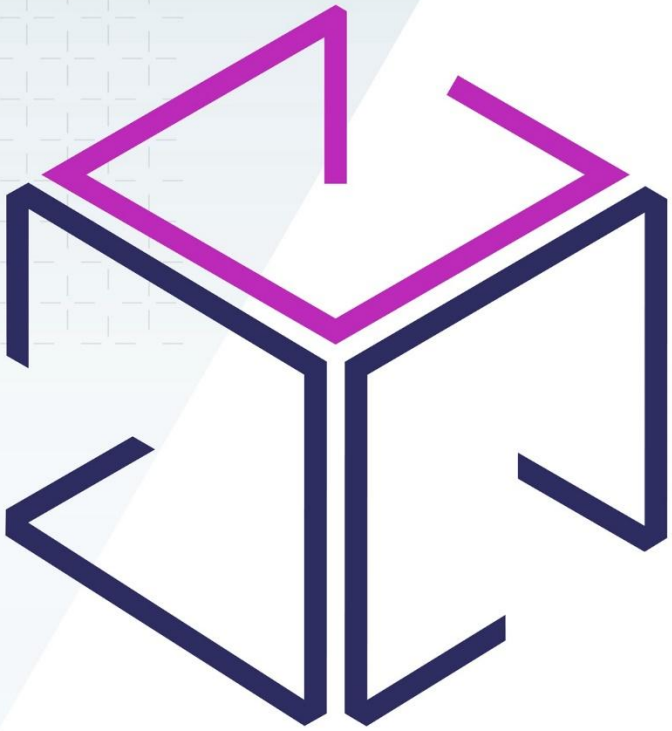
Workforce Foresighting Hub



Operationalising AI pipelines to optimise telecommunication networks for enhanced network access quality and customer experience.

Workforce Foresighting Hub findings report in collaboration with Digital Catapult and Sunderland Software City.

August 2025

CATAPULT Digital

UKRI Innovate UK

Right skills, right time, right place

Acknowledgements

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

Skills England Occupational Standards

ESCO – European Skills, Competencies, Qualifications & Occupations, EU

*O*NET – 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 March – July 2025 using the data set and tools available at that time.

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Executive Summary

Executive Summary

This report outlines findings from the Workforce Foresighting cycle focussing on ***Operationalising AI pipelines to optimise telecom networks for enhanced network access quality and customer experience.*** The study is sponsored by CGI and conducted by Digital Catapult and Sunderland Software City in collaboration with the Workforce Foresighting Hub, an Innovate UK initiative.

Workforce Foresighting is a systemic approach to planning ahead and anticipating future capability and skills 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.

Workforce Foresighting Topic

The UK Government has stated its aim to lead in **AI integration and 5G expansion**, with a goal of standalone 5G coverage in all populated areas by 2030[1]. The telecoms sector is crucial to the UK economy, contributing over **£30 billion** and supporting around **200,000 jobs**[2]. However, 5G introduces significant complexity in network management, requiring AI for optimisation, automation, and predictive maintenance.

The technology solutions considered included: AI-driven network optimisation, predictive maintenance, edge AI, AI-powered customer experience (such as Chatbots) or network digital twins.

AI driven network optimisation was the selected technology as it was seen as the key to the following objectives:

- Recouping 5G investment costs
- Enhancing customer experience
- Reducing operational expenditure
- Improving resilience and cybersecurity
- Enabling new revenue streams through AI-enabled services

The UK telecoms sector faces a workforce capability gap, particularly in AI-related roles and integration with telecom systems. This report found sector-specific challenges to be:

- Workforce Readiness: Many AI and data capabilities are not yet embedded in telecoms roles.
- Education Alignment: Apprenticeship and training standards do not fully align with the emerging needs of AI in telecoms.

[1] UK Wireless Infrastructure Strategy
[2] UKTIN – Reports and Insights

- Supply Chain Readiness: Requires collaboration across service providers, device manufacturers, cloud providers, AI innovators, and academia.
- Pace of Change: Telecoms is evolving quickly, and without action, the UK risks losing its competitive edge.

Predicted deployment of the technologies are as follows:

- Short-term (0–2 years): AI-driven network optimisation, AI customer support tools
- Medium-term (2–5 years): Edge AI, predictive maintenance
- Long-term (5+ years): Autonomous networks, digital twins

Organisational Capability gaps identified included the following:

- Out of 143 future capabilities, 19 have no match in current apprenticeship standards.
- Entry-level roles: Minimal AI integration—mostly data technician tasks.
- Mid-level roles: AI systems integration and data engineering require new capabilities.
- Senior roles: High AI specialisation required; many roles demand Master's or PhD-level education.

The telecoms industry will likely be negatively impacted if these gaps are not addressed. This impact could include delays in 5G rollout & optimisation, an increased reliance on overseas expertise, reduced competitiveness in AI-enabled telecom services and slower commercialisation of AI applications in telecoms.

Participants and stakeholders

Industry Participants	Skills Participants	Technology Participants
CGI	University of Suffolk	Digital Catapult
Acceleran	Newcastle University	Sunderland Software City
Sunderland City Council	University of Oxford	
5G Lab	University of York	
	Hartree Education Hub	

Findings and Insights

While AI-driven network optimisation is critical to achieving the UK's 5G and digital infrastructure goals, the telecoms sector currently lacks the workforce capabilities and educational pathways needed to deploy this technology at scale. The map and gap analysis of the Future Occupational Profiles (FOPs) defined for this cycle, compared against current apprenticeship standards reveals that, although there is some alignment, there are substantial gaps - particularly at the entry and mid-level roles. If these gaps are not addressed through collective action by industry, education and government, the sector's ability to operationalise AI pipelines will be severely limited - risking delayed 5G benefits and a decline in global competitiveness.

The priority Future Occupational Profiles (FOPs) from this Workforce Foresighting cycle were identified as: Machine Learning Engineers, AI/ML Ops Engineers, AI System Integration Engineers, Generative AI Engineers, Telecoms Engineers, Senior Data Engineers and IT and

Cloud Engineers. As a result upskilling or reskilling people in these FOPs will have the greatest impact on accelerating the speed and scale of AI adoption within the UK telecoms industry. This is a fast-evolving landscape and requires technology with flexible learning pathways and a modular approach to any education provision.

It is recommended that industry should look into adoption of existing relevant apprenticeships and learning pathways, whilst bearing in mind that provision should be flexible for adaption in the future.

For existing roles, AI and data capabilities will be coming into their roles and to facilitate scaling up this technology, a proactive training approach would mean faster commercialisation of AI technologies to achieve the UK government's national 5G strategy. To review the full data for this Workforce Foresighting cycle, visit visualisation tool.

Next Steps

It is recommended that to achieve desired goals, immediate action following this report, should include the following:

- Convene a working group to establish and support an action plan.
- Validate Future Occupational Profiles (FOPs) with industry feedback.
- Develop Continuing Professional Development (CPD) and modular training.
- Adapt existing apprenticeships and research new standards to me the new requirements.

Mid-term actions following this report, should include the following:

- Incorporate AI-5G specialisations into FE/HE curricula.
- Encourage PhD research aligned to telecom AI needs.
- Integrate AI data governance and ethics modules.

A typical outcome of this report would be to establish a working group to ensure the adoption of the report's findings and to discuss dissemination. In response to the findings of this report and other recent reports on the topic, a Telecoms Joint Cluster Action group has been proposed by the Workforce Foresighting Hub.

This group will coordinate between different cycle leads (e.g. Satellite Applications Catapult (SATAPPS), Compound Semiconductors Applications Catapult (CSA) and Digital Catapult. Its outcomes will be to:

- Create a joint approach to external stakeholder engagement
- Approach education bodies and policymakers with consolidated messaging
- Reduce engagement fatigue and streamline influence efforts in the same sector. Other organisations that will be invited to join this group could be employers / industry representatives, other educators / training providers, representatives from trade associations and Innovate UK representatives

Without prompt action, the UK risks falling behind global competitors in telecoms AI, limiting economic growth potential and slowing 5G innovation adoption.

1. Introduction

Introduction

1.1 Background to Workforce Foresighting

The report 'Manufacturing the Future Workforce'[3] recommended the Skills Value Chain as an approach to avoid shortfalls in workforce capabilities relating to future innovations (Figure 1). This is the genesis of the workforce foresighting programme, which is sponsored by Innovate UK and delivered through the Innovate UK Catapult Network.

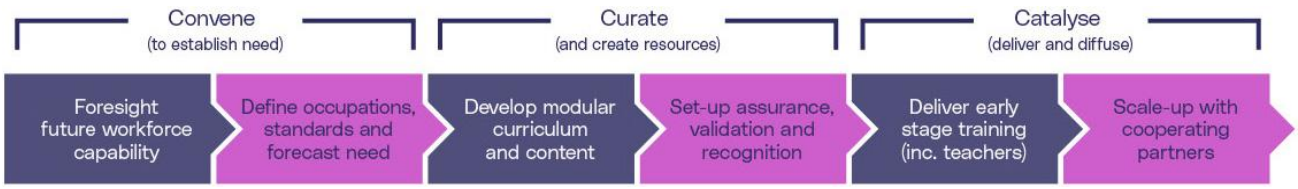


Figure 1: The Skills Value Chain

The first step of the skills value chain is to "Foresight future workforce capability": This calls for technology, industry, education, and training partners to convene using government as a focal point, to "...foresight and articulate future skills needs, standards and qualifications associated with emerging technologies"[3]

1.2 Workforce Foresighting – Process Overview

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.

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. The 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.

[3] Manufacturing the Future Workforce

As an agile development project, the Workforce Foresighting Hub team are constantly evolving and improving the detailed workshop process and workshop approach, but it 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 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

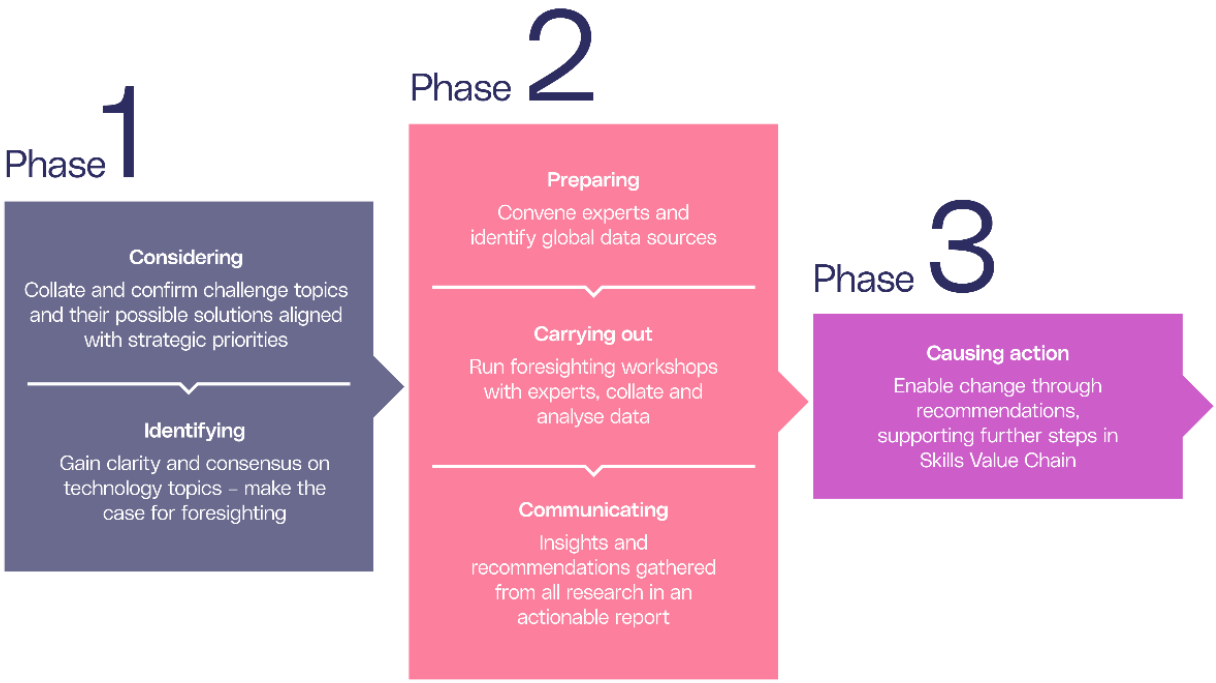


Figure 2 – The Workforce Foresighting Process

1.3 Foresighting vs Forecasting

Although this study is focussed on workforce foresighting in terms of the capabilities, required it is important to keep in mind parallel findings from forecasting in terms of the required capacities and numbers. Fore*casting*, alongside fore*sighting*, provides vital input to the sector, feeding into recruitment and development targets for employers, and consideration of economic class sizes and recruitment targets for educators. However, it is beyond the scope of the foresighting study to carry out independent forecasting, and as such readers should refer to referenced studies for detail on forecasting.

