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The contribution made by the technical workforce to research culture

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Executive summary

Over 30,000 technicians work in UK universities[1] and the technical workforce contribute to research, innovation and research culture in many ways[23]. Wellcome commissioned a study from CFE Research to explore the contribution of the technical workforce to teaching, innovation and culture in UK in universities and research institutes, and how this workforce can be sustained and developed. The data presented in this qualitative study was collected by face-to-face interviews in 21 universities and research centres from December 2019 to March 2020. The study complements Wellcome's strategic aim to examine and improve research culture[4] and the Technician Commitment[5], a sector-wide initiative supporting research technicians. The impact of the latter was evident in many of the organisations consulted.

Key findings

The technical workforce plays a critical and varied role in research in many disciplines – not just STEM – but the culture and structure of the research system does not always reflect or support this. The key findings fall under five main themes:

Recruitment, career structure and progression:

- Job descriptions do not always reflect the breadth and range of responsibilities of technical staff, especially at senior grades.
- 50 per cent of institutions said they have no idea how to replace their most experienced technical staff if they left.
- Opportunities to progress to senior grades (above Grade 6) are very limited.
- Progression routes to bridge the gap from entry level (Grades 1-3) to management (Grades 6-9) is unclear.
- The technical workforce is not as diverse in gender or ethnicity as academic researchers.

Role of technical staff in wellbeing:

- All interviewees noted that the technical workforce contribute significantly to supporting the wellbeing of the whole research team, and student pastoral support in particular. This role is rarely acknowledged formally.

Role of technical staff in robust experimental design and high-quality data collection and analysis.

- Interviewees highlighted that technical staff play a critical role in ensuring integrity and quality of data. They:
  - train and mentor researchers how to use complex equipment correctly
  - often advise on technical aspects of experimental design and identify improvements
  - provide feedback on data quality, and troubleshoot when problems arise
  - maintain hardware and ensure equipment being used for data collection is calibrated properly.

Role of technical staff in innovation:

- Technical staff sometimes use their technical and specialist knowledge to design and manufacture bespoke hardware to deliver new research outcomes.
- Technical staff often develop new code, new sensors and adapt or improve existing equipment to support the production and analysis of data, especially in imaging. This capability is under-utilised and under-recognised in some institutions.

The breadth of these roles is generally not acknowledged by institutions or funders.

Funder considerations:

- Practice on costing technical support into grant applications varies hugely. There is a tendency to cut the cost of technical support from bids. It is not clear whether this comes from the structure of funders' documentation, the

[1] 'TALENT: Advancing Status and Opportunity for the Technical Community' (Midlands Innovation (MI) consortium). https://www.mitalent.ac.uk/write/MediaUploads/Final_TALENT_brochure_singles.pdf

[2] 'Technicians under the Microscope: The Training and Skills of University Laboratory and Engineering Workshop Technicians' (SKOPE, 2011). Accessed at https://skope.ox.ac.uk/wp-content/uploads/2020/07/WP103.pdf

[3] 'Technicians receive support from the UK's largest research funder' (Feb 2020). Accessed at https://www.technicians.org.uk/technicians-receive-support-from-the-uks-largest-research-funder

[4] https://wellcome.org/what-we-do/our-work/research-culture

[5] 'Technician Commitment: One Year In' (2018) Accessed at https://www.technicians.org.uk/assets/technician-commitment/pdfs/technician-commitment-one-year-in.pdf

culture or policy of the institution, or pressure to make bids competitive.

- Technical staff are generally not acknowledged by name in grant applications. There are limited opportunities to profile their skills and expertise. Most funders do not allow technical staff to be named as the lead on a grant even when they are the best placed to do so.

What does this mean?

We have identified four challenges that impact on research effectiveness:

Challenge 1: The technical workforce's role in research is not well defined and often underestimated. Without a clear identity within a research team, it will be hard to recruit, train and formally recognise the technical experts needed for the future. **There is a critical role for the technical workforce in the quality and integrity of research data that has not been fully exploited.**

Challenge 2: The technical workforce is not routinely engaged in decision making in research funding or acknowledged in research outputs. **This sends a clear message to the sector about the relative worth of individuals within research teams and needs to be addressed as a matter of urgency.**

Challenge 3: There is clear evidence of limited diversity in the technical workforce. There is interest in apprenticeship schemes that might address some of this.

