



Balance of Programme (Skills)

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1. Executive Summary

This report summarises the conclusions of the Balance of Programme (Skills) Review that forms part of STFC's new process for evaluating the balance between, and across, its individual skills programmes. The exercise was a light touch review of the scope, breadth, strategic direction and balance across STFC's skills areas.

A Sub-group of STFC's Skills and Engagement Advisory Board (SEAB), co-chaired by Prof Martin Hendry (University of Glasgow) and Dr Richard Burguete (National Physical Laboratory), was convened to review the balance of STFC's skills activities. The review's scope covered five skills areas: apprenticeships, graduates, studentships, fellowships and public engagement – all of which are essential to meet the needs of STFC's core science programme and address skills gaps requirements for the STFC and wider society. Community input was gathered through two consultations in which STFC advisory panels coordinated responses to a set of specific questions.

Four specific funding scenarios were considered and a series of recommendations appropriate to each funding scenario was established, together with an assessment of the concomitant risks and opportunities. For low funding scenarios these recommendations display a bias towards risk mitigation, while in the context of increased funding greater emphasis is placed on creation and exploitation of opportunities.

- The panel strongly cautions that a cut of 5% to the skills budget would pose substantial risks to maintaining the STFC core science programme. In any such scenario the review panel has found it extremely challenging to propose approaches which provide for STFC's future skills requirements without risking significant damage to the reputation and standing of STFC and its ability to deliver its mission.
- The consultation revealed mission-critical risks associated with the technical support of large national facilities and laboratory departments. Therefore, in all funding scenarios the review panel recommends doubling, within the next five years, the size of the apprentice and graduate cohort in order to mitigate these risks.
- It is essential in all funding scenarios that STFC optimises its spend of the apprentice levy and utilises it to make savings from training and development budgets elsewhere, as unused training funds allocated to the levy will negatively impact the overall budget, making "flat cash" in reality a negative funding scenario.
- The panel recommends that STFC preserves in all funding scenarios the budget for public engagement in recognition of its strategic importance and seeks to achieve

even wider impact in this area through further strengthening its existing links with external public engagement organisations.

- Studentships are currently the mainstay of STFC's skills development budget and are central and essential to delivering the PPAN science programme. Given the importance of maintaining the number of DTP studentships, STFC should explore ways to increase support for studentships from industrially-oriented sources where there are clear benefits for a student working with industry. Specific examples could include studentships funded collaboratively with the UK Space sector and CASE studentships with an adjusted funding model.
- The Ernest Rutherford Fellowship (ERF) programme is recognised as a prestigious and globally-renowned beacon of STFC's research excellence that attracts the very best talent to the UK and enhances opportunities to maintain UK leadership of major international projects. STFC must seek to preserve this flagship programme.
- Based on the recommendations to double the apprentice and graduate intake, and to preserve the public engagement budget at a minimum of the 2017/18 level, the review panel sees no alternative to finding the savings required in reduced funding scenarios from the budgets currently allocated to studentships and fellowships.
- In reduced funding scenarios the review panel therefore proposes a clear choice: to essentially preserve the DTP studentship numbers and substantially cut the ERF programme to half its current size, or to apply a more balanced cut to both DTP studentships and fellowships. Both actions would risk reputational damage and degradation of the science programme.
- The number of STFC studentships funded to support operation of the National Laboratories is very small, and places at risk the sustainability of STFC's infrastructural foundations. Other Research Councils currently fund studentships for science exploitation of these Facilities, but not to support their development and operation. In the context of the new UKRI landscape, STFC should explore new ways to fund studentships that support the operation of the National Laboratories.
- In the "flat cash plus 5%" scenario introduction of an early career 3-year fellowship scheme is recommended, with a representative cohort size of 15 fellowships per annum, to address the current gap in the talent pipeline. Alternative approaches could comprise a smaller cohort of such fellowships supplemented by Equality & Diversity fellowships, international fellowships, industrial fellowships, senior CASE fellowships and STEP awards to support the transition to a postdoctoral career.
- Under the "optimal funding" scenario all "flat cash plus 5%" recommendations should be implemented first. In allocating any further funding, the recommended priority is to

investment in studentships – through, for example, an uplift in the DTP allocation, additional studentships for the existing CDTs and the initiation of one to two new CDTs. The review panel recognises, however, that the additional funding made available under an optimal scenario is likely to come with significant specific constraints that may require STFC to reconsider its investment priorities.

- There is a clear need for greater coherence across the organisation (and possibly beyond to the other research councils, in light of the new UKRI landscape) in sharing and exploiting capability and good practice in relation to all skills areas. Further, there is a need to articulate more strongly the positive impact of STFC's strategic and tactical investment in skills development at all levels.
- Feedback from the campuses was very clear on the opportunities for better connecting training for studentships and fellowships, and more widely for apprenticeships and graduate training through campus-wide training academies and secondments – particularly where development of entrepreneurial skills is required.
- The review panel recognises the importance of the UK Government's Industrial Strategy¹ for influencing future skills investment opportunities. In the context of UKRI, the review panel recommends a more holistic approach to considering skills, engagement and innovation in future balance of programmes exercises.

The wide consultation carried out in support of the review and the detailed responses gathered enabled the panel to build a comprehensive and coherent picture of STFC's skills and engagement needs across its entire programme. It provided clear guidance about the impact of the different funding scenarios considered on STFC's ability to achieve its strategic aims and indicated the future actions required to maintain and enhance the STFC's world-leading excellence in Research, Innovation and Skills.

The recommendations presented have been derived from the consultation responses, with the objective of identifying common themes and critical issues and presenting practical and realistic proposals that ensure STFC is well-placed to respond to funding challenges and opportunities that may arise over the next 5 years.

In implementing some or all of these proposals, the review panel asks that the STFC Executive Board considers with care, and actively exercises, its appetite for risk in order to select those recommendations which should be taken forward, as opposed to considering a

¹ <https://www.gov.uk/government/publications/industrial-strategy-building-a-britain-fit-for-the-future>

less challenging path, as there is now a great opportunity, during the transition to UKRI, for significant benefits to accrue to STFC in the next 5 years.

2. Introduction

In December 2015 STFC's Executive Board agreed a new process for evaluating STFC's core programmes, which was subsequently approved by Council. The revised process separates reviews within individual programmes (such as public engagement and studentships) from high-level reviews of the balance between these programmes. These processes now run in tandem, and when considered together will inform STFC in planning and implementing its strategic priorities and translating these into funding plans.

As part of the new review process, it was agreed that every three years Science Board would consider the balance within the particle physics, astronomy and nuclear physics (PPAN) programme (excluding studentships), Innovations Advisory Board (IAB) the balance within the innovations programme, and Skills and Engagement Advisory Board (SEAB) the balance of the skills (including studentships) and public engagement programmes. Cross-membership would allow Science Board to input to the review of skills at the appropriate level.

A Sub-group of SEAB was therefore convened to review the balance of STFC's skills activities, with the ***objective of defining an optimum skills programme to meet the skills needs of STFC over the next five years.***

2.1 Scope of the Review

The programme under review was identified as comprising five distinct skills areas:

1. apprenticeships,
2. graduates,
3. studentships,
4. fellowships
5. public engagement.

These areas were defined as being within the scope of the review as they are essential either to meet the needs of STFC's core science programme and to address recognised skills gaps, national laboratories skills requirements and/or STFC-relevant skills needs of the wider society. The review did *not* include a consideration of Postdoctoral Research Assistants (PDRAs), but where appropriate it drew upon the recommendations arising from the Balance of Programme (PPAN) review in which PDRAs were considered. A summary of

the skills activities identified as in or out of scope is given in **Table 1**. Studentships funded by other Research Councils were not considered.

Table 1: Skills Activities In- and Out-of-Scope of the review

In-scope	Skills Activity
Public Engagement	School grants scheme
	Public Engagement: Small Awards
	Public Engagement: Large Awards
	Public Engagement: Fellowships
	Leadership Fellows in Public Engagement
Apprenticeships	STFC Apprentice Scheme
Graduates	STFC Graduate Scheme
Studentships	Doctoral Training Programme Studentships
	Lab-based studentships ²
	Student facility users ³
	CASE studentships
	Centre for Doctoral Training Studentships
Fellowships	Ernest Rutherford Fellowships
	Rutherford International Fellowship
	Daphne Jackson Fellowships
Out-of-scope	
Staff professional development ⁴	
Postdoctoral Research Assistants ⁵	

The review sought to provide a high-level strategic framework for how the skills balance of programme should develop under the following financial scenarios:

- Flat cash
- Flat cash +/- 5%
- Optimum (i.e. without financial constraints)

It was necessary for the review panel to make certain assumptions when reviewing the information and formulating recommendations, and these assumptions (and their subsequent validity) should be borne in mind when future planning decisions are made:

- **Assumption 1:** no new large facilities will be built and operated by STFC on its campuses in the next 5 years. Were the UK to seek to develop such a facility, this would in general require corresponding adjustment and evolution of the skills

² Information on the skills needs of lab-based students could help position STFC to seek opportunities through the Industrial Strategy Challenge Fund (ISCF)

³ Student facility users were deemed important since they interact with industry and the Research Councils. Information gathered in this area was expected to be contextual. It was noted that STFC does not strategically manage these activities.

⁴ Professional development of STFC staff and graduate trainees is the responsibility of Human Resources.

⁵ Responsibility for PDRA training rests with the host university/institute.

requirement and the skills programme would need to be flexible enough to provide a surge of highly skilled individuals within a well-defined timescale in response.

