Annex K: United Kingdom

Annex to report: Vision on defence related skills for Europe today and tomorrow

January 2019
Defence-related skills:
Building evidence on skills shortages, gaps and mismatches and defining the sector’s strategy on skills
EASME/COSME/2017/014

Authors
RAND Europe: Julia Muravska, Alice Lynch, Jacopo Bellasio, Anna Knack, Katerina Galai, Marta Kepe, Antonia Ward, Sofia Meranto, Davide Maistro
Danish Technical Institute: Martin Hansen

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Annex K. United Kingdom

Figure K.1 Executive summary – UK

United Kingdom

DITB size  
Turnover €25.68 billion in 2016; ~146,000 direct employees, 120,000 employed through the supply chain

Domain focus  
Aerospace, space, naval

Defence capabilities  
Aerospace manufacturing: 15% of the F-35; nuclear submarines (Astute and Dreadnought), cyber, armoured vehicles (Ajax, Challenger update), attack and transport helicopters (Apache, Merlin), satellites (Skynet)

Exports  
€10.12 billion average annually; 85% of exports are in aerospace (wings, engines, and aircraft interiors)

Selected companies  
BAE Systems, Rolls Royce, GKN, QinetiQ, Babcock, Cobham, MBDA

Identified skills gaps and challenges
- Gaps identified include cross-cutting skillsets in advanced manufacturing, nanotechnology and quantum science
- Other skills gaps include: systems and software engineering, mechanical engineering and project management

Skills supply landscape

<table>
<thead>
<tr>
<th>National skills strategy</th>
<th>Includes defence skills?</th>
<th>Education programmes</th>
<th>Other top down initiatives</th>
<th>Industry-led initiatives</th>
<th>Collaborative initiatives</th>
<th>Investment in R&amp;D?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Systems engineering, cyber, defence modelling and simulation, military airworthiness, military analysis &amp; problem-solving, explosives &amp; CBRN forensics, military leadership &amp; strategy, engineering</td>
<td>General STEM skills; engineering; cyber</td>
<td>General STEM, manufacturing, systems engineering &amp; design, software engineering, hardware &amp; sensors engineering, weapons systems, integrated test &amp; evaluation</td>
<td>Cyber, digital, engineering &amp; technical skills, systems engineering, defence modelling &amp; simulation, CBRN forensics, military leadership &amp; strategy</td>
<td>No specific skills focus of R&amp;D investment identified, but in the European context, the UK’s R&amp;D investment is high</td>
</tr>
</tbody>
</table>

Skills focus

Examples
- MBA Defence (Cranfield University); Defence Technical Officer and Engineer Entry Scheme (Wellbeck College); Post 16 technical education T-skills plan (’T-Levels’)
- STEM returners programme, Operationalising Defence Youth STEM Outreach, Cyber Schools Programme (Cyber Discovery)
- Leonardo Engineering Apprenticeships, BAES Systems Engineering Sponsorship Programme, MBDA Engineering Graduate Programme
- Institute of Coding, MOD Enhanced Learning Credits Scheme, DTUS

Source: RAND Europe
K.1. Background

One of the largest in Europe, both in terms of active companies and number of employees, the UK defence sector directly employs over 146,000 people (including 4,300 apprentices) with a further 120,000 employed through the supply chain. Holding 17 per cent of the global aerospace market, the UK’s is the largest aerospace industry in Europe and, globally, is second only to that of the US. The UK has a large defence industrial base in the European context, and it continues to maintain its industrial capabilities in areas such as military helicopters, fixed wing aircraft, naval shipbuilding, nuclear submarines, and armoured vehicles.