Challenge 4: Progression from entry-level to senior grades is often unclear. **The sector needs to ensure that progression is possible even if it is rare; lack of a coherent training pathway is a risk with an ageing workforce and a need to replace lost expertise.**

1 Aims and methodology

Background and aims

In September 2019 Wellcome launched its Reimagine Research initiative to help build a better research culture – one that is creative, inclusive and honest. Our Director, Jeremy Farrar, said that current practices were prioritising outputs at almost any cost, and committed Wellcome to reimagining how research is conducted.

The initiative has engaged with members of the research community across the UK and the world. Over 4,000 people responded to our research culture survey, more than 450 Café Culture kits were distributed to support conversations between colleagues, and Wellcome has hosted Town Hall meetings across the UK to hear from those who help make research happen.

Our conversations revealed a culture which was driving unhealthy competition, where bullying and harassment have a major impact including mental health issues, where women and minority groups are often more disadvantaged, and where good management practices are rarely rewarded. We were told that the system is favouring quantity over quality, leaving creativity stifled. At the time of writing, Wellcome defines a good research culture as having four main goals[6]:

1. Space and security to think differently.
2. Everyone working at their best.
3. Supportive working relationships.
4. Open and trustworthy research.

In many research groups, as much as 30–50 per cent of the research workforce is made up of technical specialists that support the research scientists. The technical workforce has huge potential to contribute to changing research culture and Wellcome commissioned research to explore two research questions:

- **What is the unique contribution that the technical workforce makes to teaching, innovation and culture in research?**
- **What practical action could be taken to support the development of a sustainable, diverse technical workforce in universities or research institutes?**

Methodological approach

Sampling and primary fieldwork

Six preliminary conversations were conducted with universities, research institutes and funders. The consultation then extended to a further 19 organisations, which were selected as examples of:

- research institutes
- a range of universities (Russell Group and others)
- University Core Technical Facilities
- Wellcome Centres.

Interviews with these organisations formed the basis of this report and recommendations.

A full list of participating organisations and the questions posed during interviews is presented in Appendices A and B.

Definitions

Throughout the report, "the technical workforce" or "technical staff" is used to describe the subject of the study. The research found some dissatisfaction with the word technician as it did not adequately describe the variety of roles and specialist knowledge held by the whole technical workforce.

Participating interviewees

Interviewees held a variety of senior positions within institutions. Some held operational and technical

[6] https://wellcome.org/what-we-do/our-work/research-culture

directorship or management roles, others were senior academics and one was a Human Resources Director. Appendix C gives a full list of positions of interviewees.

Interviews lasted for around 90 minutes and were conducted face-to-face by a member of the Wellcome team. Interviews were recorded for transcription and analysis.

Analysis

CFE Research reviewed all interview transcripts and used codes and Nvivo software to identify themes. An initial broad framework of key themes and sub-groups was developed based on the first few interviews, and shared with Wellcome. As more data became available and to ensure accurate classification, these themes were reviewed and refined, and subsequent changes to the coding framework were agreed and signed off (see Appendix D).

For context, the primary evidence from the questions posed during interviews was compared against the person specifications included in a short review of technician job descriptions[7].

[7] Posted on jobs.ac.uk via a simple keyword search: https://www.jobs.ac.uk/search/?keywords=technician&location=; accessed *c*.March 2020

2 Findings

The many roles and responsibilities of the technical workforce

Core responsibilities

All interviewees said technical staff are pivotal to research undertaken in universities. Many examples of the vital contribution of the technical workforce to research outputs were described.

The stated purpose of the technical workforce within research teams was clear in the evidence. All interviewees reported that the technical workforce's typical responsibilities covered technical activities and expertise relating to specialised equipment, research and experimental techniques, workshop and laboratory processes and computational techniques where relevant.

