Workforce Foresighting Hub

Advanced Welding Automation for Defence.

Through robotics, in-series volumetric inspection, machine vision, and AI to ensure production continuity by 2030.

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Ministry of Defence

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Acknowledgements

The Workforce Foresighting process integrates data from the following international data sets:

Skills England (formerly IfATE – Institute for Apprenticeships and Technical Education, England)
ESCO – European Skills, Competencies, Qualifications & Occupations, EU
ONet – Occupational Networks Online, USA

In accordance with licence and publishing requirements of these organisations for the use of their data sets, the Workforce Foresighting Hub team states that:

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The method and process used in the Workforce Foresighting process is under development and there may be errors and omissions in the data provided.

This report was produced following workshops undertaken 2026 Q1 using the data set and tools available at that time.

Executive Summary

This report outlines findings from the Workforce Foresighting cycle, focusing on Accelerating advanced welding automation through robotics, in-series volumetric inspection, machine vision, and AI to ensure production continuity in Defence assets by 2030. This industry challenge was sponsored by the Ministry of Defence (MoD) and study conducted by The Manufacturing Technology Centre (MTC) in collaboration with the Workforce Foresighting Hub, an Innovate UK initiative.

Workforce foresighting is a systemic approach to planning ahead and anticipating future skills and capability needs associated with new technologies and government transformation targets. It involves identifying and understanding the skills required for tomorrow's jobs, ensuring our Education and Training systems are prepared so that our workforce is ready to adopt new technologies and support future industrial growth.

This report sets out the findings of the workforce foresighting study and suggests the next recommended actions required by various stakeholders to ensure a workforce is created that is prepared to effectively implement these new technologies in the sector.

Strategic context and purpose for Workforce foresighting

The UK's Defence and energy sectors were entering a period of unprecedented infrastructure demand at the same time that the welding workforce faced acute demographic pressures. With approximately 70,000 welders in the UK and an expected retirement rate of 50% by 2027, potentially creating more than 35,000 vacancies, this presented a clear strategic risk to the maintenance and production of defence assets through to 2030. This shortage was particularly critical in high-integrity environments such as land and sea defence and large defence infrastructure, where welding quality directly affects national resilience and safety. Without intervention, bottlenecks in skilled labour were expected to constrain delivery timelines, increase costs, and compromise the UK's sovereign capability in defence manufacturing and in-service sustainment.

Aligned with government missions, including the Defence Industrial Strategy (Ministry of Defence, 2025; Defence, 2025), the Advanced Manufacturing Plan (Department for Business and Trade, 2023) and the 2050 vision for automation and robotics in UK manufacturing (High Value Manufacturing Catapult, 2024), this foresighting cycle aims to anticipate and mitigate these risks by accelerating the adoption of intelligent welding automation. The strategic context recognises that traditional, manual welding models cannot meet future demand for high-integrity fabrication, especially across defence nuclear, naval, and heavy manufacturing programmes. Automation, AI-driven process control, in-series volumetric inspection, and advanced sensing are therefore not only technical enablers but essential components of national capability. They allow "right-first-time" fabrication, improved traceability, reduced rework, and greater operational continuity in regulated sectors that underpin national security.

The purpose of this workforce foresighting cycle is to understand how these technologies will reshape the skills, roles, and capabilities required across the UK welding and fabrication ecosystem by 2030. As welding processes transition from manual tasks to digitally integrated, adaptive, and automated workflows, current occupations will change to include entirely new capabilities which will need to be underpinned with the knowledge, skills, and behaviours to carry out those capabilities as duties. The cycle therefore focuses on identifying future skills gaps in robotics, machine vision, AI process optimisation, digital compliance, and the commissioning of automated systems, while also mapping how existing roles will evolve. This

ensures that training, qualifications, and workforce development pathways across engineering, manufacturing, construction, and defence are aligned with the next generation of automated welding technologies.

Ultimately, the cycle served a national strategic purpose: to ensure that the UK could sustain and grow the skilled workforce required to deploy and operate advanced welding automation, securing the resilience of defence and energy assets through 2030 and beyond. By providing a clear horizon for technology maturity (TRL 4–7)[1], adoption timelines, and associated workforce implications, the foresighting activity enables government, industry, and skills bodies to plan proactively rather than reactively. In doing so, it positions the UK to capture economic benefits - including billions in projected productivity gains, export growth, and high-value job creation - while strengthening sovereign industrial capability and safeguarding Critical National Infrastructure (CNI).

Participants and stakeholders

Technology Participants	Industry Participants	Skills Participants
The Welding Institute (TWI)	The Ministry of Defence (MoD)	Strathclyde University
The Manufacturing Technology Centre (MTC)	Rolls Royce	Warwick University
The Advanced Manufacturing Research Centre (AMRC)	BAE Systems	
	Babcock International	
	Sheffield Forgemasters	
	Atomic Weapons Authority (AWE)	

Summary of Findings

During the cycle, it was determined that traditional welding would not be included within the scope due to the already well defined and well supported apprenticeship pathways. The focus was therefore shifted towards welding automation, robotics sensing and digital inspection as these areas were in clear need of transformation. The core gap is not in welding capability itself, but in the lack of structured pathways that enable welders to acquire or develop automation, diagnostics, and integration competencies and, conversely, pathways that equip automation engineers with essential welding and special process fundamentals. This missing of a two-way skills bridge, combined with fragmented upskilling and the absence of a national centre for welding automation, presents a significant barrier to achieving Defence's 2030 automation ambitions. In addition, existing robotics focused apprenticeships which could partially address these automation capability gaps were found to have limited adoption in the Defence sector, partly due to the limited number of training providers equipped with suitable robotics infrastructure.

[1] Technology Readiness Levels (TRLs) 4–7 refer to the progression from laboratory validation (TRL 4), through validation and demonstration in relevant environments (TRLs 5–6), to prototype demonstration in an operational environment (TRL 7)

Next Steps

To address the capability gaps identified, the defence, industrial and education sectors will need to coordinate leadership to prioritise the next key steps.
An initial priority identified was the bolstering of a welding-first automation second development pipeline, supported by a modular continuing professional development (CPD) that enables a two-way path of progression between welding and automation.

Options identified included integrating baseline and contextual automation knowledge into existing welding apprenticeships, such as robotic safety, cell concepting, setup, and operation, allowing students to understand the direction of industry, the options and skills pathways that they can utilise. Conversely, the inclusion of special processes knowledge and contextual welding skills, such as safety, path planning, and materials understanding, within automation training frameworks potentially supported by a national welding automation hub. Together, these steps were viewed as essential for aligning education provision, standardising competencies, and enabling providers to invest in robotics and welding ready training infrastructure.

In addition, organisations were encouraged to expand support for high-potential employees to undertake master's level study in systems integration and automation, while simultaneously building internal change agent capability to lead and sustain transformation at scale across Defence manufacturing.

Glossary

Term	Definition
Challenge Response	Specific intervention aimed at the challenge
Capability (Organisation)	The collective abilities, and expertise of an organisation to carry out a function, because provision and preparation have been made by the organisation
Capability Classification	Classification provides a common, structured vocabulary to define capability
Capability Statements	Description of the depth and nature of each capability within an organisation
Capability Syntax	Common language to describe each capability application within organisation type
Carbon Accounting	The process of measuring, tracking, and reporting greenhouse gas emissions produced by an organisation or activity
Competencies (Workforce / Individual)	'Proficiency, aptitude, capacity, skill, technique, experience, expertise, facility, fitness related to capability
Competency definition 'KSBs' (Knowledge, Skills, and Behaviours)	Knowledge, Skills, and Behaviours are the elements used to express the required competencies for each Role Group
Competency Domain	Used during foresighting analysis to provide focus on existing and emerging competency needs
CPD	Continued Professional Development
Foresight Cycle	Set of workshops, analysis and reporting that implements the Foresight Process for each subject
Foresight Process	A series of activities which are convened to understand future competence needs, the opportunities available and actions required to deliver the right skills at the right time and place
Foresighting Champion	An individual nominated within a new user organisation of foresighting to facilitate and lead the use of foresighting processes and tools with the support of the Project Team
Foresighting Subject	The application of specific technologies in the context of a given challenge and which are candidates for foresighting
Future Competency Set	The KSB output from the Educator workshop for each Role Group
Map and Gap Analysis	A combined expert and automated process that maps the Future Competency Set against a selected reference framework
National Challenge (Industry / Sector / Region)	A recognised technological or socio-political threat or opportunity for which there is consensus that workforce action is necessary
Organisation Type	Simple description of nature of organisation for which capability is required
Participants	Technologists, Educators, Employers
Proficiencies	Proficiencies differentiate the degree of competencies required from differing Role Groups to support capabilities
Project Sponsor	Typically, a stakeholder in the challenge being successfully met who requires information to under-write plans to act
Roadmaps	Sector, Industry, Regional view of emerging opportunities and their market entry

Role Group	Role groups are a collective of roles that exist in a typical manufacturing business / industrial sector
Technologies	The technology that could be used to address the challenge
Working Scenario	To provide further context in relation to the subjects and used to position participants thinking during the detailed identification of future capabilities
Workshops	Online sessions used to undertake each step in the foresight process

Table 1 Glossary

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Figures and Tables

3. Introduction

1. Introduction

1.1 Introduction to Workforce foresighting

Workforce foresighting was identified as essential in addressing the skills challenge, by aligning the skills value chain—from early education through to advanced training—with the demands of emerging technologies. By identifying future occupational profiles and the capabilities required for new roles, foresighting enables educators, employers, and policymakers to proactively adapt curricula, qualifications, and training pathways. This supported the workforce readiness for technological change and also equipped to drive innovation and productivity. In doing so, it transforms foresighting reframed the skills gap from a reactive challenge into a strategic opportunity for national growth and resilience.

This report outlined findings from a Workforce Foresighting cycle focused on Accelerating advanced welding automation through robotics, in-series volumetric inspection, machine vision, and AI to ensure production continuity in Defence assets by 2030. The study was sponsored by the Ministry of Defence (MoD) and study conducted by The Manufacturing Technology Centre (MTC), in collaboration with the Workforce Foresighting Hub, an Innovate UK initiative. This report was intended to support strategic decision-making and inform the next steps across the Skills Value Chain.

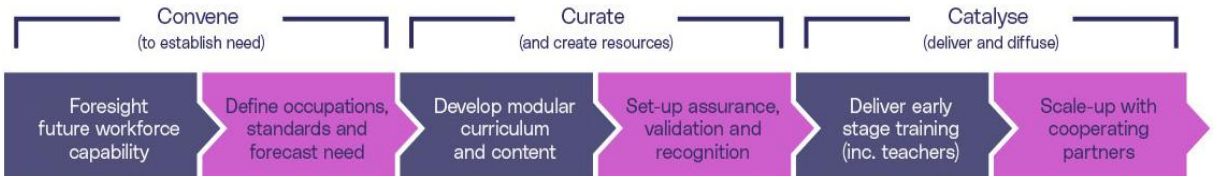

Figure 1: The Skills Value Chain (SVC)

1.2 Defining the Workforce Foresighting Topic

This foresighting cycle focused on a critical national challenge: how the UK could sustain and strengthen its welding and fabrication capabilities for defence and energy infrastructure at a time when demand is rising and the skilled workforce is contracting. The work was aligned with relevant government missions, including the Defence Industrial Strategy (Ministry of Defence, 2025), the Advanced Manufacturing Plan (Department for Business and Trade, 2023), and the 2050 vision for automation and robotics in UK manufacturing (High Value Manufacturing Catapult, 2024), as well as the wider move towards sovereign industrial resilience. The scope addresses the workforce implications with accelerating advanced welding automation across high integrity environments.

The core problem is clear. An ageing welding workforce, combined with acute skills shortages, presents a strategic risk to the maintenance and production of defence assets through to 2030. Traditional manual welding models cannot absorb the scale of upcoming demand or the retirement-driven loss of capacity. Without intervention, these pressures will constrain build programmes, increase rework, extend downtime, and reduce the UK's ability to deliver critical infrastructure at pace.

To address this challenge, the topic centred on the adoption and workforce impacts of intelligent welding automation, including robotics, AI-driven process control, digital twins, in series volumetric inspection, advanced sensing and machine vision. By 2030, these technologies were expected to shift welding from manual, resource-intensive activities to

digitally integrated, adaptive, and automated processes capable of enabling right first-time fabrication, enhanced traceability, and improved safety in regulated, high-integrity settings.

The purpose of defining this topic was therefore to understand how automation would reshape organisational capabilities, occupations and skills across the welding and fabrication ecosystem. The analysis examined where upskilling, reskilling, and the development of new competencies would be required; how automation could offset the projected decline in welding workforce; and which training and qualifications would be needed to support industry and national priorities. Put simply, the topic frames the central question this foresighting cycle sought to answer:

How could the UK develop the workforce needed to deploy, operate, and sustain advanced welding automation to ensure the continuity and resilience of defence and energy assets by 2030?

1.3 Contributing Participants

Thanks to all those organisations for their time and commitment to providing insights and data for this study, in the hope that this process would have a significant impact on the sector.

The Welding Institute (TWI)	The Ministry of Defence (MoD)	Strathclyde University
The Manufacturing Technology Centre (MTC)	Rolls Royce	Warwick University
The Advanced Manufacturing Research Centre (AMRC)	BAE Systems	
	Babcock International	
	Sheffield Forgemasters	
	Atomic Weapons Authority (AWE)	

Table 2: Contributing Participants

2. Findings & Insights

2. Findings and Insights

This report outlined a three-step foresighting process used to understand how emerging technologies would reshape supply chain capabilities and workforce needs.

- Industry - First, it explored how organisational capabilities would need to evolve to enable the adoption/deployment of new and emerging technology, identifying which supply chain partner and functions were most impacted.
- Workforce - Next, these capabilities were grouped into Future Occupational Profiles (FOPs), highlighting the occupations expected to change.
- Provision - Finally, the FOPs were compared against current Education and Training provision, using Skills England occupational standards as a benchmark to identify where existing programmes align and where gaps exist.

The report summarised priority capabilities, FOPs, and knowledge, skills, and behaviours (KSBs). Full details of the data and findings are available in the visualisation tool.

Introduction to the visualisation tool

The Workforce Foresighting Hub's visualisation tool is a powerful, innovative system, which enables the reader to explore and analyse foresighting data to determine the capabilities required for future roles. Links throughout this report make it easy to identify existing standards which meet the needs of these future roles and pinpoint where new standards are necessary to develop a skilled workforce equipped to adopt new technologies.

The data presented were generated by the foresighting cycles, integrating the expertise of technologists/domain specialists, employers, and educators. The data were used to inform the development of future curricula and course content as determined by the action plan. Using AI tools validated by human oversight, and by linking to external data sources, the tool identifies differences at the level of occupation/role as well as detailed changes required to help update/refresh knowledge, skills and behaviours thus delivering insights for learners, providers, creators, and assurers of skills.

Links: **Visualisation Tool**[2] detailed instructions on how to use the visualisation tool can be found in the appendix A. (**Online Data visualisation tool**).

[2] https://hvmcatapultforesighting.retool.com/embedded/public/e869283b-4b8a-437c-973e-64ab292e5b87?token=378f1c4ee50682c055882ac2813c6fe9

2.1 Industry - Identified Organisational Capabilities

Capabilities Identified

Exploration of organisational changes provided insights into how organisations would need to adapt their existing capabilities in order to implement the solutions that respond to the challenge addressed by the foresighting project.

Insight: In total, 88 capabilities were identified of which 77 were matched for to existing Skills England educational provision. The remaining 11 capabilities were not matched. These unmet capabilities are primarily focussed on data gathering and the development and monitoring of key aspects such as, safety standards, supply chain models, systems integration, and operational control systems. Within the context of this cycle, these gaps affect the exchange of data between supply-chain entities, the development of interoperable frameworks and their ongoing maintenance against agreed parameters that ensure safe and secure data handling and sharing between systems and entities.

There was a shared understanding among the cycle participants that the overarching aim was to embed automation capabilities into the existing welding workforce. IT was recognised that expanding capability involves multiple factors and a wide range of technologies and skills beyond fitting and operation of a welding end effector. Mechanical and data processing skills were considered to be as important as welding expertise. One workshop participant described the need to be prepared for the transition “from arc to algorithm,” alongside development of key plans and guidance to support effective workforce change management.

Participants also established the need for retrospective analysis of existing technology and methods. A number of key technologies and methods were already in place and were considered to require sharing and inclusion within education and training provision, in conjunction with new and emerging technologies such as AI.

Future Supply Chain

To understand how supply chains would need to evolve in response to emerging technologies, a forward-looking view of future supply chain operations was developed and compared to current practice. This comparison highlighted the areas where change was required to meet new demands and opportunities.

Throughout the process, participants were engaged to identify which supply chain partners would be affected by the technology in question. This ensures that the analysis was grounded in real-world contexts and considered the full ecosystem of organisations involved.

