

MANUFACTURING THE FUTURE WORKFORCE

EXECUTIVE SUMMARY



In partnership with



WE WILL...

**ESTABLISH A TECHNICAL
EDUCATION SYSTEM RIVALLING
THE BEST IN THE WORLD...**

**...ENSURE THAT WE HAVE THE
SKILLS TO TAKE ADVANTAGE
OF NEW TECHNOLOGIES**

FOREWORD



A handwritten signature in black ink, appearing to read 'Allan Cook'.

Allan Cook CBE
Chair, High Value
Manufacturing Catapult

The UK has recognised for decades that it has a real and pressing engineering and manufacturing skills challenge. Despite many well-meaning reviews and a plethora of initiatives which have continued to highlight the need to inspire people to join the sector, to equip them with skills fit for the future and provide ready access to upskilling during their working lives – progress has been slow and disappointing. In the last seven years the High Value Manufacturing Catapult, as a centre of innovation, has made great strides in working with companies large and small to develop new and disruptive technologies. Our world-class facilities around the UK, along with many other centres of innovation with whom we work, such as TWI and the National Physical Laboratory, have demonstrated the potential of these technologies to change the face of UK manufacturing. But, to anchor the benefit of this innovation in the UK, we need to make much faster progress on developing and aligning the skills of our workforce.



A handwritten signature in black ink, appearing to read 'Judith Hackitt'.

Dame Judith Hackitt
Chair, Make UK;
Chair, SEMTA;
Senior Independent Director,
High Value Manufacturing
Catapult

In a highly competitive international marketplace, early adoption and exploitation of innovation will be critical to achieving the objectives of the UK's industrial strategy. Failure to address the workforce development challenge will mean missing out on opportunities to build the UK's manufacturing base and to take market leading positions.

Industry, academia and government have a shared responsibility to build a workforce fit for the future. Learning from the past and seeking examples of good practice highlight opportunities to shape the future. Many of us have key roles to play. Leaders in industry and innovation need to work together to provide a long-term vision of our skills needs and communicate this effectively to our partners in education, training and government. We need a clear mechanism to bring us together to develop a coherent delivery plan.

This report suggests a way forward. Built from examples of international good practice, coupled with early stage discussion with other forward thinkers here in the UK, it captures valuable lessons and proposes changes which will enhance, extend and connect existing initiatives. Success will require co-operation throughout the 'Skills Value Chain', with all partners understanding their contribution, impact and importance to the whole project.

Working in isolation from each other will simply not be effective. While full collaboration and co-operation have proved difficult in the past, it must become our way of working in the future as it will bring enormous benefit to the UK. All partners sharing a common vision and purpose will maximise the potential development of the sector and in doing so improve opportunities for individuals, industry and society as a whole.

We look forward to leading discussions which will be stimulated by this report and to developing a cross-sectoral plan of action. Working together we can prepare a manufacturing workforce fit for the future.

EXECUTIVE SUMMARY

AN OPPORTUNITY FOR REGROWTH

Manufacturing delivers 10% of UK GVA, 45% of UK exports and 1/5th of inward investment to the UK. It accounts for 69% of all investment in research and development and employs some 2.7 million people. At first sight these are healthy numbers, but the overall contribution manufacturing makes to our economy, the scale of its employment and the proportion of manufactured goods in our export statistics are in decline both in absolute terms and in comparison with competitor nations¹. That decline need not be terminal. If the UK could combine its world-leading research base with a manufacturing workforce equipped with the knowledge and skills needed to deploy and exploit new technologies, it would secure its position as a world leader in the effective commercialisation of the very best ideas. The contribution our manufacturers make to our economic and social well-being would blossom.

But where are the workers?

The reality, however, is that while the UK has real strength in both its research base and capacity for technology innovation, repeated business surveys² attest to the difficulty its manufacturers face in accessing the skilled workforce they need to turn such innovation into profit and maintain their competitiveness taking advantage of the latest technologies. Manufacturers need a workforce with the ability to adapt rapidly and take on new tasks and responsibilities that require different and often higher skillsets. Instead their current workforce is ageing, new recruits with the right skills are in short supply and many are fearful that sources of overseas workers may soon dry up. In these circumstances most good employers should look to retrain existing employees and encourage growth in the pipeline of potential recruits. However, this would reverse a recent decline in demand³ and feedback from all parts of the sector shows that current education and training provision may now be unequal to the task.