- **Assumption 2:** EU funding will continue as at present, with no change to UK researchers' eligibility to access funds or to the legal status of current research infrastructures and other agreements/frameworks.

3. Balance of Programme (Skills) Process

The Balance of Programme (Skills) review (henceforth BoP (Skills) review) was a light touch exercise that considered the scope, breadth, strategic direction and balance across STFC's skills areas. Although the review was informed by the strategic priorities of each programme and by the future opportunities available, it did not consider in detail what each programme should contain and did not review individual projects. The exercise was designed to provide STFC with a strategic framework within which future planning decisions can be made. The review's Terms of Reference are given in **Appendix 2**.

Relevant input on the balance across the particle physics, astronomy and nuclear physics science programme was provided by the Balance of Programme (PPAN) review that reported in February 2017 and was further supported by the inclusion of a Science Board cross-member on the SEAB Sub-group conducting the review. This ensured that the two reviews performed complementary roles, with skills recommendations appropriately informed by the wider science landscape.

The BoP (Skills) review began in February 2017, with a commitment to report to SEAB in November 2017. The SEAB Sub-group (membership as listed in **Table 2**, with biographies in **Appendix 3**) met three times, and reported to SEAB, according to the following schedule:

14 th November 2017	Report to SEAB of initial recommendations
2 nd – 3 rd October 2017	Third BoP Sub-group meeting, Swindon
15 th September 2017	Report to SEAB on review progress
5 th - 6 th June 2017	Second BoP Sub-group meeting, Swindon
28 th March 2017	BoP Sub-group kick-off meeting (by teleconference)

Table 2 – Membership of the SEAB Sub-group

Name	Affiliation(s)
Prof Martin Hendry (<u>Co-Chair</u>)	University of Glasgow
Dr Richard Burguete (<u>Co-Chair</u>)	National Physical Laboratory
Yvonne Baker	STEM Learning Ltd.
Prof Andrew Randewich	UK Atomic Weapons Establishment
David Martin	Atomic Energy Agency
Prof Peter Clarke (<u>Science Board cross-member</u>)	University of Edinburgh

The kick-off meeting provided an opportunity for the review panel to appraise the process, establish milestones, and define the scope of the review. The second Sub-group meeting focussed on identifying the priorities of each skills area, informed by a wide range of inputs gathered from the STFC community and other stakeholders. The third Sub-group meeting addressed the balance across the skills areas subject to the constraints of each financial scenario considered. During the third Sub-group meeting advisory panel Chairs were also invited to discuss (by telecon) their combined input to the review, and in particular the main themes that emerged from the consultation.

Each skills area was assigned a rapporteur from the panel to lead and focus discussion, with all panel members contributing to discussions, ensuring that decisions were reached through consensus. An internal Working Group (see **Table 3**) was established with members each assigned a specific skills area, enabling direct dialogue between the review panel and working group. The working group were primarily responsible for information gathering, and a complete list of documentation available to the review panel is provided in **Appendix 4**.

Table 3 – Membership of the internal Working Group

Name (affiliation)	Skills area
Emily Swaine (Strategy Planning and Communications)	Fellowships
Andrew le Masurier (Programmes Directorate)	Studentships
Derek Gillespie (Programmes Directorate)	Public Engagement
Grace Thompson (HR)	Apprenticeships & Graduates
Robert McGreevy (ISIS)	National Labs skills needs

Community input was gathered through two consultation exercises in which STFC advisory panels coordinated responses to a set of questions (see **Appendix 5**). The advisory panel Chairs and STFC Programme Managers were invited to two teleconferences (24th April and 23rd June) with the review panel Co-Chair to clarify questions relating to the consultation exercise. A further teleconference was arranged during the 3rd review panel meeting on 2nd October, in which the main messages from the consultation were fed back to the advisory panels, and a range of issues were explored further - including the relative merits of studentships and fellowships in the context of both academic and non-academic career

pathways, future opportunities around Centres for Doctoral Training (CDTs) and the need to increase the awareness of apprentice and graduate training in an academic setting.

4. Overview of Skills Areas, Strategic Priorities and Recommendations

4.1 Public engagement

4.1.1 Introduction and Context

STFC's vision for public engagement is that of "a society that values and participates in scientific endeavour", with the strategy for 2016 to 2021 identifying five priorities⁶:

- Showcasing STFC science and technology.
- Building the right partnerships.
- Developing and supporting STEM influencers.
- Improving reach with diverse audiences.
- Delivering high quality public engagement activities and outcomes.

This strategy document explicitly identifies the strong link between public engagement activities and the development of STEM skills and highlights clearly the risks to the STEM skills development pipeline of any significant reduction in these activities. Quoting directly from the PE strategy, STFC acknowledges "public engagement to be the vital first step in growing the UK's STEM talent pool.... Thus, every aspect of our public engagement seeks not only to inspire the next generation as to the value of science, but also to show that STEM subjects open the door to a hugely rewarding future."

Whilst this review focuses on public engagement in the context of STFC's skills provision, and in particular how it can provide inspiration and enhance the recruitment pipeline, the review panel recognises that public engagement has a broader remit and wider purpose for STFC that includes supporting and underpinning its external relations and improving the public understanding of science. In that sense there appears to be a lack of understanding by some STFC staff of the role of public engagement in skills development – either for external audiences or for those STFC staff and researchers engaged with it.

In our consultation responses there was also, perhaps predictably, a lack of agreement on the focus of public engagement activities from different interest areas. Groups such as Life Sciences and Soft Materials highlighted the opportunity to increase the focus of public engagement on new areas, perhaps at the expense of areas that currently enjoy greater media coverage – particularly if operating within a limited budget. There was also a

⁶ <http://www.stfc.ac.uk/files/corporate-publications/stfc-public-engagement-strategy/>

suggestion that more of STFC's public engagement activity should focus on cross-cutting and multi-disciplinary areas, recognising the current strategic importance of these areas in the context of e.g. the Industrial Strategy Challenge Fund.

4.1.2 Strategic Priorities and Opportunities

There is awareness, in centrally co-ordinated activity, of the importance of STEM capital and engaging with previously under-served communities and schools. There is also a growing awareness of the importance of sustained engagement with schools as a vehicle for real change in attitudes and practice. A wider appreciation and adoption of this approach, utilising the school and community group links and intelligence of organisations such as the Science Learning Partnerships and STEM Ambassador Hubs, would be beneficial.

In terms of skills, there is potentially much damage that could result from any reduction of public engagement spend. Our consultation responses identified the main negative impacts to be:

- i. reduction in the overall numbers of people reached by STFC, with the associated negative impact on the pump-priming and nurturing of the skills pipeline, i.e. fewer children being inspired by STEM;
- ii. reduced capability to focus on improving our reach with diverse audiences, particularly those with low "science capital", a concept that is closely linked to STEM aspiration.

Whilst the role of public engagement is wider than skills alone, several opportunities can be identified to achieve greater impact in this area through:

- Articulating more clearly the role of individual and organisational public engagement activities for inspiring, engaging and attracting a wider group of young people (and adults) to considering STEM-related careers, both within and beyond STFC;
- Emphasising more strongly for individuals, STFC and partner universities the benefits of participation in public engagement activities – e.g. in terms of enhancing their own skills, boosting postgraduate student recruitment and contributing to future REF impact. (See for example the STEM Ambassador impact report);
- Enhancing the coordination of public engagement, particularly at organisational level but also with regard to individual efforts;
- Increasing the focus of public engagement activities at those schools, communities and other groups which are otherwise under-served and can thus benefit most.

4.1.3 *Specific Recommendations*

In the context of the priorities and opportunities identified in the previous sub-section, the review panel recognises that even greater impact can be achieved from the existing PE spend if STFC were to:

R1: Recommendation. Ensure that public engagement efforts are optimally matched with other organisations in crowded arenas (e.g. space science) and highlight the full scope of STFC's work, including cross-cutting and multidisciplinary topics – e.g. computing, technology, and wider career opportunities.

R2: Recommendation. Ensure that the organisation and individuals continue to target efforts at schools and groups which are otherwise under-served, and provide them with opportunities for sustained engagement, not just 'one offs'. Strengthening links with organisations such as STEM Ambassador Hubs and Science Learning Partnerships to support this ambition.

R3: Recommendation. Maintain and enhance strong sustainable collaborations at corporate level with key organisations in the public engagement/STEM education space. Identifying with these collaborators shared priorities and success criteria to strengthen the evidence of impact.

R4: Recommendation. Articulate more clearly to individuals and institutions across the organisation how its public engagement is planned, delivered and evaluated, in order to involve the organisation more widely in its delivery and the achievement of its strategic objectives. For example, embed public engagement training and activities across graduate, apprentice, undergraduate and postgraduate training programmes to attract more individuals into STEM careers.

The review panel acknowledges that appropriate actions and activities relevant to each of these recommendations are already set out within the STFC PE Strategy, which provides a firm basis upon which to shape and implement the organisation's PE vision over the next 5 years – and indeed offers an effective template for other Research Councils in the context of the new UKRI landscape.

4.2 **Apprenticeships**

4.2.1 *Introduction and Context*

Apprentices are hired by STFC as a source for the technical staff who work in the departments of the organisation and at the UK national facilities. It is clear from the consultation that those advisory panels representing areas that make extensive use of technicians (e.g. the Accelerator Strategy Board, the Physical Sciences and Engineering

Advisory Panel) and the national facilities and laboratory departments very much appreciate the importance of the apprentice programme – although it is essentially invisible to many other areas.