The supply chain partners related to the analysis are as follows:

RTO/COI – Research & Innovation Organisations
RTOs such as AMRC, MTC, TWI and key university hotbeds will prototype and validate advanced robotic welding and AI-enabled inspection, creating digital twins and reference architectures to de-risk qualification and help industry integrate next-generation robotic welding systems.

Equipment Manufacturers and System Integrators

Equipment manufacturers and integrators will deploy advanced, fault-tolerant robotic welding cells for Defence, combining high-accuracy robots, sensorised systems and model-based commissioning to cut ramp-up time and adapt high-volume automation expertise to large-scale steel fabrication.

Specialist Vendors
Specialist vendors will deliver AI, sensing, machine-vision, and digital-integration capabilities for automated Defence welding, providing adaptive control, multi-sensor fusion, and in-process NDE/volumetric inspection, along with retrofit and governed model-update support to extend automation to legacy assets.

Primes
Primes will define how advanced welding automation is applied to critical Defence structures by setting build specifications, qualification routes, NDE requirements and data-traceability standards. They will integrate automation into complex programmes, ensure compliance with Defence-grade integrity expectations, and shape supplier standards.

End Users
End users will confirm that automated-welding outputs meet Defence quality, safety, and compliance requirements, shaping sector-specific standards, digital-record expectations and repair/inspection need so advanced welding supports platform acceptance, through-life maintenance, and sovereign sustainment across major Defence assets.

Links: Link to Organisational Capabilities[3] and Supply Chain Organisational Profile[4]

The foundation of this analysis is an information architecture built around five core functional domains common to any business: **Design, Implement, Logistics, Support, and Enterprise**. These functions provide a structured lens through which capabilities shifts are assessed.

[3] Organisational capabilities https://hvmcatapultforesighting.retool.com/embedded/public/f56f84e9-8ab8-414f-aa1a-0b42ab5c71df?token=378f1c4ee50682c055882ac2813c6fe9
[4] Supply chain organisation profile https://hvmcatapultforesighting.retool.com/embedded/public/3c22a453-0b15-4414-8f3b-ba9ea10fb392?token=378f1c4ee50682c055882ac2813c6fe9&supplyChainId=297

Insight: The majority of capabilities resided within the design category. Of these, 29 capabilities were currently matched to the existing Skills England education provision, while the remaining three capabilities relate to the definition of data, secure exchange of data, the migration of legacy welding data and the modelling of work cell and robotic concepts that addressed optimisation and safety. These missing capabilities are essential for the conceptualisation of secure and optimised welding systems, the secure exchange of supporting data whether new or legacy and interoperability between different systems.

Implement and Support also showed a high level of alignment. However, capabilities relating to the implementation of guidance around secure Defence data flows to comply with digital security requirements, standardised system API's and the collation and curation of large datasets are not matched to existing education provision. This highlighted the need for the inclusion of secure system architecture and interoperability training and skills development and the standardisation of safety standards and their interoperability between vendors.

Gaps identified within Enterprise echoed these findings, particularly in the space of standardised multi-vendor certification and the compilation and publication of standards and quality data sets.

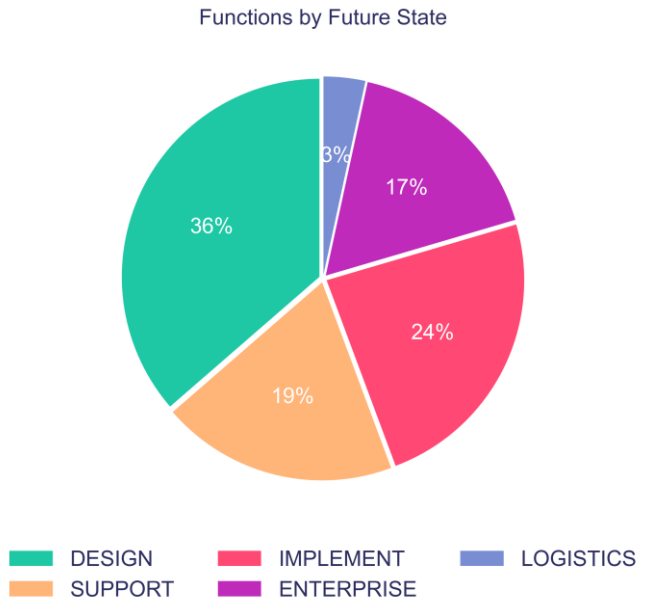

Figure 2: Whole Supply Chain Capability Function Distribution %

Links: Link to visualisation tool for **88 capabilities**[5]

By mapping these partners against the five functional domains, it was possible to identify where capability changes were required and which organisations will need to adapt, whether through new skills, new roles, or new ways of working.

[5]Capabilities https://hvmcatapultforesighting.retool.com/embedded/public/3573002a-ab48-4fad-9765-bee00876a42e?token=378f1c4ee50682c055882ac2813c6fe9

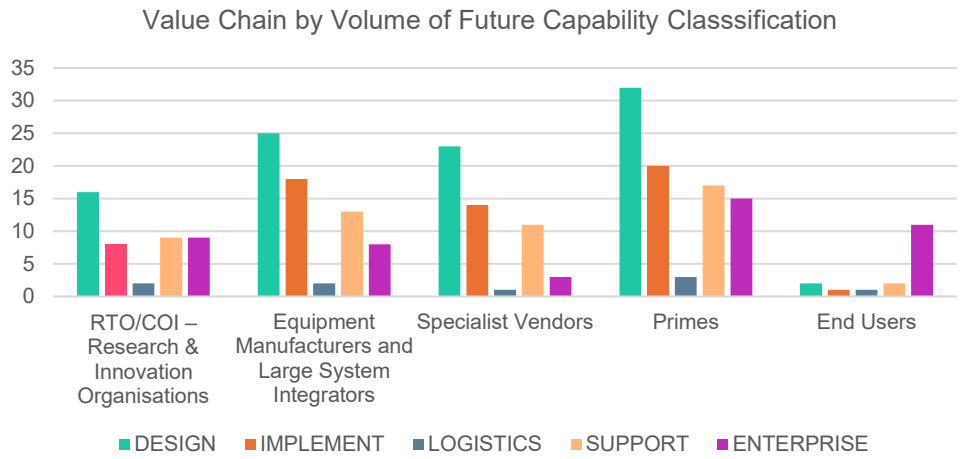

Figure 3: Distribution of Functions capabilities across each Supply Chain partner.

The graph illustrated the distribution of capabilities by function across the supply chain partners. These capability groupings were used to inform the development of Future Occupational Profiles (FOPs) within each role level.

Links: View visualisation tool for **5 supply chain partners**[6]

Functional Cycle Capabilities Currently Not Served

Of the **88 future capabilities** identified during this cycle to support technology adoption across the supply chain, **11 were found to have weak or low alignment** with any duty statements within existing apprenticeship standards.

Two key capabilities were identified as cutting across the majority of organisations: the conception of operations and robot interaction, and the implementation of synthetic data sets encompassing weld process, vision and inspection data capture and curation. This highlights the need for robust concepting and specification of systems and the processes undertaken, with a key emphasis in sensing technology. Organisations will need the capability to de-risk operational performance, environmental exposure, and data transfer from OEM through to deployment, training and use by the end user.

Spanning across the landscape from RTOs through to Primes is the collation of parsing of the data generated by these systems. This capability was identified as paramount, allowing for the creation of robust datasets that enable autonomous systems and allow end users to review and utilise curated welding analytics, thereby de-risking future task planning, and autonomous operation.

The remaining capabilities were distributed across organisations, highlighting the need for the creation of rules and validation of legacy data sets, development, implementation, and operation of both power- and thermally stable hardware, and the associated supporting software. This also includes the collation, utilisation and secure sharing and storage of collected data.

These findings indicate a clear gap within Education and Training provision, highlighting the need for both short- and long-term training solutions to upskill the existing workforce and prepare new/future entrants. The 11 unmatched capabilities are listed below.

[6] Supply chain partners https://hvmcatapultforesighting.retool.com/embedded/public/3573002a-ab48-4fad-9765-bee00876a42e?token=378f1c4ee50682c055882ac2813c6fe9

Table Key: Supply chain partners

1. RTO/COI – Research & Innovation Organisations (MTC) AW
2. Equipment Manufacturers and Large System Integrators
3. Specialist Vendors
4. Primes
5. End Users

Function	Capability statement	1	2	3	4	5
DESIGN	Model concept operations of work cell layouts and robot interactions to optimise flow and safety.		ü	ü	ü	ü
DESIGN	Create data import and validation rules to migrate legacy weld procedure and qualification records into structured systems without losing provenance.				ü	
DESIGN	Define interoperability requirements for supply chain partners to enable secure, standards-based data exchange and connectivity across hardware and software vendors.	ü	ü		ü	
IMPLEMENT	Define data flow guidance to meet defence firewall requirements for incoming and outgoing information.				ü	
IMPLEMENT	Capture and curate traceable weld process, vision, and inspection data to build large labelled and synthetic datasets for welding analytics.	ü	ü	ü	ü	
IMPLEMENT	Implement computing platforms with thermal and power protection to keep real-time weld analysis running in harsh factory conditions.		ü	ü	ü	
IMPLEMENT	Provide standardised, secure application interfaces to mainframe services using managed APIs to improve interoperability across connected digital systems.		ü		ü	
SUPPORT	Publish interoperability frameworks to standardise data formats, interfaces, and security controls for multi-vendor certification across the supply chain.				ü	ü
SUPPORT	Draft and revise national and international standards through consultation to achieve clear, practical adoption across industry and regulators.				ü	ü
ENTERPRISE	Compile and publish shared datasets across organisations using common standards, quality checks, and access controls to support parallel model development.				ü	ü
ENTERPRISE	Certify multi-vendor products against published interoperability frameworks to verify consistent data formats, interfaces, and security controls before operational deployment.	ü	ü		ü	

Table 3: Functional Cycle Capabilities Currently Not Served by Skills England

Prioritised Capability Themes

In total across the various supply chain partners **88 capabilities** were identified as shown in Appendix A (**Online Data visualisation tool**). Following a review with the expert participants, the following initial capability themes have been prioritised as critical if this technology is to be adopted.

Note: In this instance the prioritisation is based on the capabilities established as the most essential capabilities for adoption as captured by participants in a survey. It is also possible to prioritise based on the FOP distribution i.e. which capabilities are used most across the identified FOPs:

Top 5 Priority Themes:

1. Real-Time Control, Sensing & Monitoring
2. Robotic Welding & In-Line Inspection
3. Simulation, Commissioning & Scale-Up
4. Robotics Integration & Operations
5. Cybersecurity & Safety by Design

Insight:

Theme 1: Real time control sensing and monitoring
This is a key theme, integral to the core aspects of automated welding. The capability will be utilised in cell planning, in process feedback monitoring and data validation and the monitoring of consumables and high maintenance components. This enables the prevention or fast response to stoppages and system failure.

Theme 2: Robotic Welding & In Line Inspection
This is a key theme in both new and current solutions, as past knowledge of the integration of robot and cell mounted welding and vision solutions, and their respective developments will be used to set the foundation for new and emerging technologies.

Theme 3: Simulation, Commissioning & Scale Up
A key component to successful and timely commissioning of systems and robust testing. Additional development of security systems also fall under this capability, as the simulation, commissioning and testing of security and data sharing systems will be a significant portion of the work undertaken in each function.

Theme 4: Robotics Integration & Operations
The integration of both cutting edge autonomous software and supporting hardware is paramount for a successful deployment and operation of future and retrofitted automated welding cells. The development, configuration and deployment of robot and cell mounted sensing/feedback hardware and its associated software's integration into existing and future control systems (via direct connection or a unified communication protocol), will play a key part in the gathering and collation of welding data sets, allowing for in process optimisation and interoperability between systems and vendors.

Theme 5: Cybersecurity & Safety by Design
Greatly needed to meet the demands of the sector and should be baked into the foundation of each function. The magnitude of data that will be shared between systems both IT and OT will need to be parsed in a timely manner and trigger immediate action if needed.

2.2 Workforce Insight

Future Occupational Profiles

Future occupational profiles (FOPs) indicate how roles in the industry may need to evolve as the sector becomes more productised, systemised, and technology driven. They define the key responsibilities and the knowledge, skills, and behaviours required for each role, ensuring alignment with the industry's transformation.

The FOPs defined for this cycle do not capture the full extent of a current or future job role. Workforce Foresighting identifies new capabilities and changes required in an occupation required in the future to allow technology adoption.

Links: Link to **FOP Matrix**[7]

Role levels

Organisations rely on structured role levels to manage talent, drive performance, and support sustainable growth. A clear hierarchy from entry level to executive leadership ensures responsibilities are well defined and expectations aligned. Each level builds on the last in terms of complexity, autonomy and impact enabling effective collaboration and accountability.

Workforce Foresighting uses a common way of defining role levels across supply chain partners but adapts it to each technology and sector. This shared framework supports consistency, while still reflecting the specific capabilities and workforce needs for each challenge

Role levels selected for this cycle are:

- Contributor
- Executing defined tasks with supervision
- Professional & Delivery
- Diagnose, adapt, and collaborate within known systems.
- Strategic Management
- Design systems, manage resources and drive innovation.

Future Occupational Profiles results

To enable the acceleration of advanced welding automation through robotics, in-series volumetric inspection, machine vision, and AI to ensure production continuity in Defence asset, 12 FOPs were identified. These FOPs can be seen below listed by role level (RL) and across the supply chain partners identified.

Table Key:

1. RTO/COI – Research & Innovation Organisations (MTC) AW
2. Equipment Manufacturers and Large System Integrators
3. Specialist Vendors
4. Primes
5. End Users

[7] FOP Matrix https://hvmcatapultforesighting.retool.com/embedded/public/f99a913f-8827-4730-8893-d618d489bc84?token=378f1c4ee50682c055882ac2813c6fe9

RL	FOP	1	2	3	4	5
1	Quality Assurance Technician	✓	✓	✓	✓	✓
2	Cyber Security Management and Governance Specialist		✓	✓	✓	✓
	Robotics Engineer	✓	✓		✓	
	Industrial and Production Engineer	✓	✓		✓	
	Mechatronic Engineer	✓	✓	✓	✓	
	Data Architect	✓			✓	
	Quality Assurance Professional	✓	✓	✓	✓	✓
	Statistical Data Scientist	✓	✓	✓	✓	
	Digital Twin Engineer	✓	✓	✓	✓	
	PLC Engineer (Programmable Logic Controller Engineer)	✓	✓	✓	✓	✓
3	Digital Systems Architect	✓	✓	✓	✓	
	Robotics Strategy Lead	✓	✓	✓	✓	✓

Table 4: Future Occupational Profiles by supply chain partner

Priority FOPs

The FOPs were reviewed by our expert cycle participants against the context of importance to the sector, demand, and mapping against current provision. The following FOPs have been prioritised for initial action and further analysis. The FOPs outlined below have been identified as key roles within the future workforce, essential for delivering the capabilities required to drive industry transformation, enabling the adoption advanced automation welding technologies.

As part of our strategic workforce planning, we identify and prioritise FOPs based on a set of key criteria. A Priority FOP is a role that is critical to our future success and must be developed ahead of others to meet evolving business needs.

These FOPs are prioritised because they:

- Were strategically important to the sectors long-term goals.
- Faced current or anticipated capability gaps.
- Had a high impact across multiple functions.
- Required early talent planning and pipeline development.
- Needed to be ready within a defined timeframe.

Links: **List of full Future Occupational Profiles**, **Capabilities Matched to Current Provision**[8] and **12 FOPs**[9]

[8] Capabilities matched to current provision https://hvmcatapultforesighting.retool.com/embedded/public/219ff6af-36ea-4b5e-bda1-b0b989c0e3f0?token=378f1c4ee50682c055882ac2813c6fe9

[9] FOPs https://hvmcatapultforesighting.retool.com/embedded/public/81d272f0-ad80-421c-8926-86655913acdf?token=378f1c4ee50682c055882ac2813c6fe9

Insight: Cycle selected FOPs and why they were selected:

1. Cyber Security Management and Governance Specialist
Cyber Security Management and Governance Specialists will secure AI-enabled robotic and autonomous systems by embedding security-by-design, real-time anomaly detection and defence-grade data governance.
Evolving from today's policy-focused cyber roles, they will integrate automated testing, interoperability standards, and resilience frameworks to protect connected manufacturing networks and assure compliant, traceable production.

2. Robotics Engineer
A Robotics Engineer develops and writes the software that controls robots and automated systems. They create, test, and optimise code to ensure robots move accurately, perform tasks reliably, and interact safely with their environment. Additional capabilities include the initial commissioning of robotic and associated welding equipment, ensuring correct setup, communication configuration and system safety and validate robotic system compliance.