The UK defence budget totalled €41.12 billion for the fiscal year 2018-19. Between 2008 and 2016 UK defence spending as a percentage of GDP steadily decreased, largely due to tighter budgets resulting from the global financial crisis. Between 2002 and 2009 defence spending remained consistently at about 2.65-2.70 per cent of GDP. Following the global financial crisis defence spending began to steadily decline, but it is worth noting that despite this decline the UK remained one of the highest defence spenders in Europe in terms of GDP (currently estimated at 2.1 per cent), coming in third after Estonia and Greece. Since 2017 the UK’s defence budget has once again begun to increase; up to fiscal year 2020-21, defence spending is planned to increase by an annual average of 1.3 per cent in real terms. By 2020-21, the defence budget is planned to be €2.14 billion greater than in 2016-17. In 2018, the highest share (39 per cent) of the UK’s defence spending was in ‘other’ costs. This includes operations and maintenance expenditure and R&D investment. The remaining expenditure was accounted for by spending on personnel (37 per cent), equipment (22 per cent) and infrastructure (2 per cent).

second-largest defence exporter, and holds an estimated 12 per cent share of the global export market.\(^{11}\) The country’s defence exports were valued at €10.12 billion in 2017, representing a 53 per cent increase from the previous year.\(^{12}\) This growth was largely driven by sales in defence aerospace, such as a number of F-35 sales to the USA and Rolls Royce engines for Germany’s Multi Role Tanker Transport (MRTT) aircraft.\(^{13}\)

### K.1.1. Key industry players

BAE Systems is the dominant player within the UK defence industry and is also Europe’s largest defence contractor. BAE Systems operates across all traditional military domains— including high-end tasks such as the design and production of nuclear submarines and aircraft carriers— as well as in electronics, weapons systems, cyber and applied intelligence.\(^{14}\) BAE operates mainly in the aerospace (fixed wing) and maritime (ships and submarines) domains, and also has a presence in other sectors. Although many of the country’s other largest defence firms operate in the aerospace and maritime domains, many of these also have a strong presence in sectors such as electronics, weapons systems, armoured vehicles and satellites. These companies include Rolls-Royce, Leonardo, MBDA, QinetiQ, Babcock International Group, Serco, GKN and Ultra Electronics.\(^{15}\)

<table>
<thead>
<tr>
<th>Table K.1 Selected UK Defence Companies</th>
</tr>
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<tbody>
<tr>
<td><strong>Company</strong></td>
</tr>
<tr>
<td>-------------</td>
</tr>
<tr>
<td>BAE Systems</td>
</tr>
<tr>
<td>Rolls Royce</td>
</tr>
<tr>
<td>Leonardo</td>
</tr>
<tr>
<td>Serco</td>
</tr>
</tbody>
</table>

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\(^{15}\) Schutz, Torben and Christian Molling. 2018. ‘Fostering a defence-industrial base for Europe: The impact of Brexit’. *International Institute of Strategic Studies*


K.2. Overview of skills gaps and shortages

Changing technological and market trends have led to challenges in harnessing the volume and quality of skills necessary to sustain the UK’s current market position. Many organisations within the UK’s defence sector are facing substantial demographic challenges within their workforce; many of the skilled and experienced employees are due to retire within the next decade, and freezes on recruitment during the ‘peace dividend’ years of the 1990s have led to a reduced pool of mid-career staff to backfill these experts. Companies have reported difficulties in both recruiting mid-career professionals and retaining recent graduates in the face of competition for highly sought after skills from civil industry, where firms are often able to offer more attractive financial and non-financial incentives.

Furthermore, the UK is currently planning for or (mostly) implementing number of large-scale acquisition programmes, particularly in the maritime and aerospace sectors, with subsequent impact on the sector’s future skills requirements. The implementation of the Naval Shipbuilding Strategy, for example, will increase demand for high-skilled manufacturing jobs in the maritime domain, especially concentrated at the regional level. The successful delivery of the UK’s future capabilities in this field will depend upon sufficient indigenous skills to design, manufacture and repair naval equipment and systems, as well as to integrate naval ships and their associated security-sensitive equipment. At present, however, the UK is experiencing a shortfall of skilled workers to deliver on these requirements, and this

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20 MBDA. n.d. ‘Engineering Graduate Programme.’ As of 28 September 2018: https://www.mbdacareers.co.uk/university-students/engineering-graduate-programmes/
shortage is expected to increase in the near future. While the aerospace and defence sector has experienced a net 38 per cent increase in its engineering and technical workforce over the past three years, some 51 per cent of businesses in the sector have reported a shortage of appropriate skills amongst their current employees. Furthermore, 60 per cent of defence and aerospace companies predict difficulties in recruiting adequately skilled engineering and technical staff over the next three years.