The review panel also heard a consistent message that retention of technicians is problematic due to the gap between the STFC reward package and local market forces. In the last 10 years 12 apprentices have resigned (since the apprentice scheme started in 1992 the overall retention rate has been 60%); whilst this movement into other sectors represents a useful investment by STFC in the broader UK skills base, it leaves a critical skills gap across all STFC campuses. This, combined with the likelihood that fewer apprentices now expect to join an employer for the long term, means that a higher number of apprentices need to be trained. The review panel heard that some of the National Facilities could be put into operational jeopardy by the loss of just a few key technicians, for which apprentice recruitment is a crucial mitigation. However, out of the STFC overall annual budget (~£490M) just 0.13% (£680k) is currently spent on apprenticeships each year. A relatively small additional investment could therefore have a large positive impact on future technical skills.

4.2.2 Strategic Priorities and Opportunities

It is crucial to emphasise is that apprenticeships represent skills development for the UK just as much as studentships or fellowships do. When the majority of PhD students end up in non-academic employment this is considered as healthy for the country as a whole, yet when an apprentice leaves STFC it is considered by the national laboratory departments as having a detrimental impact on their operations rather than being celebrated as a significant example of knowledge transfer from the organisation. The review panel believes that this is symptomatic of a failure by STFC to sufficiently signpost the range of skills development that it undertakes and its strategy to develop skills for the wider society. There is an opportunity to over-recruit apprentices at no risk to STFC and high benefit to the UK by providing trained technical skills for the wider community. However, in setting the overall balance, STFC should remain cognisant that apprentice training goes on in other industries (albeit that such training may not be straightforwardly transferable to STFC positions) while studentships are more uniquely the purview of the research councils.

In terms of assessing the current status of the apprentice scheme, the response from the STFC departments was mixed – with some (such as RAL Space) noting that it works very well, and others replying less positively. There would be merit in the STFC departments analysing why they find such differences in exploiting the scheme and sharing best practice.

It may be that by being more involved it becomes possible for some STFC departments to extract more benefit. It also seems that the scheme has made recent changes, for example to alter the balance of craft and technical apprenticeships by recruiting at different levels, which has not yet been communicated effectively to the STFC departments (i.e. the latter are asking for something already apparently in hand). The documentation provided to the panel showed richer data and analysis for the graduate scheme than the apprentice scheme; we presume that the schemes are actually both monitored closely, but if this is not the case then they should be.

4.2.3 Specific Recommendations

R5: Recommendation. It is vital that the apprentice levy is fully exploited: flat cash is only flat cash if this is achieved. STFC should explore all possible uses of the levy, beyond simply enhancing the training of the current apprentice cohort, taking in to consideration opportunities to upskill STFC staff and to blur the boundary of the apprenticeship and graduate training programmes (see also **Recommendation 8**).

R6: Recommendation. There is a clear opportunity for STFC to better share good practice from the apprentice scheme, with national laboratories departments learning from those who currently value the scheme (most notably RAL Space and ISIS).

A key limiting factor for the apprentice scheme is the availability of laboratories in which apprentices can work and train, and the bandwidth of those who provide the apprentice training. The apprenticeship levy does not help with this aspect, although STFC's training capacity could be greater if more STFC departments participated in the apprenticeship scheme.

R7: Recommendation. There is an opportunity to remove or mitigate this limiting factor by STFC working in partnership with universities and industry who could provide space for and oversight of such training. This could be achieved by sub-contracting the training or by sharing the opportunities to recruit the outturn between the partners. While there could be losses from the scheme to these institutions, this is perfectly consistent with STFC's mission to provide training in apprenticeships to support industrial and academic science in the UK, in just the same way as it does with studentships that become academics and fellows.

4.3 Graduate Trainees

4.3.1 Introduction and Context

Since 2002 STFC has been running a two-year graduate scheme that is recognised by other publicly-funded research organisations for its quality and high standards. It is run as an 'in-post' scheme where each graduate fills a post within a department and focusses on the

delivery of programmatic priorities. Numbers on the graduate scheme have ranged from an average of 11 per annum in the early years of the programme to 24 in recent years, and there exists an aspiration to further increase these numbers by a factor of two in the next five years to address high attrition rates and the lack of mid-career STEM professionals.

Whilst the scheme is available across STFC, most graduates are based at RAL and are concentrated within three main areas (RAL Space, ISIS and the Technology department). The extent of engagement with the graduate programme is the responsibility of each department to decide. RAL Space, ISIS and Technology department indicate that they are at capacity with respect to supervision of graduate trainees.

4.3.2 Strategic Priorities and Opportunities

Various models of graduate schemes exist in other organisations, from in-post graduate programmes to full supernumerary schemes, with differing advantages and drawbacks. It was noted by the review panel that the 72 graduates currently on the STFC scheme cover 41 distinct skill types, 26 of which are covered by only one individual graduate. This situation seems to be the result of recruiting a new graduate trainee to replace the specific individual who has just resigned, adopting the same post title. Hence, the current approach of in-post recruitment in this manner has reduced flexibility in resource planning and left STFC vulnerable to single point failures (e.g. the dependence of ISIS on four or five critical roles – see below).

4.3.3 Specific Recommendations

R8: Recommendation. STFC should consider moving the graduate training scheme to a supernumerary or partial supernumerary model, with graduates given a greater say in their destination to improve retention and to address future pinch points within the organisation. The Government apprenticeship levy presents an opportunity in this regard (see also **Recommendation 5**), providing a mechanism through which STFC can create a flexible workforce better able to respond to changing organisational needs.

In common with other national labs and employers, STFC are struggling to recruit mid-career staff in STEM areas. Factors impacting this are government pay restraint, availability of suitable candidates and the cost of housing in Oxfordshire where the majority of graduates are based. Similarly, STFC considers retention to be an issue, with attrition rates higher than historical levels. For example, in early career schemes four of the 2013 graduate intake, two of the 2014 intake and two of the 2015 intake have left STFC for other employment.

Information on how retention rates compare to those of other organisations was not provided to the review panel.

These recent losses, when combined with other staff resignations, have resulted in an inverted normal distribution for the age demographic of STFC staff. Despite sustained recruitment effort, vacancies have stubbornly remained at around 100 per annum over the last few years. These factors are resulting in near-critical or even critically low resilience in some areas: for example, ISIS state that the loss of four or five specialised people could result in the facility being unable to operate.

The capacity of the organisation to supervise more graduates has been questioned, and this issue needs to be addressed ahead of any expansion of the graduate trainee scheme since poor supervision could lead to higher attrition rates if graduates were to become disillusioned or feel undervalued. Promotion of collaborative working by pairing graduates is a possible solution to this issue but may not work well in the context an 'in-post' graduate trainee scheme. Distributing supervision more evenly by placing graduates in other geographical and operational areas is another strategy that could improve the training capacity of the organisation. The decision by STFC to focus on 10 universities in the future (the number is currently 36) should lead to higher impact and more brand awareness of the graduate trainee scheme. Additionally, a higher number of students joining the graduate training scheme from each university should improve university engagement with the programme.

R9: Recommendation. STFC should explore and address retention and supervision issues as an essential priority before any future growth of the graduate scheme, in order to maximise the scheme's contribution to alleviating long-term recruitment pressures. Communication about, and management of, the graduate and apprentice schemes should seek to avoid any perception in the minds of graduates and apprentices that they represent different classes of employee; learning from those STFC departments that currently value the graduate scheme would help in this regard.

4.4 Studentships

4.4.1 Introduction and Context

Studentships account for the largest single financial component in STFC current budget for skills, with an allocation of £17.8M in 2018-19 (see **Figure A.1** in **Appendix 1**). The annual cohort comprises approximately 220 new DTP studentships together with CASE and CDT studentships and around 20 students (i.e. about 10% of the regular DTP annual cohort) who are trained across the UK National Facilities and Laboratory Departments each year. In the

baseline scenario considered here the panel's assumptions are based solely on this studentship figure. The further allocation of 102 studentships from additional funds made available in the 2016 Autumn statement is, however, considered in the specific funding scenarios in Section 5.

The following objectives set by STFC provide the core rationale for why it supports studentships:

- to feed the career pipeline (initially to postdoctoral positions and then either into industry or academic posts);
- to underpin the generation of scientific outputs;
- to provide the wider economy with a highly trained and skilled workforce.

These objectives sit within the wider framework of STFC's aims, namely to meet the needs of STFC's core science programme, to fill recognised current and future skills gaps, to address skills requirements for the National Laboratories and to provide for STFC-relevant skills needs of the wider society.

The academic career pipeline is the largest single, immediate beneficiary of the studentship funding programme, as 50% of PhD graduates move into postdoctoral positions – with 20% of that postdoctoral cohort eventually securing faculty positions. Currently, therefore, the studentship programme fulfils the objective of feeding the career pipeline; thus, the *optimum* number of studentships might be more readily determined by making an assessment against the need to generate scientific outputs and to provide the wider economy with highly trained and skilled people. Reducing their number significantly would put at risk the delivery of STFC's science objectives and significantly impact the supply of people with economically important skills to the UK economy.

The advisory panels are generally in favour of the current balance of funding for studentships in relation to the other skills areas, as they recognise their vital role in meeting key STFC objectives. Studentships are currently the mainstay of STFC's skills development budget and are central and essential to delivering the PPAN science programme.

On the other hand, the number of additional studentships funded by STFC to support the operation of the national laboratories is currently very small and this places at risk the success and sustainability of STFC's infrastructural foundations. Other Research Councils currently fund studentships for science exploitation of the national facilities, but not generally in support of their development and operation.