No surprise, then, that manufacturers are therefore increasingly concerned that they will be unable to secure a higher-skilled workforce fit for the future and are calling for action. Many are turning to the potential of new industrial digital technologies, such as artificial intelligence and automation. For some these will offer a short-term remedy but, despite the determined media association between new technologies and job losses, the likelihood is that these technologies will increase pressure on the skills base by boosting demand for the skills manufacturers are already struggling to find as well as those that will be needed to complement the new technologies being developed by Centres of Innovation (CoIs) like the High Value Manufacturing (HVM) Catapult, National Physical Laboratory (NPL) and TWI.

¹ [Make UK \(in partnership with BDO LLP\). May 2019. *Manufacturing Outlook 2019 Q2*.](#)

² For example, [Royal Academy of Engineering: National Engineering Policy Centre. August 2019. *Engineering priorities for our future economy and society*.](#)

³ [Social Mobility Commission. January 2019. *Adult Skills Gap Report 2019*.](#)

Learning from the best

HVM Catapult, with TWI and NPL and supported by the Gatsby Foundation, decided to study how Cols might play a greater role in developing the future workforce that UK manufacturing needs, by seeking examples of international good practice. Over the course of eight months a study team visited 39 organisations in Ireland, Germany, Switzerland, Singapore and the USA. Although each country had taken a different approach, appropriate to their culture, geography, manufacturing base and national imperatives, all were exploring how to update the skills of their current and future manufacturing workforce in the light of industrial digitalisation and emerging technologies. Our study found many examples of good practice which offer a source of evidence and ideas for policy makers, education providers and other Cols to consider.

Benefits beyond the shop floor

It was clear that where there was a strong link between innovation and skills development, the benefits extended beyond the shop floor. In Ireland, for example, we were reminded that having the skills required for innovation did not just raise the productivity of existing firms, it also helped to attract high value inward investment. Access to a high skills base was seen as a key enabler in the €10 billion flowing into the Irish economy from biopharma businesses over the past decade.

In the US, targeted workforce development was also playing a part in supporting smaller businesses. Agencies engaging with SMEs see workforce development and knowledge transfer as a key success factor, responding to the needs of smaller businesses to access facilities and funding that enable them to introduce new technologies at the same time as acquiring related training. Lorain County Community College in Ohio, for example, receives discretionary local taxes that directly support the College to provide joined-up approaches to education programmes, technology innovation (working with Cols), and also access to finance for start-up businesses to implement new technologies and provide training in how to make use of them.

Centres of Innovation have an important part to play

The headline message of the study, in all locations, was that successful innovation is dependent on the availability of a workforce with the right skills needed for its full exploitation and that Cols have a role to play in their development. That role was seen to be fulfilled in several different ways:

- **A number of Cols deliver training directly to learners at all levels (from apprentice to doctorate) building a supply of candidates ready to move into industrial or academic roles.**

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- Some Cols draw on their deep sectoral insights to inform the development of education provision. For example, in Germany, government and unions work jointly to assist the redrafting of occupational standards to reflect changes brought about by technology, digitalisation and de-carbonisation. In the USA, Manpower Recruitment has worked with DMDII⁴, a Manufacturing USA Institute, to develop a complete taxonomy of digital skills for future roles in the manufacturing workforce and LIFT convenes panels of ‘Expert Educators’ to consider future competence needs and to generate sample syllabuses for new technologies.
 - In Singapore, innovation organisation SimTech convenes transformational roadmapping processes in close conjunction with businesses, which lead to shared ownership of delivery plans aimed at benefiting as many supply chain organisations as possible and that encompass workforce development actions.

New approaches to provision

A second strong message from the study was that the rapid pace of technological change demands more modular and flexible training courses that can be used to upskill and reskill the existing workforce, sometimes alongside full-time learners. Curriculum development undertaken in partnership between education providers and Cols to produce highly modularised courses, together with a responsive teacher training system, ensures that content and pedagogy can promptly accommodate changes in skills needs. An example of this in practice is SimTech’s work with SkillsFuture Singapore to develop manufacturing content for the ‘Future Series’ of modular courses, which are approved as electives within existing qualifications and as standalone awards.

‘Learning Factories’ are evident as an important tool in the diffusion of the industrial digitalisation technology being driven by Cols. A Learning Factory is not a simple duplicate of an industrial factory but is designed as a simulation to enable experiential learning based on common scenarios. In the German state of Baden-Württemberg, some 40 ‘Smart Factories’ are now in place across the network of Technical Schools. The Institute for Technical Education in Singapore is developing a manufacturing curriculum around a Learning Factory with a strong focus on supporting culture change in small businesses. DMDII in the USA houses a number of Learning Factory examples used to promote culture, skills and behaviour change around data management, analysis and use, and cyber security.