While the DGP, a joint government-industry organisation, has identified four other critical defence skills (software engineering, project management, mechanical engineering, and technicians) in addition to systems engineering, there does not appear to be any government programme specifically designed to address these shortages. It is worth noting that a number of companies within the defence industry do address these skills as part of their general apprenticeship programmes. While there is a widely recognised need for skills within the broader STEM area and a number of programmes designed to address this, only a small amount focus on advanced skills at the more granular level, including for both dual-use and defence-specific applications. A greater number of programmes at the foundational level is to be expected, as fewer individuals are likely to proceed to further high-level specialisations and therefore fewer courses are required. However, the small number of specialist courses currently supplied may not be sufficient to meet the needs of the defence industry.

In addition to the critical skills identified by the DGP, the MOD has also recognised a significant gap relating to digital skills. This reflects the broader emphasis being placed on digital skills by the UK Government, which has emphasised these skills as one of the seven key ‘pillars’ of its 2017 Digital Strategy. Digital skills will be increasingly integrated into engineering professions as design and production processes within the defence sector become progressively more digitised. The emergence of a more data-driven defence industry has also raised concerns regarding a shortfall of cyber skills within both the defence sector and the wider UK economy, both to secure the networks of defence companies as well as to build cybersecurity and resilience into their products themselves. A further challenge for the defence sector is meshing and integrating the different, fragmented areas of specialism required to support future industrial requirements. Technological advances will result in an increased need for cross-

cutting skills across areas such as advanced manufacturing, nanotechnology and quantum science. However, skills programmes are yet to catch up with this technological trend, and defence firms face stiff competition from civil industries, many of whom can offer more attractive financial and non-financial incentives to attract high-skilled specialists.

Other skills that are regarded by industry to be of high importance, as well as being particularly difficult to access at present are those relating to software design, mission systems design, synthetics environments engineering and information architecture. In addition, both skills gaps and skills shortages have been identified to be simultaneously present in software design and engineering, project management, procurement, and mission management concept design, development and integration. Industry stakeholders also identified a number of skills that are challenging to access quickly enough, including cost estimation, autonomy engineering, and unmanned systems engineering.

It is also possible to identify the anticipated evolution of skills gaps over the next five to ten years. Important defence-related skills that are expected to become increasingly difficult to access within the next five years include unmanned systems engineering, propulsion/combustion and fluid dynamics engineering, design engineering and synthetic environments engineering. Over the next ten years, the skills that are expected to be most difficult to access are mechanical and thermal engineering, mission systems design, systems engineering, and software design and engineering.

K.3. National and regional policies and programmes

K.3.1. Overview of national and regional policies

While there is no dedicated UK defence skills strategy and the DGP is yet to deliver a cohesive strategy, (this strategy remained under development as of the end of 2018) the UK’s priorities and approach regarding defence-related skills can be found within a collection of national strategies and policies. The 2013 White Paper ‘Securing Prosperity: A strategic vision for the UK defence sector’, and the 2017 Defence Industrial Policy emphasise developing critical STEM skills, both at the broader level and in specific areas such as advanced manufacturing, electronics and software. In line with the 2014 DGP

RAND Europe survey analysis (2018)
Ibid.
Ibid.
Ibid.
Ibid.
Ibid.
survey, which identified engineering-related professions as three of the five critical skills, defence engineering is a particular area of focus across the UK's skills programmes. The Defence Engineer Professionalisation Strategy, launched by the Defence Engineering and Science Group (DESG) in 2018, is one example that illustrates the high priority being given to this skills area in the UK. Box K.1 below provides a more detailed overview of one key skills initiative being led by the UK Government.