3. Industrial and Production Engineer
Industrial and Production Engineers will orchestrate AI-enabled robotics, digital twins, and advanced process control to design autonomous welding and manufacturing cells that self-optimise quality and throughput.
Evolving from today's focus on resource-efficient production flows, they will architect data-rich, scalable systems that integrate design-to-disposal operations and support defence-grade automation programmes.

4. Digital Systems Architect
Digital Systems **Architects** will design secure, interoperable architectures for autonomous, AI-enabled manufacturing systems, integrating multi-vendor hardware, data services, and automated testing.
Evolving from today's component-focused system design, they will validate configurations through real-time trials, enforce defence-grade standards, and orchestrate scalable, lifecycle-wide digital infrastructures for robotic production.

5. PLC Engineer (Programmable Logic Controller Engineer)
A PLC Engineer designs, programs, commissions, and maintains industrial automation systems using programmable logic controllers. They programme for HMI (Human Machine Interface) design. They troubleshoot equipment, optimise processes, and ensure machines run safely and efficiently across manufacturing and production environments.
And further in the context of welding, translate welding knowledge and practices to machine parameters and safety configurations. Additionally ensuring core hardware and non-autonomous systems communicate with and react correctly to proposed future AI driving systems.

6. Robotics Strategy Lead
Robotics Strategy Leads will shape national and international standards, align strategic and technical requirements, and drive cross-industry adoption of advanced robotics and AI.
Evolving from today's technology-planning roles, they will coordinate the build of shared, high-quality datasets and champion scale-able automation to enhance precision, productivity, and regulatory confidence across the sector.

2.3 Education & Training provision insights

Provision Analysis of FOPs and Capabilities

Below is a comparison of each priority FOP against highest scoring existing education provision. The tables highlight the highest-scoring standard for each and identify capabilities that are not currently addressed by the selected standard. These unmet capabilities could inform the development of future education and training provision, either by adapting existing programmes or through the creation of short continuing professional development (CPD) courses aimed at upskilling the current workforce.

Cyber Security Management and Governance Specialist

Key Tasks: Embed security-by-design; monitor threats and vulnerabilities; govern policies, standards, and data architectures; manage configuration control and secure APIs; run penetration tests and resilience planning; ensure compliance and interoperability; safeguard automated and defence-grade systems with integrity, traceability, and anomaly-response measures.

Aligned to supply chain partners: Equipment Manufacturers and Large System Integrators, Specialist Vendors, Primes, End Users

In FOP vs Provision there was a 26.3% Fit with Skills England Cyber Security Technologist (2021)[10]. The unmatched FOP capabilities are shown below:

Function	Capability Statement
DESIGN	Implementing real-time anomaly detection and response systems for cyber security of autonomous robotic systems using artificial intelligence and machine learning
DESIGN	Implement standardised systems and tools to enhance insights across integrated design, manufacturing, through-life support, and end-of-life management.
IMPLEMENT	Supply ring-fenced automated systems that comply with defence-specific technical and security standards.
IMPLEMENT	Implement and maintain configuration control systems to ensure consistent management of changes.
IMPLEMENT	Define data flow guidance to meet defence firewall requirements for incoming and outgoing information.
IMPLEMENT	Provide standardised, secure application interfaces to mainframe services using managed APIs to improve interoperability across connected digital systems.
LOGISTICS	Manage the scale up of new technologies for effective deployment in the sector
SUPPORT	Produce resilience guides to define failover steps, reduced-operation procedures, and recovery actions to sustain cell operations, network functionality, and data continuity.
SUPPORT	Gather, analyse, and store routine quality performance data to support governance and reporting.
SUPPORT	Set data integrity, cybersecurity, and traceability requirements for robotic welding and in-line inspection, then update internal standards to assure defence production continuity.
SUPPORT	Publish interoperability frameworks to standardise data formats, interfaces, and security controls for multi-vendor certification across the supply chain.
ENTERPRISE	Maintain standards for data architectures, models, tools, and databases.

[10] Cyber security technologist apprenticeship standard https://hvmcatapultforesighting.retool.com/embedded/public/3573002a-ab48-4fad-9765-bee00876a42e?token=378f1c4ee50682c055882ac2813c6fe9

Function	Capability Statement
ENTERPRISE	Monitor regulatory changes and ensure compliance for robotic and autonomous systems.
ENTERPRISE	Develop regulatory and organisational policies to ensure compliance and effective governance.

Table 5: Cyber Security Management & Governance Specialist capabilities not served by Provision

This FOP showcased one of the largest identified knowledge gaps within the field. The number of unmatched capabilities indicated a lack of an initial springboard for potential candidates. Most of the capabilities within the gap relate to the development of emerging technologies and their associated documentation, which are mainly held within the RTO findings, OEM development, and system optimisation work. This has resulted in fragmented standardisation and the presence of hidden or uncategorised data, making dissemination to the education sector challenging and limiting the subsequent development of structured learning modules.

Addressing this gap is critical, as this FOP is identified as essential to the secure development and operation of the future state welding cells and processes. The capabilities associated with this FOP span multiple functional areas and as a result as significant volume of individuals will be required to operate effectively within the scope of this FOP.

A greater level of collaboration and data sharing between RTO's, OEM's and primes was identified as necessary to establish the foundational data required for future learning modules. Given the breath of technology associated with automated welding, substantial effort will be required to develop modules focused on the design of secure automated systems and the integration of current and horizon security technologies between field devices and IT systems.

Multiple potential pathways were identified for potential candidates progressing towards the capabilities within this FOP. These include the inclusion of additional modules within robotic and controls courses and career pathways, additionally through IT and software development provision that explicitly demonstrate the interface between the IT and OT worlds.

Links: FOP vs Provision[11] to see full list of capabilities for this FOP against provision

[11] FOP vs Provision https://hvmcatapultforesighting.retool.com/embedded/public/d9f485a2-6d23-45dd-ab48-4c4c87ced0c7?token=378f1c4ee50682c055882ac2813c6fe9

Robotics Engineer

Key Tasks: Develop robotic welding solutions; plan and model offsite/online commissioning; integrate robots, weld sources, and networks; program via digital twins; optimise sequencing, control, and AI; design safe co-pilot interfaces; ensure traceable data and standards compliance; diagnose faults; maintain resilient, protected compute in harsh conditions.

Aligned to supply chain partners: RTO/COI – Research & Innovation Organisations, Equipment Manufacturers and Large System Integrators, Primes

In FOP vs Provision there was an 66.7% Fit with Skills England **Robotics Engineer – Degree**

Function	Capability Statement
DESIGN	Develop frameworks to integrate machine learning that improves autonomous selection of welding technologies.
IMPLEMENT	Tune controller parameters in real time using bounded optimisation and safety limits to maintain stable operation under changing conditions.
IMPLEMENT	Execute online commissioning to minimise on-site effort and accelerate production ramp-up.
IMPLEMENT	Execute model-based offsite commissioning tests to validate operating sequences to reduce on-site effort and accelerate production ramp-up.
IMPLEMENT	Implement computing platforms with thermal and power protection to keep real time weld analysis running in harsh factory conditions.
SUPPORT	Align spares and consumables with asset health signals to maintain fault-tolerant cells and minimise downtime of critical equipment.
SUPPORT	Commission and calibrate robotic welding cells using automated self-diagnostics, machine vision checks, and remote augmented reality guidance to maintain production continuity.

Table 6: Robotics Engineer capabilities not served by Provision

This FOP was identified as having a strong foundation within the degree-level Robotics Engineer provision. However, the absence of machine learning and offline commissioning capability was highlighted as a key gap. The missing capabilities are evident within OEM literature and RTO outputs but appear to be largely absent from the educational offerings. This indicates a need for the development of launchpad modules that expose students to welding methodologies and the key interactions between joining processes, devices, and the systems typically found within an automation cell.

A clear progression pathway was also identified as being required for learners who are working towards or are already employed within welding occupations. This pathway should outline the core enabling technologies and the relevant programming and configuration methodologies required for welding operations. In particular, clear guidance on safety, cell design, system configuration, and path programming for smooth continuous motion was identified, as necessary. Associated welding packages offered by OEM's and relevant accessory vendors should be showcased and reviewed to allow learners to understand the range of approaches employed across industry.

To establish a robust dataset suitable for teaching and learning, collaboration and data sharing between RTO's, OEM's and prime contractors would be needed to lay the foundational data for future learning modules.

Industrial and Production Engineer

Key Tasks: Design scalable robotic cells; model work cells, welding, and inspection; build process/material databases; develop digital twins; optimise sequencing, AI control, and quality; create schedules and manage digital production; apply sourcing and scale-up; ensure standards, operator co-pilots, robust compute, and spares alignment.

Aligned to supply chain partners: RTO/COI – Research & Innovation Organisations, Equipment Manufacturers and Large System Integrators, Primes

In FOP vs Provision there was an 34.8% Fit with Skills England **Robotics Engineer – Degree**

Function	Capability Statement
DESIGN	Build process and material databases that support automated decision making and control using AI and inspection methods.
DESIGN	Model concept operations of workcell layouts and robot interactions to optimise flow and safety.
DESIGN	Model concept operations for welding and automated inspection to predict performance and constraints.
DESIGN	Forecast demand in consultation with supply chain planners to optimise inventory and resources.
DESIGN	Develop digital twin process models to simulate material flows, cycle times, and constraints, informing equipment design decisions before installation.
DESIGN	Implement standardised systems and tools to enhance insights across integrated design, manufacturing, through-life support, and end-of-life management.
IMPLEMENT	Create production schedules using virtual cycle times, capacity limits and pace needs to maximise throughput.
IMPLEMENT	Implement advanced process control techniques to improve operational efficiency.
IMPLEMENT	Manage digital production processes to accurately track and update work orders, bills of materials, and revision statuses.
IMPLEMENT	Establish frameworks and standards to capture and analyse production rates, time, motion, methods, and speed in operations.
IMPLEMENT	Implement computing platforms with thermal and power protection to keep real time weld analysis running in harsh factory conditions.
LOGISTICS	Apply selection and award criteria for sourcing requirements from external suppliers.
LOGISTICS	Manage the scale up of new technologies for effective deployment in the sector
LOGISTICS	Manage the scale-up of automation equipment manufacture to meet defence asset programme deliveries and quality requirements.
SUPPORT	Align spares and consumables with asset health signals to maintain fault-tolerant cells and minimise downtime of critical equipment.

Table 7: Industrial and Production Engineer capabilities not served by Provision

This FOP currently demonstrates a 34.8% fit against existing provision. The capabilities within the identified gap are key to the development and design of systems, as well as their subsequent operation. This represents another key FOP that is likely to be populated by individuals drawn from the existing welding talent pool, or those progressing towards an expert-level knowledge of welding processes. The capability gaps indicate the need to integrate modules from other disciplines, including mechanical design, system controls and IT. Additional design-focused capabilities are predominantly held within OEM's and integrators, showcasing the need for greater support to be developed within Industry.

Digital Systems Architect

Key Tasks: Develop automated test environments; define system requirements and interoperability; manage configuration control and secure APIs; maintain data architectures; ensure cybersecurity and compliance; validate multi-vendor systems; design technical roadmaps; diagnose faults; deploy protected compute platforms and real-time installation/commissioning tools.

Aligned to supply chain partners: RTO/COI – Research & Innovation Organisations, Equipment Manufacturers and Large System Integrators, Specialist Vendors, Primes.

In FOP vs Provision there was an 31.8% Fit with Skills England **Advanced Robotics Engineer**

Function	Capability Statement
DESIGN	Define acceptance criteria for business and system changes.
DESIGN	Ensure security by design in all system development processes to protect against cyber and physical threats.
DESIGN	Implement Application Programming Interfaces (APIs) between systems to facilitate frequent and reliable updates.
DESIGN	Compare component parts of automation systems to optimise performance.
DESIGN	Define interoperability requirements for supply chain partners to enable secure, standards-based data exchange and connectivity across hardware and software vendors.
IMPLEMENT	Monitor cybersecurity vulnerabilities and threats for organisational security.
IMPLEMENT	Implement and maintain configuration control systems to ensure consistent management of changes.
IMPLEMENT	Supply ring-fenced automated systems that comply with defence specific technical and security standards.
IMPLEMENT	Implement computing platforms with thermal and power protection to keep real-time weld analysis running in harsh factory conditions.
SUPPORT	Implement systems and tools for real-time, visual, interactive step by step installation/commissioning
SUPPORT	Design technical roadmaps for data life-cycles to ensure appropriate support and business processes.
SUPPORT	Set up and maintain databases and remote data services that support automated systems.
ENTERPRISE	Maintain standards for data architectures, models, tools, and databases.
ENTERPRISE	Develop standards, best practices, and competencies for system usage procedures in organisational operations.
ENTERPRISE	Certify multi-vendor products against published interoperability frameworks to verify consistent data formats, interfaces, and security controls before operational deployment.

Table 8: Digital Systems Architect capabilities not served by Skills England

In the context of automated welding, this FOP will need to handle OT system monitoring, alongside knowledge of industrial controls and devices, advanced system configuration also forming a key requirement. The core capability gaps, however, relate to IT system integration, security, and management. These capabilities are more commonly found to relate to IT solutions, software development, and cyber security technologist education pathways. Some of the new emerging capabilities extend beyond current welding-related education provision and could be incorporated into the Process Leader apprenticeship or delivered through a targeted CPD curriculum.

PLC Engineer (Programmable Logic Controller Engineer)

Key Tasks: Develop automated test rigs and digital twins; define requirements and models; program and tune PLCs with advanced process control; execute offsite/online commissioning and calibration; deploy vision and defect detection; diagnose faults; manage configuration, data capture, scheduling, and spares-aligned resilience.

Aligned to supply chain partner: RTO/COI – Research & Innovation Organisations, Equipment Manufacturers and Large System Integrators, Specialist Vendors, Primes, End Users.

In FOP vs Provision there was an 29.2% Fit with Skills England **Advanced Robotics Engineer**.[12]

Function	Capability Statement
DESIGN	Create standard virtual models and tools to support verification and validation of systems, subsystems, and components.
DESIGN	Compare component parts of automation systems to optimise performance.
DESIGN	Develop digital twin process models to simulate material flows, cycle times, and constraints, informing equipment design decisions before installation.
IMPLEMENT	Create production schedules using virtual cycle times, capacity limits and pace needs to maximise throughput.
IMPLEMENT	Implement advanced process control techniques to improve operational efficiency.
IMPLEMENT	Implement and maintain configuration control systems to ensure consistent management of changes.
IMPLEMENT	Tune controller parameters in real time using bounded optimisation and safety limits to maintain stable operation under changing conditions.
IMPLEMENT	Execute online commissioning to minimise on-site effort and accelerate production ramp-up.
IMPLEMENT	Execute model-based offsite commissioning tests to validate operating sequences to reduce on-site effort and accelerate production ramp-up.
IMPLEMENT	Capture and curate traceable weld process, vision, and inspection data to build large labelled and synthetic datasets for welding analytics.
IMPLEMENT	Establish frameworks and standards to capture and analyse production rates, time, motion, methods, and speed in operations.
SUPPORT	Design operator co-pilot interfaces that explain robotic weld and inspection decisions, enabling rapid intervention and safe continuation during defence asset production.
SUPPORT	Deploy machine vision inspection models to detect welding defects and trigger corrective actions with minimal operator intervention.
SUPPORT	Align spares and consumables with asset health signals to maintain fault-tolerant cells and minimise downtime of critical equipment.
SUPPORT	Commission and calibrate robotic welding cells using automated self-diagnostics, machine vision checks, and remote augmented reality guidance to maintain production continuity.
SUPPORT	Gather, analyse, and store routine quality performance data to support governance and reporting.
ENTERPRISE	Develop standards, best practices, and competencies for system usage procedures in organisational operations.

Table 9: Programmable Logic Controller Engineer capabilities not served by Provision

[12] Advanced Robotics Engineer https://skillsengland.education.gov.uk/apprenticeships/st1381-v1-0

These specific industry requirements are not currently addressed within existing education programmes. The capabilities are largely developed within industry, driven by market and system demands. As a result, the inclusion of relevant modules or industry-specific CPD programmes focusing on these capabilities could provide clear benefit to future education and training initiatives.

Robotics Strategy Lead

Key Tasks: Research emerging robotics; run benchmarks and publish shared datasets; develop and influence standards; define strategic and technical requirements; drive adoption and change management; promote advanced robotics and AI to improve automation performance, quality, and industry-wide interoperability.

Aligned to supply chain partners: RTO/COI – Research & Innovation Organisations, Equipment Manufacturers and Large System Integrators, Specialist Vendors, Primes, End Users

In FOP vs Provision there was an 57.1% Fit with Skills England **Robotics Engineer – Degree**.[13]

Function	Capability Statement
DESIGN	Run benchmark trials and publish open datasets and interoperability profiles to validate robotic welding automation and in-series volumetric inspection.
SUPPORT	Draft and revise national and international standards through consultation to achieve clear, practical adoption across industry and regulators.
ENTERPRISE	Compile and publish shared datasets across organisations using common standards, quality checks, and access controls to support parallel model development.

