value manufacturing sectors, in addition to the core subjects of English, Maths and Science.

A consortium of employer partners large and small including JLR, National Grid, Prodrive, Ricardo, Automotive Insulations and Squires Gears are involved in every detail of the WMG Academy from the content of the curriculum to the student performance frameworks. The qualifications on offer, endorsed by industry and enriched by work experience, hands-on problem-solving projects and by industry mentoring, will increase employability prospects of young people and challenge traditional ways of learning. It helps to address very important issues at the beginning of the educational

cycle, exciting young people about careers in engineering and developing talent, with the growth of companies like JLR only sustained if they, and their suppliers, can access the right people with the right skills. The Academy is designed to produce a number of learning pathways into engineering, all the way from technical qualifications through advanced and higher apprenticeships to access to degree-level qualifications.

The second activity is support of degree provision for the JLR higher apprenticeship programme. For higher apprenticeships in advanced manufacturing sectors, WMG has created a highly innovative, work-based undergraduate engineering programme delivered part-time over four years to individuals in companies. It provides a firm grounding in mathematics, technical subjects and modules related to finance, supplier management and other commercially-related topics, delivered in the engineering / advanced manufacturing context through a 'case study' approach. Learning supports the internal pathways within Jaguar Land Rover.

At its heart is a tripartite relationship involving academic supervisors, industry and the student at the centre, to create personal learning plans. These recognise the need for work-based flexibility in modules, timing /

location of delivery and to manage short-notice work commitments of participants. In addition to the lectures, laboratories, seminars and tutorials apprentices have access to an internet-based bespoke "Managed Learning Environment" and undertake "activity based learning" which is embedded in the laboratory-based part of the programme.

Finally, WMG are working with 1,000 existing Jaguar Land Rover employees to provide training to degree level in product engineering and manufacturing engineering. WMG and Jaguar Land Rover are working together on curriculum development.

Lessons from overseas

MIT (Massachusetts Institute of Technology) USA

One of the great academic institutions of the world is The Massachusetts Institute of Technology (MIT)²⁶ – yet it was founded against the early opposition of the Board of Education because of its then controversial focus on ‘mere’ technology rather than the ‘pure’ academic vision of institutions such as Harvard. William Barton Rogers, an academic at MIT, recognised that industrial need and changes in technology required the creation of an educational institution with a focus on the real world applications of research in areas such as engineering and architecture. He understood that this could form the basis of high quality education, and that technology and academia could be combined in exceptional aspiration.

MIT was originally known as Boston Tech and admitted its first students in 1865, the culmination of an extended effort to establish “a new kind of independent educational institution relevant to an increasingly industrialised America.”²⁷

In its founding vision, MIT sought to challenge the divide between the highest quality education and the need to keep pace with rapid developments in technology. The Institute used a polytechnic university model and stressed laboratory instruction – MIT’s early emphasis on applied technology at the undergraduate and graduate levels led to close cooperation with industry.

Today MIT is a world-class educational institution: teaching and research – with relevance to the practical world as a guiding principle – continue to be its primary purpose. Yet in addition to its 81 Nobel laureates, MIT retains a strong entrepreneurial culture, and the aggregated revenues of companies founded by MIT alumni would rank as the eleventh-largest economy in the world.

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...a special type of educational institution which can be defined as a university polarized around science, engineering, and the arts. We might call it a university limited in its objectives but unlimited in the breadth and the thoroughness with which it pursues these objectives.

James Rhyne Killian
MIT president

Fraunhofer Institute (The Fraunhofer Academy) Germany

The Fraunhofer-Gesellschaft²⁸ is the leading organisation for applied research in Europe. Its research activities are conducted by 67 institutes and research units at locations throughout Germany. Affiliated international research centres and representative offices provide contact with the regions of greatest importance to present and future scientific progress and economic development.

Innovation clusters

A key element of the German government’s high-tech strategy is to promote cluster initiatives. In the “Pact for Research and Innovation”, the Fraunhofer-Gesellschaft has assumed the task of conceiving and implementing innovation clusters. While the public establishments create the basis for new products and services, the funds provided by industry are used to implement and market these innovations. This promotes collaboration in the development of concrete products. The positive effects of jointly achieved success on further cooperation are invaluable.

The Fraunhofer Academy

The Fraunhofer Academy also offers specialists and managers training and development based on the research activity of the Fraunhofer Institutes in cooperation with prestigious partner universities. The latest findings from applied research are channelled directly into the teaching content, providing a genuine platform for research and innovation.