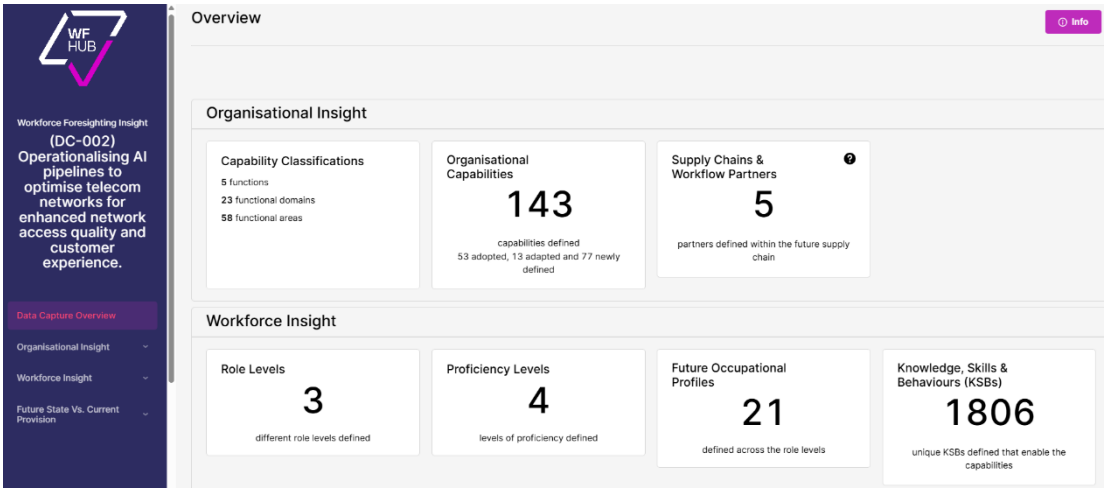
1.4 Introducing the Visualisation Tool

The Workforce Foresighting Hub's Visualisation Tool is a powerful, innovative system, which will enable 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 is generated by the foresighting cycles, integrating the expertise of technologists/domain specialists, employers and educators. The data informs the development of future curriculums 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.

Detailed instructions on how to use the Visualisation Tool can be found in the appendix.

Link to Visualisation Tool for the cycle - ***Data Capture Overview***



Visualisation Tool Dashboard

2. Aligning the Challenge and Solutions with National Priorities

Aligning the Challenge and Solutions with National Priorities

2.1 Positioning and national context of challenge

World-class digital infrastructure underpins the digital economy and was worth £143 billion in 2021, accounting for 5% of the national workforce[4]. Both the current and previous government's ambition for the majority of the population to have access to a 5G signal by 2027, has been met early through the deployment of basic, or non-standalone 5G which is built on a 4G core network. The government has helped make the business case for 5G through its 5G Testbeds and Trials programme and has invested £200 million in projects across the UK to deploy and test 5G technology.

Adoption of 5G-enabled services is gathering pace[4]. Prior to this, the Future Telecoms Infrastructure Review (2018) set out a market-led approach to deploying 5G and gigabit broadband[5]. Now the UK Government's 2030 ambition is for standalone 5G coverage in all populated areas, including rural communities[4].

AI is seen as critical to recouping 5G investments, improving customer experience, and enabling new revenue streams. Telecoms contribute £30+ billion to the UK economy and supports ~200,000 jobs[6]. The UK is a global leader in AI research and telecom innovation but faces increasing competition. Formed in 2022, the UK Telecoms Innovation Network (UKTIN) supports innovation and collaboration across industry, academia, and government[6].
5G introduces new complexities in network management, requiring AI for optimisation, automation, and cost control. The National AI Strategy builds on the UK's current strengths and represents the start of a step-change for AI in the UK, recognising that maximising the potential of AI will increase resilience, productivity, growth and innovation across the private and public sectors[7].

AI is an enabling technology to enhance 5G networks to reduce capital expenditure, optimise network performance, enhance customer experience, and enable real-time decision-making. AI adoption also introduces new data and workforce capability challenges, which will be discussed in this report.

2.2 Potential and prioritised technology solutions responding to the challenge

Evaluation of the technology solutions was based on readiness, impact on 5G performance, cost-efficiency, and alignment with national goals. Supply chain maturity, data infrastructure, and workforce readiness were also considered.

[4] UK Wireless Infrastructure Strategy
[5] Future Telecoms Infrastructure Review – GOV.UK
[6] UKTIN – Reports and Insights
[7] UK AI Roadmap – GOV.UK

Table 1 below shows the various technology solutions options. The emphasis of this cycle was on the use of AI as a tool in optimising 5G networks.

Technology Solution	Description	Relevance to 5G & AI Challenge	Readiness	Supply Chain Impact
AI-Driven Network Optimisation	Real-time traffic and resource management	Enables 5G efficiency and QoS	High	High
Predictive Maintenance	AI to detect faults before failure	Reduces downtime, improves reliability	Medium	Medium
Edge AI	Local AI processing at base stations	Supports low latency 5G use cases	Medium	High
AI-Powered Customer Experience	Chatbots, personalisation, sentiment analysis	Enhance customer satisfaction	High	Medium
Network Digital Twins	Simulated environments for testing and planning	Supports 5G rollout and resilience	Low	Low

Table 1: Technology solutions supporting AI pipelines to optimise telecom networks

Timing considerations for each solution were also considered. The following timings were discussed during the scoping of the cycle:

- Short-term (0–2 years): AI-driven optimisation, customer experience tools
- Medium-term (2–5 years): Predictive maintenance, edge AI
- Long-term (5+ years): Digital twins, autonomous networks.

2.3 Workforce Foresighting topic for chosen prioritised technology solutions

The chosen prioritised technology is AI-Driven Network Optimisation. This was selected because of its high readiness, its direct impact on 5G performance and its alignment with national digital infrastructure goals.

Title of Cycle	Operationalising AI pipelines to optimise telecom networks for enhanced network access quality and customer experience
Horizon for implementation	0–5 years
Impact	High – improves network quality, enables 5G use cases, supports policy momentum
Scale	National, with export potential
Supply Chain	Involves Telecom service providers, AI Solution Providers, IT and Cloud providers, Network Infrastructure and Device Providers and Technology Innovators (including RTOs).

Table 2: Summary of prioritisation for chosen cycle

To equip the telecommunications industry with the foundational capabilities needed to operationalise AI pipelines at scale, both the existing workforce and new entrants must augment their telecommunications expertise with specialised AI knowledge and skills.

2.4 Current and predicted scale of technology deployment in UK

AI may be considered to be one of the most important innovations in human history, and the government has expressed that it is critical to both our economic and national security that the UK prepares for the opportunities AI brings, and that the country is at the forefront of solving the complex challenges posed by an increased use of AI[8]. AI is being used in network operations centres, predictive maintenance, and customer service automation.

The £200 million 5G Testbeds and Trials (5GTT) programme, which began in 2017, has fostered the development in the UK of the 5G ecosystem, building the business case for investment to support 5G use cases. The programme helped to establish the UK's leadership in 5G adoption and supported industry, academic institutions and local authorities to realise the benefits that 5G can bring[9].

The 5GTT programme also demonstrated ways in which government could drive deployment and accelerate 5G adoption in key sectors in the following subsectors:

Transport

The 5GTT funded Smart Junctions 5G project used artificial intelligence to improve traffic signal control efficiency by reducing waiting times at signals, which in turn reduces journey times and cuts pollution.

Health and social care

The Liverpool 5G Health and Social Care Testbed demonstrated the technology's potential to provide solutions for health and social care services that can reduce the cost of those services and create extra capacity.

Automotive

The Connected Automotive Logistics project (5G CAL) project demonstrated how 5G networks can drive operational efficiencies and improve productivity for automated logistics. A self-driving truck could distribute parts and assemblies across the Nissan plant in Sunderland.

Supply Chain Impact:

- Increased demand for AI systems technicians, cloud and data engineers, and AI assurance and integration specialists.
- Growing collaboration between telecoms, academia, and AI startups.

[8] *https://www.gov.uk/government/publications/national-ai-strategy/national-ai-strategy-html-version*
[9] *https://www.gov.uk/government/publications/uk-wireless-infrastructure-strategy/uk-wireless-infrastructure-strategy#chapter-5--realising-the-full-benefits-of-5g-and-advanced-wireless-connectivity*

3. Findings and Results

Findings and Results

3.1 Methodology and Findings

A summary of the findings is provided below, with a narrative based on the underlying data which is also provided using bespoke visualisations to enable greater insight and access to detail. The report is aligned to the needs of those responsible for workforce planning – employers, educators, and skills providers.

Step One – How will the Supply chain change? - Organisational Changes
Exploration of organisational changes provides insights into how organisations will need to adapt their current capabilities to implement the solutions that respond to the challenge addressed by the foresighting project.

Typically, organisational changes will also require the adoption of new capabilities and a change in the distribution of these capabilities across supply chain partners. The change in capabilities within an organisation as well as their supply chain partners will determine how the workforce will need to change for each Supply Chain partner.

Step Two – How will the Workforce change? - Occupational Changes
A set of 'Future Occupational Profiles' (FOPs) is produced by the foresight process that demonstrates how current occupations may need to change in the future. FOPs are generated using a combination of attributes from the underlying capability classification and from data collected in the workshops. The FOP generation algorithm works to group capabilities into logical sets reflecting role levels, function, proficiency and capability similarity. As part of the foresighting process the generated FOPs are reviewed, revised and distilled by the Employer group. The agreed set of FOPs are then compared with selected current education provision; the default reference is the set of Skills England Occupational Standards; to assess which current training and education provision could be used in the future. Two bespoke metrics - match and surplus - are used to evaluate the alignment of current provision with the set of FOPs proposed. Summaries are presented of the key findings related to each Supply Chain partner.

Findings are aimed at both Employers, and Education and Training Providers, identifying matches and gaps in future training needs compared with current provision to guide further detailed investigation.

Step Three – How the current Education provision meets the future need - Highlighted Changes to Future Provision
The report identifies suggested changes to education and training provision – principally apprenticeship standards that will deliver the knowledge, skills and behaviours required by future occupations. In some cases, this will include the development of short courses and continued professional development (CPD) to upskill the current workforce to meet future needs. Additionally, foresighting outputs can be used to develop programmes, qualifications, and apprenticeship standards for new entrants to the workforce joining via apprenticeship, taught qualification, or other training programme.

The insight and data in this part of the report are primarily aimed at educators training providers, apprenticeship standards bodies and awarding organisations. Combined with insight arising from the Supply Chain capability changes, the provision insight offers an effective way for employers to identify training opportunities that align to their future needs.

3.2 Step One – How will the Supply Chain change? - Organisational Changes Insight

Organisation functions

The Workforce Foresighting process uses an information architecture built on five functional areas which are common to any business:

Design	The function of an organisation that focuses on activities relating to product, service or solution design.
Implement	The function of an organisation that focuses on activities relating to producing / making / providing its products or services.
Logistics	The function of an organisation that focuses on activities relating to procurement, delivery, materials, or services necessary for operations – service / manufacturing, etc.
Support	The function of an organisation that focuses on activities relating to users, in-service support, repair / maintenance, recycling, end of life disposal.
Enterprise	Core functions of an organisation - e.g., strategic planning, leadership and management, human resources, digital backbone and data systems, integration of relevant statutory / regulatory requirements and compliance.

Table 3: Five functional areas across cycles

The functional structure is developed to levels of detail that enable the foresight process to reference external data sets including O*NET (US) Occupational Information Network [9F[10]], ESCO – European Skills, Competences, Qualifications and Occupations[10F[11]], Skills England Occupational Standards [11F[12]] .

The five root functions comprise around 40 domains which are broken down to around 140 functional areas. The architecture is used to position ~ 25,000 capability statements which are the building blocks used in the workforce foresight process. Each capability statement has several attributes - some are static and reflect the position of the capability statement in the

[10] O*NET - Occupational Information Network - https://www.onetcenter.org/
[11] ESCO - European Skills, Competences, Qualifications and Occupations - https://esco.ec.europa.eu/en
[12] Skills England Occupational Standards - https://skillsengland.education.gov.uk/

architecture, whilst others are dynamic and are assigned values through a cycle and set of workshops.