Table 10: Robotics Strategy Lead capabilities not served by Provision

To equip the future workforce with these capabilities, additional modules could be integrated into existing robotics degrees and potentially with the right backing be presented as an accreditation, this is a good pathway for those already within the robotics sphere and looking to further advance and create change within the sector.

An addition of modules that also include literacy on compiling and maintaining datasets, functional knowledge of standards the route to the generation or modification of hardware and software standards. The most paramount is the ability for a candidate to learn the fundamentals of welding and material theory to be able to communicate with experts and interoperate gathered data into strategy.

[13] Robotics Engineer – Degree https://skillsengland.education.gov.uk/apprenticeships/st1317-v1-2

FOPs with the biggest Education provision gaps

The table below lists the total FOPs defined for this foresighting cycle. It highlights provision gaps by showing the best fit current apprenticeship standard, based on Maximum Fit Factor. The Maximum Fit Factor is combined with the Surplus Factor to determine the Apprenticeship Suitability score of Low, Medium, or High. A detailed comparison of current apprenticeship provision against the capability requirements of the identified FOPs is available in the data visualisation tool: **FOP vs Provision.**[14]

Table Key: Supply chain partners

1. RTO/COI – Research & Innovation Organisations (MTC) AW
2. Equipment Manufacturers and Large System Integrators
3. Specialist Vendors
4. Primes
5. End Users

Role level	FOP Title	Supply chain partners	Best Fit Apprenticeship Standard/s	Apprenticeship Suitability
Contributor	Quality Assurance Technician	1.2.3.4.5	Electro-mechanical engineer	LOW
Professional & Delivery	**Cyber Security Management and Governance Specialist**[15]	2,3,4,5	Cyber security technologist (2021)	LOW
	PLC Engineer	1,2,3,4,5	Advanced robotics engineer	LOW
	Quality Assurance Professional	1,2,3,4,5	Food industry technologist	LOW
	Statistical Data Scientist	1,2,3,4	Data engineer	LOW
	Data Architect	1,4		
	Digital Twin Engineer	1,2,3,4	Robotics engineer - degree	LOW
	Industrial and Production Engineer	1,2,4		
	Mechatronic Engineer	1,2,3,4	Robotics engineer - degree	MEDIUM
	Robotics Engineer [15]	1,2,4	Robotics engineer - degree	MEDIUM
Strategic Management	**Digital Systems Architect**	1,2,3,4	Advanced robotics engineer	LOW
	Robotics Strategy Lead	1,2,3,4,5	Robotics engineer - degree	MEDIUM

Table 11: FOPs mapping to Skills England apprenticeship provision

Links: FOP Priorities[16]

[14] FOP vs Provision https://hvmcatapultforesighting.retool.com/embedded/public/d9f485a2-6d23-45dd-ab48-4c4c87ced0c7?token=378f1c4ee50682c055882ac2813c6fe9
[15] **Bold title** Selected as a cycle priority Future occupational profile
[16] FOP priorities https://hvmcatapultforesighting.retool.com/embedded/public/ad0f6dcb-9535-4239-96a7-c8d0e005477a?token=378f1c4ee50682c055882ac2813c6fe9

Knowledge, Skills, and Behaviour tags and its observations.

For each capability in a foresighting cycle, a team of expert educators have determined the relevant KSB required by the workforce to deliver the capability. This approach enables two key use cases:

- **Informing / Guiding understanding of the alignment between future-state capability requirements and current educational provision.**
- **Driving action by equipping educators to embed these capabilities into their curriculum**.

While capabilities define what organisations need to thrive in the future, KSBs provide a practical framework for how education must evolve to support that transformation. Tags associated with capabilities that align well with current educational provisions may also reveal shifts in KSBs. Capabilities introduced during the cycle will also have the relevant tags that will support educators to integrate those capabilities into curriculum effectively.
This intersection between capability relevance and KSB evolution is critical for identifying where curriculum updates are needed to keep pace with industry transformation.

Application

The complete list of KSBs associated with each capability is available within the visualisation tool, alongside all other relevant contextual information.

The application of this data can be broadly divided into two key areas:

1. **Macro Trend Analy**sis
   By examining KSB tags at an aggregate level across all capabilities, educators can identify major shifts in demand. This high-level view helps narrow the focus to areas where change is most significant or emerging.

2. **Detailed Research**
   Once priority areas are identified through the macro lens, educators can drill down into specific capabilities or explore the detailed KSBs linked to a particular tag. This supports more targeted curriculum development and informed decision-making.

This report presents a selection of aggregated insights intended to illustrate potential use cases. Readers are strongly encouraged to explore the visualisation tool for a more detailed and interactive engagement with the data. The tool offers deeper context, flexible filtering, and access to the full range of capabilities and KSB tags, enabling users to tailor their exploration to specific interests or needs.

Most frequent tags

The following graphic highlights the most frequently used tags across all capabilities in the foresighting cycle. These tags reveal macro trends that can guide the focus of training provisions.

Insight:

Analysis of the Knowledge and Skills tags against the five Priority Capability Themes revealed the following:

Integration was the connective tissue. System integration and integrate systems & software were among the most common cross-theme tags, reflecting that success in this cycle hinged on consistent data and control interfaces across devices, cells, and IT/OT layers.

Welding and inspection were not isolated and pervaded operations. Robotic welding, welding, inspect weld joints, machine vision, evaluate NDT systems all appeared across the full set of themes, not just the “Robotic Welding & In-Line Inspection” theme. This validated the theme set and demonstrated that welding QA activity is integral to commissioning, operations, and safety.

Cyber and safety were embedded rather than treated as an afterthought. Cybersecurity, regulatory compliance, robot safety was prominent across four themes, indicating mainstreaming of “safety by design” and pre-deployment assurance practices (for example, penetration testing during factory acceptance.

Real-time control intersected with data quality and monitoring. Tags such as process/control systems, sensors, SPC and monitoring, data quality showed that ability to observe and respond in real time depended on robust sensing, validation, and anomaly response pipelines.

Most frequent Knowledge Tags

Tag	Tag Frequency
Industrial Robotics	24
Robotics	19
Robot Welding	17
System Integration	13
Automation	11
Information Security	10
Artificial Intelligence (AI)	9
Regulatory Compliance	8
System Testing	8
Welding	8
Control Systems	7
Data Governance	7
Process Control	7
Business Requirements	6
Data Management	6
Machine Vision	6
Quality Control	6

Table 12: Most frequent Knowledge Tags

Most frequent Skills Tags

Tag	Tag Frequency
Develop robotic systems and software	17
Integrate systems and software	13
Assess robot system safety	10
Inspect weld joints	9
Develop production line sequences and procedures	8
Evaluate Non-Destructive Testing (NDT) systems	8
Analyse design requirements for systems	7
Simulate mechatronic design concepts	7
Design processes and components using CAD and simulation tools	6
Find faults in automation control systems	6
Maintain robotic equipment	6
Programme equipment for automated tasks	6
Use automated testing tools	6

Table 13: Most frequent Skills Tags

This data served as a starting point to identify emerging knowledge and skill areas that may not be traditional within the industry but were gaining traction due to the adoption of new technologies. It also highlighted expected tags that rank lower than anticipated, potentially indicating a decline in demand.

Using this insight, readers could explore the visualisation tool to examine the KSBs unique to a specific capability or FOP, enabling more informed decision-making.[17]

Priority evaluation of underserved and high demand capability themes

Educators conducted a targeted review of capability statements and FOPs to identify areas where there was:

- High forecasted demand for specific capabilities in the future workforce, and
- Only some current curriculum coverage, meaning these capabilities were not adequately addressed in existing educational programmes.

By focusing on this intersection—high demand but only some provision—educators were able to pinpoint priority capability gaps that may hinder workforce readiness if left unaddressed.

This approach supported strategic curriculum development by highlighting which capabilities should be prioritised for inclusion or enhancement in training programmes.

[17]Capability distribution across FOPs https://hvmcatapultforesighting.retool.com/embedded/public/ce67cca1-5beb-4557-8482-8a0b6e174933?token=378f1c4ee50682c055882ac2813c6fe9

2.4 Discussion on Noteworthy Observations

A number of themes emerged from the clustering of capability statements associated with high demand and partial provision. These themes reflect areas where current education and training offerings may not have sufficiently prepared individuals for future roles, particularly in sectors undergoing rapid technological and organisational transformation.

Five priority capability themes were identified:

1. Real-Time Control, Sensing & Monitoring
2. Robotic Welding & In-Line Inspection
3. Simulation, Commissioning & Scale-Up
4. Robotics Integration & Operations
5. Cybersecurity & Safety by Design

These themes are key areas that require coverage across education provision, for both the upcoming workforce entrants and for existing workforce. Addressing these gaps will require coordinated efforts across educators, industry partners, and curriculum designers to ensure future professionals are equipped for evolving occupational demands.

Key findings: Workforce and Skills Gaps in Welding Automation

The analysis highlighted a set of structural and systemic issues underpinning the current skills gaps:

- **Hybrid skills gap**: Existing artisan skillsets lack diagnostics and system level integration of welding automation platforms, while automation engineers lack core special processes fundamentals.
- **Training misalignment:** Current apprenticeships and future occupational profiles show partial alignment but do not meet Defence automation complexity.
- **Expense of building specialist MScs or apprenticeships:** Given the high cost of developing specialist MSc programmes or apprenticeships, industry requires a more efficient mechanism to identify and sponsor high-potential employees to undertake master's-level study. This approach would allow organisations to selectively handpick candidates from within the workforce, invest in their advanced education, and systematically review the outputs to ensure tangible organisational benefit.
- **Workplace Learning initiatives:** Workplace learning initiatives should prioritise professional mentoring, structured development pathways, and community-based learning opportunities to build capability, strengthen peer networks, and support continuous professional growth across the organisation.
- **Key Apprenticeship Pathways:** Key apprenticeship pathways - specifically the Robotics Engineer and Advanced Robotics Engineer standards - should be reviewed to ensure strong alignment with emerging workforce and technological needs. There is also a strategic opportunity to encourage adoption of these critical apprenticeships (even in their current form) across the supply chain, helping to build a consistent, future-ready talent pipeline.
- **Fragmented upskilling, no hub:** Informal, ad-hoc learning and no UK centre for welding automation slow capability building.
- **Attraction and 2030 risk:** Industrial perceptions deter talent; without coordinated action, 2030 automation ambitions stall.
- **Change Agent Skills:** Developing strong change-agent skillsets is a foundational requirement, ensuring the organisation has the capability to drive strategic transformation from the outset. These skills act as a catalyst, helping to create the conditions and demand for the technical capabilities that must later be embedded into day-to-day operations.

2.5 Summary of Key Recommendations

Educators identified several capability gaps where curriculum provision does not currently meet forecasted workforce demand. To address these gaps, the following headline recommendations were proposed:

- **Re-establish a Welding first pipeline:** Build process knowledge, then add on automation knowledge building. Emphasise materials, physics, and control fundamentals to close the capability gap.
- **Deploy modular CPD pathways:** Two-way upskilling: welders gain robotics, vision, and automation; automation engineers gain contextual welding knowledge.
- **Enhance Welding apprenticeships with light-touch automation:** Integrate robot operation, basic troubleshooting, digital tools, and automated inspection to prepare hybrid roles.
- **Cross sector alignment and momentum:** Create a Defence Industrial Automation Training Framework, establish a Welding Automation Hub, and launch a MOD-backed skills campaign linking adoption to productivity.
- **Defence-specific considerations:** Within the Defence sector, relying on a small number of individuals to independently 'do the right thing' creates strategic vulnerability. A more sustainable approach is to embed capability by positioning trained business leaders at the centre of the organisation, empowering them to drive transformation from the top and lead systemic, long-term change.
- **Safety considerations:** ensure that all training explicitly includes the safe and responsible operation of systems to reduce risk and support compliant, secure practice across the organisation.

These recommendations reflect concerns that the current image of welding may discourage some potential candidates from viewing it as an attractive or viable future path. Addressing this will require investment, from the MOD, to facilitate training provision that sits outside mainstream apprenticeship and degree routes, enabling selected and motivated candidates to further their skills.

Current apprentice provision in this area is largely geared towards mechanical and electrical. Robotics capability is more limited, primarily due to restricted access to equipment and a lack of appropriate training for educators. Much of the advanced training currently sits with OEMs and system integrators, highlighting a potential role for The MTC in supporting access and capability development.

Introducing welding automation into a broader education provision presents additional challenges, including the need to cover underpinning areas such as material science and non-destructive examination. There is currently no single apprenticeship standard that covers the capability needs illustrated at the outset of this report. The group consensus indicated that a master's level qualification, or equivalent, may be required to establish a foundational knowledge necessary before individuals can make informed progression decisions. This could also act as a springboard to demonstrate demand and stimulate further pathways including apprenticeships.

An additional option is the development of an accreditation route that recognises capability gained through live work. This would require an agreed standard, potentially developed by OEMs or the Ministry of Defence, and would require motivated technical staff with a development pathway that can be achieved alongside operational delivery.

3. Conclusion & Next Steps

3. Conclusions and Next Steps

To drive meaningful transformation across the industry, strong leadership, strategic investment, and a deep understanding of emerging innovations are essential. The foresighting analysis underscores the importance of aligning workforce development with future demands, particularly through the adaptation of apprenticeship and degree programmes and the creation of flexible CPD opportunities. These measures are required to ensure individuals have the skills and knowledge required to work with evolving as technologies and practice.

The analysis identifies an urgent need to realign workforce development with the accelerating integration of robotics, automation, machine vision, and in-line inspection across Defence manufacturing. While strong foundational welding expertise exists, adoption of advanced automation is constrained by fragmented upskilling, limited educational provision, and a growing hybrid skills gap between artisan welders and automation engineers. Addressing this challenge will requires coordinated leadership, strategic investment, and targeted curriculum reform, particularly through enhanced apprenticeships, flexible CPD pathways, and the deliberate development of change-agent capabilities.

Taken together, the analysis identified the following structural and capability challenges that must be addressed to enable scalable adoption of welding automation across the Defence supply chain.

- **Hybrid skills gap**
  Artisan welding skillsets lack diagnostics and systems integration for automated welding platforms, while automation engineers lack core special processes fundamentals.
- **Training misalignment** Current apprenticeships and FOPs partially align but do not reflect the complexity of Defence automation systems.
- **Cost barriers to specialist provision**
  The expense of building specialist MSCs or new apprenticeships standards limits availability and scale.
- **Reliance on individual development routes**
  Advanced capability is often developed through hand-picked candidates undertaking master's level study, completement by professional mentoring, development activity, or community-based learning rather than structured pathways.
- **Key Apprenticeship Delivery**
  Greater focus is required on relevant standards, including Robotics Engineer and Advanced Robotics Engineer alongside stronger adoption across the Defence supply chain.
- **Fragmented upskilling, and absence of a hub**
  Informal, ad hoc training and lack of a UK centre for welding automation slow capability development and reduce consistency.
  Attraction and 2030 risk
- **Industrial perceptions continue to deter entrants/talent**; without coordinated action, Defence automation ambitions toward 2030 are at risk.
- **Need to prioritise change-agent capability**
  Leadership skillsets are required to drive strategy and to create demand for technical skill, enabling automation capability to be embedded into day-to-day operations.

3.1 Key Findings & Conclusions

From the Workforce Foresighting Cycle the following data points were identified and focus areas were developed.

Key Findings

Future Capabilities & Roles:
88 future capabilities were identified, leading to 12 FOPs across five supply chain partners.

Priority Capabilities Themes:
These capability themes have been prioritised because they directly address the most pressing challenges and opportunities in the process **Accelerating advanced welding automation through robotics, in-series volumetric inspection, machine vision, and AI to ensure production continuity in Defence assets by 2030.**

- Real-Time Control, Sensing & Monitoring
- Robotic Welding & In-Line Inspection
- Simulation, Commissioning & Scale-Up
- Robotics Integration & Operations
- Cybersecurity & Safety by Design

High-Priority Roles:
The following roles will be instrumental in driving industry-wide change by facilitating informed decision-making and ensuring the compliance and economic viability of new technologies:

- Cyber Security and Governance Specialist
- Robotics Engineer
- Industrial and Production Engineer
- Digital Systems Architect
- PLC Engineer
- Robotics Strategy Lead

Education provision gaps:
Current educational provision did not meet the depth or breadth of capability required to support advanced welding automation. Existing apprenticeships, including Robotics Engineer and Advanced Robotics, showed partial alignment but did not fully/adequately address Defence-specific system complexity, hybrid skill requirements, or the emerging need for advanced integration and diagnostics skills. There was no national centre of expertise dedicated to welding automation, and the cost and risk associated with developing specialist MSc programmes or new apprenticeships remains a significant barrier.