In summary, the consultation responses with respect to studentships can be considered to fall in to two categories: those that relate to national laboratory facilities and departments

and those applicable to STFC as a whole and how it supports the delivery of the scientific programme. Insofar as studentship funding is seen as the lifeblood of STFC's skill development programme, the advisory panels and national facilities made very clear statements about the desire for studentship funding to be maintained or increased. More specifically, all PPAN advisory panels identified studentships as either their 1st or 2nd priority. The message underpinning this response was that PhD studentships are a primary mechanism for maintaining and building the specialist pool of expertise that is one of the keystones for STFC now and into the future.

4.4.2 *Strategic Priorities and Opportunities*

The priority areas for action on skills development related to studentships⁷ are:

- Transferrable and industry relevant skills e.g. analytical skills, project management, network/systems engineering, financial and budget management.⁸
- Better support for enhancing skills to aid the transition from studentship into postdoctoral positions through the STEP⁹ programme, and from studentship into senior academic roles through early career fellowships.
- Provision of more CASE studentships funded by industrial strategy targeted funds to better enable industrial collaboration and, via a *revised funding model*, leveraging STFC's studentship funding allocation.
- Research projects and placements based at the facilities and industry partners to increase impact, training opportunities and partnerships.
- Development of a facilities-based CDT (administered by the STFC and linked to *all* universities) to support the STFC-relevant skills and talent pipeline in detector, sensor and instrument development, e-skills, space science and technology, medical physics, advanced accelerators and free electron lasers.

The key opportunity that presents itself is that growth of PhD studentships in the skills areas covered in this review aligns very closely with Government strategy, insofar as it supports the first three (out of 10) pillars of the Industrial Strategy Green Paper¹⁰: "Investing in science, research and innovation"; "Developing skills"; "Upgrading infrastructure". STFC also has national reach and is well placed regionally to play a key role in ensuring growth and development of high technology STEM skills across the UK.

⁷ Skills Shortage Survey

⁸ Examples gathered from consultation responses from all advisory panels.

⁹ STEP awards provide 6-12 months funding for students who have recently submitted their thesis to increase their competitiveness in obtaining postdoctoral positions.

¹⁰ <https://www.gov.uk/government/consultations/building-our-industrial-strategy>.

It is clear from all the evidence gathered that studentship funding programmes are in general serving the majority of STFC's needs. However, any significant cut to – or more constraints on the flexibility of – the DTP studentships allocation would harm the ability of STFC to deliver its mission. Moreover, with respect to the national facilities and laboratory departments, there is an urgent need to support instrument development, access and delivery of specialist expertise to industrial and academic users. An increase in the number of studentships based in the national facilities and laboratory departments could address this need.

In addition, PhD graduates are highly sought after across industry and commerce for their well-developed skills and capabilities, as demonstrated by the very low percentage (only 3%) of postdocs not using their training in their postdoctoral career. The difficulties with retention identified by our community consultation, which indicate a strong and competitive market for personnel qualified at postdoctoral level in core STEM subjects, is a strong indicator that there will indeed be capacity to absorb across the UK more suitably qualified and highly skilled PhD graduates.

Feedback from the campuses was very clear on the opportunities for better connecting training for studentships and fellowships (and possibly more widely for apprenticeships and graduate training) through campus-wide training academies, secondments and placements – particularly where development of business and entrepreneurial skills is required. The added benefit from this model of skills development by 'delivery in partnership' (exemplified by e.g. the Daresbury Skills Factory) is a well optimised and efficient use of financial, infrastructure and human resources.

In any increased funding scenario there is capacity for growth in the number of PhD studentships (of all types) because of the latent supervisory capacity in universities and the high subscription rate to funding calls. It is also apparent, from recent CDT and industry strategy linked calls, that there is strong industry interest in postgraduate research and training as more than 70 non-academic partners were involved in the recent data intensive science CDT call. More specific information about the need for, and the capacity to absorb, PhD level personnel needs to be obtained from industries related to STFC (e.g. the organisation's supply chain) and the wider industrial eco-system surrounding the facilities and in the campuses. The general thrust from Government, however, based on relevant research, is to generate more PhDs to support the UK's high technology industry.

4.4.3 *Specific Recommendations*

The picture built up through the consultation process can be condensed in to two main areas of activity that form the basis for the recommendations that follow. These are:

1. Achieving balance between research and support for facilities
2. Improving engagement with industry, retention and sustainability

In support of these activities we make the following specific recommendations:

- **R10: Recommendation.** Recognising that studentships are central and essential to delivering the PPAN science programme, STFC should seek to preserve, under all funding scenarios, the current volume of DTP studentships.
- **R11: Recommendation.** STFC should explore new ways to fund, and indeed increase, the cohort of studentships that support the operation of the national laboratories and facilities – including, where appropriate, through collaboration with other funding councils.
- **R12: Recommendation.** STFC should work jointly with industry, particularly SMEs on STFC campuses, to develop more industry support for PhD studentships; a target of 20 such awards, representing approximately 10% of the overall studentship cohort, would seem realistic. STFC should invest in people to broker these engagements so that industry leverage and two-way knowledge transfer is strongly enabled and realised. Seeking industry support should not be limited to the CASE model and other, innovative and creative, models to leverage industry funding should be actively developed.

4.5 **Fellowships**

4.5.1 *Introduction and Context*

STFC, in accordance with most other UK Research Councils and with best practice across the international research community, offers postdoctoral fellowships to support the delivery of its core science programme. These provide the very best early career researchers with opportunities to develop their own independent research programmes, establish their credentials as potential future research leaders and enhance a range of transferable skills that will serve them equally well should they pursue a career outside of the standard academic pathway.

In the past STFC has offered a suite of fellowship programmes – including junior 3-year fellowships aimed at researchers who were within a few years after completing their PhD and senior fellowships designed to support highly experienced researchers seeking to focus their efforts on specific, advanced research programmes freed from other teaching and

administrative responsibilities. Currently, however, only Ernest Rutherford Fellowships (ERFs) are offered by STFC. These are highly prestigious, effective at identifying and nurturing future academic leaders and very competitive – with currently a success rate of only 8% among nominated applicants, and a quota system of limited nomination places assigned to STFC groups that effectively makes the ERFs even more selective. In 2017-18 the total cohort size of ERFs, at all stages of their Fellowship, was 59 fellows – i.e. corresponding to a new intake of approximately 12 per annum.

The ERFs provide 5-year positions to exceptional candidates to lead their own research programme in conjunction with a host institution and are normally well-supported by STFC with additional funding for research travel and equipment. Until recently STFC has also operated a scheme whereby ERFs could apply for additional research grants e.g. to support a graduate student. This could provide important leverage to help ERFs with securing a proleptic academic position at their host institution. It is no surprise, therefore, that the importance of ERFs as vital career-advancing steps for the best young scientists was highlighted by all PPAN advisory panels. Even with the very high attrition rate for applicants, they are widely regarded as a valuable tool for attracting and retaining STFC postdoctoral talent since they provide a clear target and focal point for postgraduate students and younger postdoctoral researchers at which to aim.

4.5.2 Strategic Priorities and Opportunities

The discontinuation of the 3-year fellowship programme previously offered by STFC was widely regarded in the advisory panel consultation responses as unfortunate – leaving a significant gap in the skills pipeline at an early stage and in particular removing an important opportunity for the very best early career researchers to first demonstrate their research independence and future leadership potential. Furthermore, the importance of this potential early career gap is likely to grow in the future following the UK's withdrawal from the European Union if this restricts STFC researchers' access to European Research Council funding. (The availability of ERC 'starter' grants has partially mitigated the removal of the STFC 3-year fellowships over the past few years). The re-instatement of a 2- or 3-year junior fellowship scheme across the PPAN science areas would be broadly welcomed – especially in those areas such as theoretical particle physics with a historically low ratio of PDRAs to academic staff, where the recruitment of junior fellows could provide invaluable additional postdoctoral support.

More generally, across many PPAN areas surveyed by the advisory panel consultation, *any* increase in the provision of fellowships – whether junior or senior – would be warmly

welcomed since the overall level of research FTE supported by STFC has been falling steadily for many years under successive flat cash funding settlements. An important caveat, however, is to ensure that any new junior fellowships were not simply funded by a reduction in PDRAs on consolidated grants since their function and utility is perceived as rather similar to the latter category of appointment.

On balance, therefore, the PPAN advisory panels would generally prioritise the retention of senior fellowships over the creation of junior fellowship positions in flat cash or negative funding scenarios, as the former fulfil a particular role within the academic pipeline that is not provided elsewhere (although the ERFs are broadly similar to e.g. Royal Society University Research Fellowships – albeit that such positions are, if anything, even more competitive so do little to address the high rate of unsuccessful ERF candidates). Moreover, in any negative funding scenario that required a significant saving through reduction in the numbers of studentships or fellowships, most PPAN advisory panels noted a preference for preserving the studentship population.

Finally, building stronger links between studentships and postdoctoral positions (both fellowships and PDRAs) by funding initiatives such as the STEP award programme (see also **Section 4.6**) could be highly beneficial for skills development, as it has been shown to deliver an increase in productivity and enables a more rapid transition from research student to independent postdoctoral researcher.

4.5.3 Specific Recommendations

The career progression of computing staff both within STFC and in universities remains a chronic problem – and one which potentially threatens the long-term resilience of some of STFC's key Facilities and projects.