4 Since relaunched as MxD in 2019

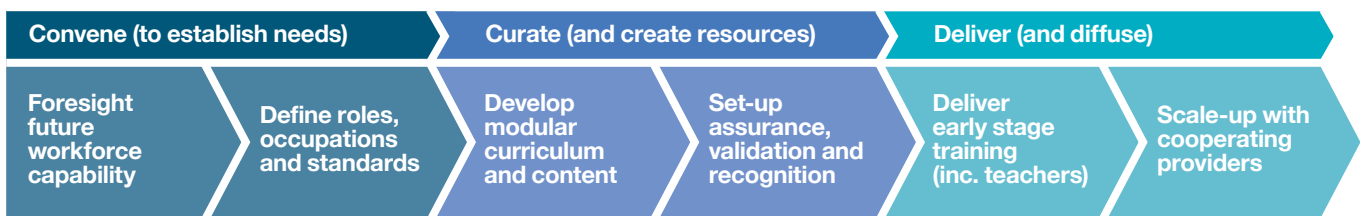
SECURING SUCCESS WITH COMMON PURPOSE

Our study visits illustrated that the growing complexity of engineering and manufacturing developments associated with emerging, data-rich technologies will require a systematic response to workforce development if the UK is to leverage its public investment in innovation. This will, in part, address the current stark productivity gap and help to forge a globally competitive, advanced manufacturing nation.

It would be easy to conclude that the UK's competitors are already well ahead in the race to equip their manufacturing workforce with the skills necessary to benefit from the opportunities that industrial digitalisation will provide. None of the countries the study visited were confident that their solutions were a panacea for global manufacturing problems; however, the stability of their skills systems and the degree of collaboration between the different stakeholders clearly enabled workforce development related to innovation to take place.

The UK should learn from the successes and failures of other countries – there is still time to catch up with, and even overtake, competitors but only if all the different stakeholders in government, industry and academia work together with a lasting common purpose to ensure that the UK manufacturing workforce is equipped with the skills of tomorrow. A 'Skills Value Chain' approach (Figure 1) is proposed to capture this common purpose and to promote connectivity between the UK's innovation and skills systems at the same time as enabling better co-operation within the education and training systems. Though shown as linear, the model will contain feedback loops and is unlikely to operate strictly sequentially in practice.

Figure 1.
Skills value chain



Ultimately, this skills value chain has the potential to result in competitive advantage for the UK manufacturing industry because workforce talents and skills will become more aligned with technology and productivity opportunities. Higher value employment will result with lead times of technology adoption reduced by developing workforce skills in parallel with technologies.

Each activity in the value chain provides value to others and depends on them in turn to fully succeed. Cols should take a number of roles to deliver and support these activities:

- 1. Convene technologists, industry, education and training partners, and government as a focal point for their technology to foresight and articulate future skills needs, standards and qualifications associated with emerging technologies.**
- 2. Work with others to curate knowledge that has been created in a form suitable for a range of learner groups, co-develop additional material as required and support assurance and accreditation organisations.**
- 3. Deliver early-stage training, acting as a primary point of transmission of this knowledge to early industry adopters as well as to teachers who will educate others, then on an on-going basis support diffusion through wider teaching and training networks of specialist emerging technologies.**

OVERVIEW OF RECOMMENDATIONS FOR ACTION AND LEADERSHIP

This study provided much evidence that Cols elsewhere are recognised as being able to make a unique and essential contribution to workforce development. Our detailed recommendations below are drawn from observed good practice considered in the context of the current UK skills landscape and our proposals to further engage Cols in workforce development set out in the value chain.

Develop and pilot the application of skills foresighting

Foresighting processes will need to be developed that convene groups of education and technology specialists to analyse and articulate any required changes to current standards and provision necessary to respond to future employer skills needs related to emerging technologies. Cols are well positioned to promote collaboration and to convene participants including industry, sector specialists working with further education (FE) and higher education (HE) representatives and Semta to develop the pilot programme.

These groups should closely engage with stakeholders from the Institute for Apprenticeships and Technical Education (IFATE), the Department of Education (DfE), Innovate UK (IUK) and the Department for Business, Energy and Industrial Strategy (BEIS) to assist policy review and to ensure outputs contribute to the current UK system.

Support the development of Higher Technical Qualifications and National Standards

The skills needs of industrial digitalisation at a higher technical level should be met by cross-sector standards because of high levels of commonality. Since much of the future skills demand will be for the incumbent workforce, apprenticeship standards at this level should also guide the creation of higher technical qualifications comprised of discrete, credit-bearing modules reflecting workplace credentials that are suitable for upskilling needs.

Cols should continue to work with IFATE, employers and a wide group of stakeholders drawn from the Made Smarter Commission, sector groups (e.g. Aero, Auto and Defence, Nuclear, Food and Drink), IFATE, DfE, BEIS, FE and HE.