As a result, workforce upskilling has largely been informal, fragmented, inconsistent, and dependent on individual or organisational initiative rather than structured pathways—leaving the sector without a scalable or coordinated talent pipeline capable of supporting sustained adoption and expansion of automated welding technologies.

Key Conclusions

The most significant gaps in Education and skills provision currently sit within industry-led pathways, namely OEM, and systems integrator training. These routes are led through rapid technology adoption and facilitated by the infrastructure and financial backing of the companies. As a result, the entry point for developing advanced welding automation capability either needs to be brought forward within the educational journey or sit within a structured accreditation pathway.

The development of these pathways is greatly needed as the workforce will need to grow in line with both the technologies currently employed and, on the horizon, the resulting action will strongly influence the Country's readiness to tackle its welding related Defence supply chain. Strong leadership and the introduction of changemakers into the sector will be needed to kick off and see through the development of the future workforce.

Delivery of this ambition will be dependent on a strong bond between the MOD, Defence supply chain, and the education sector. This collaboration will need to further identify and quantify the organisational requirements, while establishing, setting, and maintaining clear guidance and system, security, and technology frameworks to ensure there is a working definition and a clear structured upskilling pathway withing automated welding.

At the same time, industry demands/needs are ever increasing, due to global geopolitical pressures and the current ageing workforce approaching retirement. With the potential replacement workforce avoiding the welding sector, either through lack of knowledge of current methods and visibility of modern career pathways spanning systems controls, automation, robotics, and data. Addressing this perception gap is critical. The sector must clearly signal to the potential workforce that the options within the welding industry have branches to a wide variety of accompanying skills and vocations. Conversely the robotics and automation workforce will need to be shown that the pathway to welding is accessible and supported, it is not out of reach.

The sector will also see consistent iteration of technology. The future workforce will need to actively contribute and be present to shape and develop the standards and to the design and assurance of emerging technologies.

The ongoing development of AI and advance sensing technology will have a great impact on future welding operations, the potential for in process correction via advanced monitoring systems and robust software support are key to the success of automated welding. These technologies will need to be adopted to push the sector forward and help ease the gap in the skilled workforce.

Overall, the evidence indicated that strategic leadership, cross-sector collaboration, and sustained investment in skills infrastructure were essential for Defence to meet its 2030 automation ambitions. Priority actions centred on establishing a strong welding-first skills pipeline, strengthening hybrid diagnostic and systems-integration skillsets, and embedding change-agent capability across organisations to drive adoption, uptake, and operational transformation. The interdependencies between supply chain integration, Education and Training provision, and regulatory compliance meant that no single stakeholder could act alone/in isolation. Realising the benefits of accelerating digitalisation, robotics adoption, and cyber-secure operations will require rapid upskilling and reskilling, coupled with reform of apprenticeships, degree programmes, and CPD to ensure long-term, system-wide transformation.

3.2 What this means for Industry

To realise the benefits of welding automation, industry must embed innovation into organisational strategy, with explicit prioritisation of hybrid welding-automation capability and change-agent leadership. Organisations (Leaders) should formalise workforce development plans, invest in structured CPD and expand deployment and use of robotics, sensing, and digital inspection technologies. Clear pathways to be established for high-potential employees to pursue and progress into advanced, Master's-level study aligned to automation and special process needs.

Stronger collaboration with OEMs, colleges, and universities will be essential to align training with real operational needs and support compliance with Defence-specific standards. Employers (Organisations) should also review their talent pipelines, clarify and support emerging roles, including Robotics Integrator and Automation Safety Specialist, ensuring teams are equipped, have the skills, to scale automation safely, efficiently, and in alignment with future operational models.

3.3 What this means for Educators

Educators play a critical role in shaping a future-ready workforce and must adapt curricula to reflect the rapid convergence of welding, robotics, inspection, data, and safety disciplines. This should include strengthening core welding science, introducing light-touch automation content into welding apprenticeships, and expanding robotics and automation programmes to incorporate contextualised welding and special-process knowledge.

Modular CPD packages should be developed to support two-way upskilling between welders and automation engineers, alongside leadership development programmes that build change-agent capability across organisations. Close collaboration with industry will be essential to ensure curricula remain aligned with emerging technologies, while ongoing workforce foresighting and skills data should inform ongoing programme design and continuous improvement.

3.4 Summary of next steps:

The next phase of activity should focus on building a coordinated, sector-wide approach to skills development, beginning with a shared Defence Industrial Automation Training Framework and the establishment of a Welding Automation Hub to act as a centre of excellence. Key stakeholders: including MOD, primes, SMEs, education providers, and professional bodies, should work together to harmonise training provision, define competency pathways, and launch a skills campaign to drive adoption of critical apprenticeships.

Immediate priorities should include integrating of automation modules into welding apprenticeship standards, developing modular CPD offer, targeted support for high-potential candidates into Master's-level study, and the embedding of change-agent capability within leadership roles. Ongoing and sustained workforce foresighting, curriculum alignment, and cross-sector collaboration will be required to ensure the sector remains responsive to emerging technologies and evolving operational requirements.

A scalable welding automation skills strategy

The strategy should establish a coherent progressive approach to building welding automation capability across the Defence industrial base, recognising the need to strengthen core expertise while systematically introducing automation.

1. Welding-first pipeline

Capability development should prioritise foundation welding competence before layering automation. This includes strengthening understanding of materials, welding physics, process control, and quality fundamentals onto which automation, robotics and digital systems can be added. This approach supports addressing the identified capability gap.

2. **Modular CPD pathways**

Continuous professional development should enable two-way upskilling:

- Skilled welders to progressively acquire competencies in robotics, vision, and automation.
- Automation and control engineers to gain contextual welding knowledge of welding processes, materials behaviour, defect mechanisms, and quality assurance. This modular approach allows skills to be built incrementally and aligned to operational need.

3. Welding apprenticeships with light touch automation

Existing welding apprenticeship standards to be enhanced to include introductory automation content. To incorporate robot operation, basic troubleshooting, use of digital tools and exposure to automated inspection techniques. The intent is not to produce automation specialists, but to prepare hybrid roles capable of working effectively in increasingly automated environments.

4. Sector alignment and momentum

Sustained progress will require coordinated sector action.
This could include:

- Development of a Defence Industrial Automation Training Framework
- Establishment of a Welding Automation Hub to act as a centre of excellence
- A MoD-backed skills campaign linking automation skills adoption to productivity, **resilience, and industrial competitiveness.**

In the defence context, reliance on a small number of individuals driving change informally presents a structural risk. A more sustainable approach requires trained business and operational leaders, equipped to champion automation and workforce transformation from the top, embedding change into organisational strategy rather than individual effort.

5. Safety considerations

All training pathways must explicitly include safe operation of automated and robotic welding systems. This should encompass human-machine interaction, safeguarding, fault response, and operational risk management to ensure productivity gains are delivered without compromising safety.

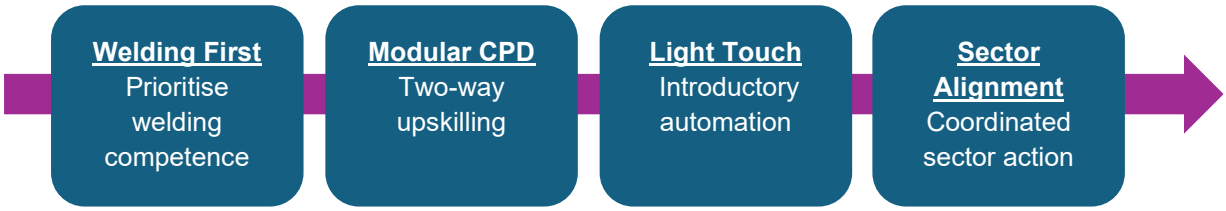

Figure 4: Proposed scalable welding automation skills strategy

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Appendix

Appendices

A. Online Data visualisation tool

The interested reader may wish to access the online data visualisation tool which provides several different ways to view the cycle data. Links to relevant parts of the tool are given with brief guidance below[18]. This content is provided and maintained by the Workforce Foresighting Hub.

Visualisation tool section	What is it and what can it be used for?
Data Capture Overview	Provides a summary of the data captured across the foresight cycle, bringing together the work of the Technologists / Domain Specialists, Employers and Educators into one overview. Full URL: https://hvmcatapultforesighting.retool.com/embedded/public/e869283b-4b8a-437c-973e-64ab292e5b87?token=378f1c4ee50682c055882ac2813c6fe9
Supply Chain Capabilities	Provides an overview of the identified capabilities at a Supply Chain / Workflow Partner level. By selecting/deselecting each Supply Chain / Workflow Partner you can review the capabilities identified as required in that area of the Supply Chain / Workflow. This can be used to generate organisational capability profiles for each area of the workflow /supply chain to help prioritise and focus the acquisition of new capabilities that will be required in the future. It can also be used to generate combined organisational profiles, where an organisation may be involved in more than one area of the supply chain. Full URL: https://hvmcatapultforesighting.retool.com/embedded/public/3573002a-ab48-4fad-9765-bee00876a42e?token=378f1c4ee50682c055882ac2813c6fe9
FOP Detail	This page allows you to review a specific Occupational Profile, including the capabilities contained within it and the Knowledge, Skills & Behaviour (KSB) tags associated with the capability. You can select an individual Role Family and linked FOP in the two available dropdowns. The table in the lower section of the page will then be populated with all relevant capabilities. The search control above the table allows you to filter content of any of the columns of data. A key piece of functionality in this table is the presence of the KSB tags associated with the capabilities. Full URL: https://hvmcatapultforesighting.retool.com/embedded/public/81d272f0-ad80-421c-8926-86655913acdf?token=378f1c4ee50682c055882ac2813c6fe9
FOP Matrix	Provides a detailed breakdown of future occupational profiles that could be required in the future workforce. These were generated using a combination of attributes collected through the workshops and an algorithm. These suggested profiles were then reviewed and ratified by small groups of employers who were able to add/remove capabilities and uprate/downrate proficiency levels required. You can view all the FOPs in a role family by selecting one (or more) of these from the drop down. This will then allow you to select the FOPs aligned to that role family. The populated table allows you to review and compare different FOPs within or across role families. You can view the capabilities in each FOP and the assigned proficiency levels. You can also toggle 'Hide Empty Capabilities' on/off to reduce the view down to only those capabilities included in the role family you are reviewing. Full URL: https://hvmcatapultforesighting.retool.com/embedded/public/f99a913f-8827-4730-8893-d618d489bc84?token=378f1c4ee50682c055882ac2813c6fe9

Visualisation tool section	What is it and what can it be used for?
Future KSBs Summary	Not yet completed in this cycle. Provides a view of the complete set of capabilities within the cycle along with all of the associated KSB tags which are linked to them. It is, essentially, the superset of all details displayed on the FOP detail page. This is used to: • To review the identified Knowledge, Skill and Behaviour tags for a given capability, to support development of future education and learning material. • To review the requirements from a capability level, rather than a role family/occupational profile grouping. Full URL: https://hvmcatapultforesighting.retool.com/embedded/public/8634650f-9700-4627-8431-068b4b764222?token=378f1c4ee50682c055882ac2813c6fe9
FOP Distribution	This page allows provides a breakdown of the Capabilities within the selected Cycle and how they are distributed across the FOPs with the addition of a distribution chart showing the required proficiency across those FOPs. Clicking the “View FOPs” button alongside each capability will provide a list of the proficiencies (EPA) with the FOPs that fall into them. The exported version of this data will include a full breakdown of the FOP IDs which contain the capability within a specific proficiency. This is used to: • understand the levels/volumes of common/crossover Capabilities, to support prioritisation of Capability Development • identify which Occupational Profiles contain these common/crossover capabilities, and so which may be prioritised for development activity. Full URL: https://hvmcatapultforesighting.retool.com/embedded/public/ce67cca1-5beb-4557-8482-8a0b6e174933?token=378f1c4ee50682c055882ac2813c6fe9

Visualisation tool section	What is it and what can it be used for?
Capabilities Matched to Current Provision	This page allows you to review and compare individual capabilities against 'Duty' statements in an Apprenticeship / Occupational Standard. You can select individual capabilities to review their specific matches. These matches are shown in the bottom panel, including the Standard, the Level, and the Duty Statement this is matched to. You can filter in several ways to focus your review: • By the Capability Classification Framework (left-hand panel). • By capabilities that **are** served by the reference mapping framework – the default is Institute for Apprenticeships and Technical Education (Skills England Apprenticeships) provision. By capabilities that **are not** served by the reference mapping framework, e.g., Skills England Apprenticeships provision – these are capabilities required in the future that may require new/bespoke training and CPD materials to be developed to upskill/re-skill the workforce. This page can be used to identify where existing provision may exist across the broad spectrum of Apprenticeships, and not just within a narrow range of sector-specific Standards. The data also allows you to identify where provision may already exist to support specific capabilities. Full URL: https://hvmcatapultforesighting.retool.com/embedded/public/219ff6af-36ea-4b5e-bda1-b0b989c0e3f0?token=378f1c4ee50682c055882ac2813c6fe9
Fit & Surplus Factors	This page allows you to review the 'Fit' and 'Surplus' of Prototype Future Occupation Profiles (FOP) against existing training provision e.g. Institute for Apprenticeships and Technical Education (Skills England Occupational Standards). It is possible for the 'Fit' and 'Surplus' comparison to total over 100%, as they are two separate calculations based on a two-way comparison. Full URL: https://hvmcatapultforesighting.retool.com/embedded/public/c699e504-3f64-45a0-b52e-ad44a95f9aa4?token=378f1c4ee50682c055882ac2813c6fe9
Fit & Surplus Matrix	This page is a visual representation of the 'Fit and Surplus Factor' insight. You can visually review 'Fit' and 'Surplus' of Future Occupation Profiles (FOP) against existing training provision e.g. Institute for Apprenticeships and Technical Education (Skills England Occupational Standards). This can help you identify which provision may align strongest, or which may require adaptation, to provide the suitable provision fit for each future role. It will help you focus in on which provision to focus your attention for analysis. Full URL: https://hvmcatapultforesighting.retool.com/embedded/public/1c4e204b-3927-4226-9f8e-2f62ce0643c5?token=378f1c4ee50682c055882ac2813c6fe9

Visualisation tool section	What is it and what can it be used for?
FOP Capability Matches	This page allows you to view the matches between Capabilities and Institute for Apprenticeships and Technical Education (Skills England Occupational Standards) Duty Statements. Clicking the arrow next to a number in the 'Matches' column will open a popup with more detail for each Capability. Each capability also includes Knowledge, Skill, and Behaviour Tags, to support with scaffolding future education provision. You can review individual Future Occupational Profiles (FOPS) or review all FOPs under a Role Family, to give a more holistic view of Capabilities and Matches Where a future capability has been matched to existing provision (currently, by default, Skills England Occupational Standards) it is possible to interrogate the data and identify specific statements in standards that align to enable identification of existing training materials and activities that could be used or adapted to meet future requirements. This can be used to review the capability requirements for Role Families and FOPs, from Job / Occupation level through to Knowledge, Skill, and Behaviour level. Full URL: https://hvmcatapultforesighting.retool.com/embedded/public/6a205e7e-8f33-4765-b39b-82f1f549217a?token=378f1c4ee50682c055882ac2813c6fe9
FOP vs Provision	This page allows you to compare FOPs against existing Skills England Occupational Standards. The information here allows you to prioritise effort or action over the short, medium, or long-term. This is displayed as a Matched/Not Matched Capability, comparing the Capability in a FOP to the Duties in a Standard. The left-hand side allows you to select the Role Family and FOP, while the right-hand modal allows you to compare against the top 10 matched Skills England Occupational Standards for that Occupational Profile. Where a future capability has been matched to existing provision (currently, by default, Skills England Occupational Standards) it is possible to interrogate the data and identify specific statements in standards that align to enable identification of existing training materials and activities that could be used or adapted to meet future requirements. Full URL: https://hvmcatapultforesighting.retool.com/embedded/public/d9f485a2-6d23-45dd-ab48-4c4c87ced0c7?token=378f1c4ee50682c055882ac2813c6fe9
FOP Priorities	Provides a list of all the FOPs within the selected cycle with details of their fit and surplus factors. The information here allows you to prioritise effort or action over the short, medium, or long-term. Full URL: https://hvmcatapultforesighting.retool.com/embedded/public/ad0f6dcb-9535-4239-96a7-c8d0e005477a?token=378f1c4ee50682c055882ac2813c6fe9

Table 14: Online Data visualisation tool

B. List of full Future Occupational Profiles

Role level: Contributor - Quality Assurance Technician

Required for supply chain partners: RTO/COI – Research & Innovation Organisations, Equipment Manufacturers and Large System Integrators, Specialist Vendors, Primes, End Users