- **R13: Recommendation.** This career progression issue for computing staff could be mitigated by the introduction of a cohort of “Research Software Engineer” (RSE) fellowship positions similar to those introduced by EPSRC. These exist in small measure only for DiRAC at present. Such RSE positions could provide enhanced skills badly needed to secure the evolution of software to new technologies and to decrease code execution times in all areas of science. An initial cohort of at least five such RSE fellows is recommended.
- **R14: Recommendation.** The Ernest Rutherford fellowship (ERF) programme is recognised as a prestigious and globally-renowned beacon of STFC's research excellence. STFC should avoid any significant erosion of the ERF programme, which

would send entirely the wrong message about STFC's core strategic research programme.

- **R15: Recommendation.** The review panel recommends the introduction of early career fellowships (with a representative cohort size of 15 for fellowships of 3 years). These fellowships would address a significant gap in the talent and development pipeline as identified by our community consultations. Alternative approaches, as detailed in the ETCC consultation response, could comprise a smaller cohort of early career fellowships supplemented by Equality & Diversity fellowships, international fellowships, industrial fellowships and senior CASE fellowships.

4.6 Cross-Cutting Skills Considerations

4.6.1 Introduction and Context

In prioritising STFC skills funding it is important to consider the different career paths relevant to the different skills areas, and thereby to seek to use the balancing exercise to target any bottlenecks, gaps and vulnerabilities within the existing skills pipeline. (**Figures 1 and 2** show the different career pathways that currently exist, or could exist in a more flexible model, between academia, industry and STFC).

For example, there is considerable additional capacity in the academic pipeline for supervising more studentships and fellowships, whereas a minimum level of staff and studentships are required to operate the national laboratories and facilities. This latter factor, in particular, limits the extent of re-balancing of the Skills programme towards studentships and fellowships that would be possible before the adverse impact on the national facilities becomes 'mission critical' to their future operation. Moreover, a further overarching consideration is STFC's mission; what is the priority balance between providing staff to run the national labs and facilities, future academics and industrial scientists, engineers and technicians?

In seeking to balance the STFC skills provision it is, therefore, crucial to acknowledge that the investments made by STFC are dual purpose. Studentships and fellowships enhance the skills of their recipients but also are the engines of research and innovation, and it is not reasonable to consider the skills priorities within and between these two areas without also considering their potential impact on the research programmes that they support and underpin. Similarly, apprenticeships and graduates are recruited as a means of investing in the UK skills base, but also with the more specific objective of providing the scientists, engineers and technicians required to operate the STFC national facilities. Again, therefore, the skills priorities within and between the areas of graduates and apprentices cannot be

addressed without also considering the balance required between operations and research. It follows, moreover, that it is also more difficult to balance the skills priority between STFC’s investments that are primarily *research* focussed (i.e. studentships and fellowships) and those that are primarily focussed on the staff of the organisation itself (i.e. apprenticeships and graduates).

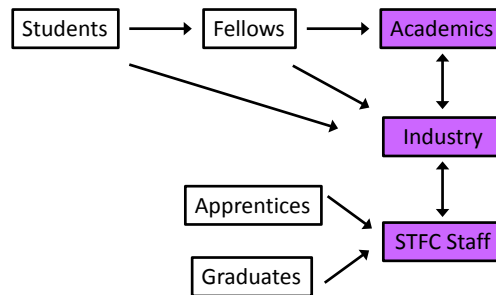


Figure 1: Schematic highlighting the range of different career pathways, between academia, industry and STFC, for the various cohorts considered in this review.

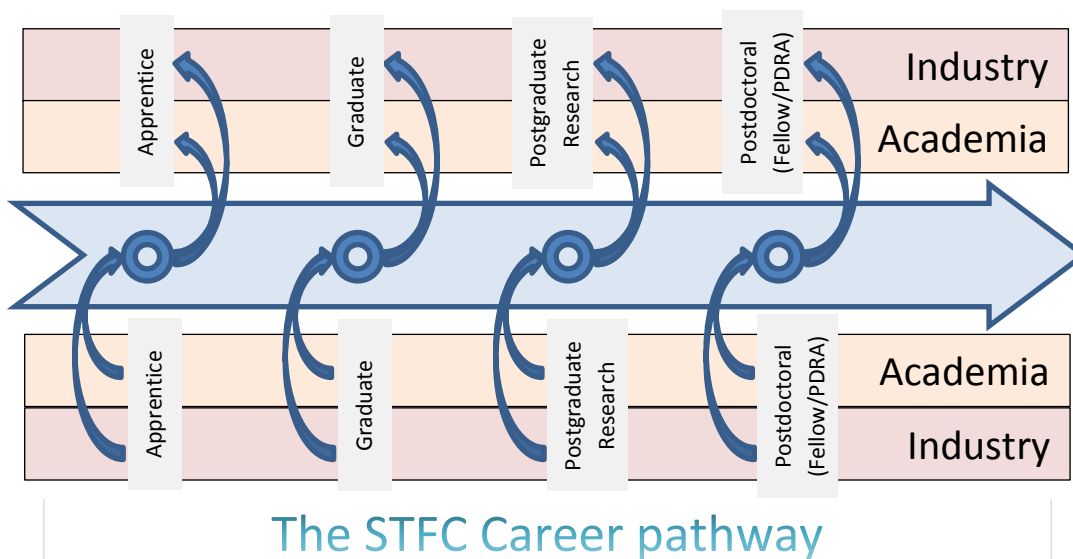


Figure 2: Schematic highlighting a more flexible model of career pathways in which there are opportunities for greater mobility between academia, industry and STFC (the blue arrow) at all career stages.

4.6.2 Strategic Priorities and Opportunities

Notwithstanding the challenges set out in the previous sub-section, STFC should seek to manage its investments and support for skills as a *continuum* – at least across the “apprenticeships/graduates” boundary, and the “studentships/fellowships” boundary.

Moreover, where appropriate STFC should look to better integrate this continuum more widely, embedding skills training coherently across the entire spectrum from apprenticeships to fellows. Data intensive science is one area where the adoption of a broad skills continuum may work well – perhaps within an “Academy” model where individuals across the full range of career stages work together on common data intensive problems. Novel approaches to apprenticeships, such as internships that could be carried out by graduates or fellows, should also be considered to promote greater skills transfer and development between the national laboratories, industry and academia.

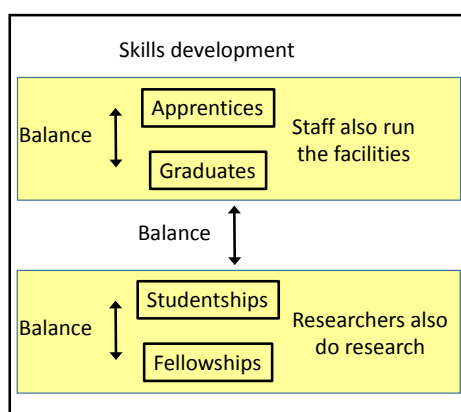


Figure 3: schematic highlighting how STFC’s investments in skills should be considered as ‘dual purpose’ in view of the other vital outputs (in research and facility operation) provided by those investments – making a purely skills-based prioritisation both difficult and indeed undesirable.

4.6.3 Specific Recommendations

- **R16: Recommendation.** STFC should fund initiatives such as the STEP awards, which have been shown to deliver increased productivity and a more rapid transition from research student to independent postdoctoral researcher. The review panel endorses the ETCC consultation response which recommended 60 STEP awards per annum, each of 6-12 months duration.
- **R17: Recommendation.** STFC should seek to develop a campus-wide central training academy (exemplified by e.g. the Daresbury Skills Factory) serving all training levels. This would be an efficient use of funds and increase opportunities for collaboration and networking.
- **R18: Recommendation.** STFC should enable circulation between the organisation and related industry/academic partners, on and off campuses/facilities, to allow for further career development via a structured internship or placement programme. Using STFC’s existing strategic partners, and through its campuses and CDT partnerships, there is

scope for developing up to 50 internships or placements per annum, of typical duration 6 to 12 months, within 5 years.

- **R19: Recommendation.** STFC should ensure that programmes developed to enhance funding, skills and retention are simple and executed across the organisation rather than as isolated schemes. Sharing of best practice should create STFC-wide ‘corporate cohesion’.

5. Programme Balance under Different Funding Scenarios

5.1 Introduction and overview of approach

The key messages emerging from the consultation were identified by the review panel in the context of their associated risks and opportunities. The main criterion used to develop the recommendations for each of the funding scenarios considered was the goal of minimising or mitigating the risks while simultaneously exploiting the opportunities.

For reduced funding scenarios the review panel’s recommendations display a bias towards risk mitigation, while for increased funding scenarios greater emphasis is placed on creation and exploitation of opportunities. The review panel considered carefully the impact of the recommendations on the STFC’s strategy to develop world class research, innovation and skills; in all cases the review panel’s proposals aim to support the STFC in realising this core mission by enhancing its skilled workforce and training a future generation of scientists and technologists both to deliver the core science programme and to provide general benefits to the UK’s society and economy.

The following sub-sections set out a series of risks and opportunities and specific actions under the different funding scenarios considered, drawing upon the area-specific recommendations detailed in **Section 4** above.

Finally, there are several over-arching messages and conclusions that the review panel identified as relevant to *all* scenarios:

- There is a need for greater coherence across the organisation to share and exploit good practice, enable human resource and skills balancing (across campuses and facilities over time) and capitalise from economies of scale. The STFC should consider implementing a thorough capability mapping exercise to ensure that robust and high-quality data are collected, in order to plan rigorously for its skills needs over the next decade.