The data architecture is implemented in a bespoke ‘data-cube’ which underpins the foresight process, workshops, and enables extensive use of LLM and AI tools. Additionally, a key feature of the data-cube is that the data from each foresight topic cycle is added into the data set and can then be used, where relevant, in future cycles. This ensures that the capabilities of the system are dynamic and up to date.

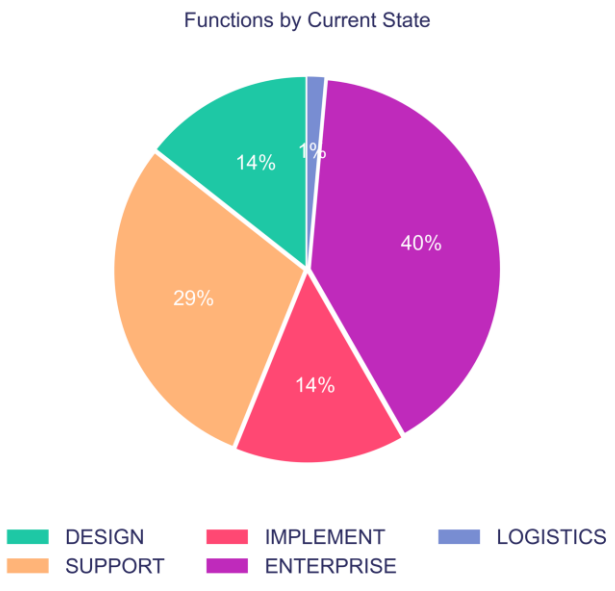
Identifying the Future Supply Chain Capabilities

The following charts and graphs summarise the changes in the set of capabilities that will be required by the production side supply chain in the future. The pie-charts reflect the distribution of capabilities across the five functions of the capability classification. The future state data is captured in three technology focused workshops. The current state data is derived from information collected on apprenticeship standards used across current supply chain partners in the telecoms sector. This latter information is not as detailed as that produced by the workshops but is indicative and used to provide a point of comparison.

These pie charts summarise the changes that will be required by the whole supply chain, across the five functions from current state to future state.

- Indicates an overall relative **increase** in **Design, Implement** and **Logistics** capabilities
- Indicates an overall relative **decrease** in **Enterprise** and **Support** capabilities

The increase in capabilities in design, development and implementation of AI pipelines in telecoms systems could mean a reduction in operational capabilities in the support and enterprise functions as some of these will be automated by the technology adoption.



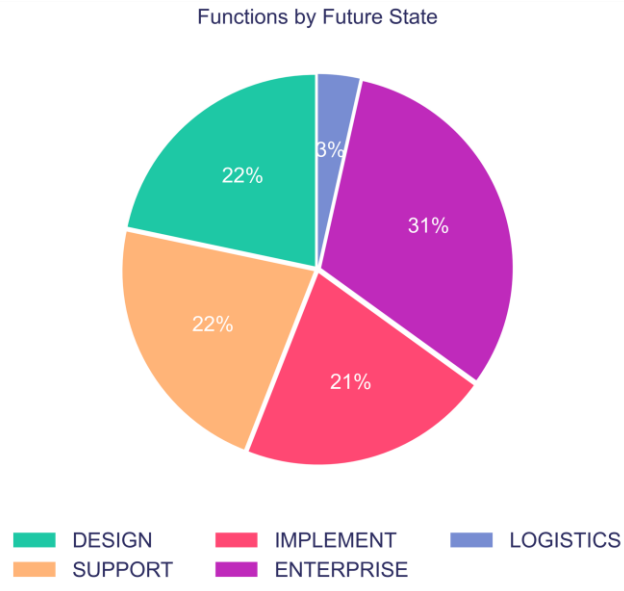


Figure 3: Current and Future – Whole Supply Chain - Capability Function Distribution %

Whilst the information on current and future Supply Chain capabilities is useful to indicate relative changes, factors such as volume of activity will also determine which functions may have greater future significance.

Functional Cycle Capabilities currently not matched to apprenticeship standards

Out of the 143 future capabilities identified for this cycle to adopt this technology across the supply chain, 19 are currently unmatched with any duty statements found in existing apprenticeship standards.

This could be indicative of a potential gap across all levels of education provision, highlighting the need to develop both short and long-term training solutions to upskill the current workforce and prepare new entrants. The 19 unmatched capabilities are listed below.

Function	Capability statement
DESIGN	Use standardised APIs for communication between AI systems
DESIGN	Design digital twin environments to emulate real systems and create synthetic data for training AI in telecom activities.
DESIGN	Testing to conduct initial tests to ensure network readiness.
DESIGN	Investigate the deployment of real-time anomaly detection and response systems for OT cybersecurity using artificial intelligence and machine learning.
DESIGN	Develop software tools for AI integration into telecom network systems.
DESIGN	Refine generative AI models to address specialisation in specific use cases.
IMPLEMENT	Implement digital twin environments in telecom operations to emulate real systems and generate synthetic data for training AI.
IMPLEMENT	Utilise prompt engineering in Generative AI to produce tailored content for user needs.
IMPLEMENT	Plan the adoption of digital twin environments to emulate real systems for telecom activities.
IMPLEMENT	Use AI to detect bugs and ensure optimal network performance.
LOGISTICS	Identify suppliers of energy-efficient hardware for AI-enabled networks.
SUPPORT	Develop AI-powered chatbots to handle customer enquiries and troubleshoot network issues for improved customer service.
SUPPORT	Implement and improve release automation & orchestration, often using Application Programming Interfaces (API), as part of a continuous delivery and continuous deployment pipeline, ensuring that team(s) are able to deploy new code rapidly and safely.
SUPPORT	Use machine learning algorithms to automate the identification and resolution of common operator errors.
SUPPORT	Design and configure cloud applications tailored for AI integration to optimize telecom network performance and scalability.
ENTERPRISE	Generate synthetic network data to improve AI training and fine-tuning.
ENTERPRISE	Integrate AI-driven chat assistants and machine learning technologies with regulatory documentation systems to enhance real-time compliance tracking and updates.

ENTERPRISE	Automate regulatory monitoring and industry standard research using AI-powered data analysis tools.
ENTERPRISE	Develop and update policies related to AI and telecoms to optimize network access quality and customer experience.

Table 4: Cycle Capabilities Currently Not Matched to any Apprenticeship Standards

Visualisation Instructions

To explore all capabilities defined for this cycle, the visualisation tool link is used. The instructions for the tool are shown in the table below:

Visualisation Data Link	What is it and what can it be used for?
Organisational Capabilities	*The page provides details of the capabilities required by each supply chain partner and the supply chain as whole. The information is presented using the Capability Classification Framework, Design / Implement / Logistics / Support / Enterprise and can be interrogated and then exported to suit specific user requirements and interest.* *The information provided also identifies capabilities supported by existing provision, and also where there may be gaps that require new development to support to equip the future workforce.*

3.3 Step Two – How will the Workforce change? - Occupational Change Insight

Insight into occupational change uses the understanding of how capabilities will change across business functions (section 3.2) to inform proposals for how occupations and their associated skills sets for each supply chain partner may need be revised to reflect change for each role level within that partner.

Supply Chain partner organisation types

The workforce foresighting process recognises that different partners in a Supply Chain will require appropriate capabilities, and these are determined and agreed in the initial workshops. In this cycle, the following Supply Chain partners were identified and then used during participant workshops and data analysis to determine the organisational needs:

1. Telecom Service Providers
2. Network Infrastructure and Device Providers
3. Technology Innovators (including RTOs)
4. IT and Cloud Providers
5. AI Solution Providers

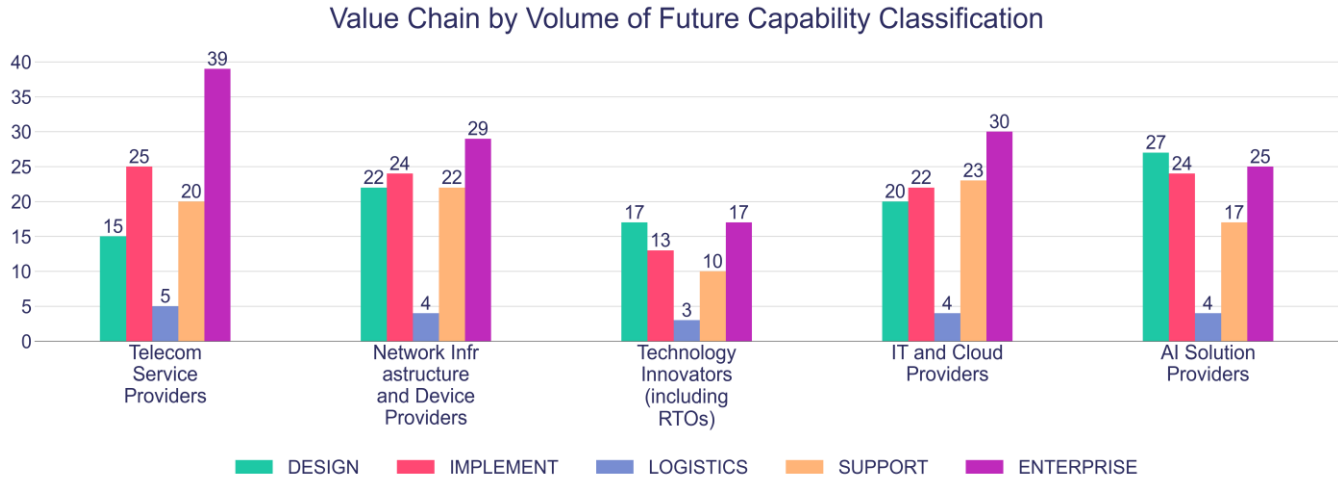


Figure 4: Distribution of Functions across each Supply Chain Partner

The graph illustrates the distribution of capabilities by function across the Supply Chain Partners. These capability sets are used to form the set of Future Occupational Profiles within each role level.

This insight indicates that adopting AI operationalisation technology will require almost equal workforce change across 4 out of 5 of the Supply Chain Partners with capabilities shared across multiple Supply Chain Partners.

The highest scored value chain was in the Enterprise category at 39 in the supply chain partner Telecom Service Providers. Enterprise generally had the highest volume of future capability classifications.

The lowest scored value chain was around 3-5 in the Logistics category, and this was across all five supply chain partners. This is due to the nature of the scope of the report.

Visualisation Instructions

Detailed instructions can be found in the appendix.

Visualisation Data Link	What is it and what can it be used for?
Supply Chain Capabilities	*This page provides an overview of the identified capabilities at a Supply Chain Partner level.* *By selecting/deselecting each Supply Chain Partner you can review the capabilities identified as required in that area of the Supply Chain.* *This can be used to generate organisational capability profiles for each area of the 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.*

Role Levels

The foresighting process uses the concept of Role Levels to represent future occupations. Utilising this approach acknowledges that the workforce is not homogeneous, there will be varying levels of proficiency required across a workforce and qualifications and training may be aligned/require different types of vocational or academic qualifications. Additionally, the role level approach seeks to avoid presuming that the future workforce will be operating at a different level to the current state.

Role levels determined through workshops:

There were three role levels in this sector determined through workshops:

1. Entry-Level
2. Mid-Level
3. Senior-Level

Proficiencies

Each of these role levels will require proficiency that reflects their role and the needs of each Supply Chain Partner. The foresight process uses a three-point scale to capture and differentiate the proficiencies required. This information is used both in the generation of the Future Occupational Profiles, and to assist the definition of training needs identified. Within the workforce foresight process proficiency is defined as:

> **Awareness (A)** - Has a foundational knowledge of tools, technology, techniques relevant to sector, industry, or organisation. Sufficient comprehension to know where to seek further information/details as necessary for a particular issue.

Practitioner (P) - Has the ability to apply and use independently a tool, system, or process. Understands the implications, consequences, and impact for their role/function. A Practitioner knows what key actions are required and in what context.

Expert (E) - Has detailed knowledge of process, system, tool, or technology. Can support others and identify improvements required for a process, system, or tool. An Expert can implement improvements personally or direct and guide others.

During the workshops participants applied their insight to assign proficiency for each role group to each capability. Individual responses were aggregated by the system to arrive at a consensus.