ID	Capability Statement - Quality Assurance Technician	Function	Functional Domain	Functional Area	Proficiency
323186	Develop advanced test set-ups to run automated trials and inspections that validate system performance.	DESIGN	Technical Research	Research & Develop Technologies	Practitioner
214257	Evaluate non-destructive testing AI tools to assess their suitability for specific future applications, ensuring they meet operational readiness.	DESIGN	System/Equipment Design & Implementation	Test Equipment & Systems	Practitioner
306649	Diagnose and fix errors in complex technical systems using automated testing to optimise workflows.	DESIGN	System/Equipment Design & Implementation	Test Equipment & Systems	Expert
303863	Conduct inspections using a specified Non-Destructive Testing (NDT) method to assess capabilities and limitations.	DESIGN	System/Equipment Design & Implementation	Test Equipment & Systems	Practitioner
323097	Validate system configurations using integration tests and acceptance criteria to confirm design performance within the integrator's tools, data, and operating constraints.	SUPPORT	Operator Support	Design and configure support systems	Practitioner
323051	Perform in-line volumetric inspection and machine-vision verification to detect weld defects early and prevent unplanned stoppages in critical asset builds.	SUPPORT	System/Equipment Maintenance	Inspect Facilities & Equipment	Practitioner
323081	Deploy machine vision inspection models to detect welding defects and trigger corrective actions with minimal operator intervention.	SUPPORT	System/Equipment Maintenance	Inspect Facilities & Equipment	Practitioner
323030	Commission and calibrate robotic welding cells using automated self-diagnostics, machine vision checks, and remote augmented reality guidance to maintain production continuity.	SUPPORT	System/Equipment Maintenance	Repair Equipment	Practitioner
323180	Analyse real-time measurement data to confirm process stability and trigger corrective actions when defect indications exceed acceptance limits.	SUPPORT	Quality Control	Manage Quality Control	Practitioner

ID	Capability Statement - Quality Assurance Technician	Function	Functional Domain	Functional Area	Proficiency
323177	Configure in-process monitoring sensors and adaptive control to maintain weld quality despite joint variation.	SUPPORT	Quality Control	Manage Quality Control	Expert
323203	Operate data-quality checks for weld and inspection data with automated quarantines and fixes for completeness, timeliness, and drift.	SUPPORT	Quality Control	Manage Quality Control	Practitioner
323179	Gather, analyse, and store routine quality performance data to support governance and reporting.	SUPPORT	Quality Control	Manage Quality Control	Awareness
323185	Monitor compliance with standards and regulations using advanced sensor systems.	ENTERPRISE	Regulatory Compliance	Monitor Compliance	Practitioner

Table 15: Contributor - Quality Assurance Technician FOP

Role level: Professional & Delivery - Robotics Engineer

Required for supply chain partners: RTO/COI – Research & Innovation Organisations (MTC) AW, Equipment Manufacturers and Large System Integrators, Primes

ID	Capability Statement – Robotics Engineer	Function	Functional Domain	Functional Area	Proficiency
323151	Research robotic technologies to create new AI systems that improve automation performance.	DESIGN	Technical Research	Research & Develop Technologies	Expert
323153	Apply advanced robotics and AI to enhance the precision and efficiency of innovative manufacturing processes and increase production quality.	DESIGN	Technical Research	Research & Develop Technologies	Expert
323157	Develop frameworks to integrate machine learning that improves autonomous selection of welding technologies.	DESIGN	Prototype Design & Development	Select Technologies	Expert
323156	Select appropriate technology for autonomous or collaborative robotic systems to enhance operational efficiency and safety.	DESIGN	Prototype Design & Development	Select Technologies	Expert
323160	Analyse welding processes for implementation into an automated system.	DESIGN	Prototype Design & Development	Select Technologies	Expert
323159	Design sustainable, scalable robotic systems that meet customer needs, technical specifications, and relevant standards.	DESIGN	Prototype Design & Development	Design Systems & Applications	Expert
209218	Programming and optimizing robotic equipment using digital twin simulation software for seamless workflow integration	DESIGN	Prototype Design & Development	Design Systems & Applications	Expert
210372	Develop custom robotic welding solutions aligned with ship layouts and specifications.	DESIGN	Product Engineering	Create Engineering Designs	Expert
323166	Design robotic systems that simplify installation at customer sites and reduce space use.	DESIGN	System/Equipment Design & Implementation	Install Equipment	Expert
306649	Diagnose and fix errors in complex technical systems using automated testing to optimise workflows.	DESIGN	System/Equipment Design & Implementation	Test Equipment & Systems	Expert
323169	Optimise robotic welding systems using AI and effective work plan sequencing to improve throughput and quality.	IMPLEMENT	Plan Operations	Plan Operations	Expert
323062	Tune controller parameters in real time using bounded optimisation and safety limits to maintain stable operation under changing conditions.	IMPLEMENT	Manage Operations	Manage Operation Control Systems	Awareness
323173	Integrate robots, welding power sources, and cell networks to enable traceable production data to be shared to a wider network.	IMPLEMENT	Manage Operations	Manage Operation Control Systems	Expert

ID	Capability Statement – Robotics Engineer	Function	Functional Domain	Functional Area	Proficiency
323170	Execute online commissioning to minimise on-site effort and accelerate production ramp-up.	IMPLEMENT	Manage Operations	Manage Operation Control Systems	Practitioner
323171	Execute model-based offsite commissioning tests to validate operating sequences to reduce on-site effort and accelerate production ramp-up.	IMPLEMENT	Manage Operations	Manage Operation Control Systems	Practitioner
323198	Implement computing platforms with thermal and power protection to keep real-time weld analysis running in harsh factory conditions.	IMPLEMENT	System/Equipment Operation & Monitoring	Monitor Operations	Awareness
205756	Plan and execute robotic welding operations using industry-standard techniques and safety guidelines.	IMPLEMENT	System/Equipment Operation & Monitoring	Operate Equipment	Expert
322995	Design operator co-pilot interfaces that explain robotic weld and inspection decisions, enabling rapid intervention and safe continuation during defence asset production.	SUPPORT	Operator Support	Develop & Encourage Operators	Expert
323053	Align spares and consumables with asset health signals to maintain fault-tolerant cells and minimise downtime of critical equipment.	SUPPORT	System/Equipment Maintenance	Maintain Systems	Practitioner
323030	Commission and calibrate robotic welding cells using automated self-diagnostics, machine vision checks, and remote augmented reality guidance to maintain production continuity.	SUPPORT	System/Equipment Maintenance	Repair Equipment	Expert
323182	Capture technical and strategic requirements and constraints for robotics projects to inform project planning.	ENTERPRISE	Product Management	Develop Specifications	Expert

Table 16: Professional & Delivery - Robotics Engineer FOP

Role level: Professional & Delivery - Cyber Security Management and Governance Specialist

Required for supply chain partners: Equipment Manufacturers and Large System Integrators, Specialist Vendors, Primes, End Users

ID	Capability Statement - Cyber Security Management and Governance Specialist	Function	Functional Domain	Functional Area	Proficiency
209227	Implementing real-time anomaly detection and response systems for cyber security of autonomous robotic systems using artificial intelligence and machine learning	DESIGN	Technical Research	Research & Develop Technologies	Expert
321697	Ensure security by design in all system development processes to protect against cyber and physical threats.	DESIGN	Prototype Design & Development	Design Systems & Applications	Expert
323167	Implement standardised systems and tools to enhance insights across integrated design, manufacturing, through-life support, and end-of-life management.	DESIGN	Supply Chain Design & Implementation	Develop Supply Chain Models & Systems	Expert
323192	Create penetration test scenarios for digital factory acceptance tests to identify and reduce cybersecurity risks before system sign-off.	IMPLEMENT	Manage Operations	Manage Operation Control Systems	Expert
323190	Supply ring-fenced automated systems that comply with defence-specific technical and security standards.	IMPLEMENT	Manage Operations	Manage Operation Control Systems	Awareness
323191	Define data flow guidance to meet defence firewall requirements for incoming and outgoing information.	IMPLEMENT	Manage Operations	Manage Operation Control Systems	Expert
309311	Implement and maintain configuration control systems to ensure consistent management of changes.	IMPLEMENT	Manage Operations	Manage Operation Control Systems	Expert
210237	Monitor cybersecurity vulnerabilities and threats for organisational security.	IMPLEMENT	Manage Operations	Manage Operation Control Systems	Expert
323100	Provide standardised, secure application interfaces to mainframe services using managed APIs to improve interoperability across connected digital systems.	IMPLEMENT	Service Delivery	Provide Financial Services	Expert
210320	Manage the scale up of new technologies for effective deployment in the sector	LOGISTICS	Supply Chain Management	Coordinate Logistics	Expert
323202	Produce resilience guides to define failover steps, reduced-operation procedures, and recovery actions to sustain cell operations, network functionality, and data continuity.	SUPPORT	Operator Support	Prepare Informational or Reference Materials	Expert
323179	Gather, analyse, and store routine quality performance data to support governance and reporting.	SUPPORT	Quality Control	Manage Quality Control	Expert
323007	Set data integrity, cybersecurity, and traceability requirements for robotic welding and in-line inspection, then update internal standards to assure defence production continuity.	SUPPORT	Health, Safety & Environment	Develop Safety Standards	Expert

ID	Capability Statement - Cyber Security Management and Governance Specialist	Function	Functional Domain	Functional Area	Proficiency
323066	Publish interoperability frameworks to standardise data formats, interfaces, and security controls for multi-vendor certification across the supply chain.	SUPPORT	Health, Safety & Environment	Develop Safety Standards	Expert
311482	Maintain standards for data architectures, models, tools, and databases.	ENTERPRISE	Data Management	Monitor Data Governance	Expert
323194	Analyse cyber-attack security risks to prevent accidental or malicious damage linked to higher automation levels.	ENTERPRISE	Risk Management	Analyse Business Risks	Expert
210468	Monitor regulatory changes and ensure compliance for robotic and autonomous systems.	ENTERPRISE	Regulatory Compliance	Monitor Regulation Changes	Expert
304439	Develop regulatory and organisational policies to ensure compliance and effective governance.	ENTERPRISE	Regulatory Compliance	Design Policies and Procedures	Expert
323184	Develop standards, best practices, and competencies for system usage procedures in organisational operations.	ENTERPRISE	Regulatory Compliance	Design Policies and Procedures	Expert

Table 17: Professional & Delivery - Cyber Security Management and Governance Specialist FOP

Role level: Professional & Delivery - Industrial and Production Engineer

Required for supply chain partners: RTO/COI – Research & Innovation Organisations, Equipment Manufacturers and Large System Integrators, Primes

ID	Capability Statement - Industrial and Production Engineer	Function	Functional Domain	Functional Area	Proficiency
323153	Apply advanced robotics and AI to enhance the precision and efficiency of innovative manufacturing processes and increase production quality.	DESIGN	Technical Research	Research & Develop Technologies	Expert
323187	Build process and material databases that support automated decision making and control using AI and inspection methods.	DESIGN	Technical Research	Research & Develop Technologies	Expert
323160	Analyse welding processes for implementation into an automated system.	DESIGN	Prototype Design & Development	Select Technologies	Expert
323159	Design sustainable, scalable robotic systems that meet customer needs, technical specifications, and relevant standards.	DESIGN	Prototype Design & Development	Design Systems & Applications	Expert
323162	Model concept operations for welding and automated inspection to predict performance and constraints.	DESIGN	Process Design & Implementation	Model Processes	Expert
323161	Model concept operations of work cell layouts and robot interactions to optimise flow and safety.	DESIGN	Process Design & Implementation	Model Processes	Expert
323166	Design robotic systems that simplify installation at customer sites and reduce space use.	DESIGN	System/Equipment Design & Implementation	Install Equipment	Expert
303495	Compare component parts of automation systems to optimise performance.	DESIGN	System/Equipment Design & Implementation	Test Equipment & Systems	Expert
323057	Develop digital twin process models to simulate material flows, cycle times, and constraints, informing equipment design decisions before installation.	DESIGN	Supply Chain Design & Implementation	Develop Supply Chain Models & Systems	Expert
308499	Forecast demand in consultation with supply chain planners to optimise inventory and resources.	DESIGN	Supply Chain Design & Implementation	Develop Supply Chain Models & Systems	Awareness
323167	Implement standardised systems and tools to enhance insights across integrated design, manufacturing, through-life support, and end-of-life management.	DESIGN	Supply Chain Design & Implementation	Develop Supply Chain Models & Systems	Expert
323200	Create production schedules using virtual cycle times, capacity limits and pace needs to maximise throughput.	IMPLEMENT	Plan Operations	Plan Operations	Expert

ID	Capability Statement - Industrial and Production Engineer	Function	Functional Domain	Functional Area	Proficiency
323169	Optimise robotic welding systems using AI and effective work plan sequencing to improve throughput and quality.	IMPLEMENT	Plan Operations	Plan Operations	Expert
194441	Implement advanced process control techniques to improve operational efficiency.	IMPLEMENT	Manage Operations	Manage Operation Control Systems	Expert
323201	Manage digital production processes to accurately track and update work orders, bills of materials, and revision statuses.	IMPLEMENT	Manage Operations	Manage Operation Control Systems	Expert
323174	Establish frameworks and standards to capture and analyse production rates, time, motion, methods, and speed in operations.	IMPLEMENT	Manage Operations	Analyse Operations Data	Expert
323198	Implement computing platforms with thermal and power protection to keep real-time weld analysis running in harsh factory conditions.	IMPLEMENT	System/Equipment Operation & Monitoring	Monitor Operations	Practitioner
323196	Apply selection and award criteria for sourcing requirements from external suppliers.	LOGISTICS	Supply Chain Management	Identify Suppliers	Awareness
210320	Manage the scale up of new technologies for effective deployment in the sector	LOGISTICS	Supply Chain Management	Coordinate Logistics	Practitioner
323197	Manage the scale-up of automation equipment manufacture to meet defence asset programme deliveries and quality requirements.	LOGISTICS	Supply Chain Management	Coordinate Logistics	Expert
322995	Design operator co-pilot interfaces that explain robotic weld and inspection decisions, enabling rapid intervention and safe continuation during defence asset production.	SUPPORT	Operator Support	Develop & Encourage Operators	Expert
323053	Align spares and consumables with asset health signals to maintain fault-tolerant cells and minimise downtime of critical equipment.	SUPPORT	System/Equipment Maintenance	Maintain Systems	Practitioner
325310	Promote the use of advanced robotics and AI to enhance precision and efficiency in manufacturing processes and increase production quality.	ENTERPRISE	Marketing	Promote Products & Services	Expert

Table 18: Professional & Delivery - Industrial and Production Engineer FOP

Role level: Professional & Delivery - Mechatronic Engineer

Required for supply chain partners: RTO/COI – Research & Innovation Organisations, Equipment Manufacturers and Large System Integrators, Specialist Vendors, Primes

ID	Capability Statement - Mechatronic Engineer	Function	Functional Domain	Functional Area	Proficiency
323151	Research robotic technologies to create new AI systems that improve automation performance.	DESIGN	Technical Research	Research & Develop Technologies	Expert
323186	Develop advanced test set-ups to run automated trials and inspections that validate system performance.	DESIGN	Technical Research	Research & Develop Technologies	Expert
325308	Develop technologies that enable retrofitting of sensing systems to existing installations to ensure right-first-time outcomes and monitor efficiency.	DESIGN	Technical Research	Research & Develop Technologies	Expert
323156	Select appropriate technology for autonomous or collaborative robotic systems to enhance operational efficiency and safety.	DESIGN	Prototype Design & Development	Select Technologies	Expert
323160	Analyse welding processes for implementation into an automated system.	DESIGN	Prototype Design & Development	Select Technologies	Expert
323159	Design sustainable, scalable robotic systems that meet customer needs, technical specifications, and relevant standards.	DESIGN	Prototype Design & Development	Design Systems & Applications	Expert
209218	Programming and optimizing robotic equipment using digital twin simulation software for seamless workflow integration	DESIGN	Prototype Design & Development	Design Systems & Applications	Expert
323166	Design robotic systems that simplify installation at customer sites and reduce space use.	DESIGN	System/Equipment Design & Implementation	Install Equipment	Expert
306649	Diagnose and fix errors in complex technical systems using automated testing to optimise workflows.	DESIGN	System/Equipment Design & Implementation	Test Equipment & Systems	Expert
303495	Compare component parts of automation systems to optimise performance.	DESIGN	System/Equipment Design & Implementation	Test Equipment & Systems	Expert
323167	Implement standardised systems and tools to enhance insights across integrated design, manufacturing, through-life support, and end-of-life management.	DESIGN	Supply Chain Design & Implementation	Develop Supply Chain Models & Systems	Expert
323169	Optimise robotic welding systems using AI and effective work plan sequencing to improve throughput and quality.	IMPLEMENT	Plan Operations	Plan Operations	Expert