- Further, there is a need to articulate more strongly the positive impact of STFCs strategic and tactical investment in skills development across all levels, and in collaboration with academic and industrial partners.
- It is essential in *all* funding scenarios that STFC optimises its spend of the apprentice levy, to be applied across apprentices and graduates at levels 3 to 6 (and later to level 7/8) and utilises it to make savings from development budgets elsewhere. Unused training funds allocated to the levy will have a negative impact on the overall budget, exacerbating the adverse impact of a “flat cash” or negative funding scenario or directly reducing the potential benefits of any positive funding scenarios.
- There is an opportunity to make more clearly the argument (already widely accepted for PhD studentships) that the attrition of apprentices and graduates trained by STFC, who subsequently leave the organisation for positions in commerce and industry, nonetheless represents a positive skills outcome for the UK. Increasing the number of such highly-trained individuals would be of general benefit to the UK economy, whether or not these staff are retained in the longer term by STFC.
- The consultation revealed mission-critical risks associated with the technical support of large national facilities. The review panel recommends as essential mitigation of this risk by directing resources (to the extent that each funding scenario permits) that will boost the number of apprenticeships and graduate trainees, and studentships that support the operation of the national facilities and strengthen links to industry.
- There is a significant risk that the difficulty of retaining graduates and apprentices could limit or prevent operation of STFC’s national facilities. There exists a clear opportunity to address this issue and plug gaps in the training continuum – particularly in collaboration with the STFC supply chain via campus-based collaborating industries such as the Daresbury Skills Factory.
- Recruitment and retention challenges, both most acute at the mid-career stage and for roles with critical skills requirements (e.g. engineers, data scientists) have resulted in a workforce with an inverted normal distribution for its age demographic. This problem poses a major risk for sustaining the effective operation of the STFC over time and the review panel has identified several specific recommendations designed to mitigate it.
- The fact that the public engagement budget and the apprenticeships budget represent relatively small fraction of STFC’s overall skills budget provides an opportunity to make a significant difference in these areas at comparatively little cost, whilst simultaneously meeting the government Apprentice Levy requirement for 2.3% of STFC’s head-count to be new apprentice starts, or upskilled existing staff.

- STFC is asked to preserve the budget for public engagement at a minimum of the 2017/18 budget level in recognition of its strategic importance, and to seek to achieve wider impact in this area through enhancing its existing links with external public engagement organisations.
- The job market for STFC postdoctoral researchers is far from saturated and the university community has significant additional capacity for training postgraduate students. It is therefore recommended that STFC seek to better understand the UK capacity for employing STFC-trained postgraduate students and postdoctoral researchers, in order to be well positioned to seek further government funding aimed at populating the skills pipeline in support of a high-tech UK plc.
- There is a significant risk that the career gap between early-career postdoctoral positions and long-term academic positions may widen, particularly with the possible withdrawal of European funding which currently supports junior fellows. Increasing the transition pathways for postdoctoral researchers to establish independent and self-sustaining careers is key among the review panel's recommendations.

5.2 Funding Scenario 1: “Flat Cash”

- In a “flat cash” scenario the stress points that present critical challenges in each area are: the level of investment for apprenticeships and fellowships; the development and maintenance of a critical skills base (both technical and transferable); the difficulty of maintaining the overall number of DTP studentships; the focus of public engagement and its visibility and coherence within STFC and maintaining the support for effective operation and future development of the national facilities. The potential harm caused by even modest funding cuts in any of these areas could be significant if not addressed and reversed within the next 2 – 3 years. (These challenges are potentially even more critical in a reduced funding scenario; see **sub-section 5.3**).
- The review panel recommends doubling, within five years, the apprentice and graduate intake – commensurate with the levy and subject to clarification of STFC's capacity in the graduate and apprentice schemes, and the level of resources allocated to the associated support structures. This action will mitigate the critical skills shortage in the national facilities and laboratory departments. The training of apprenticeships and graduates in the wide range of technologies which STFC encompasses provides a valuable source of skills to both STFC and to UK industry.
- In view of the strategic importance of public engagement, notwithstanding its relatively small current budget, the review panel recommends that STFC preserve the public engagement budget at a minimum of the 2017/18 budget level, to protect it from any further reduction.

- In view of the strategic importance of DTP studentships for the development of skills and delivery of STFC science, the review panel recommends maintaining as far as possible the current number of DTP studentships at the 2018 level of 220 new studentships per annum.
- Ernest Rutherford fellows are widely regarded as highly prestigious and have a global reach and appeal that attracts the very best talent to the UK and helps to retain postdoctoral talent at an earlier career stage. The review panel recommends maintaining as far as possible the current number of new ERFs appointed per annum.
- Given the above series of constraints, the review panel concludes that in a “flat cash” scenario the costs of doubling within five years both the apprentice and graduate intake would need to be met from the funding allocation for studentships and fellowships. To achieve this doubling would require a cut of approximately 5.7% in the combined budget for studentships and fellowships over the next five years.
- The review panel acknowledges that most PPAN advisory panels noted a preference for preserving the studentship population in any negative funding scenario that required a significant reduction in the numbers of studentships or fellowships.
- The review panel therefore recommends the following actions:
 - Reduce the number of new DTP studentships awarded by approximately 5 studentships per annum and reduce the number of new ERFs awarded by approximately 3 – 4 per annum. (This would reduce the total size of the ERF cohort to 42 after 5 years).
 - Restore funding for all, or almost all, of these DTP studentships by leveraging fully-funded industry studentships and, working with UKRI, by redefining the STFC CASE studentship model to optimise the industrial contribution (see Recommendation **R12**).
- The review panel acknowledges the risk of reputational damage to the STFC associated with the approximately one third reduction in the total size of the ERF cohort after 5 years, which is required to implement the above actions in a “flat cash” scenario. The review panel asks the STFC Executive Board to consider carefully its appetite for this risk, and notes that it could be mitigated by a slightly higher reduction in the number of new DTP studentships awarded per annum. For example, reducing the number of new DTP studentships awarded by a total of 50 over five years (out of approximately 1100 new studentships awarded over that period were the 2018 level to be maintained) should then require a reduction of only 2 in the number of new ERFs awarded per annum and total ERF cohort after five years of approximately 50.

5.3 Funding Scenario 2: “Flat Cash” minus 5%

- STFC has a responsibility to operate large national facilities and provide suitably qualified technical staff at a variety of levels, as is the norm at international facilities. There is a clear need to recruit more apprenticeships and graduates to create a resilient skills pool for STFC. The review panel therefore believes that, even in a reduced funding scenario, it is critical that STFC doubles the apprentice intake – as recommended in **Section 5.2**.
- Given the strategic importance of public engagement the review panel again recommends that STFC preserve the public engagement budget at a minimum of the 2017/18 budget level, to protect it from any further reduction, even in a reduced funding scenario.
- The strategic importance of both DTP studentships and fellowships remains clear. However, in a reduced funding scenario and given the above constraints, the review panel again sees no alternative to finding the savings required from the budgets currently allocated to studentships and fellowships.
- To achieve a saving of 5% in the annual total skills budget over the next five years, while also meeting the costs of doubling within five years the apprentice and graduate intake, would be extremely challenging – requiring a cut of approximately 11.5% in the combined 5-year STFC budget for studentships and fellowships.
- This outcome could be achieved while essentially preserving the DTP studentship numbers (i.e. by restoring a minimal reduction in the number of new DTP awards per annum through leveraging fully-funded industry studentships and, working with UKRI, by redefining the STFC CASE studentship model to optimise the industrial contribution) only by applying a substantial cut to the ERF programme, reducing the total ERF cohort after five years to around half its current size. Moreover, in view of the short-term committed spend on existing ERFs, it seems likely that this scenario could only be achieved through suspending the appointment of new ERFs for approximately two years, followed by a phased re-introduction of the programme.
- The review panel regards as unacceptable the reputational damage to the STFC associated with such a drastic cut to the ERF programme. The review panel therefore recommends instead a somewhat larger – but still modest – reduction in the number of new DTP studentships awarded per annum. For example, reducing the new DTP cohort by an average of about 15 studentships per annum (a reduction of about 7% on the size of the 2018 cohort) would permit the retention of the ERF

programme at a minimal level, with around half the current number of new fellows appointed for the next three years.

- The above reduction in the new DTP studentship could be partially mitigated in the first instance by leveraging fully-funded industry studentships and, working with UKRI, by redefining the STFC CASE studentship model to optimise the industrial contribution. Further restoration of the total number of STFC studentships could be achieved by exploiting alternative funding sources for studentships. (See **Sections 5.4 and 5.5** below).

5.4 Funding Scenario 3: “Flat Cash” plus 5%

- **In this scenario priority should first be given to the recommendations in Section 5.2, i.e. a “flat cash” funding scenario**, with a doubling of apprenticeships and graduates essential to address the critical technical and engineering skills gaps at the national facilities and a preservation of the public engagement budget at a minimum of the 2017/18 budget level. Before introducing additional investments we recommend that STFC examine carefully the case for reversing the cuts to fellowships and/or studentships proposed under the flat cash and -5% scenarios.
- The Review panel recommends the introduction of early career fellowships (with a representative cohort size of 15 for fellowships of 3 years). These fellowships would address a significant gap in the talent pipeline as identified by our community consultations. Alternative approaches, as described in the ETCC consultation response, could involve a combination of fewer early career fellowships supplemented by Equality & Diversity fellowships, international fellowships and industrial fellowships and senior CASE studentships – together with shorter-term STEP awards aimed at supporting the transition from a PhD to a postdoctoral career.