A visualisation of the distribution of required proficiency for the role levels in this cycle is demonstrated in the following graph.

	Entry-Level	Mid-Level	Senior-Level
Awareness	0	1	13
Practitioner	8	14	54
Expert	0	23	186

Table 5: Proficiency details by Role Level

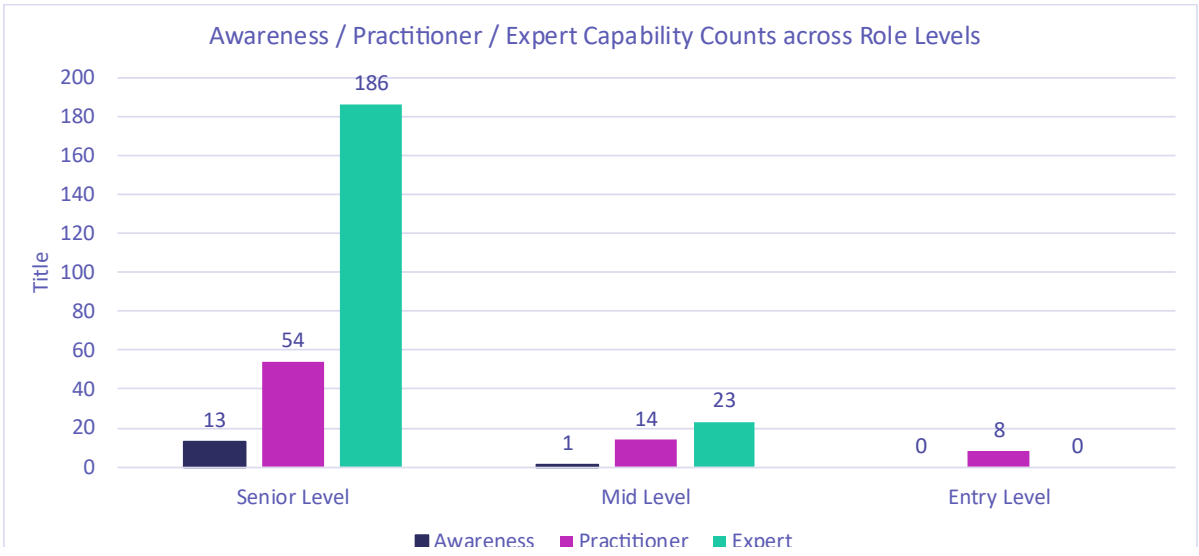


Figure 5: Proficiency details by Role Level

As can be seen from the graph above, the most prominent finding is that at entry level only 8 capabilities were identified, all of which were at practitioner level. All 8 capabilities were assigned to a single role of data technician. This role exists across all five supply chain partners.

Additionally. a large percentage of experts (62% overall) were identified to be required at senior level. The role that these senior experts have are very specialised in either AI or the telecom networks.

Further discussion for the other proficiency levels can be seen below:

Future Occupational Profiles

FOPs are used to describe and suggest occupations, or roles, that may be required in the future and provide a framework to indicate capabilities and related duties. They can be used to review the impact on current roles and the adaptation that may be required in the future.

Educators can review current apprenticeship standards against the requirements of the FOPs and interpret which need to be changed to fill the gaps between the current and future state.

Employers can consider existing apprenticeship standards and make a judgement on adapting an existing apprenticeship standard to upskill their workforce to meet the requirements of a particular FOP.

FOPs and indicative skills need

Combining proficiency with the identified FOPs, the following graphs indicate the priority needs across the supply chain for each Role Group to deliver future capabilities.

Entry Level Role Level FOPs:

In this cycle the Entry Level role level was defined as occupations and roles requiring a minimum Level 3 qualification or apprenticeship, or equivalent industry experience

For adoption of this technology, most FOPs require higher skills levels to carry out capabilities as duties at their role level. However, the cycle identified a small impact on workforce capabilities required at entry level. To enable the operationalisation of AI pipelines, Data Technicians will require 8 new capabilities at practitioner level. These capabilities are also captured in FOPs in mid and senior roles but a Data Technician will be enabling these capabilities by carrying out the tasks involved as a practitioner.

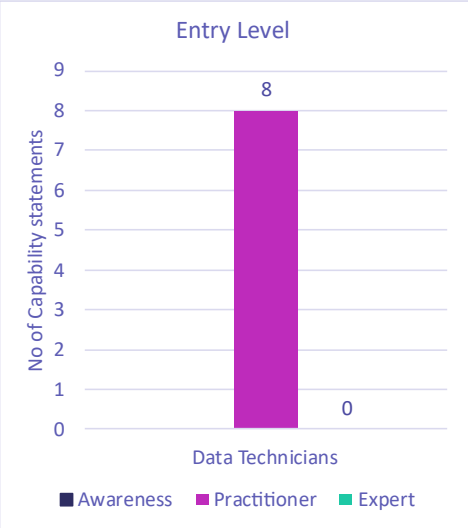


Figure 6: FOPs - Entry Role Level

Mid-Level Role Level FOPs:

In this cycle the Mid-Level role level was defined as occupations and roles requiring a minimum Level 5 qualification or apprenticeship, or equivalent industry experience.

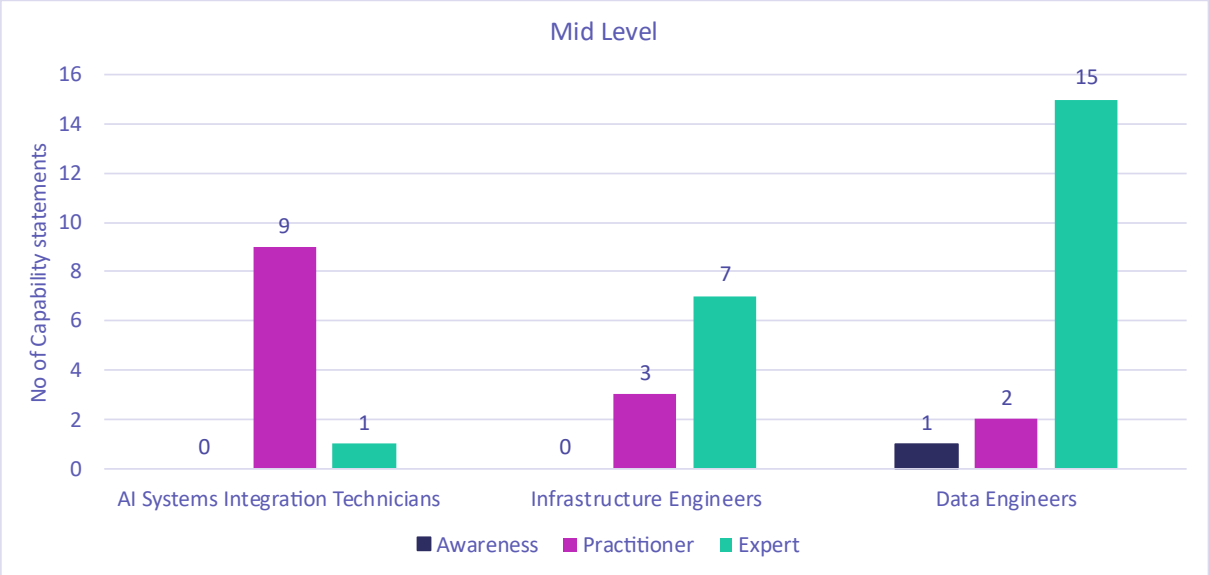


Figure 7: FOPs - Mid Role Level

At Mid-level there are three FOPs.

The FOPs for Data engineers and Infrastructure engineers are across all 5 supply chain partners. The FOPs for AI Systems Integration engineers are across 4 supply chain partners, and not in IT and Cloud providers.

There was one awareness and that was for Data Engineers to 'Procure necessary software, hardware, and services to enable AI models integration'.
Data Engineers had the highest expert proficiencies at 15, these included functional areas such as.

- Monitor operations
- Prepare materials
- Perform data analysis
- Evaluate business performance
- Design data storage

Infrastructure Engineers had the second highest expert proficiencies at 7, these were in the following functional areas.

- Research & Develop Technologies
- Plan Operations
- Design and configure support systems
- Select Equipment
- Identify suppliers

On closer analysis, the infrastructure engineers FOP has many AI-infrastructure related capabilities. Data Engineers on the other hand have new AI-related capabilities that are not typically associated with today's data engineers.

Senior Level Role Level FOPs:

In this cycle the Senior Level role level was defined as occupations and roles requiring a minimum Level 6 qualification or apprenticeship, or equivalent industry experience.

The majority of FOPs that will be required to adopt technology are senior roles are at least Level 6 qualifications, these increase up to PhD level. The mapping carried out here is only carried out up to Level 7 (Masters level). New capabilities will require new emerging FOPs such as ML Engineers, AI Ops/ML Ops Engineers and Generative AI Engineers.

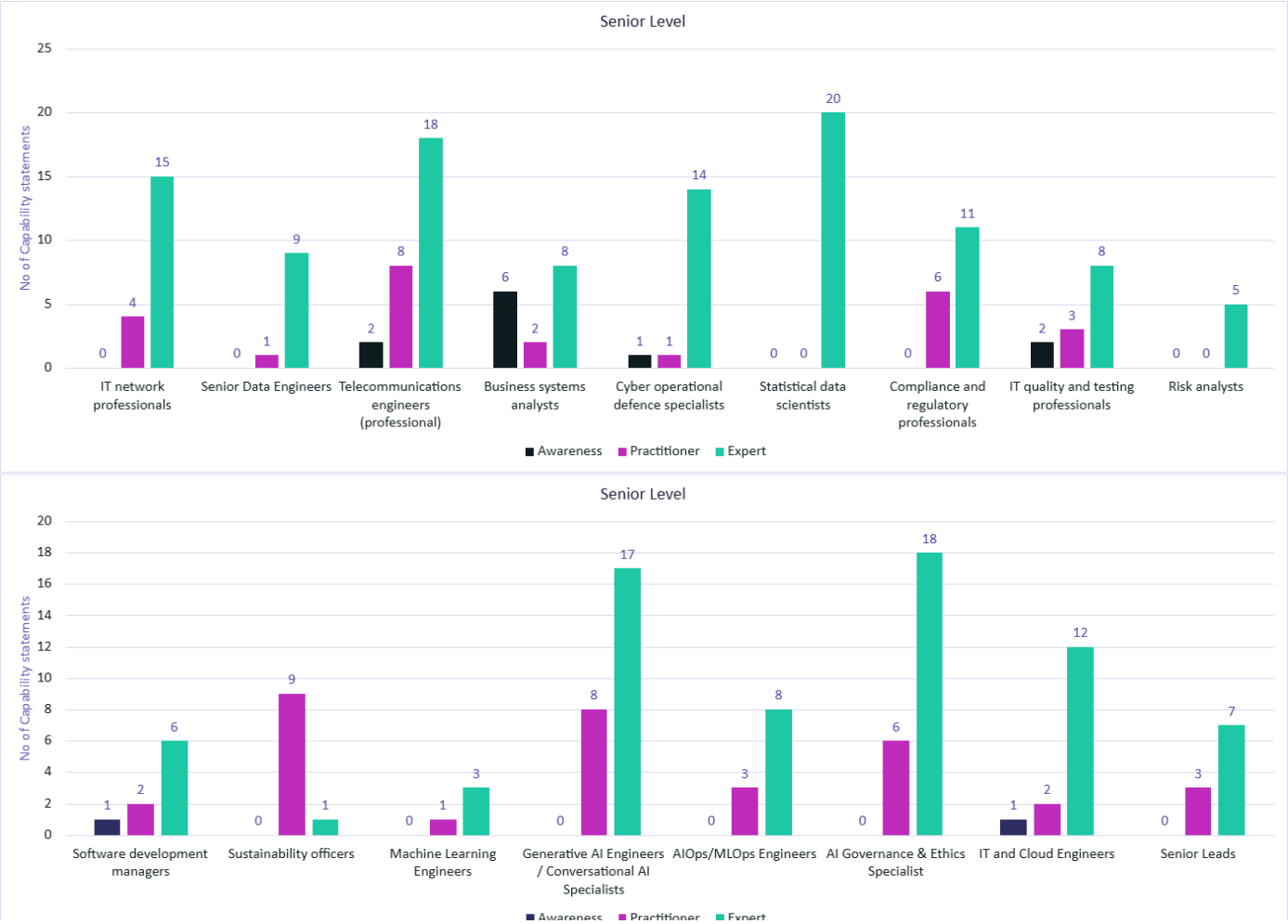


Figure 8: FOPs - Senior Role Level

From the graphs above for Senior-level there are seventeen priority FOPs.