ID	Capability Statement - Mechatronic Engineer	Function	Functional Domain	Functional Area	Proficiency
323062	Tune controller parameters in real time using bounded optimisation and safety limits to maintain stable operation under changing conditions.	IMPLEMENT	Manage Operations	Manage Operation Control Systems	Awareness
323173	Integrate robots, welding power sources, and cell networks to enable traceable production data to be shared to a wider network.	IMPLEMENT	Manage Operations	Manage Operation Control Systems	Expert
323170	Execute online commissioning to minimise on-site effort and accelerate production ramp-up.	IMPLEMENT	Manage Operations	Manage Operation Control Systems	Awareness
325307	Retrofit sensing technologies to existing installations to ensure right-first-time outcomes and monitor efficiency.	IMPLEMENT	Manage Operations	Manage Operation Control Systems	Practitioner
205701	Implement real-time monitoring and adjustment using advanced sensors and monitoring technology	IMPLEMENT	System/Equipment Operation & Monitoring	Monitor Operations	Expert t
323196	Apply selection and award criteria for sourcing requirements from external suppliers.	LOGISTICS	Supply Chain Management	Identify Suppliers	Awareness
323030	Commission and calibrate robotic welding cells using automated self-diagnostics, machine vision checks, and remote augmented reality guidance to maintain production continuity.	SUPPORT	System/Equipment Maintenance	Repair Equipment	Expert

Table 19: Professional & Delivery - Mechatronic Engineer FOP

Role level: Professional & Delivery - Data Architect

Required for supply chain partners: RTO/COI – Research & Innovation Organisations, Primes

ID	Capability Statement- Data Architect	Function	Functional Domain	Functional Area	Proficiency
323187	Build process and material databases that support automated decision making and control using AI and inspection methods.	DESIGN	Technical Research	Research & Develop Technologies	Expert
321697	Ensure security by design in all system development processes to protect against cyber and physical threats.	DESIGN	Prototype Design & Development	Design Systems & Applications	Expert
323158	Create standard virtual models and tools to support verification and validation of systems, subsystems, and components.	DESIGN	Prototype Design & Development	Design Systems & Applications	Expert
323091	Create data import and validation rules to migrate legacy weld procedure and qualification records into structured systems without losing provenance.	DESIGN	Process Design & Implementation	Develop Processes	Expert
323163	Implement Application Programming Interfaces (APIs) between systems to facilitate frequent and reliable updates.	DESIGN	Process Design & Implementation	Develop Processes	Awareness
323167	Implement standardised systems and tools to enhance insights across integrated design, manufacturing, through-life support, and end-of-life management.	DESIGN	Supply Chain Design & Implementation	Develop Supply Chain Models & Systems	Expert
323191	Define data flow guidance to meet defence firewall requirements for incoming and outgoing information.	IMPLEMENT	Manage Operations	Manage Operation Control Systems	Expert
305733	Design technical roadmaps for data life-cycles to ensure appropriate support and business processes.	SUPPORT	Operator Support	Design and configure support systems	Expert
323202	Produce resilience guides to define failover steps, reduced-operation procedures, and recovery actions to sustain cell operations, network functionality, and data continuity.	SUPPORT	Operator Support	Prepare Informational or Reference Materials	Expert
323176	Set up and maintain databases and remote data services that support automated systems.	SUPPORT	System/Equipment Maintenance	Maintain Systems	Expert
325309	Collaborate to develop shared datasets across organisations using common standards, quality checks, and access controls to support parallel model development.	ENTERPRISE	Data Management	Perform Data Analysis	Expert
313495	Optimise access to and analysis of complex datasets to deliver business outcomes.	ENTERPRISE	Data Management	Perform Data Analysis	Expert

ID	Capability Statement- Data Architect	Function	Functional Domain	Functional Area	Proficiency
323183	Compile and publish shared datasets across organisations using common standards, quality checks, and access controls to support parallel model development.	ENTERPRISE	Data Management	Monitor Data Governance	Expert
311482	Maintain standards for data architectures, models, tools, and databases.	ENTERPRISE	Data Management	Monitor Data Governance	Expert
304439	Develop regulatory and organisational policies to ensure compliance and effective governance.	ENTERPRISE	Regulatory Compliance	Design Policies and Procedures	Expert
323184	Develop standards, best practices, and competencies for system usage procedures in organisational operations.	ENTERPRISE	Regulatory Compliance	Design Policies and Procedures	Expert
323199	Conduct audits to verify compliance, assess AI impact, and mitigate risks associated with AI deployment.	ENTERPRISE	Regulatory Compliance	Monitor Compliance	Expert

Table 20: Professional & Delivery - Data Architect FOP

Role level: Professional & Delivery - Quality Assurance Professional

Required for supply chain partners: RTO/COI – Research & Innovation Organisations, Equipment Manufacturers and Large System Integrators, Specialist Vendors, Primes, End Users

ID	Capability Statement - Quality Assurance Professional	Function	Functional Domain	Functional Area	Proficiency
323186	Develop advanced test set-ups to run automated trials and inspections that validate system performance.	DESIGN	Technical Research	Research & Develop Technologies	Expert
305255	Define acceptance criteria for business and system changes.	DESIGN	Prototype Design & Development	Validate Requirements	Practitioner
323188	Define a full system requirements framework that aligns automation, AI, inspection, and welding with application acceptance criteria.	DESIGN	Prototype Design & Development	Create Detailed Product Specification	Expert
214257	Evaluate non-destructive testing AI tools to assess their suitability for specific future applications, ensuring they meet operational readiness.	DESIGN	System/Equipment Design & Implementation	Test Equipment & Systems	Expert
323190	Supply ring-fenced automated systems that comply with defence-specific technical and security standards.	IMPLEMENT	Manage Operations	Manage Operation Control Systems	Awareness
323197	Manage the scale-up of automation equipment manufacture to meet defence asset programme deliveries and quality requirements.	LOGISTICS	Supply Chain Management	Coordinate Logistics	Practitioner
323097	Validate system configurations using integration tests and acceptance criteria to confirm design performance within the integrator's tools, data, and operating constraints.	SUPPORT	Operator Support	Design and configure support systems	Expert
323180	Analyse real-time measurement data to confirm process stability and trigger corrective actions when defect indications exceed acceptance limits.	SUPPORT	Quality Control	Manage Quality Control	Expert
323203	Operate data-quality checks for weld and inspection data with automated quarantines and fixes for completeness, timeliness, and drift.	SUPPORT	Quality Control	Manage Quality Control	Expert
323179	Gather, analyse, and store routine quality performance data to support governance and reporting.	SUPPORT	Quality Control	Manage Quality Control	Expert
323007	Set data integrity, cybersecurity, and traceability requirements for robotic welding and in-line inspection, then update internal standards to assure defence production continuity.	SUPPORT	Health, Safety & Environment	Develop Safety Standards	Expert

ID	Capability Statement - Quality Assurance Professional	Function	Functional Domain	Functional Area	Proficiency
304439	Develop regulatory and organisational policies to ensure compliance and effective governance.	ENTERPRISE	Regulatory Compliance	Design Policies and Procedures	Expert
323184	Develop standards, best practices, and competencies for system usage procedures in organisational operations.	ENTERPRISE	Regulatory Compliance	Design Policies and Procedures	Expert
323199	Conduct audits to verify compliance, assess AI impact, and mitigate risks associated with AI deployment.	ENTERPRISE	Regulatory Compliance	Monitor Compliance	Expert
323185	Monitor compliance with standards and regulations using advanced sensor systems.	ENTERPRISE	Regulatory Compliance	Monitor Compliance	Expert
323064	Certify multi-vendor products against published interoperability frameworks to verify consistent data formats, interfaces, and security controls before operational deployment.	ENTERPRISE	Regulatory Compliance	Coordinate Compliance activities	Expert

Table 21: Professional & Delivery - Quality Assurance Professional FOP

Role level: Professional & Delivery - Statistical Data Scientist

Required for supply chain partners: RTO/COI – Research & Innovation Organisations, Equipment Manufacturers and Large System Integrators, Specialist Vendors, Primes

ID	Capability Statement - Statistical Data Scientist	Function	Functional Domain	Functional Area	Proficiency
323152	Run benchmark trials and publish open datasets and interoperability profiles to validate robotic welding automation and in-series volumetric inspection.	DESIGN	Technical Research	Research & Develop Technologies	Awareness
323187	Build process and material databases that support automated decision making and control using AI and inspection methods.	DESIGN	Technical Research	Research & Develop Technologies	Expert
323167	Implement standardised systems and tools to enhance insights across integrated design, manufacturing, through-life support, and end-of-life management.	DESIGN	Supply Chain Design & Implementation	Develop Supply Chain Models & Systems	Expert
323011	Capture and curate traceable weld process, vision, and inspection data to build large labelled and synthetic datasets for welding analytics.	IMPLEMENT	Manage Operations	Gather Operations Data	Expert
323175	Monitor equipment condition data using AI to detect anomalies early and trigger planned interventions.	IMPLEMENT	System/Equipment Operation & Monitoring	Monitor Equipment	Expert
305733	Design technical roadmaps for data life-cycles to ensure appropriate support and business processes.	SUPPORT	Operator Support	Design and configure support systems	Expert
323176	Set up and maintain databases and remote data services that support automated systems.	SUPPORT	System/Equipment Maintenance	Maintain Systems	Expert
323180	Analyse real-time measurement data to confirm process stability and trigger corrective actions when defect indications exceed acceptance limits.	SUPPORT	Quality Control	Manage Quality Control	Expert
323203	Operate data-quality checks for weld and inspection data with automated quarantines and fixes for completeness, timeliness, and drift.	SUPPORT	Quality Control	Manage Quality Control	Expert
323179	Gather, analyse, and store routine quality performance data to support governance and reporting.	SUPPORT	Quality Control	Manage Quality Control	Expert
325309	Collaborate to develop shared datasets across organisations using common standards, quality checks, and access controls to support parallel model development.	ENTERPRISE	Data Management	Perform Data Analysis	Expert

ID	Capability Statement - Statistical Data Scientist	Function	Functional Domain	Functional Area	Proficiency
313495	Optimise access to and analysis of complex datasets to deliver business outcomes.	ENTERPRISE	Data Management	Perform Data Analysis	Expert
323061	Monitor deployed models for drift, bias, and performance issues to trigger retraining, rollback, and incident response within agreed tolerances.	ENTERPRISE	Data Management	Monitor Data Governance	Expert
323183	Compile and publish shared datasets across organisations using common standards, quality checks, and access controls to support parallel model development.	ENTERPRISE	Data Management	Monitor Data Governance	Expert
311482	Maintain standards for data architectures, models, tools, and databases.	ENTERPRISE	Data Management	Monitor Data Governance	Expert

Table 22: Professional & Delivery - Statistical Data Scientist FOP

Role level: Professional & Delivery - Digital Twin Engineer

Required for supply chain partners: RTO/COI – Research & Innovation Organisations, Equipment Manufacturers and Large System Integrators, Specialist Vendors, Primes

ID	Capability Statement - Digital Twin Engineer	Function	Functional Domain	Functional Area	Proficiency
323154	Define simulation requirements for work cell layouts and robot interactions to test concept operations before deployment.	DESIGN	Prototype Design & Development	Validate Requirements	Practitioner
323158	Create standard virtual models and tools to support verification and validation of systems, subsystems, and components.	DESIGN	Prototype Design & Development	Design Systems & Applications	Awareness
323155	Define simulation requirements for welding processes and automated inspection to assess feasibility and risks.	DESIGN	Prototype Design & Development	Develop Prototypes	Expert
323162	Model concept operations for welding and automated inspection to predict performance and constraints.	DESIGN	Process Design & Implementation	Model Processes	Practitioner
323161	Model concept operations of work cell layouts and robot interactions to optimise flow and safety.	DESIGN	Process Design & Implementation	Model Processes	Practitioner
323057	Develop digital twin process models to simulate material flows, cycle times, and constraints, informing equipment design decisions before installation.	DESIGN	Supply Chain Design & Implementation	Develop Supply Chain Models & Systems	Expert
323171	Execute model-based offsite commissioning tests to validate operating sequences to reduce on-site effort and accelerate production ramp-up.	IMPLEMENT	Manage Operations	Manage Operation Control Systems	Awareness

Table 23: Professional & Delivery - Digital Twin Engineer FOP

Role level: Professional & Delivery - PLC Engineer (Programmable Logic Controller Engineer)

Required for supply chain partners: RTO/COI – Research & Innovation Organisations, Equipment Manufacturers and Large System Integrators, Specialist Vendors, Primes, End Users

ID	Capability Statement - PLC Engineer	Function	Functional Domain	Functional Area	Proficiency
323186	Develop advanced test set-ups to run automated trials and inspections that validate system performance.	DESIGN	Technical Research	Research & Develop Technologies	Practitioner
323153	Apply advanced robotics and AI to enhance the precision and efficiency of innovative manufacturing processes and increase production quality.	DESIGN	Technical Research	Research & Develop Technologies	Awareness
323188	Define a full system requirements framework that aligns automation, AI, inspection, and welding with application acceptance criteria.	DESIGN	Prototype Design & Development	Create Detailed Product Specification	Awareness
323159	Design sustainable, scalable robotic systems that meet customer needs, technical specifications, and relevant standards.	DESIGN	Prototype Design & Development	Design Systems & Applications	Awareness
323158	Create standard virtual models and tools to support verification and validation of systems, subsystems, and components.	DESIGN	Prototype Design & Development	Design Systems & Applications	Awareness
323166	Design robotic systems that simplify installation at customer sites and reduce space use.	DESIGN	System/Equipment Design & Implementation	Install Equipment	Awareness
306649	Diagnose and fix errors in complex technical systems using automated testing to optimise workflows.	DESIGN	System/Equipment Design & Implementation	Test Equipment & Systems	Practitioner
303495	Compare component parts of automation systems to optimise performance.	DESIGN	System/Equipment Design & Implementation	Test Equipment & Systems	Practitioner
323057	Develop digital twin process models to simulate material flows, cycle times, and constraints, informing equipment design decisions before installation.	DESIGN	Supply Chain Design & Implementation	Develop Supply Chain Models & Systems	Awareness
323167	Implement standardised systems and tools to enhance insights across integrated design, manufacturing, through-life support, and end-of-life management.	DESIGN	Supply Chain Design & Implementation	Develop Supply Chain Models & Systems	Practitioner
323200	Create production schedules using virtual cycle times, capacity limits and pace needs to maximise throughput.	IMPLEMENT	Plan Operations	Plan Operations	Practitioner
323062	Tune controller parameters in real time using bounded optimisation and safety limits to maintain stable operation under changing conditions.	IMPLEMENT	Manage Operations	Manage Operation Control Systems	Practitioner

ID	Capability Statement - PLC Engineer	Function	Functional Domain	Functional Area	Proficiency
323170	Execute online commissioning to minimise on-site effort and accelerate production ramp-up.	IMPLEMENT	Manage Operations	Manage Operation Control Systems	Practitioner
194441	Implement advanced process control techniques to improve operational efficiency.	IMPLEMENT	Manage Operations	Manage Operation Control Systems	Expert
323171	Execute model-based offsite commissioning tests to validate operating sequences to reduce on-site effort and accelerate production ramp-up.	IMPLEMENT	Manage Operations	Manage Operation Control Systems	Practitioner
309311	Implement and maintain configuration control systems to ensure consistent management of changes.	IMPLEMENT	Manage Operations	Manage Operation Control Systems	Practitioner
323011	Capture and curate traceable weld process, vision, and inspection data to build large labelled and synthetic datasets for welding analytics.	IMPLEMENT	Manage Operations	Gather Operations Data	Awareness
323174	Establish frameworks and standards to capture and analyse production rates, time, motion, methods, and speed in operations.	IMPLEMENT	Manage Operations	Analyse Operations Data	Practitioner
322995	Design operator co-pilot interfaces that explain robotic weld and inspection decisions, enabling rapid intervention and safe continuation during defence asset production.	SUPPORT	Operator Support	Develop & Encourage Operators	Practitioner
323081	Deploy machine vision inspection models to detect welding defects and trigger corrective actions with minimal operator intervention.	SUPPORT	System/Equipment Maintenance	Inspect Facilities & Equipment	Practitioner
323053	Align spares and consumables with asset health signals to maintain fault-tolerant cells and minimise downtime of critical equipment.	SUPPORT	System/Equipment Maintenance	Maintain Systems	Practitioner
323030	Commission and calibrate robotic welding cells using automated self-diagnostics, machine vision checks, and remote augmented reality guidance to maintain production continuity.	SUPPORT	System/Equipment Maintenance	Repair Equipment	Awareness
323179	Gather, analyse, and store routine quality performance data to support governance and reporting.	SUPPORT	Quality Control	Manage Quality Control	Practitioner
323184	Develop standards, best practices, and competencies for system usage procedures in organisational operations.	ENTERPRISE	Regulatory Compliance	Design Policies and Procedures	Practitioner