**Box K.1 Case study: UK Year of Engineering 2018**

The UK's skills initiatives targeting engineering are part of a wider, cross-sectoral effort to increase the engineering capacity of the country's current and future workforce. As part of the UK Industrial Strategy, the Government declared 2018 to be the 'Year of Engineering', a campaign supported by a range of defence and civil partners including: Airbus, BAE Systems, Boeing, Bombardier, MBDA, QinetiQ, Rolls Royce, the Armed Forces, Defence Equipment and Support (DE&S) and the Defence Science and Technology Laboratory (Dstl) of the UK Ministry of Defence. The objective of this campaign is to promote the uptake of engineering courses and career paths amongst school-age students, and involves launching challenges and events in locations across the UK in collaboration with industrial and academic partners. One example of such an initiative is the Royal Navy Engineering Challenge which targeted naval engineering skills in areas such as the design, assembly and operation of remotely-operated vessels.

Source: UK Year of Engineering

K.3.2. Overview of national and regional programmes

Over the past few years, the UK has established a number of skills initiatives (both defence and dual-use) that align with the existing skills strategies and policies. While the majority of these programmes are run at the national level, regional Catapult Centres focusing on areas such as aerospace manufacturing, quantum systems engineering and digital skills are also in place. These centres are part of the UK’s...


42 HM Government. n.d. 'What is the Year of Engineering?' As of 28 September 2018: https://www.yearofengineering.gov.uk/about


Catapult initiative, which established a network of regional hubs to support the growth of innovation in specific areas and drive economic growth.50 The majority of national and regional-level skills programmes are delivered in collaboration with academic or industry partners. Current national and regional programmes broadly target two levels of the career lifecycle:

1. Youth outreach and training the future workforce; and
2. Professionalising or transferring the skills of the current workforce (incl. moving from civil industry to defence).

The UK Government also runs a number of programmes aimed at attracting and developing future talent within the MOD, and is also placing increased effort into targeting experienced professionals through skills transfer programmes (see Table K.2). Both Dstl and DESG run dedicated graduate and apprenticeship schemes, covering skills across a range of disciplines such as mechanical, electrical, materials, systems and software engineering; land, maritime and aerospace systems architecture; and nuclear systems.51 DESG also runs a student sponsorship scheme, through which it provides science and engineering graduates with paid ten-week summer placements within the MOD.52 One key initiative is the new Trailblazer Level 7 Defence Apprenticeship in Advanced Systems Engineering (SEMAP), which aims to both attract new graduates to the defence industry as well as upskilling the existing workforce.53 The government is also seeking to meet demand for technical skills through its post-16 technical skills plan which has involved the creation of technical qualifications (T-Levels’) based on employer-designed standards and content in order to prepare students for highly-skilled roles in industry.54 In response to the identified cybersecurity skills gap within defence, in March 2018 the MOD launched a Defence Cyber
Academy to develop specialist cyber skills within the MOD and other Government departments.\textsuperscript{55} Although these initiatives target government skills development, former government employees constitute a major source of talent for the defence industry.