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First-class vocational training lays the foundation for a promising career... Lifelong learning is now a must.²⁹

²⁶ <http://web.mit.edu/>

²⁷ MIT Facts, *Origins and Leadership*. <http://web.mit.edu/facts/origins.html>

²⁸ <http://www.academy.fraunhofer.de/en.html>

²⁹ Prof. Dr. Hans-Jörg Bullinger, *President of the Fraunhofer-Gesellschaft, Excellent Training and Development for Specialists and Managers*. https://www.fraunhofer.de/content/dam/zt/en/documents/01_Dachbrochure_englisch_tcm210-143008_tcm63-8278.pdf (p.2)



Listening to the experts

What apprentices say...

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Since I started my placement at the AMRC I have grown rapidly as a person and an engineer. I started with little knowledge of engineering and I am now producing jobs for companies such as Rolls-Royce using a variety of machines. I really enjoy training through the AMRC. I would recommend it to anyone who is willing to put the effort in to become a first class engineer.

Anthony
Second Year Apprentice, JRI

I've completed a lot of work for the Composites Centre and Rolls-Royce. The work I do is important and has meaning. The best aspect of this year has been moving onto the CNC milling machine and learning the whole concept of CNC work. I would definitely recommend the apprenticeship – where else can you work on important projects, get paid and learn as well?

Connor
Second Year Apprentice, AMRC



I originally went to college for a year to study AS level chemistry, physics and philosophy but I didn't like the lifestyle and don't cope well with exam conditions. Ultimately I hope my apprenticeship will be a platform for me to reach my goal of achieving a master's degree in engineering physics and be on my way to becoming one of the best engineers in the country.

Tom
First Year Technical apprentice at ATI Allvac

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96% of employers offering apprenticeships think their business has benefited, around 70% report improved workplace productivity.

Minister for Skills at the Sutton Trust,
July 2014³⁰

What employers say...

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Rolls-Royce is committed to apprenticeships. They provide people with the foundation required to excel and can lead to highly rewarding careers. Apprentices at Rolls-Royce have the opportunity to work with some of the world's most advanced technology and build the skills they will need to succeed in engineering.

Graham Schuhmacher, Head of Development Services
Rolls-Royce (sponsors of University of Sheffield AMRC Advanced Apprentices and Tier One partners within the AMRC)



Apprenticeships should be the lifeblood of all companies that want a future, especially SMEs. Too many companies have ended up with 'Dad's Army' workforces and then realise, sometimes too late, not only will valuable and traditional skills be lost but also years of critical experience.

It is often difficult for SMEs to organise structured training programmes, especially if they have less than 20 employees or are in niche markets. However, now is the time for industries to come together and with the help & support of organisations like the AMRC, create structured training environments for quality and worthwhile apprenticeships thereby securing a multi-skilled workforce for the future.

Vince Middleton, Chairman
Newburgh Engineering (sponsors of University of Sheffield AMRC Advanced Apprentices)

30 M. Hancock, 7 July 2014, Matthew Hancock's speech on a skills revolution <https://www.gov.uk/government/speeches/matthew-hancocks-speech-on-a-skills-revolution>

Recommendations for change

The UK-wide challenge

Transform the status of vocational education

How?

- Simplify qualifications

- Make funding equal

Current funding models are too complex and differentiate between vocational education and higher education. This reinforces a false choice which could be overcome by an approach such as a voucher system.

- Elite universities working with the UK's top companies should lead in the provision of a new 'gold standard' higher vocational education

There is existing high quality provision of vocational education in the further education and higher education sectors. We are not looking to duplicate this activity. We are looking to provide the kind of high-level technical education, linked to cutting-edge research, that only leading universities can provide. This 'gold standard' education will help raise the esteem of vocational education at all levels.

- Aim for 40,000 higher apprentices nationally

- Higher vocational places within universities to be funded by HEFCE to provide a premium for quality

- Establish a pilot to demonstrate what is possible

The UK's leading universities need to signal a shift in approach by uniting with our leading companies to provide exceptional vocational routes in key areas such as scientific technological education and manufacturing – those areas which are key to growth and prosperity for the future. This is what Warwick and Sheffield have been trying to do.

Yet achieving high quality higher vocational education associated with leading universities and industrial leaders will not be achieved overnight, but pilot programmes in universities which build on existing strengths and a willing culture would demonstrate what is possible. Initial conversations with leaders of elite universities show that others may also be interested in responding to this challenge, if the level of quality is high enough.

In conclusion

A word of warning – the need for quality

There is a reason many employers, parents and young people are wary of apprenticeships and vocational education. Beyond the baggage of culture, there is a genuine issue of variable quality. When we hear the term apprentice, the first question is: what do you mean? Apprenticeships in the UK vary from the highly-regarded apprenticeships with companies such as Rolls-Royce, Boeing or Jaguar Land-Rover along with their high-tech supply chains, in which young people are employed and receiving state of the art experience, to low quality and short-term courses in manual skills without any meaningful guarantee of demand or employment.