The technical workforce based almost exclusively in research facilities tended towards significant specialisation. Examples of specific expertise included: developing deep working knowledge of standard operating procedures for high-tech equipment; solving complex problems with experimental design; and coding of new software interfaces with imaging machines.

Technical staff who either support undergraduate teaching or work in central services like IT facilities fulfilled roles across a wide range of disciplines and comprised meaningful proportions of an organisation's workforce.

A couple of interviewees commented on a perceptual distinction made between laboratory-based scientific roles and those in IT or informatics. The latter sometimes viewed themselves as engineers rather than technicians. This preference may suggest a negative connotation for some with the title "technician". Alternative job titles suggested in some interviews included "technologist", "research officer" or "research scientist".

In addition, the depth in knowledge and experience of core responsibilities increased with the pay grade and associated level. For instance, Grade 2 and 3 technical staff worked far more closely with undergraduates and aided the set-up and delivery of experiments. However, the technical workforce employed at Grades 6 and 7 were commonly highly skilled at analytical techniques, experimental design, data analysis, teaching, technical demonstration and induction. This was mirrored in a short review of person specifications in job descriptions for technicians undertaken as context for the study[8]. In this review, person specifications for Grades 1-3 listed common core features to those described above while person specifications at higher grades requested high-order skills, knowledge and specialist skills and listed additional responsibilities such as aspects of teaching, management and research support.

Teaching and training responsibilities

Most interviewees reported that senior technical staff had specific responsibilities covering theory and practice of a range of analytical techniques. Principal Investigators told us that:

[8] Posted on jobs.ac.uk via a simple keyword search: https://www.jobs.ac.uk/search/?keywords=technician&location= accessed *c*.March 2020

“Research technicians who are, kind of, more closely aligned to labs will also train people in different techniques”.

“[The technical workforce] do initial inductions for people who are coming in to the lab, practical inductions to teach them what they need to know in order to work in there, and they will teach them how to use bits of equipment. And this is undergraduate students, postgraduate students, post-docs, even PIs [Principal Investigators], although they're not in the lab very much. But you know, they would practically teach them how to do things”.

Interviewees sometimes said that experienced technical staff possessed better practical knowledge of equipment and underlying theoretical application relating to specialised processes than academic staff. This was especially true in specialist facilities that support more than one research group. A high level of expertise was central to operational and delivery aspects of research. In many instances, the technical workforce also mentored researchers in best practice in experimental design and quality assurance.

The technical workforce was said to play a prominent role training graduate students and postdoctoral staff in basic science techniques and the use of analytical machines as a pre-requisite to working independently using complex or dangerous equipment, and until they could reproduce their own data consistently. They also supported students with programming or the use of media equipment.

The format of delivering learning varied from institution to institution. Some emphasised that the technical workforce lectured and developed teaching modules while others described the role of the technical workforce in supporting workshop delivery. One institution also stated that they had commercial contracts for which their technical workforce taught external courses. As demonstrated in the quote below, one institution's “technical tutors” were at the forefront of designing and teaching a module, contrasting with the more common supporting and instruction role. A laboratory manager told us:

“We have virtually all practical run sessions are set up and organised by technicians. So all the consumables, all the procurement, all the health and safety, all of that stuff would be organised by technical staff. Then we also have these technical tutors which quite often do the design and the development of those modules. We have some that are module leading so there's no academic present for that module, it's all technical tutors.”

As highlighted in the case study in Box 1, one institution formalised teaching responsibilities among the technical workforce by utilising the Higher Education Role Analysis Framework (HERA) to design job roles and monitor progression. This is crucial, as discussed later, many additional responsibilities undertaken by the technical workforce, including teaching, are not usually formally recognised and this limits both acknowledgment and career development.

Box 1: Teaching responsibilities example
At one institution, job roles are assessed and analysed using the Higher Education Role Analysis Framework (HERA) and within this research the technical workforce (usually a funded position from a specific project) would have some teaching responsibility. The HERA framework evaluates an employee's daily role and updates their job description accordingly. This can then lead to a re-grading, if necessary, based on new competency levels being displayed. In addition, a team leader development programme works alongside this process to identify potential leaders of the future, enabling the institution to select candidates who could benefit from further development opportunities.