**Table K.2 Selected national and regional programmes**

<table>
<thead>
<tr>
<th>Programme</th>
<th>Career stage</th>
<th>Domain</th>
<th>Skills focus</th>
</tr>
</thead>
<tbody>
<tr>
<td>DGP Defence Apprenticeship in Advanced Systems Engineering (SEMAP) \textsuperscript{56}</td>
<td>Both early-stage and mid-career professionals</td>
<td>Cross-domain</td>
<td>Systems Engineering</td>
</tr>
<tr>
<td>DGP Defence Enterprise Export Programme (DEEP) \textsuperscript{57}</td>
<td>Mid-career professionals</td>
<td>Cross-domain</td>
<td>Defence exports</td>
</tr>
<tr>
<td>Dstl STEM Returners Programme \textsuperscript{58}</td>
<td>Mid-career professionals</td>
<td>Cross-domain</td>
<td>Defence-specific STEM skills such as platform systems, cyber and information systems and defence and security analysis.</td>
</tr>
<tr>
<td>Department for Education Post-16 technical skills plan and T-level qualifications\textsuperscript{59}</td>
<td>Early and entry-stage</td>
<td>Cross-domain</td>
<td>A range of technical skills within the fields of engineering and manufacturing, such as naval shipbuilding</td>
</tr>
<tr>
<td>Naval Undergraduate Leadership Programme \textsuperscript{60}</td>
<td>Early and entry-stage</td>
<td>Naval</td>
<td>Management skills</td>
</tr>
<tr>
<td>Cranfield University postgraduate qualifications</td>
<td>Early-stage and military professionals</td>
<td>Cross-domain</td>
<td>Military airworthiness of aircraft (including design, test and evaluation); defence modelling and</td>
</tr>
</tbody>
</table>


\textsuperscript{56} Defence Growth Partnership. n.d. ‘Skills.’ As of 28 September 2018: https://www.defencegrowthpartnership.co.uk/our-plan/strengthening-industries-capabilities/defence-growth-partnership-skills-team/

\textsuperscript{57} Defence Growth Partnership. n.d. ‘Skills.’ As of 28 September 2018: https://www.defencegrowthpartnership.co.uk/our-plan/strengthening-industries-capabilities/defence-growth-partnership-skills-team/

\textsuperscript{58} STEM Returners (homepage). n.d. As of 28 September 2018: https://www.stemreturners.com/


\textsuperscript{60} Royal Navy. n.d. ‘Undergraduate Leadership Programme.’ As of 28 September 2018: https://www.royalnavy.mod.uk/careers/levels-of-entry/graduates/ulp
### K.4. Overview of industry defence related skills policies and programmes

The UK’s industry-led skills programmes are mostly funded and managed internally, although some degree of collaboration between industry, academia and government organisations is also present. Skills programmes led by large industry consortia include the Aerospace Industrial Cadets programme, which aims to develop skills relating to aerospace engineering and provide accredited qualifications to young people aged between nine and twenty. There is also a high level of industry involvement in government-funded skills programmes such as Year of Engineering initiatives, the Systems Engineering Trailblazer Apprenticeship, and wider DGP initiatives. This apprenticeship provides a Masters-level standard (level 7) in Advanced Systems Engineering.

The majority of the UK’s largest defence companies also run graduate programmes, apprenticeships and internships on an individual company basis. Depending on the specialism of the company in question, some of these programmes specifically target defence-specific skills such as naval shipbuilding, while others seek to develop dual-application skills and provide opportunities for individuals to then specialise in defence later in the career development process. One example is Bombardier’s Aerospace Apprenticeship and Graduate programmes. Although Bombardier is a Canadian-owned firm, its UK site is integrated into the local DTIB and relies on UK skills. Bombardier’s apprenticeship and graduate

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programmes lead to formal certification in Aeronautical Engineering which can then facilitate access into a defence aerospace career either within or outside Bombardier.65

Rolls-Royce offers graduates the opportunity to develop specialisms in areas such as electrical systems, electronics, materials, nuclear engineering, nuclear controls, software and systems.66 Meanwhile MBDA’s Engineering Graduate Programme equips graduates with a wide range of skills, from skills in aerodynamics and propulsion to lethality and warheads, human factors, and simulation modelling.67 In addition to entry-level training programmes, several of the UK’s largest defence companies have also made substantial investments in upskilling the existing workforce. Box K.2 provides an example of one such initiative.