Develop modular training and resources to support future workforce skills development

Modular content related to emerging technologies should be developed to support the achievement of amended and new skills requirements. Content will be used and refined during early-stage adoption by geographically distributed and relatively low volumes of learners at specialist locations, including Cols, and then as ‘blueprints’ for wider diffusion and scale-up responding to local industry demand.

Training and resources must be suitable both for new workforce entrants and to upskill and reskill those already in work and previously qualified. This will require flexible and modular modes of learning that fit around the working and personal lives of adult learners and which also provide a recognition of achievement.

Promote Learning Factories as an education model to enable industrial digitalisation

Looking at the scope and options for further development of Learning Factories in the UK, there would appear to be significant need, and certainly opportunities, since the UK already has strong expertise in digital learning technologies.

The suggested approach is to build systematically on existing assets, strengths and initiatives with Cols working with the Made Smarter Commission, Institutes of Technology supported by their FE and HE partners and DfE.

Seek improved recognition and funding of modular and lifelong learning

Increased take-up of modular courses with formal recognition of continued achievement has been shown by the study to be an important factor in making reskilling and upskilling programmes effective for individuals and industry alike by providing incentives for learners. Action will be required by Professional Engineering Institutions, academia, government and industry bodies to increase access to courses with related national and local funding, and to motivate adults to undertake upskilling that reacts to future industry needs.

Leadership – embedding common purpose

Our proposed Skills Value Chain approach offers an efficient and deliverable response to help address the economically damaging shortages of current and future workforce skills. Study visits have illustrated how the recommendations will contribute to growing competitiveness of UK manufacturing supply chains and critically, will help to anchor the benefits of on-going public and private investment in innovation in the UK.

Acknowledging, funding and promoting a greater workforce development role for UK CoIs will ensure their contribution to the skills value chain and create a means of securing competitive advantage from emerging technologies. At the same time, education and training providers should be encouraged to engage with CoIs in the development and delivery of training programmes to improve responses to future local needs.

Achieving these changes will require collective endeavour across government, industry and education, with collaborative leadership and with wide stakeholder commitment to the shared benefits of co-operation supported by public and private investment. Drawn from both industry and government, a Senior Leadership Group should be put in place to deliver on the findings of this report. Using the Skills Value Chain as a guide, their remit should be to oversee the creation and connecting together of the Value Chain, encouraging and sponsoring future activities and related investments that align with the longer term, forward looking view of industries' skills needs. In doing this we will take a major step towards achieving a sustainable transformation of UK workforce development.

THIS REPORT

The *Manufacturing the Future Workforce* report has been published to present the findings and recommendations of an international study into workforce development and its link to innovation, led by the High Value Manufacturing (HVM) Catapult with funding and support from the Gatsby Foundation and with partners from Institute for Manufacturing (IfM), TWI, National Physical Laboratory (NPL) and participation from the Department for Education (DfE) and the Institute for Apprenticeships and Technical Education (IFATE).

The report is complete in its own right and has a considerable amount of associated further information provided in visit reports and their references with most made available for download. Observations of good practice captured during 39 study visits are summarised, contextualised and then developed into recommendations for action to be taken forward by Centres of Innovation (such as HVM Catapult) and their partners. This document represents the first section of the full report.

HVM Catapult were assisted by IfM to develop a study approach that would relate to their prior work on innovation systems and increasing research interests in workforce development. Visit organisation was supported in the USA, Singapore, Germany and Switzerland by the UK Foreign Office Science and Innovation Network, whose personnel provided effective support in a field beyond their typical scope of activities.

The report and its associated documents have been prepared by Ian Collier and Paul Shakspeare for HVM Catapult, with valuable guidance and input from Daniel Sandford Smith of the Gatsby Foundation and significant assistance from Dr Chris Beck of TWI.

Publication date: January 2020

Download the full report at hvm.catapult.org.uk/mtfw



ABOUT THE HIGH VALUE MANUFACTURING CATAPULT

The High Value Manufacturing Catapult creates the conditions for economic growth by enabling UK manufacturers to achieve significant improvements in their performance and productivity. We do this by providing open access to world-class innovation capability and technical expertise, enabling companies to embrace different ways of working, adopt new technologies and achieve step-change in their performance.

To find out more about the High Value Manufacturing Catapult, please visit: hvm.catapult.org.uk

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ABOUT THE GATSBY FOUNDATION

Gatsby is a foundation set up by David Sainsbury to realise his charitable objectives. We focus our support on a limited number of areas: plant science research; neuroscience research; science and engineering education; economic development in Africa; public policy research and advice; the Arts.

To read more about its work in Education, please visit: www.gatsby.org.uk/education

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