Six interviewees said that their technical workforce instructed rather than taught postgraduate students. This instruction covered equipment demonstration and standard operating procedures. The distinction between teaching and demonstration/instruction is not always clear. However, the technical workforce's instructive activities complemented academic theoretical teaching: they translated theory into practice.

Responsibilities for health and safety

The technical workforce held several important health and safety responsibilities within interviewees' departments and institutions. However, due to the ever-evolving nature of the experiments undertaken in the research labs, this aspect of the role of technical staff was demanding and time consuming, especially when added to their other responsibilities. For example, the health and safety requirements when doing cutting-edge research with viruses is significant and unrelenting.

The technical workforce is well placed to support students and staff understand the dangers associated with specific equipment, chemicals and complex theoretical research procedures. This sits within the context of the technical workforce's contribution towards teaching and technical demonstration.

Other responsibilities

Alongside the main responsibilities discussed above, interviewees acknowledged that the technical workforce had a variety of other roles in addition to those formally recognised in their job description. Common additional roles included the following:

- supporting **wellbeing** through informal pastoral responsibilities
- support on **experimental design and control of data quality** by critically reviewing researchers' methodologies
- responding to requests from researchers for **innovation**, for example to develop new hardware, or independently working on existing equipment and software to deliver new outcomes.

Each of these three additional roles are described further in later sections.

Perceptions of the technical workforce

Institutional perceptions

The role of the technical workforce was viewed as "supporting researchers" by many of the institutions for which interviewees worked. However, this was interpreted very differently between universities (and sometimes between facilities). At times, it felt like there was a mismatch between the view of the institution about where the technical workforce featured in the hierarchy and the individuals consulted as part of this research. Many interviewees personally thought the technical workforce possessed vital specialist and technical knowledge required to support theoretical knowledge, research and innovation. One researcher said:

“They deliver some advanced scientific support. They deliver key components where they innovate in the service of research projects.”

One institution reported that the technical workforce employed at Grades 5 and 6 undertook a similar role to academic staff but from a technical perspective, covering teaching, technical demonstration, designing practical experiments and supporting research:

“**As far as I can tell from talking to everyone they're all doing a very similar job, now some of those see themselves as university teachers/academic and others see themselves as technical, but they all seem to be doing the same thing”.**

Additionally, some interviewees felt the technical workforce was undervalued by some institutional staff who know little or nothing of technical staff roles. The wider institutional view perceived such occupations as lower skilled and repetitive, especially for technical staff employed at Grades 2 or 3. That said, the evidence exemplified that there was a mismatch between person specifications in job descriptions and the activities reportedly undertaken by the technical workforce, such as aspects of wellbeing. Consequently, several interviewees suggested that the technical workforce occupy a role that is “behind the scenes”, despite being crucial in supporting the delivery of research. A laboratory manager suggested:

“We [the technical workforce] are the people sometimes behind the curtains that make things happen. We are becoming more at the forefront, we work very closely with all our researchers, our teaching academic staff to deliver what needs to be delivered.”

As a result, many interviewees felt the work conducted by the technical workforce, particularly those tasks that fall outside of job descriptions, was largely unrecognised by institutions. Institutions need to respond and raise the profile of the technical workforce to address this negative perception, for example through the Technician Commitment[9].

The research found a few examples where the contribution of the technical workforce was institutionally valued and recognised. This was often, though not always, as a response to the Technician Commitment. Several institutions attempted to address the lack of recognition for the technical workforce through celebratory events and achievement awards. One university developed a “career spotlight” website as part of their Technician Commitment. Here, the technical workforce was able to put themselves forward for awards or be recommended by a colleague. As illustrated in the quote below, one university ensured their strategy highlighted these issues and put actions in place to raise the profile of the technical workforce.