**Box K.2 The BAE Academy of Skills and Knowledge**

| BAE Systems established the Academy of Skills and Knowledge to provide a specialised learning environment for BAE staff. The Academy is equipped with technology replicating that used in the company’s manufacturing facilities and engineering labs68 in order to continuously upskill the workforce in line with the integration of new technologies and processes into the company.69 The Academy is also designed to act as a collaborative skills hub for the companies across the regional engineering and manufacturing sector with requirements for a skilled STEM workforce.70 |

Source: BAE Systems

**K.5. SWOT analysis of national and industry programmes**

There are a large number of ongoing skills programmes in the UK. The quantity and diversity of programmes indicates an appreciation on the part of both the government and industry of the UK’s skills requirements and recognition of current or future projected gaps in light of the demands of the UK’s £200 billion defence equipment programme and export ambitions. Current defence-related skills initiatives in the UK are, in some cases (such as the SEMAP apprenticeship), closely aligned with the skills priorities set out in its various strategy and policy documents. However in the absence of a single

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67 MBDA. n.d. ‘Engineering Graduate Programme.’ As of 28 September 2018: https://www.mbdacareers.co.uk/university-students/engineering-graduate-programmes/
document setting out the UK’s defence skills requirements, these programmes are distributed across agencies and sectors. As the skills strategies and long-term business plans of defence companies are not usually available in the public domain, it is not possible to gauge precisely the extent to which their various skills programmes align with these, though they will reflect company’s projections of future UK and non-UK demand. However, the range of entry-level programmes in place indicates that UK industry is investing in developing a future workforce equipped with skills that reflect the identified UK requirement for engineering, manufacturing and technical skillsets. At the same time, the continuation of many of these programmes relies heavily on continued government funding, either directly through initiatives such as the DGP, or indirectly through the promise of future development programmes to incentivise industry to invest its own resources in skills development in a competitive but uncertain marketplace.

Figure K.2 SWOT analysis of national and industry programmes

<table>
<thead>
<tr>
<th>Internal factors</th>
<th>Weaknesses</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Strengths</strong></td>
<td>STEM skills targeted by national youth engagement programmes are generally broad in nature and not aligned directly with specific defence sector requirements.</td>
</tr>
<tr>
<td>The UK Government is actively investing in the promotion of STEM skills amongst the younger population (including school-aged children and graduates), aligned directly with identified needs.</td>
<td></td>
</tr>
<tr>
<td>Industry-led programmes are relatively strong in terms of providing entry-level training programmes such as apprenticeships and graduate schemes to support skills development. These programmes cover a wider range of skillsets that can be applicable to defence across the fields of engineering and manufacturing.</td>
<td></td>
</tr>
<tr>
<td>Defence companies appear to have been effective in capitalising on the opportunities provided by the UK apprenticeship levy.</td>
<td></td>
</tr>
<tr>
<td><strong>Weaknesses</strong></td>
<td>The rotational nature of many entry-level industry career programmes has led some companies to experience difficulties in retaining graduates and apprentices following the completion of their programmes.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>External factors</th>
<th>Threats</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Opportunities</strong></td>
<td>In the event that government-funded national and regional programmes are unable to sustain financial resilience, this may pose a threat to the continuity of certain initiatives. With the majority of existing programmes being too new to assess immediate benefits in terms of skills generation, generating sufficient political will to continue funding may prove challenging.</td>
</tr>
<tr>
<td>The DGP is working to identify areas of strength and best practice in UK defence skills development, which will inform the development of future targeted initiatives and programmes.</td>
<td></td>
</tr>
<tr>
<td>There are a large number of ongoing skills programmes (largely dual-use) in the UK that, if successful, will substantially increase the defence sector’s access to relevant skills.</td>
<td></td>
</tr>
<tr>
<td><strong>Threats</strong></td>
<td>The long-term effectiveness of industry apprenticeship schemes such as the Trailblazer apprenticeship will rely on continuity of government funding. Any disruption would reduce the number of apprentices that companies can take on, and the quality of the training delivered.</td>
</tr>
</tbody>
</table>