To challenge this state of affairs, the Government needs to address the question of brand. Who will assure employers of quality, who will accredit qualifications and which companies will help to develop a curriculum which will equip those who undertake vocational education to progress in their education or to qualify for senior roles in successful companies?

As the Husbands Review highlights, "In most other northern European countries, apprenticeships are level 3 qualifications that last between two and five years and include at least a day a week of off-the-job learning as well as significant on-the-job training. In England, too many apprenticeships are at a level that would not be recognised in these countries" and which does not properly serve the interests of young people. Indeed, in the UK the majority (57%) of the increase between 2009/10 and 2011/12 was in level 2 apprenticeships with almost two-thirds of all apprenticeships at level 2, and 20% of all apprentices report receiving no training at all.³¹

The proposal to lift the status of apprentices through high-quality University-accredited provision leading to full qualifications and progression in an aspirational context will only be convincing if quality is preserved, and the industrial partnership which links the UK's leading universities and companies remains the context for a new form of elite education.

What would kill the dream? A low-quality environment. Repackaging what we already have, either in HE or FE. Seeing vocational education as a mass-market cheap option. Lack of aspiration and belief in the parity of esteem and opportunity. Poor engagement with trainers who are not immersed in the industrial experience. Isolation from leading centres where global companies and their supply chain already engage closely with universities.

But... a sense of opportunity

However, it is the view not only of the authors of this report but of our partner companies that higher vocational education set in the context of world-class research centres with industry offer a new kind of technical education for the UK, one which our country and economy desperately needs and which is also vital for the development of the kind of skills our young people will need to compete in a global market.

This kind of higher vocational education redefines what a research intensive university can be. Through genuine partnership with industry, vocational education of this kind becomes truly research-led teaching, with innovation immediately translated into the curriculum. It also offers the UK's young people – those who are currently not taking advantage of higher education but have the talent to do so, as well as some who may be choosing options which do not deliver the sustainable employment they wish for – new routes into University without the debt associated with fees.

Such a vocational education is rich in teaching and research, a tutorial system reminiscent of the best of our elite institutions but based around the lab. It is also a stimulus to economic growth and the renewal of regional industry.

In the United States, the newly industrialised America was supported by the founding of a technical university which later became world famous as the Massachusetts Institute of Technology or MIT. There is a real need for the UK to also develop a technical education which is world-class in its ambition but rooted in industrial partnership. Through a new form of partnership between universities and industry, we would urge the UK to think of vocational education in terms of the highest quality which will allow our nation to truly thrive economically and which will give young people of every background the opportunities they deserve.

³¹ Labour Party, September 2013. *A revolution in apprenticeships: a something-for-something deal with employers: The Husbands Review of Vocational Education and Training*. http://www.yourbritain.org.uk/uploads/editor/files/Skills_taskforce_-_apprenticeships.pdf (p.2)

Appendix 1

Possible BEng/MEng in Manufacturing Technology

Year 1 (120 credits)

- Intro to Design (20 credits)
- Engineering materials (20 credits)
- Materials Processing
- Applied Mathematics
- Solid Modelling and CAD/CAM
- Machining processes
- Forming processes
- Non-conventional manufacturing processes
- Composites manufacturing processes
- Welding and fabrication

Year 2 (120 credits)

- Design of Engineering Structures and Components (20 credits)
- Quality, Standards and the Environment (20 credits)
- Sensors, Actuators and Controllers
- Electric Circuits
- Robotics and Automation
- Manufacturing Systems
- Modelling Manufacturing processes
- Virtual reality, simulation and modelling
- Manufacturing management

Year 3 (120 credits)

- Design for manufacture (20 credits)
- Powder based manufacturing processes (20 credits)
- Advanced Machining
- Forging
- Casting
- Advanced welding and fabrication
- Supply chain management
- Individual investigative project (30 credits)

Year 4 M. Eng (120 credits)

- Large industrial based project (60 credits)
- Finance for Manufacturing Engineers
- Law for Manufacturing Engineers
- The Professional Responsibility for Manufacturing Engineers
- Project Management and HRM for Manufacturing Engineers
- Sustainable manufacturing

Choice of one from:

- Manufacturing for the Medical Sector
- Manufacturing for the Aerospace sector
- Manufacturing for the Nuclear sector

Each module requires 24 hours of directed study based on the model shown below

Industrially based applications (6 hours)

Industrially based applications (6 hours)

AMRC based teaching (18 hours)

AMRC based teaching (18 hours)

- In this model the candidates will study for 20 hours within the AMRC and the industrial sponsor for each module. This will include 12 hours AMRC based teaching and 8 hours industrially based practical sessions.
- Each year will contain two 48 hour modules (30 hour AMRC and 18 hour practical session). The AMRC component will be carried out as one-week full time courses.
- In addition candidates will study eight 24 hour modules, which will comprise 18 hours based at the AMRC and a 6 hour industrially based practical/self learning module application session.
- Assessment will be based on the practical application sessions and two integrating examinations.
- AMRC-based teaching sessions will be presented as three-day intensive sessions, one per month over eight months.