The top 5 experts with the highest capability statements were as follows:

- Statistical data scientists (20)
- Telecommunications engineers (18)
- AI Governance & Ethics Specialists (18)
- Generative AI Engineers (17)
- IT network professionals (15)

Due to the specialisation of the experts, awareness in other FOPs was low in all the 17 senior role levels.

The top 3 practitioners with the highest capability statements were as follows:

- Sustainability Officers (9)
- Telecommunications engineers (8)
- Generative AI Engineers at (8)

Due to the highly specialist skills and expertise required across various roles, cross-role knowledge and awareness remain relatively low. This trend is evident across all FOPs, where awareness is limited. Consequently, a high number of experts will be needed, reflecting the specialist nature of the workforce.

Visualisation Instructions

Detailed instructions can be found in the appendix.

Visualisation Data Link	What is it and what can it be used for?
FOP Matrix	*This page 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.* *All the FOPs can be viewed by role level through selecting one (or more) of these from the drop down. This will then allow the reader to select the FOPs aligned to that role level.* *The populated table allows review and comparison of different FOPs within or across role levels. The capabilities in each FOP and the assigned proficiency levels can also be viewed*

3.4 Step Three – How the current education provision meets the future need - Highlighted Changes for Future Provision

From the 21 Future Occupational Profiles (FOPs) defined for this cycle, the 7 FOPs outlined below represent critical roles within the evolving telecoms workforce, essential for enabling AI pipeline operationalisation and driving industry transformation.

While there is some alignment with existing education and training programmes, several emerging capabilities are insufficiently addressed. These gaps highlight priority areas for innovation and the development of new educational and training solutions.

The FOPs defined for this cycle do not capture the full extent of a current or future job role, as the Workforce Foresighting aims to capture the key new capabilities that represent **a change in an occupation** that will be required in the future to allow technology adoption. A detailed comparison of current apprenticeship provision against the requirements of the identified FOPs is available via the data visualisation tool: *FOP vs Provision.*

Priority Future Occupational Profiles

Priority FOPS to fully address the needs of the workforce have been identified as including the following roles:

1. **Machine Learning Engineers**
2. **AI Ops/ML Ops Engineers**
3. **AI Systems Integration Technicians**
4. **Generative AI Engineers / Conversational AI Specialists**
5. **Telecommunications Engineers**
6. **Senior Data Engineers**
7. **IT and Cloud Engineers**

Preparing the Telecoms Supply Chain Workforce:

Key Steps to Address Capability Gaps in Priority FOPs

- **Identify shared capability gaps** to inform CPD development that supports upskilling across multiple telecom occupations.
- **Collaborate with training providers** to create short CPD courses tailored to upskill or reskill both current workers and new entrants in this field.
- **Assess industry adoption** of relevant apprenticeship standards and raise awareness to encourage uptake among existing and future workforce.
- **Review higher education (HE) course offerings** to identify gaps in each priority FOP and develop targeted modules to address them.
- **Identify Industry partners to sponsor PhDs** to develop highly skilled specialist technologists and engineers.
- **Contribute to apprenticeship standard updates** by recommending modular content that covers identified capability gaps.

1. Machine Learning Engineers – Senior Role Level

Why this FOP is a priority: A Machine Learning Engineer is critical for operationalising AI pipelines in telecoms because they bridge the gap between AI research and real-world deployment. They design, build, and optimise the AI models that power intelligent network functions, predictive maintenance, and customer experience enhancements—making them central to the performance and scalability of AI-driven telecom systems.

Key Tasks: Developing and deploying resource-efficient AI models, implement MLOps for reliability, generate synthetic data, conduct A/B testing, automate error detection, and create integration frameworks—ensuring AI systems are production-ready, scalable, and aligned with telecom-specific use cases.

Aligned to supply chain partners: Telecom Service Providers, Network Infrastructure and Device Providers, Technology Innovators (including RTOs), IT and Cloud Providers, AI Solution Providers.

In FOP vs Provision there was an 80% Fit with Skills England for Machine Learning Engineer (degree). The unmatched FOP capabilities are shown in the table below:

Function Area	Unmatched FOP Capabilities
ENTERPRISE	Generate synthetic network data to improve AI training and fine-tuning.
DESIGN	Create frameworks to enable seamless integration of AI technologies and telecoms platforms.
DESIGN	Develop software tools for AI integration into telecom network systems.
DESIGN	Scrutinise AI models to identify specific customisation opportunities to enhance customer experience on telecoms networks.
SUPPORT	Use machine learning algorithms to automate the identification and resolution of common operator errors.

This FOP closely matches the apprenticeship standard with the same name, covering 80% of the required capabilities. However, the apprenticeship was only approved for delivery in December 2024 and may not be known to key supply chain partners or may have limited training providers or spaces for apprentices to enrol. Some of the capabilities not covered in the apprenticeship are telecoms-specific and it would be a priority to create additional CPD training or a longer-term module addition to this apprenticeship to cover these capabilities.

The 'FOP vs Provision' data can be reviewed in the Visualisation tool, where it will show the full list of matched and unmatched capabilities.

Additionally, it is important to review the details of the FOP, as it outlines all the required capabilities for the Machine Learning Engineer FOP. This includes the knowledge, skills, and behaviours needed to perform these capabilities effectively as part of the occupation's duties. This information should be used to inform the development of FE and HE provision and the changes or additions that will be required to degree and Masters degree courses.

There is currently a shortage of ML engineers in UK Telecoms sector[13]. The demand for AI Engineers continues to outpace the supply, leaving many organisations scrambling to fill critical roles without a solid hiring strategy.

2. AI Ops/MLOps Engineers – Senior Role Level

Why this role is a priority: An AI Ops/MLOps Engineer is vital for operationalising AI pipelines in telecoms because they ensure the continuous, scalable, and reliable deployment of AI models, enabling real-time optimisation, predictive analytics, and seamless integration across complex network environments.

Key tasks: Responsibilities include monitoring concept drift, deploying and optimising machine learning models, implementing MLOps and DevOps practices, integrating AI into network operations and logistics, automating release pipelines, and developing sustainable, scalable AI systems to enhance network performance and customer experience.

Aligned to supply chain partners: Telecom Service Providers, Network Infrastructure and Device Providers, Technology Innovators (including RTOs), IT and Cloud Providers, AI Solution Providers.

In FOP vs Provision there was a 58.3% Fit with Skills England for Machine Learning Engineer (degree).The unmatched FOP capabilities are shown in the table below:

Function Area	Unmatched FOP Capabilities
IMPLEMENT	Utilise AI predictive analytics to forecast network demands and optimise network resources for enhanced network access quality and customer experience.
IMPLEMENT	Use AI to detect bugs and ensure optimal network performance.
IMPLEMENT	Develop workflows using AI tools to enhance the efficiency of operational activities.
IMPLEMENT	Integrate AI algorithms to analyse sensor data and proactively detect potential equipment failures.
IMPLEMENT	Monitor operations for any deviations or abnormalities using advanced analytics software
ENTERPRISE	Capture real-time network data to improve AI training and fine-tuning.
DESIGN	Develop software tools for AI integration into telecom network systems.
DESIGN	Create frameworks to enable seamless integration of AI technologies and telecoms platforms.
SUPPORT	Implement and improve release automation & orchestration, often using Application Programming Interfaces (API), as part of a continuous delivery and continuous deployment pipeline, ensuring that team(s) are able to deploy new code rapidly and safely.
LOGISTICS	Integrate AI tools into telecoms logistics to streamline operations.

This FOP has a fair fit to the same apprenticeship standard as 'ML Engineer' but AI Ops/ML Ops Engineers will need further CPD to be trained in above unmatched capabilities – **a high priority to get these capabilities covered**. A longer-term action is to investigate the addition

[13] https://www.corecomtechacademy.co.uk/news/closing-the-ai-engineering-skills-gap-in-tech

of specialised modules into the Machine learning Engineer apprenticeship to cover these unmatched capabilities.

Review the FOP vs Provision data to see full list of matched and unmatched capabilities.

It is important to also review the details of the FOP, as it outlines all the required capabilities for the AI Ops/MLOps FOP. This includes the knowledge, skills, and behaviours needed to perform these capabilities effectively as part of the occupation's duties. This information should be used to inform the development of FE and HE provision and the changes or additions that will be required to degree and Masters degree courses.

3. AI Systems Integration Technicians – Mid Role Level

Why this FOP is a priority: AI Systems Integration Technicians are essential for operationalising AI pipelines in telecoms because they ensure the seamless deployment, integration, and maintenance of AI-driven systems across complex network environments, enabling real-time performance and reliability.

Key tasks: Responsibilities include installing and commissioning AI systems, integrating AI algorithms for predictive maintenance and control, testing and monitoring AI tools in production, diagnosing and resolving technical issues, and supporting network upgrades with AI hardware and software integration.

Aligned to supply chain partners: Telecom Service Providers, Network Infrastructure and Device Providers, Technology Innovators (including RTOs), AI Solution Providers.

In FOP vs Provision there was a 50.0% Fit with Skills England for Machine Learning Engineer (degree) The unmatched FOP capabilities are shown in the table below:

Function Area	Unmatched FOP Capabilities
SUPPORT	Implement systems and tools for real-time, visual, interactive step by step installation/commissioning
SUPPORT	Offer technical support for AI-controlled systems.
SUPPORT	Diagnose and fix errors in complex technical systems that involve many interacting factors, making use of automated testing systems to optimise workflows.
SUPPORT	Resolve AI technical performance issues to maintain system reliability and support continuous improvement.
SUPPORT	Undertake asset operational support (technical issue investigation, management and logistics support to maximise asset operational availability)
DESIGN	Participate in network technology upgrade or expansion projects, including installation of AI-related hardware and software and integration testing.
IMPLEMENT	Integrate AI algorithms to analyse sensor data and proactively detect potential equipment failures.
ENTERPRISE	Test and monitor AI in production to ensure optimal performance and enhance customer experience on telecom networks.

The AI Systems Integration Technician FOP has some alignment with the same apprenticeship standard as the 'Machine Learning Engineer'. While it also shows a 50%

match with the 'Robotics Engineer' apprenticeship standard, the surplus capabilities as detailed in the FOP vs Provision visualisation tool, these are less relevant compared to those associated with the 'Machine Learning Engineer' apprenticeship. If the workforce is recruited from these apprenticeship pathways, then CPD would need to be developed **as a priority** to equip the workforce with the appropriate knowledge, skills and behaviours (KSBs) to carry out these currently unmatched capabilities.

Review the FOP vs Provision data to see full list of matched and unmatched capabilities.

4. Generative AI Engineers / Conversational AI Specialists

Why this role is a priority: A Generative AI Engineer/Conversational AI Specialist is key to operationalising AI in telecoms by enhancing customer engagement, automating support, and enabling intelligent, scalable communication systems that improve service delivery and operational efficiency.

Key tasks: Their responsibilities include developing and refining AI chatbots, applying prompt engineering for tailored content, integrating AI with compliance and documentation systems, implementing MLOps for reliability, designing predictive analytics for customer behaviour and building energy-efficient generative models for telecom-specific use cases.

Aligned to supply chain partners: Telecom Service Providers, Network Infrastructure and Device Providers, IT and Cloud Providers, AI Solution Providers.

In FOP vs Provision there was a 54.5% Fit with Skills England for Artificial Intelligence (AI) Data Specialist (Academic level 7). The unmatched FOP capabilities are shown in the table below:

Function Area	Unmatched FOP Capabilities
SUPPORT	Develop AI-powered chatbots to handle customer enquiries and troubleshoot network issues for improved customer service.
DESIGN	Refine generative AI models to address specialisation in specific use cases.
IMPLEMENT	Utilise prompt engineering in Generative AI to produce tailored content for user needs.
IMPLEMENT	Implement MLOps in AI operations systems to enhance performance and reliability in telecommunications networks.
ENTERPRISE	Integrate AI-driven chat assistants and machine learning technologies with regulatory documentation systems to enhance real-time compliance tracking and updates.