5.5 Funding Scenario 4: Optimal

- **In this scenario priority should first be given to the recommendations in Section 5.4, i.e. “flat cash” plus 5%**, with a doubling of apprenticeships and graduates essential to address the critical technical and engineering skills gaps at the national facilities, preservation of the public engagement budget at a minimum of the 2017/18 budget level and the introduction of new fellowship schemes crucial for building a more sustainable academic career pathway in support of the PPAN science programme.

- The Review panel recommends that STFC increases volume in the DTP allocation, to address particular skills gaps and generate a more highly skilled workforce for UK plc. The number of additional studentships allocated should be informed by further research to better identify the untapped supervisory capacity in the university community and the needs of the industrial and academic sectors.
- The Review panel recommends that STFC should allocate additional studentships to the existing centres for doctoral training in data intensive science, and further that STFC issues a call for up to 5 proposals for new Centres for Doctoral Training (CDTs). Potential science areas for these CDTs include: detector/sensor/instrument development; space science and technology; medical physics; advanced accelerator and nuclear physics; development and applications of free electron lasers.
- An optimal funding scenario would provide opportunities to invest in studentships supporting the National Laboratories. Currently there are only around 20 such studentships across STFC, so even a modest number of 5 – 10 additional studentships would significantly strengthen the skills base and improve the sustainability of STFC’s infrastructural foundations.
- STFC should seek to drive better coordination across its campuses by directing specific resources to pump-prime integration of industrial and academic partners and establishing an “Academy” model for training, secondments and internships. The upskilling of its existing staff should be promoted following the models proposed by the Daresbury Skills Factory and Harwell Campus.

6. Concluding Remarks

The wide consultation carried out in support of the BoP (skills) review and the detailed and diverse responses gathered from the advisory panels and other stakeholders enabled the Review panel to build a comprehensive and coherent picture of STFC’s skills and engagement needs across its entire programme. Most importantly the consultation provided clear and precise guidance about the consequences – both positive and negative – of the different funding scenarios considered, and how these would impact on STFC’s ability to achieve its strategic aims. It was also clear from the consultation responses that the advisory panels, National Facilities and Campus management teams understand, and were able to articulate, the STFC’s strategic vision, their place within it, and the future actions required to maintain and enhance the STFC’s world-leading excellence in Research, Innovation and Skills. The recommendations set out in this report have sought to distil those consultation responses – identifying common themes and critical issues and presenting practical and realistic proposals – with the goal of ensuring that STFC is well-placed to

respond to both the challenges that negative funding scenarios may present and the opportunities that positive funding scenarios may offer over the next 5 years.

In implementing the review panel's proposals, or an appropriate subset thereof, it is essential that the STFC Executive Board consider with care its appetite for risk, in order to select those recommendations which should be taken forward. Moreover, whilst the benefits to be derived from the positive scenarios can be very high, care should be taken that the outcome is not simply dictated by the path of least resistance but that of the greatest benefit.

Finally, it should be noted that the consultation questions that formed the basis of the review did not include any explicit reference to equality and diversity within the overall context of the BoP for Skills, and no explicit comments were received on this issue in the consultation responses. Although this omission might appear to be a concern, the review panel notes and commends the commitment of STFC to championing issues of equality and diversity – as evidenced, for example, within the accreditation process recently adopted by the ETCC for assessing the suitability of university departments for hosting DTP studentships and the submission of an Athena Swan Bronze application by the STFC in November 2017.

7. List of Appendices

1. Current budget and future financial commitment for each skills area
2. Terms of Reference of the review
3. Sub-group Members' biographies
4. List of documentation and information sources considered by the review Sub-group
5. Questions posed to the advisory panels by the review consultation
6. Glossary of acronyms

Appendix 1 Current budget and future financial commitment for each skills area

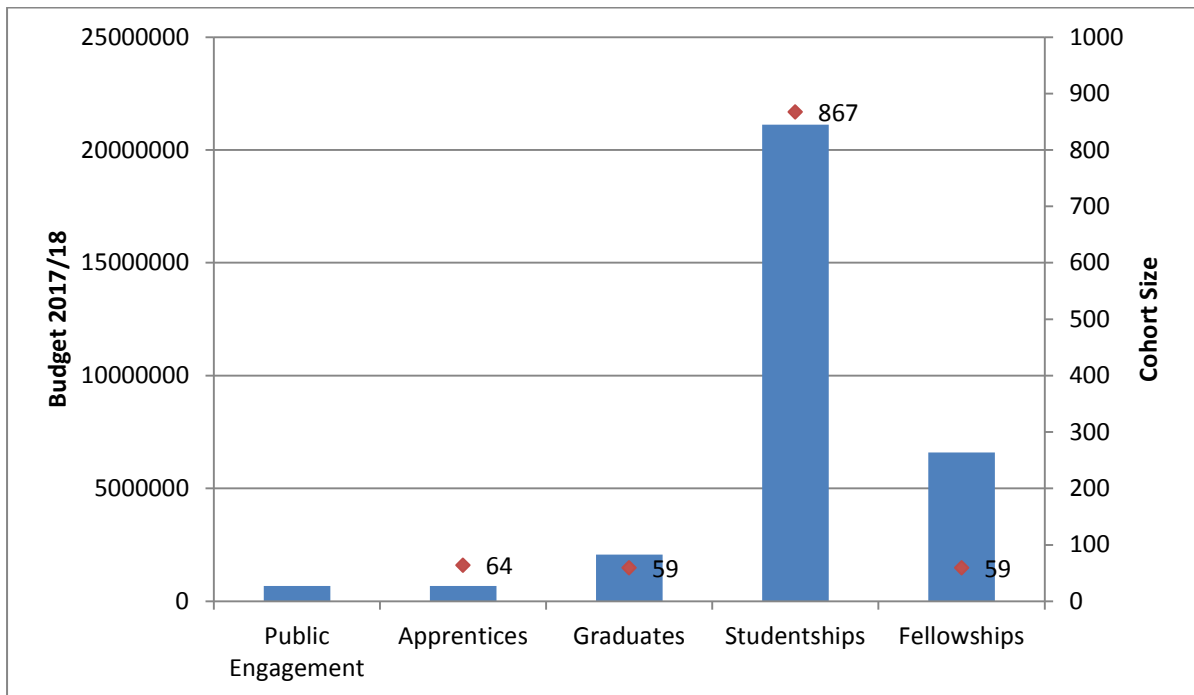


Figure A.1: 2017/18 budget for each skills area with associated cohort size (i.e. total no. of funded individuals in each skills area) also indicated. Note that the graduate cohort spans 2 years, apprenticeships 4 years, studentships 3.5 years and fellowships 5 years.

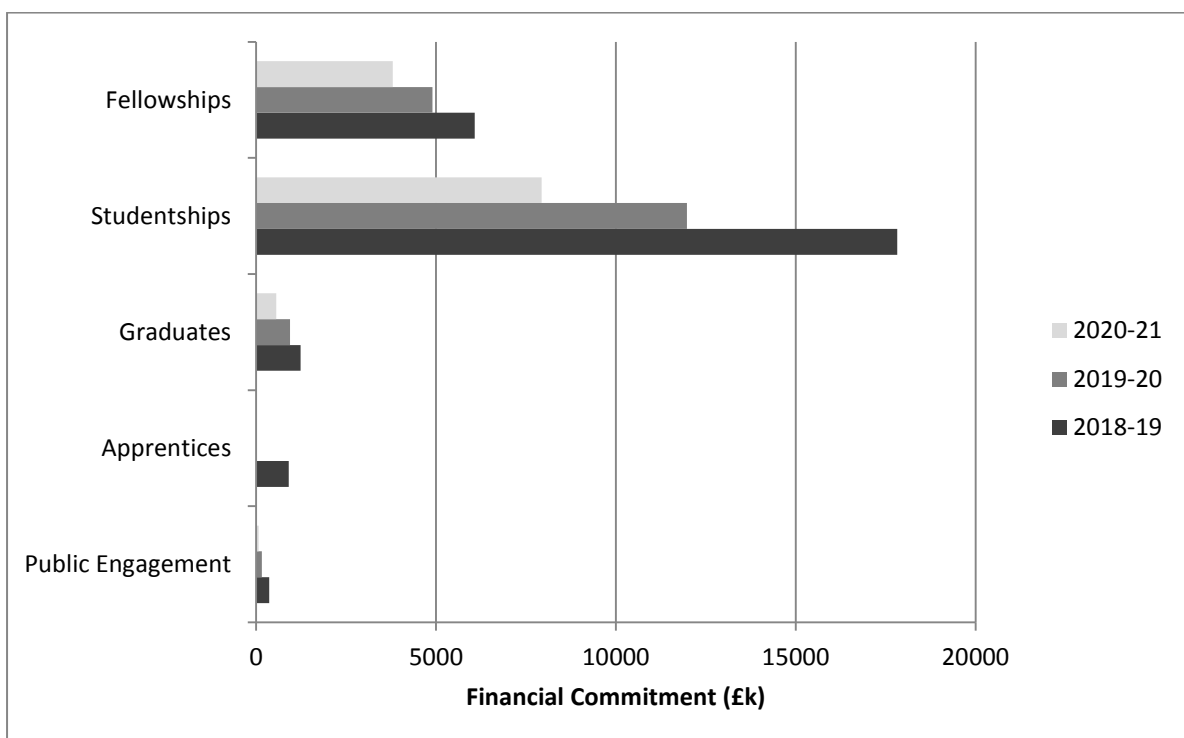


Figure A.2: Future financial commitment for each skills area based on 2017/18 funded activities

Appendix 2 Terms of Reference

Balance of Programme (Skills) SEAB Sub Group

The purpose of the Balance of Programme exercise is to ensure the balance of STFC's skills programme is the most appropriate to deliver STFC's core research programme, to help meet STFC's skills requirements and to contribute to the skills needs of the relevant industries and of wider society.