Appendix 2

Definitions for some of the common terms used in discussions of vocational education can be found below. Definitions for some of these terms vary, and several reports have set out their own working definitions.

- Advanced level – level 3 qualifications (equivalent to AS and A levels).
- Apprenticeship – A paid job that incorporates on and off the job training.
- BTEC (Business and Technology Education Council) – vocational qualifications awarded by Pearson Education Ltd (Edexcel).
- Careers colleges – specialised colleges offering 14- to 19-year-olds the opportunity to take full-time, vocationally-focused programmes. Similar, although not the same as, UTCs.
- Higher level – Level 4 qualifications and above (level 4 is equivalent to a HNC, level 5 is a HND or Foundation Degree, level 6 is a Bachelor's degree, level 7 is a Master's Degree, level 8 is a Doctoral Degree).
- Higher vocational education / vocational higher education – Interchangeable terms, used to describe vocational education that leads to qualifications of level 4 and above. The government has used both of these terms, among others, in its reports.³²
- Intermediate level – level 2 qualifications (equivalent to GCSEs grades A*-C).
- Studio schools – small schools (typically with around 300 pupils) for 14 to 19 year-olds. Students work with local employers and a personal coach, and focus on employability skills.
- Technical baccalaureate (TechBacc) – To receive a TechBacc, students have to obtain an approved level 3 tech level qualification, an approved level 3 mathematics qualifications and an extended project qualification.
- Technical education – the academic and vocational preparation of students for jobs involving applied science and modern technology.
- Technology education – the study of technology, in which students learn about the processes and knowledge related to technology.
- Technological education – this term currently lacks a widely agreed upon definition.
- Tech levels – level 3 qualifications for students who wish to specialise in a particular technical occupation or occupational group. Tech levels can count towards the achievement of a TechBacc.
- Traineeships – Work placement programmes targeted at young people who are not in work and have little work experience. Traineeships can last from six weeks to six months and have three core elements: work placement, work preparation training and support in English and mathematics.
- University Technical Colleges (UTCs) – specialised colleges, sponsored by a university, offering 14- to 19-year-olds the opportunity to take full-time, technically-oriented courses in science, technology, engineering and mathematics. Each UTC focuses on one or two technical specialisms.
- Vocational education / vocational education and training (VET) – education and training that focus on delivering skills and knowledge required for specific industries.

³² For a discussion of the various terms used and their definitions see *Understanding College Higher Education Literature review*. <http://www.uel.ac.uk/wwwmedia/microsites/continuum/che/Draft-literature-review-%28website%29.pdf> (p.9)

Acknowledgements

We would like to acknowledge the work and thinking about vocational education undertaken by the following individuals and organisations which we have drawn upon throughout:

Advanced Manufacturing Research Centre with Boeing; AMRC Training Centre – in particular Director Alison Bettac, Assistant Director Kerry Featherstone and Head of Training Roger Davis-Green; Paul Blomfield MP, Member of the all party group on Higher Education and co-founder with the President of the NUS of the all party group on Students; Lord Kumar Bhattacharyya – Labour peer and founder of Warwick Manufacturing Group; Liam Byrne MP, Shadow Minister for Universities, Science and Skills; the Cambridge Public Policy Review; the City Growth Commission funded by the Joseph Rowntree Foundation; the Department for Business, Industry and Skills; the Fraunhofer Academy; the Global Manufacturing Festival; Hamid Mughal, Director of Global Manufacturing at Rolls-Royce; High-value Manufacturing CATAPULTs; Husband Review of Vocational Education and Training, Labour Policy Review; the Institute of Public Policy Research (IPPR); Lord Adonis; Mary Curnock-Cook, Head of UCAS; Matthew Hancock, Minister for Business; Massachusetts Institute of Technology (MIT); the Nuclear AMRC; Professor Richard Jones, Pro-Vice-Chancellor for Research and Innovation, The University of Sheffield; Richard Caborn – former Minister for Trade and Industry, advisor to the AMRC; Sir Andrew Witty, author of the Witty review into Universities and Growth; the Sutton Trust; Tristram Hunt MP; The University of Sheffield National Summit on Apprenticeships and Higher Vocational Education; Vince Cable MP, Secretary of State for Business, Industry and Skills.

Our particular thanks also to:

Professor Keith Ridgway, Research Director and co-founder of the Advanced Manufacturing Research Centre and to Ruth Arnold, Sally Green and Jack Brown of the Vice-Chancellor's Office at The University of Sheffield who supported the drafting of this report.

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