This FOP has a 54.5% fit with 'The Artificial Intelligence (AI) Data Specialist' apprenticeship standard that achieves an academic level 7, equivalent of a Masters degree standard. There are unmatched capabilities, particularly around the development of chatbots and refinement of generative AI models Therefore there needs to be CPD training and/or development of the apprenticeship standard as a priority to meet these capabilities.
Review the FOP vs Provision data to see full list of matched and unmatched capabilities

5. Telecommunications Engineers (professional)

Why this role is a priority: Telecommunications Engineers are essential for operationalising AI pipelines in the UK telecoms sector as they provide the foundational infrastructure, system integration, and performance optimisation needed to support AI-driven network intelligence, automation, and resilience.

Key tasks: Responsibilities in the future will include configuring and maintaining network systems, integrating AI and MLOps tools, implementing digital twins and predictive maintenance, enhancing cybersecurity against adversarial AI, optimising network performance using AI analytics, and ensuring ethical, scalable deployment of AI technologies across telecom operations.

Aligned to supply chain partners: Telecom Service Providers, Network Infrastructure and Device Providers, Technology Innovators (including RTOs), IT and Cloud Providers, AI Solution Providers.

In FOP vs Provision there was a 48.3% Fit with Skills England for Digital and Technology Solutions Professional (degree).The unmatched FOP capabilities are shown in the table below:

Function Area	Unmatched FOP Capabilities
DESIGN	Develop and implement defence mechanisms to protect telecom networks against adversarial AI attacks, ensuring network integrity and security.
DESIGN	Design digital twin environments to emulate real systems and create synthetic data for training AI in telecom activities.
DESIGN	Create frameworks to enable seamless integration of AI technologies and telecoms platforms.
DESIGN	Design AI operations systems with MLOps to enhance performance and reliability in telecommunications networks.
DESIGN	Develop software tools for AI integration into telecom network systems.
DESIGN	Configure equipment with the use of advanced machine learning algorithms.
SUPPORT	Utilize predictive maintenance to anticipate and prevent potential telecom network disruptions, ensuring enhanced customer experience.
SUPPORT	Design and configure cloud applications tailored for AI integration to optimize telecom network performance and scalability.
SUPPORT	*Apply effective systems engineering practice, considering the interfaces between work packages and promoting and maintaining effective communications between disciplines
SUPPORT	Deliver responsive technical engineering support services; to mitigate operational impact whilst ensuring business continuity.
IMPLEMENT	Implement digital twin environments in telecom operations to emulate real systems and generate synthetic data for training AI.
IMPLEMENT	Plan the adoption of digital twin environments to emulate real systems for telecom activities.
ENTERPRISE	Test and monitor AI in production to ensure optimal performance and enhance customer experience on telecom networks.
ENTERPRISE	Utilise artificial intelligence and machine learning for advanced data analysis across telecoms networks.
IMPLEMENT	Implement MLOps in AI operations systems to enhance performance and reliability in telecommunications networks.

This FOP has a 48.3% fit against this apprenticeship standard. The Telecommunications Engineer's role is rapidly evolving due to the speed of network advancements, and they are required to develop new skills in AI that are emerging into this sector. The priority is how they will be upskilled or reskilled in time for the scaled uptake of the technology.

Review the FOP vs Provision data to see full list of matched and unmatched capabilities

6. Senior Data Engineers

Why this role is a priority: Senior Data Engineers are critical to operationalising AI pipelines in telecoms by building the robust, scalable data infrastructure required to support real-time analytics, AI model training, and intelligent decision-making across complex network environments.

Key tasks: Responsibilities include designing and optimising large-scale data systems, selecting appropriate cloud and database solutions, integrating AI-driven telemetry and digital twins, enabling real-time and batch analytics, and ensuring data architecture supports advanced AI and machine learning applications in telecom operations.

Aligned to supply chain partners: Telecom Service Providers, Network Infrastructure and Device Providers, Technology Innovators (including RTOs), IT and Cloud Providers, AI Solution Providers.

In FOP vs Provision there was a **45.5% Fit with Skills England for Artificial Intelligence (AI) Data Specialist (Academic level 7).** The unmatched FOP capabilities are shown in the table below:

Function Area	Unmatched FOP Capabilities
SUPPORT	*Choose appropriate computational infrastructure and database solutions - including internal or external/cloud resources.
SUPPORT	Design and configure cloud applications tailored for AI integration to optimize telecom network performance and scalability.
DESIGN	Design digital twin environments to emulate real systems and create synthetic data for training AI in telecom activities.
ENTERPRISE	Utilise artificial intelligence and machine learning for advanced data analysis across telecoms networks.
ENTERPRISE	Integrate AI-driven product telemetry to collect and analyse real-time data from products and devices including customer review sentiment analysis.

This FOP has a 45.5% fit against the apprenticeship standard. It requires a deep level of expertise gained from academic qualifications and industry experience. The unmatched capabilities are around developing bespoke AI solutions for the business which requires specialist skills to deliver. The growth in these roles could be expedited by an industry funded programme of PhD sponsorships to develop people into this key future occupation.

Review the FOP vs Provision data to see full list of matched and unmatched capabilities

7. IT and Cloud Engineers

Why this role is a priority: IT and Cloud Engineers are essential for operationalising AI in telecoms by providing the secure, scalable infrastructure and deployment environments needed to support AI model integration, real-time analytics, and continuous service delivery. IT and Cloud Engineers role had the biggest gap in provision against an apprenticeship standard, this role is a high priority for training to fill the gap in the workforce.

Key tasks: Responsibilities include designing cloud-native applications for AI, provisioning infrastructure using APIs and modern technologies (e.g. containers, serverless), ensuring cybersecurity, supporting live AI deployments, performing validation and testing, and optimising operational processes through simulation and automation.

Aligned to supply chain partners: IT and Cloud Providers
In FOP vs Provision there was a 33.3% Fit with Skills England for Machine Learning Engineer (degree). The unmatched FOP capabilities are shown in the Table below:

Function Area	Unmatched FOP Capabilities
IMPLEMENT	Implement the software development lifecycle stages to ensure timely product delivery.
IMPLEMENT	Use version control software to manage and maintain different product version labels.
IMPLEMENT	Monitor operations for any deviations or abnormalities using advanced analytics software
SUPPORT	Design and configure cloud applications tailored for AI integration to optimize telecom network performance and scalability.
SUPPORT	Implement systems and tools for real-time, visual, interactive step by step installation/commissioning
SUPPORT	Solve operational inefficiencies through process optimization using advanced simulation software.
SUPPORT	*Choose appropriate computational infrastructure and database solutions - including internal or external/cloud resources.
SUPPORT	Provision cloud infrastructure using APIs, continually improve infrastructure-as-code, considering use of industry leading technologies as they become available (e.g. Serverless, Containers).

This has a 33.3% fit against closest match apprenticeship standard. These gap capabilities will need to be covered with alternative training provision or a development of flexible apprenticeship modules. The unmatched capabilities are either in the Support or implement functional area and they are quite diverse, hence why there is a low match. This FOP requires more input from industry to inform and refine the role further.

Review the FOP vs Provision data to see full list of matched and unmatched capabilities

Table 6 show all Future Occupational Profiles FOPs listed with lowest to highest matched current apprenticeships.

Supply Chain Partners Key:

1. Telecom Service Providers
2. Network Infrastructure and Device Providers
3. Technology Innovators (including RTOs)
4. IT and Cloud Providers
5. AI Solution Providers

Role Level	FOP Title	Required for SCP	Max. Fit Factor	Surplus Factor	Best Fit Apprenticeship Standard/s	Apprenticeship Suitability
Senior Level	**IT and Cloud Engineers**	4	33.33%	63.16%	Machine learning engineer	LOW
Entry Level	Data Technicians	1,2,3,4,5	37.50%	75.00%	Data analyst	LOW
Mid Level	Infrastructure Engineers	1,2,3,4,5	40.00%	89.47%	Machine learning engineer	LOW
Senior Level	Software development managers	1, 2, 5	44.44%	26.67%	Artificial intelligence (AI) data specialist	LOW
Senior Level	**Senior Data Engineers**	1,2,3,4,5	45.45%	13.33%	Artificial intelligence (AI) data specialist	LOW
Senior Level	IT quality and testing professionals	2, 3, 5	46.15%	54.55%	Electro-mechanical engineer	LOW
Senior Level	**Telecommunications engineers (professional)**	1,2,3,4,5	48.28%	69.49%	Digital and technology solutions professional	LOW
Mid Level	**AI Systems Integration Technicians**	1, 2, 3, 5	50.00% 50.00%	64.71% 68.4%	Robotics engineer – degree Machine Learning Engineer	LOW
Senior Level	Sustainability officers	1, 2	50.00%	65.00%	Sustainability business specialist (integrated degree)	LOW
Senior Level	**Generative AI Engineers / Conversational AI Specialists**	1, 2, 4, 5	54.55%	26.67%	Artificial intelligence (AI) data specialist	MEDIUM
Senior Level	Cyber operational defence specialists	1,2,3,4,5	55.56%	78.95%	Machine learning engineer	MEDIUM
Senior Level	**AIOps/MLOps Engineers**	1,2,3,4,5	58.33%	26.32%	Machine learning engineer	MEDIUM
Senior Level	Senior Leads	1,2	60.00%	53.33%	Artificial intelligence (AI) data specialist	MEDIUM
Mid Level	Data Engineers	1,2,3,4,5	72.22%	31.58%	Machine learning engineer	HIGH
Senior Level	Statistical data scientists	3	75.00%	21.05%	Machine learning engineer	HIGH
Senior Level	Business systems analysts	1, 3, 4, 5	75.00%	71.19%	Digital and technology solutions professional	HIGH

Senior Level	Compliance and regulatory professionals	1, 2, 4, 5	76.47%	89.47%	Machine learning engineer	HIGH
Senior Level	IT network professionals	1, 2, 3, 4	78.95%	74.58%	Digital and technology solutions professional	HIGH
Senior Level	**Machine Learning Engineers**	1,2,3,4,5	80.00%	31.58%	Machine learning engineer	HIGH
Senior Level	Risk analysts	1, 2, 4, 5	80.00%	53.33%	Artificial intelligence (AI) data specialist	HIGH
Senior Level	AI Governance & Ethics Specialist	3, 5	86.67%	84.21%	Machine learning engineer	HIGH

Table 6: All Future Occupational Profiles FOPs listed with lowest to highest matched current apprenticeships.

Visualisation Instructions and links to full data set

Visualisation Data Link	What is it and what can it be used for?
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 Level 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.*
Future KSBs Summary	*This page 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 level/occupational profile grouping.*
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 Skills England Occupational Standards provision.* • *By capabilities that **are not** served by the reference mapping framework, e.g., Skills England Occupational Standards 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 Apprenticeship standards, 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.*
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. 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.*
Fit & Surplus Matrix	*This page is a visual representation of the 'Fit and Surplus Factor' insight. You can visually review 'Fit' and 'Surplus' of Prototype Future Occupation Profiles (FOP) against existing training provision e.g. 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.*
FOP Capability Matches	*This page allows you to view the matches between Capabilities and 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 Prototype Future Occupational Profiles (FOPs) or review all FOPs under a Role Level, 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 Levels and FOPs, from Job / Occupation level through to Knowledge, Skill and Behaviour level*

4. Conclusion and Next Steps

4. Conclusion and Next Steps

4.1 Summary of key insights

Operationalising AI pipelines to enhance network quality and customer experience is essential to realising both government and industry ambitions for expanding 5G coverage and access across the UK. This advancement will be a cornerstone in driving the growth of the digital economy.

This workforce foresighting cycle has outlined the critical capabilities needed across supply chain partners to achieve these goals -capabilities that depend on a highly skilled workforce. While it identifies a small number of apprenticeship standards that are a fair to good fit, it also highlights the need to adapt existing apprenticeships, evolve degree programmes, and develop flexible continuing professional development (CPD) pathways. These efforts are vital to equipping the workforce with the knowledge and skills required to meet future demands.

Priority FOPs were identified to be:

- Machine Learning Engineers,
- AI/ML Ops Engineers,
- AI System Integration Engineers,
- Generative AI Engineers,
- Telecoms Engineers,
- Senior Data Engineers
- IT and Cloud Engineers.

Training or reskilling people in these FOPs will have the greatest impact on accelerating the speed and scale of AI adoption within the UK telecoms industry.