For the purpose of the review, STFC's skills programme is defined as formal, funded training and engagement schemes.

The SEAB sub-group will identify the most appropriate balance between STFC's key skills areas (including development for future opportunities) identified as:

- Graduate trainees
- Apprenticeships
- Studentships (including DTP, data-intensive science CDT, CASE and grant-funded studentships)
- Fellowships (of different kinds)
- Public Engagement

Recommend the appropriate balance of programme to ensure provision for STFC's highest strategic priorities for skills development, for the following financial scenarios:

- Flat cash
- Flat cash + / - 5%
- Optimum scenario

The SEAB sub-group will provide recommendations to SEAB.

SEAB will make recommendations to EB and Council in the autumn of 2017.

Appendix 3 Members' Biographies

Co-Chair: Professor Martin Hendry (University of Glasgow)

Martin Hendry is Professor of Gravitational Astrophysics and Cosmology and Head of School of Physics and Astronomy at the University of Glasgow, Professor Hendry's main research interests are in gravitational wave astrophysics and cosmology. As a member of the LIGO Scientific Collaboration: an international group of more than 1000 scientists who, together with colleagues in the Virgo Collaboration, in February 2016 reported the first ever

direct detection of gravitational waves from the collision of two massive black holes more than one billion light years from the Earth. Professor Hendry is a passionate enthusiast for public engagement in science, recognised with an MBE for services to public engagement in science in the Queen's New Year Honours 2015 list, Chair of the Institute of Physics in Scotland and a member of the Institute for Gravitational Research and the Astronomy and Astrophysics research group.

Co-Chair: Dr Richard Burguete (National Physical Laboratory)

As Postgraduate Institute Director at NPL Dr Burguete brings together nearly 200 postgraduate researchers co-supervised by NPL staff, in collaboration with over 30 UK universities to enable a postgraduate experience which will place students well for future employability and skills. He is passionate about a joint industry and academic framework being the ideal platform for postgraduate training, leading to the development of extremely desirable skillsets for the benefit of industry and academia alike, so increasing career prospects for postgraduate researchers. Dr Burguete worked previously at Airbus in Bristol where he was trans-national programme manager for structures test research and responsible for the development and implementation of the structure test research strategy. This came after a career specialising in the development and implementation of optical stress and deformation measurement techniques. The value of collaborative engagement is well understood by Dr Burguete where from 2002 to 2004 as chairman of the British Society for Strain Measurement where he fostered the creation of stronger links between industry and academia along with similar societies.

Yvonne Baker (National STEM Learning Centre)

As Chief Executive of MyScience Ltd since 2010, Yvonne Baker is Director of the National STEM Learning Centre in York and responsible for the wider network of Science Learning Centres and Partnerships supporting STEM (science, technology, engineering and mathematics) education. The National STEM Learning Centre enables teachers, technicians and others involved in STEM education, from primary through to post-16, to participate in high quality, subject specific professional development, including residential opportunities, throughout their careers. The wider network of Science Learning Centres and Partnerships works with teachers and technicians to provide further professional development opportunities in their local areas, supported by the Department for Education.

Professor Peter Clarke (University of Edinburgh)

Peter Clarke is Professor of Physics at the University of Edinburgh. Having moved to the University of Edinburgh in 2004 to take up the Chair of eScience he later became Director of

the National eScience Centre 2006-09. He is a Fellow of the Institute of Physics and the Institute of Engineering and Technology.

Prof Clarke has been involved in UK e-Science since its inception. He has held roles in international grid computing infrastructure projects including the management board of the UK grid for particle physics (GridPP), the European Data Grid and the EGEE projects. He was a member of the Steering Committee of the Global Grid Forum international standards body between 2002-04 and co-Director of the Data Area. His present research is as a member of the LHCb experiment at the Large Hadron Collider at CERN. LHCb is searching for the signals associated with the imbalance between the interactions of matter and anti-matter. He has produced the world's most precise measurement of a CP violating phase called "phis" and he is deputy computing coordinator of the experiment.

David Martin (UK Atomic Energy Authority)

David Martin became Chief Operating Officer for UKAEA in March 2016, having previously been Operations Director. Mr Martin is a Chartered Mechanical Engineer and Fellow of the Institution of Mechanical Engineers who joined Culham after completing an apprenticeship at UKAEA Harwell in 1979. Following a role in the build and operation of the Neutral Beam Testbed on JET, he joined the Engineering Group in Neutral Beams before establishing the Engineering Analysis Section. He became Engineering Group Leader and then Department Manager in 2008. In 2011 he was appointed Head of Physics and Engineering Development Division and in 2012 Head of the Operations and Programme Delivery Division. In 2013 he was appointed Operations Director (Operations). He has held other senior engineering posts such as Engineer in Charge and Deputy Chief Engineer. David is committed to staff development and has initiated many of the training schemes presently being run at Culham Centre for Fusion Energy – including the apprentice and graduate programmes – helping to achieve accreditation by the Institution of Engineering and Technology, Institution of Mechanical Engineers and the Power Academy.

Professor Andrew Randewich (Atomic Weapons Establishment)

As AWE Chief Scientist, Professor Randewich is responsible for the quality and direction of the science capability at AWE, with topics spanning high energy density physics, shock physics, hydrodynamics, material science, analytical chemistry, computational physics and high performance computing. He also has accountability for academic outreach at AWE, liaising with universities and other high tech industries in the UK and US, and holds a visiting Professorship at the Physics Department of Imperial College London. Outreach remains vital for AWE in order to provide access to high quality recruits, and to tap into expert knowledge

and science facilities. Professor Randewich therefore remains passionate about physics, and works closely with the Institute of Physics to promote Continuous Professional Development, but also to encourage uptake of the subject at school and university level.

Appendix 4 Documentation List

Document
STFC Corporate Strategy 2010-2020
STFC Delivery Plan 2016-2020
Balance of Programme (PPAN) Final Report
STFC (draft) Skills Strategy
Building Our Industrial Strategy: Government Green Paper January 2017
Sci-Tech Daresbury Campus Strategy (The Business of Success: Our Strategy for Science, Innovation and Growth)
STFC Delivery Plan 2016-2020
STFC Impact Report 2016
UK Science and Innovation Strategy 2014
Finance: budget, spend and future commitment in each skills area
Reports from skills managers: <ul style="list-style-type: none"> • Current funding level and activities (FY 2015/16 and 2016/17) • Planned programme development (FY 2017/18) i.e. what level of funding, and does this deliver new/different activities to the previous year? Or are the same activities delivered but at increased costs, for example? • Strategic priorities • Pressing issues • Future opportunities
Advisory panels' response to BoP Questions
Sci-Tech Daresbury Company Survey Report 2016
Sci-Tech Daresbury Skills Factory Business Plan

Note: The report is based on information from community consultations (through STFC's advisory panels) and published reports. For more information on the process please contact strategies@stfc.ac.uk.

Appendix 5 Advisory Panel Questions

Initial Consultation Questions

- 1) What would be the impact on research programmes of reduced/increased funding for skills activities relevant to them?

- 2) What is the most appropriate balance between skills areas and activities at different stages of the skills pipeline (public engagement, apprenticeships, graduate trainees, studentships, fellowships), in order to ensure a sustainable skills programme?
- 3) What are the opportunities for STFC in the skills domain to increase industrial impact and respond to the Industrial Strategy, GCRF and Newton Fund?
- 4) What are the opportunities for STFC in the skills domain to increase industrial impact and respond to the Industrial Strategy, GCRF and Newton Fund?
- 5) Our science programmes depend on a pipeline of skilled people. - Do you feel the current balance that exists for students, PDRAs, academic staff, technicians, engineers, software engineers etc. is roughly correct in your field? - Are there sufficient skills, experience and leadership for the current and projected future programme or are there areas where these are lacking? - Please comment on how this field generates skills impact for the UK

Follow-up Consultation Questions

- 6) In relation to the five skills areas in scope of the review (apprenticeships, graduates, studentships, fellowships and public engagement) please comment on the level of resources currently allocated to the facilities operated by STFC. Please indicate if up to now these have been too low, about right or too much for all the skills areas you are able to comment on.
- 7) What skills should be maintained or strengthened to enable your community to respond flexibly to new funding opportunities such as (but not exclusively) those offered by the Global Challenges Research Fund and Industrial Strategy Challenge Fund? Wherever possible, please link the skills that you identify explicitly to the skills area(s) expected to deliver them – e.g. to project management (fellowships) if advanced training in project management is required, or to mechanical engineering (apprenticeships) for early career skills training in mechanical engineering.
- 8) Under the following funding scenarios indicate a clear prioritisation (1-5, 1 is highest priority; no equal priorities to be given) of skills areas (including all five skills areas in scope of the review – apprenticeships, graduates, studentships, fellowships and public engagement):
 - Flat cash + 5% (List skills areas (essential) + justification (optional))
 - Flat cash – 5% (List skills areas (essential) + justification (optional))