Table 24: Professional & Delivery - PLC Engineer (Programmable Logic Controller Engineer) FOP

Role level: Strategic Management - Robotics Strategy Lead

Required for supply chain partners: RTO/COI – Research & Innovation Organisations, Equipment Manufacturers and Large System Integrators, Specialist Vendors, Primes, End Users

ID	Capability Statement - Robotics Strategy Lead	Function	Functional Domain	Functional Area	Proficiency
323151	Research robotic technologies to create new AI systems that improve automation performance.	DESIGN	Technical Research	Research & Develop Technologies	Awareness
323152	Run benchmark trials and publish open datasets and interoperability profiles to validate robotic welding automation and in-series volumetric inspection.	DESIGN	Technical Research	Research & Develop Technologies	Expert
323181	Draft and revise national and international standards through consultation to achieve clear, practical adoption across industry and regulators.	SUPPORT	Health, Safety & Environment	Develop Safety Standards	Expert
210268	Lead change management for robotic and autonomous systems adoption, ensuring team readiness and acceptance.	ENTERPRISE	Leadership & Strategy	Manage Change & Transformation Programmes	Expert
323182	Capture technical and strategic requirements and constraints for robotics projects to inform project planning.	ENTERPRISE	Product Management	Develop Specifications	Expert
323183	Compile and publish shared datasets across organisations using common standards, quality checks, and access controls to support parallel model development.	ENTERPRISE	Data Management	Monitor Data Governance	Expert
325310	Promote the use of advanced robotics and AI to enhance precision and efficiency in manufacturing processes and increase production quality.	ENTERPRISE	Marketing	Promote Products & Services	Expert

Table 25: Strategic Management - Robotics Strategy Lead FOP

Role level: Strategic Management - Digital Systems Architect

Required for supply chain partners: RTO/COI – Research & Innovation Organisations, Equipment Manufacturers and Large System Integrators, Specialist Vendors, Primes

ID	Capability Statement - Digital Systems Architect	Function	Functional Domain	Functional Area	Proficiency
323186	Develop advanced test set-ups to run automated trials and inspections that validate system performance.	DESIGN	Technical Research	Research & Develop Technologies	Awareness
305255	Define acceptance criteria for business and system changes.	DESIGN	Prototype Design & Development	Validate Requirements	Expert
323188	Define a full system requirements framework that aligns automation, AI, inspection, and welding with application acceptance criteria.	DESIGN	Prototype Design & Development	Create Detailed Product Specification	Expert
321697	Ensure security by design in all system development processes to protect against cyber and physical threats.	DESIGN	Prototype Design & Development	Design Systems & Applications	Expert
323159	Design sustainable, scalable robotic systems that meet customer needs, technical specifications, and relevant standards.	DESIGN	Prototype Design & Development	Design Systems & Applications	Expert
323163	Implement Application Programming Interfaces (APIs) between systems to facilitate frequent and reliable updates.	DESIGN	Process Design & Implementation	Develop Processes	Practitioner
306649	Diagnose and fix errors in complex technical systems using automated testing to optimise workflows.	DESIGN	System/Equipment Design & Implementation	Test Equipment & Systems	Awareness
303495	Compare component parts of automation systems to optimise performance.	DESIGN	System/Equipment Design & Implementation	Test Equipment & Systems	Awareness
323063	Define interoperability requirements for supply chain partners to enable secure, standards-based data exchange and connectivity across hardware and software vendors.	DESIGN	Supply Chain Design & Implementation	Develop Supply Chain Models & Systems	Expert

ID	Capability Statement - Digital Systems Architect	Function	Functional Domain	Functional Area	Proficiency
323167	Implement standardised systems and tools to enhance insights across integrated design, manufacturing, through-life support, and end-of-life management.	DESIGN	Supply Chain Design & Implementation	Develop Supply Chain Models & Systems	Expert
323190	Supply ring-fenced automated systems that comply with defence-specific technical and security standards.	IMPLEMENT	Manage Operations	Manage Operation Control Systems	Expert
309311	Implement and maintain configuration control systems to ensure consistent management of changes.	IMPLEMENT	Manage Operations	Manage Operation Control Systems	Practitioner
210237	Monitor cybersecurity vulnerabilities and threats for organisational security.	IMPLEMENT	Manage Operations	Manage Operation Control Systems	Expert
323198	Implement computing platforms with thermal and power protection to keep real-time weld analysis running in harsh factory conditions.	IMPLEMENT	System/Equipment Operation & Monitoring	Monitor Operations	Awareness
305733	Design technical roadmaps for data life cycles to ensure appropriate support and business processes.	SUPPORT	Operator Support	Design and configure support systems	Expert
323097	Validate system configurations using integration tests and acceptance criteria to confirm design performance within the integrator's tools, data, and operating constraints.	SUPPORT	Operator Support	Design and configure support systems	Practitioner
210148	Implement systems and tools for real-time, visual, interactive step by step installation/commissioning	SUPPORT	Operator Support	Design and configure support systems	Practitioner
323176	Set up and maintain databases and remote data services that support automated systems.	SUPPORT	System/Equipment Maintenance	Maintain Systems	Expert
311482	Maintain standards for data architectures, models, tools, and databases.	ENTERPRISE	Data Management	Monitor Data Governance	Expert
210468	Monitor regulatory changes and ensure compliance for robotic and autonomous systems.	ENTERPRISE	Regulatory Compliance	Monitor Regulation Changes	Awareness

ID	Capability Statement - Digital Systems Architect	Function	Functional Domain	Functional Area	Proficiency
323184	Develop standards, best practices, and competencies for system usage procedures in organisational operations.	**ENTERPRISE**	Regulatory Compliance	Design Policies and Procedures	Expert
323064	Certify multi-vendor products against published interoperability frameworks to verify consistent data formats, interfaces, and security controls before operational deployment.	**ENTERPRISE**	Regulatory Compliance	Coordinate Compliance activities	Practitioner

Table 26: Strategic Management - Digital Systems Architect FOP

C. Background to Workforce Foresighting Hub

Addressing future workforce challenges

The global marketplace is changing at a rapid pace, and the continued development of innovative technologies is creating opportunities for growth in all sectors.

Whilst we are well placed to take advantage in the UK, the Government and industry have identified that we need a workforce able to adapt to new capabilities that require different and often higher skill sets. The 'Manufacturing the Future Workforce' report, published in 2020, states: "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."

Developing this workforce and preventing a skills shortfall will provide future-thinking organisations with the capabilities to successfully adopt innovation and enable the UK to build a prosperous economy.

The Skills Value Chain

A Skills Value Chain (SVC) approach promotes connectivity between upstream UK innovation and downstream skills systems, as well as enabling better co-operation within education and training provider eco-systems. It aligns and integrates innovation and skills strategies with a common purpose.

The SVC approach was proposed in the 'Manufacturing the Future Workforce' report, which examined global best practice and convened UK pioneers to explore how the UK can develop skills to exploit innovative technologies.
And it starts with workforce foresighting.

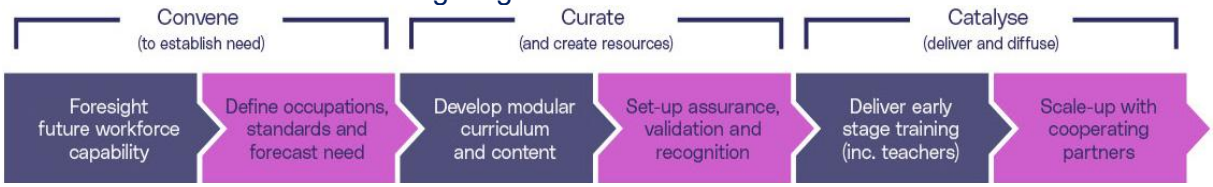

Figure 5: The Skills Value Chain (SVC)

Workforce foresighting

Using the Skills Value Chain approach, the UK will start building the skilled workforce required by tomorrow's industries and employers, and understanding what these future needs will be is where workforce Foresighting comes in.

Workforce Foresighting is a systemic approach to identifying the organisational capabilities and workforce skills necessary to enable industry to adopt and exploit innovative technologies which respond to global, national and sector challenges.

The Workforce Foresighting Hub, initiated and funded by Innovate UK, and built in collaboration with the Catapult Network, provides the processes and data that inform insight and support the recommendations required for industry, policymakers, and educators to respond to continuing change.

Our Vision: To foster the organisational capabilities and workforce skills required to adapt to continuing change and enable adoption of innovative technologies to enable a prosperous UK industry.

Our Mission: To provide the process, insight and recommendations required to identify and address future skills demands to enable the UK to adopt innovation and succeed in the dynamic global marketplace.

Our Goals:
Define future capabilities required across a sector in response to a challenge, or technology innovation and consequently define the skill sets of the workforce of the future.
Understand and explain gaps between technology adoption, organisational capability and workforce profiles that could hamper innovation.
Identify and communicate insights, future requirements and the action required by industry and educators.
Enable and deliver a consistent approach to workforce Foresighting.

Outcomes:
The process integrates insight from experts in three categories – domain specialists/technologists, employers, and educators. Using a structured and facilitated series of collaborative information-gathering workshops, combined with data from open-source global data sets, the workforce Foresighting process can produce a wealth of detailed quantitative data to inform action.

At the heart of the Foresighting process are working groups consisting of the industry sponsor and centre of innovation, with support from the Workforce Foresighting Hub team, who undertake detailed analysis to report and summarise key data insights and recommendations for action. This report details future supply chain capabilities, prototype future occupational profiles and identifies changes required to current training provision for the sponsor to take forward and address skills challenges relating to the specific topic.

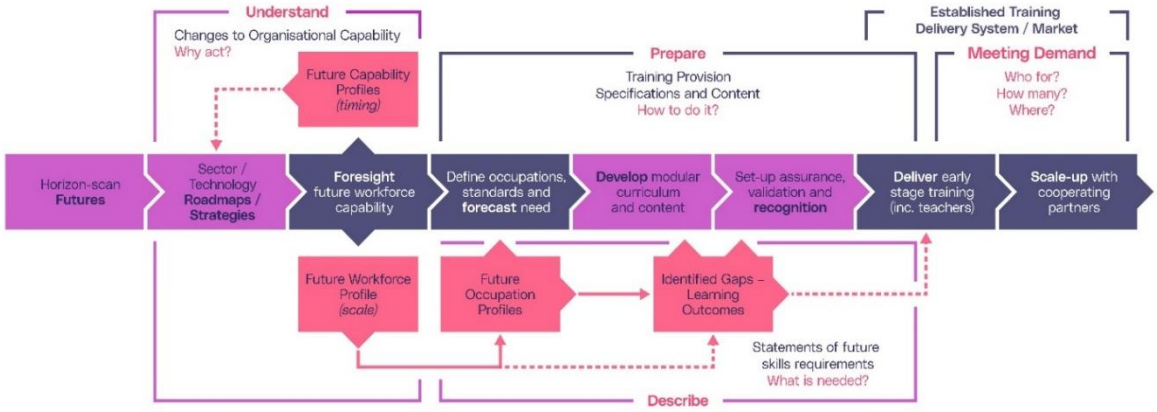

Figure 6: Workforce Foresighting & Skills Value Chain

Approach used - principles and implementation

The core of workforce Foresighting is convening three groups of relevant specialists to conduct structured, Delphi-style, facilitated workshops to capture and discuss the set of organisational capabilities that will be required to respond to and exploit technology innovation. Lists of workshop participants are provided in Section 1.3 (**1.3 Contributing Participants**)

Organisational capabilities are captured using a bespoke classification that has been developed by the Workforce Foresighting Hub. The classification uses a structured common language to enable cross sector and cross-centre collaboration and integration of data. Additionally, the classification enables data from a number of other national and international open-source workforce datasets to be integrated through the same common language. This data is held in a cloud based "data-cube" that is dynamically growing as each workforce Foresighting cycle adds to the shared data relating to future workforce capabilities.

Using cutting edge AI and Large Language Model data tools, the data-cube is used to undertake detailed analysis to 'map' future workforce capability requirements against the current education and training provision to identify where existing provision can be used and where new provision, CPD or qualifications are required.

As an agile development project, the WFH team are constantly evolving and improving the detailed workshop process and workshop approach, but essentially always consists of the following stages:

Considering – Clarifying the Challenge to be met (the 'what' and the 'when') and collating solutions (the 'how') as Foresighting topic suggestions align with strategic priorities.

Identifying – Gain clarity and consensus about the solutions to be put forward – make the case for Foresighting.

Preparing – The convening of specialists and scheduling of workshops

Carrying out – Run Foresighting workshops with experts, collate and analyse data.

Communicating – Insights, findings and recommendations gathered from all research in an actionable report.

Causing action – The driving of action based on the recommendations (promoting progress down the rest of the skills value chain) built on the findings and recommendations of Foresighting.

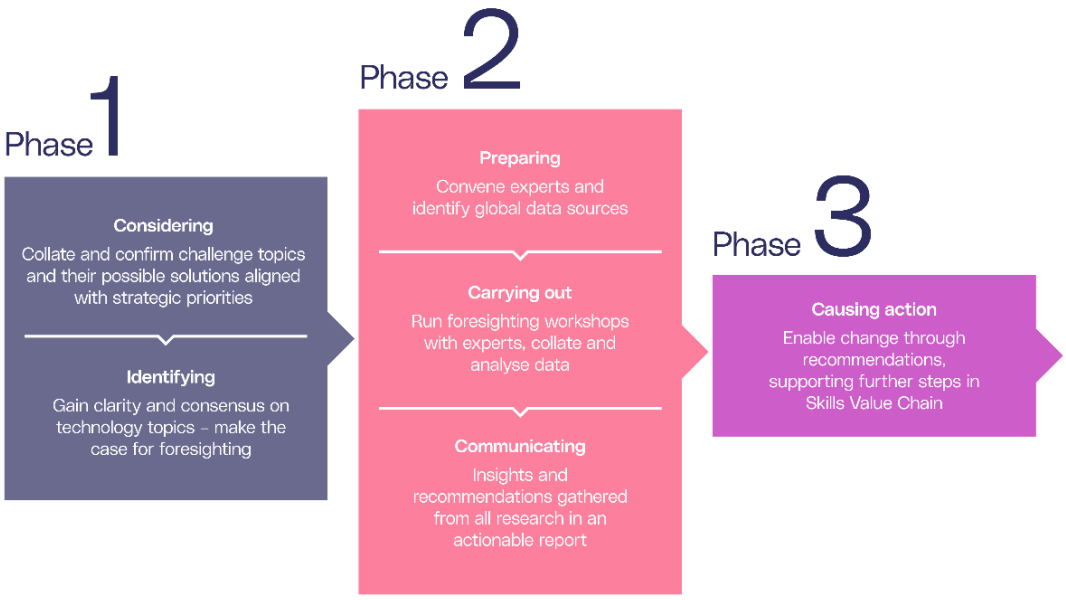

Figure 7: The workforce foresighting process.

Forecasting and Foresighting
The result of workforce Foresighting is understanding why skills requirements will need to change to enable the adoption of innovative technologies, and to define what this change is likely to be in terms of future occupations and shorter-term skills gaps. Forecasting of demand can then take these future focused findings and work with industry and government stakeholders to estimate the quantity of workers necessary for an industry to fulfil emerging skill demands at a given time and place. The two approaches are linked in that workforce Foresighting identifies the requirements and forecasting can then determine the quantity needed; the people needing the skills and therefore prepare programmes to deliver them.

Outcomes - insights and recommendations
Workforce Foresighting is a data intensive approach that can provide sponsors, stakeholders, and participants with detailed insight about future workforce requirements. A dynamic data set is provided for each cycle to allow all stakeholders and participants to freely access and interrogate the data. Additionally, the WFH team will support the production of a report that provides targeted recommendations that require action to address gaps in training and education provision relevant to the challenge and planned technology solution.

The dynamic data portal provides a range of standard data sets and visualisations. Additionally, users can download data to undertake their own more detailed interrogation of data to guide and inform subsequent actions.

The key aspect is to provide insight about gaps – which capabilities required in the future are NOT addressed by aspects of current provision – apprenticeship standards, qualifications, or other provision. Gaps represent:

- **Short term CPD** – topics required across the workforce to upskill members of current workforce.
- **Medium term** – topics to be included as current provision / standards are reviewed and updated.

- **Longer term** – new qualifications and standards that may be needed to equip new entrants.

The insight produced by a workforce Foresighting cycle (project) provides:

- **Technologists** and technical leads with insight of the organisational capability sets required across future supply chain partners in response to the identified challenge.
- **Employers** with insight about possible future roles and occupations that may be required across the whole workforce, operators to researchers, to ensure they are equipped and ready.
- **Educators** with details of the gaps to be addressed by short-course training to upskill the existing workforce and also insight about qualifications and provision that will be required to support new entrants in the future.