Low Suitability Apprenticeships

Many of the FOPs essential for AI adoption in telecoms poorly align with existing apprenticeship standards. Notably, three out of four of the entry and mid-level FOPs are amongst the lowest fit against current apprenticeship standards. The least suitable apprenticeships would require major revisions to be suitable. Even moderately matching apprenticeships will still necessitate additional training to gain the relevant knowledge and capabilities needed to effectively operationalise AI within the telecoms sector. To address this, adaption of existing apprenticeship standards or the creation of new apprenticeships, taking a mix and match approach from other apprenticeships as well as new module creation should be investigated.

Highest Suitability Apprenticeships

A small number of FOPs demonstrate a fair to good alignment with existing apprenticeship standards. However, it remains unclear how well-known these standards are within the telecoms industry and there may still need to be adaptions or additional training required. There is likely a need to raise awareness and encourage employers to begin training apprentices through these pathways. Doing so could significantly support AI adoption across

the sector, especially as apprenticeships are a funded provision—offering a cost-effective route to developing the necessary workforce skills.

Upskilling the Existing Technical Workforce

To close the knowledge and skills gaps in AI operationalisation within telecoms, industry stakeholders and educators should consider collaborating to develop modular continuing professional development (CPD) programmes. These should be specifically designed to upskill and reskill the current technical workforce, ensuring they are equipped to support the effective integration of AI technologies across the sector.

Shared Modules Across Technical Roles

Many key capabilities are common across FOPs. It is recommended to explore training and CPD solutions that address these shared skills, enabling the upskilling of multiple job roles simultaneously. This approach can deliver high impact at a lower cost by maximising efficiency and reducing duplication in workforce development.

Advanced Knowledge and Skills requirements

The data indicates that senior-level roles will demand a high degree of knowledge and expertise. While some skills can be developed through on-the-job experience, relying solely on this approach may slow progress and reduce overall impact. To address this, Higher Education (HE) institutions may need to adapt existing degree-level and postgraduate programmes—including master's and PhD courses—to incorporate modules that specifically develop the capabilities identified in this cycle.

The fast-paced development of AI technologies will require continuous change in required workforce skills. To keep up, training must be flexible, adaptable, and easily accessible, enabling rapid upskilling as new demands emerge. This approach will be essential to ensure the workforce remains agile and capable in a constantly evolving technological environment.

4.2 What this means for Industry and the Workforce

Foresighting has been developed to provide insight and the detailed information required to enable action by relevant stakeholders but is the first step of the Skills Value Chain. Collective action will be required by all stakeholders to ensure that the changes identified by foresighting – to the supply chain, the workforce and education provision are implemented.

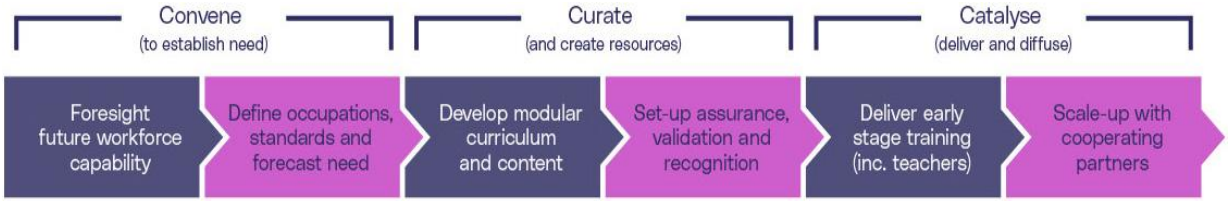


Figure 1: The Skills Value Chain

Employers in the telecom network sector must take proactive steps, both individually and collectively, to ensure that the development of skilled professionals meets industry needs. It is essential for employers to embrace upskilling and reskilling initiatives across various

departments in the sector, actively fostering a pipeline of future talent from schools, colleges and universities.

As the industry evolves, particularly with advancements in technology, greater technical collaboration among partners will be crucial. This collaboration should commence early in the project lifecycle, including the design phase. We may see an increase in working groups and interface design teams, led by industry leaders, to address the specific needs of emerging roles. Employers should review the organisational changes that have been identified as a result of the technology to start to plan for the changes across their entire supply chain. This insight is valuable in strategic planning and coordinated thinking.

The UK telecoms technical workforce currently lacks both awareness of and access to CPD opportunities that would enable them to upskill and reskill for emerging AI operationalisation capabilities.

Much of the current upskilling and reskilling is self-directed or informally shared among colleagues, leading to slower progress. This process should be supported through accessible, flexible learning options—delivered either in the workplace or through external providers.
To effectively tackle the anticipated skills gap, the telecom network sector must engage with key stakeholders to develop realistic workforce demand forecasts. This includes collaboration with educational institutions and industry organisations to ensure that training programmes are aligned with current and future job requirements. By taking these coordinated actions, the sector can secure a skilled workforce capable of meeting the demands of rapidly evolving technologies.

4.3 What this means for Education

The findings from this foresighting study indicate that future needs can be addressed through modifications to existing courses and degrees. The capabilities and potential occupational profiles generated through the foresighting cycle suggest that, in general, **modifications to existing courses** and degrees are sufficient to meet future needs. **A modular approach** in AI model specialisation is more likely to be achievable within the required timescales, compared to wholesale course design.

Education modules for HE and FE courses can be developed with reference to the FOPs and capability sets for example machine learning engineers, data engineers and AI data specialists

Where there are more specialist technical areas that require capability development, these should be addressed through routes such as PhD sponsorships and engagement with industry. University-led PhD studies can investigate problems and technologies in detail, before professionals in industry and RTOs provide support to refine and scale up solutions. It is important that these types of specialist areas are identified in good time.

A challenge for academia is to engage with industry proactively, supporting ongoing dialog so that research topics can be identified collaboratively.

The rapid evolution of AI and machine learning technologies means that current Further Education (FE), Higher Education (HE), and funded training provision may be falling behind. To keep pace, there is a need for flexible, modular CPD (Continuing Professional Development) that can be integrated into existing education pathways and offered commercially.

4.4 Recommended next steps

To ensure the telecom network sector is prepared to meet future demands, particularly in the area of AI optimisation for enhanced network access quality and customer experience, the following actions are recommended:

1. **Leverage Future Occupational Profiles (FOPs):**
   - Utilise FOPs to address current and anticipated skill gaps by updating industry standards and creating Continuing Professional Development courses for both, those currently employed in this sector and those transitioning from other sectors.
   - Advocate for the revision of apprenticeship standards to align with future workforce needs, ensuring the sector remains competitive.
   - Perform a gap analysis of the current skills/capabilities vs the FOPs and identify and prioritise roles that need upskilling.

2. **Short-term Actions:**
   - *Reskilling and Upskilling*. Educators, awarding bodies, and employers should collaborate to tailor course content that aligns with new capabilities and existing apprenticeship standards, focusing on design and lifecycle activities such as trainings in AI lifecycle in telecom, MLOPs in the telecom sector, edge AI etc. There also can be co-development of micro credentials or certifications.
   - *Immediate efforts are needed to prepare short-term training solutions that meet the current demands of technology. Recruitment from Other Industries*. Identify and reskill individuals with transferable skills from other sectors to fill high-demand roles, from machine engineers to Data Scientists to Digital Twin Engineers and Technicians. Form a taskforce that consists of different skillsets from AI engineers, 5G specialists, cybersecurity professionals and so on. Identify any metrics that maybe needed for the different FOPs.
   - *Policy and Regulatory Frameworks*. Contribute to existing or draft any new ethical and regulatory frameworks in AI-5G in line with the new and evolving FOPs. Engage any regulators that can look at the AI Data 5G spectrum.

3. **Mid-term Actions:**
   - *Integration of Future Skills Training*. Formalise the integration of future skills requirements into existing apprenticeship standards and training programs, particularly for new entrants, based on prioritised FOPs. Introduce AI in 5G career tracks within universities and any educational programs.

   - *Modular Course Updates.* Implement modular changes to existing educational programs rather than complete overhauls. This approach allows for quicker adaptation to evolving industry needs, ensuring flexibility and responsiveness.

4. **General Actions for Educators:**
   - *Assessment and Feedback*. Continuous review of the Skills England Occupational Standards. Review standards and relevant qualifications in partnership with employers is essential. This process should focus on identifying gaps and providing necessary feedback.

   - *Commissioning New CPD Courses*. Evaluate existing CPD provisions and commission new courses where necessary, promoting collaboration among stakeholders and industry to maintain a unified approach to workforce development.

5. **Dissemination and Review:**
   - *Dissemination of Findings*. Establish a working group to create an action plan and widely share the findings among stakeholders. This will influence workforce development initiatives and ensure strategic alignment.

   - *Ongoing Review and Adaptation*. Regularly review findings with stakeholders, adapting Future Occupational Profiles (FOPs) as needed to better fit emerging roles. This will ensure that actions remain robust and validated.

By addressing these recommended actions, the telecom network sector is significantly more likely to secure a skilled workforce capable of meeting the demands of evolving technologies, particularly in AI-driven optimisation. These strategies emphasise the importance of coordinated efforts from educators, employers, and stakeholders to bridge the skills gap and support the National AI strategy.

The recommendations in this report emphasise the importance of immediate and coordinated efforts by educators, employers, and other stakeholders to address the anticipated skills gap in the telecom networks sector. The actions are divided into short-term and mid-term strategies, data engineers will already have some degree of network optimisations knowledge, the AI element of access of network quality and customer experience will be specific to the telecom network provider.

5. Appendix

5. Appendices

Section	Title
5.1	List of participants
5.2	Cycle timeline
5.3	Access to output data - link and authorisation
5.4	Glossary - common language
5.5	Visualisation links and illustrations

5.1 Participants

Industry Participants	Skills Participants	Technology Participants
CGI	University of Suffolk	Digital Catapult
Acceleran	Newcastle University	Sunderland Software City
Sunderland City Council	University of Oxford	
5G Lab	University of York	
	Hartree Education Hub	

5.2 Cycle timeline

Workforce Foresighting cycle started the Carry Out phase in March 2025. The Carry Out phase concluded in July 2025. The Findings report was prepared following the data validation period and published in August 2025.

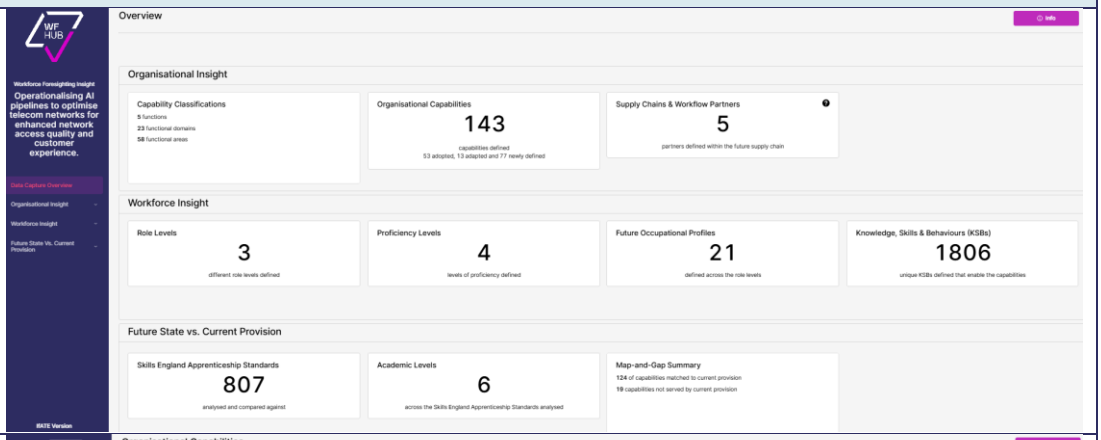
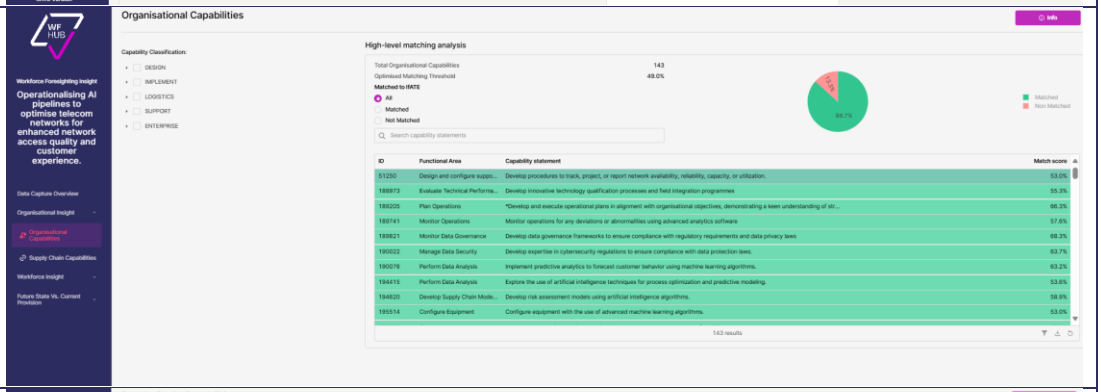
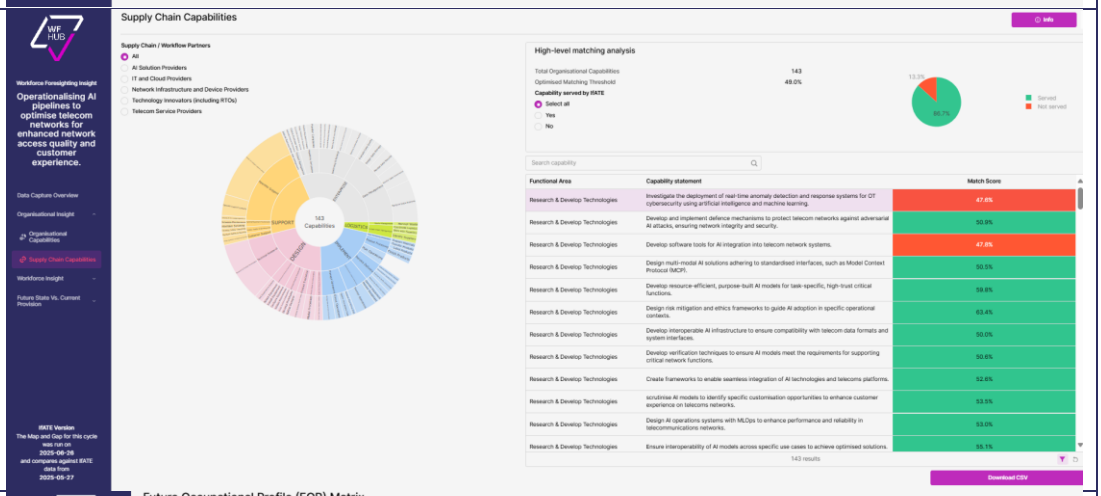
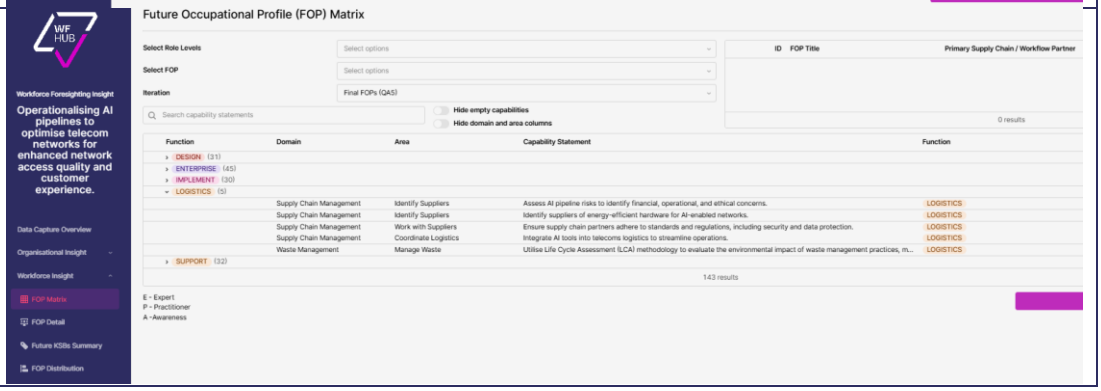
5.3 Access to output data - link and authorisation

Data Capture Overview

5.4 Glossary - common language

Term	Definition
Impact Domains	Innovate UK domains used as Strategic Categories to assist setting and monitoring priorities
National Challenge (Industry / Sector / Region)	A recognised technological or socio-political threat or opportunity for which there is consensus that workforce action is necessary
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
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
Delphi Process	Foresighting takes a Delphi approach which has come to represent consulting expert opinion. (Harking back to the Delphic Oracle of ancient Greece)
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 KBS 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
Organisation Type	Simple description of nature of organisation for which capability is required
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
Role Group	Role groups are a collective of roles that exist in a typical manufacturing business / industrial sector
Syntax	The way in which a statement is phrased to ensure reliable, repeatable and meaningful interpretation
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
Roadmaps	Sector, Industry, Regional view of emerging opportunities and their market entry
Participants	Technologists, Educators, Employers

5.5 – Visualisation links and Illustrations

Link to Visualisation	View of data
Data Capture Overview	
Organisational Capabilities	
Supply Chain Capabilities	
FOP Matrix	

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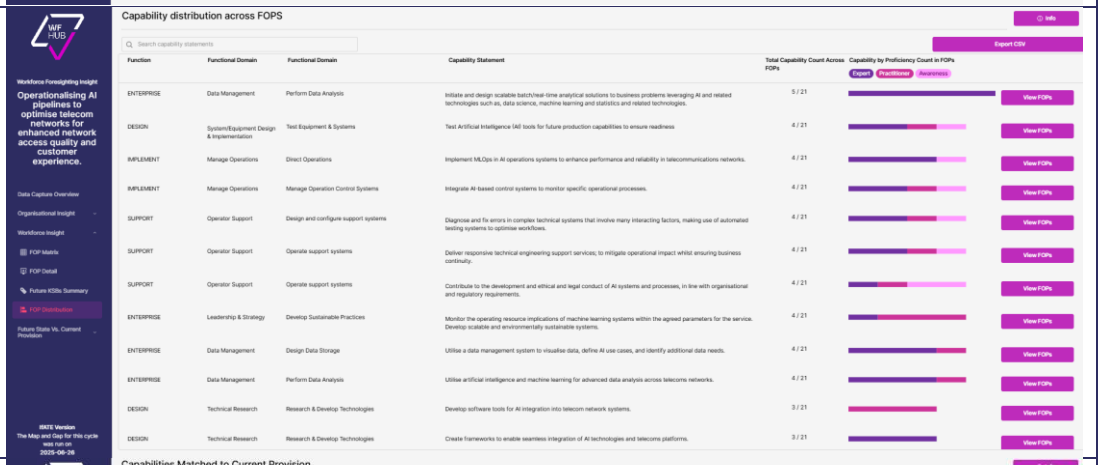
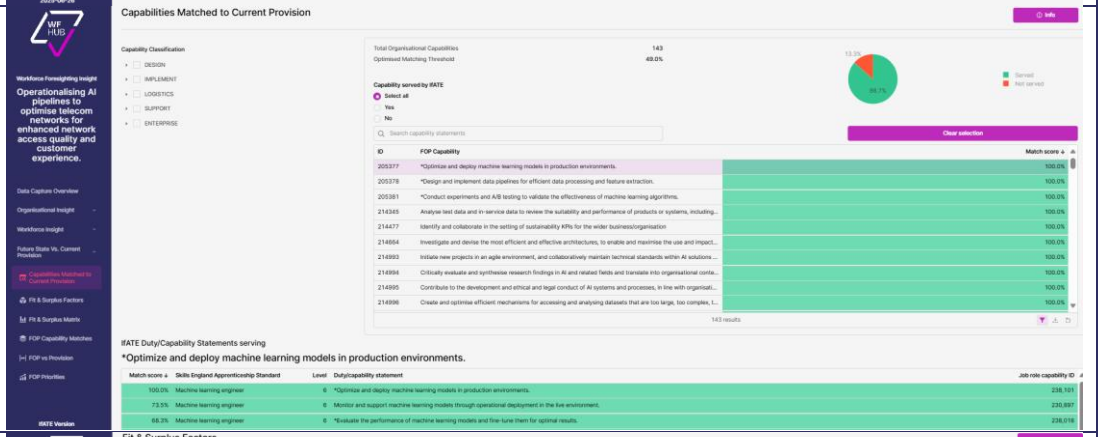
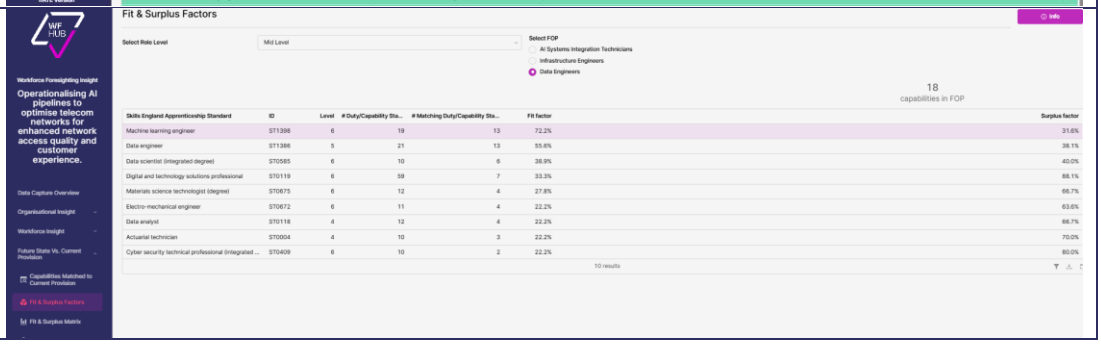
[FOP Distribution]	
[Capabilities Matched to Current Provision]	
[Fit Surplus Factors]	

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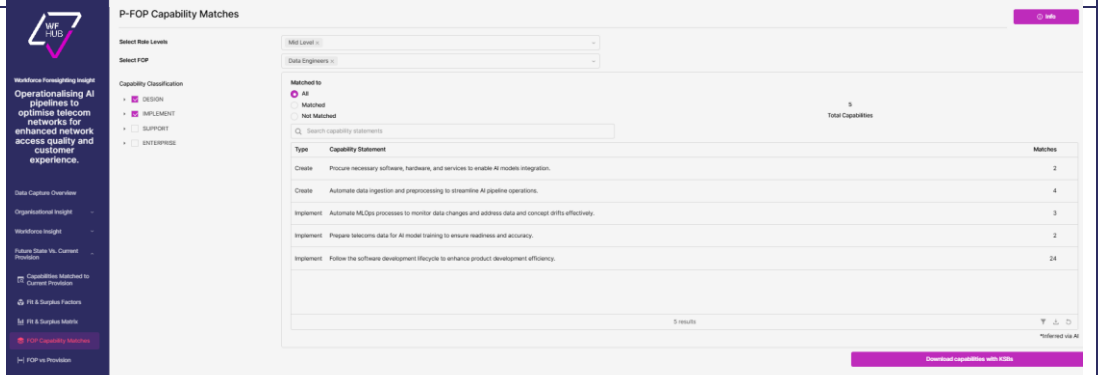
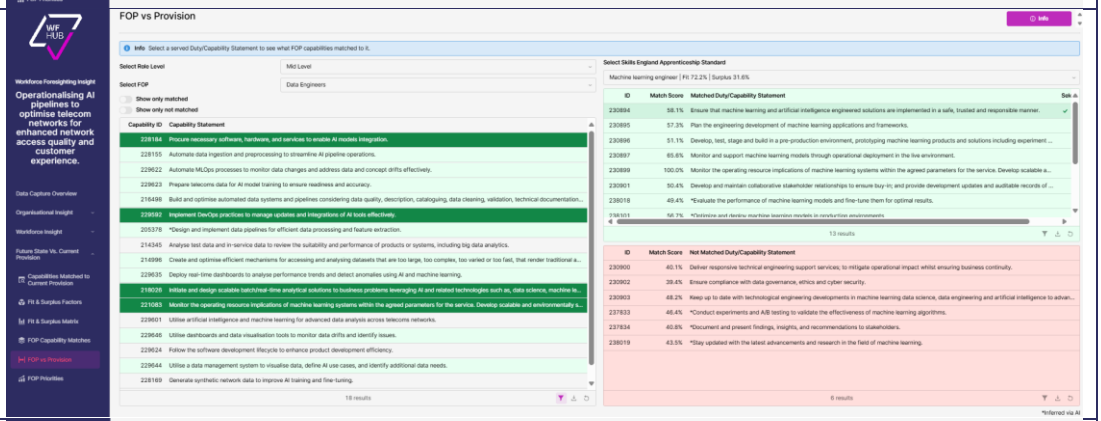
[FOP Capability Matches]	
[FOP vs Provision]	
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