“It's still a major issue. I think that the contribution that the technical workforce make for many research PIs is invisible still, and it's hugely important that we address that. Certainly, one of the key parts of our technical strategy here at [name] is to raise the profile of what the technical workforce do and ensure they receive appropriate recognition, both in terms of what they do day-to-day and also their career development.”

[9] https://www.technicians.org.uk/technician-commitment

Students' and postgraduates' perceptions

Interviewees told us the technical workforce is highly valued by undergraduate and postgraduate students for two key reasons. First, interviewees described the close experimental and technical support and oversight of data generation in laboratories, workshops and studios that the technical workforce provided to students. This aspect of their role was fundamental in bringing hypothetical and/or theoretical project ideas to fruition, allowing meaningful results to be obtained. These activities contributed to quality assuring the entire research process. Second, the technical workforce act as mentors to students, allowing them time and support to become technically more able, through the provision of training or shadowing, or during field trips. One Principal Investigator told us:

"You only have to open any undergraduate project dissertation and read the acknowledgements, or any PhD thesis, particularly if they're STEM-based, though not just STEM, to see that acknowledgement."

The technical workforce's role in student and staff wellbeing

There was an overarching view that wellbeing is and should be a responsibility for all staff. However, interviewees are clear that the technical workforce contributes significantly to overall wellbeing and performed an essential role in signposting relevant services. In one university, we were told:

"I don't think we realised until in the last six months or so, just what a contribution they're making to that. I think it becomes an innate thing of the technical workforce, being so approachable and knowing lots. They are the sign-posting people."

One reason that the technical workforce was well placed to be involved in wellbeing is the daily presence of technical staff in labs and workshops. This often made them the first point of contact for students, particularly as technical staff work closely with postgraduates and undergraduates in an instructive and advisory capacity. The technical workforce could therefore build rapport with students and many interviewees made a connection between such rapport and opportunities to provide wider pastoral support for the student body.

Moreover, the technical workforce spends a lot of time around researchers at all levels in laboratories, workshops, studios and IT suites. As a result, technical staff often build stronger relationships with postgraduates and postdoctoral staff compared to Principal Investigators, which can make technical staff trusted confidants. This can lead the technical workforce to take on a mentoring role, providing both students and researchers with emotional, political and practical support on a day-to-day basis.

Many interviewees said the technical workforce could talk through technical research process problems, identify flaws in logic or process in student work and offer practical advice or tuition. Students valued this interaction as it enabled their research or studies to continue. A laboratory manager told us:

"PhD students get really very stressed even up to distressed about the research they're having to do and my impression is they generally don't feel they can go to the supervisor with these sort of things so they come to us. And they come and cry on our shoulders and we try to

calm them down and try to make suggestions about what they're going to do."

The technical workforce's relationship with students differed to that of Principal Investigators in two ways. First, their continued presence within the laboratory, workshop or studio meant students could receive quick answers and solutions to their queries – Principal Investigators were less likely to be present to offer advice. Second, the technical workforce was able to offer comfort in times of stress without students fearing they would be seen as a failure in front of their supervisor. Principal Investigators were those that ultimately assessed and graded students, whereas the technical workforce are seen as less judgemental because they are not assessing work.

Finally, In comparison to the technical workforce, the academic population were viewed as transient. Interviewees therefore felt the technical workforce had more opportunities to forge close relationships with students over the longer term. A Centre Manager told us:

"[The technical workforce] might not be so transient; quite a lot of them might be the fire wardens, all those keeping us safe and happy".

In most cases, the technical workforce's pastoral roles were not formally recognised. One interviewee told us:

"They're largely doing it ……without any sort of formal understanding that a pastoral aspect would be part of their role, almost it happens because they're there and suddenly there's a student with a problem and they have to deal with it."

However, interviewees in a few institutions recognised some formalisation of support for students' mental health. One university had appointed wellbeing champions to take the lead on student wellbeing and help students to access the right action or advice. One institution described a mental health first-aiders scheme which some of the technical workforce attended in recognition of their role providing informal pastoral support. The technical workforce in another institution had similar roles but were reportedly unclear to what extent supporting student wellbeing was in their role: support, signposting and offering the correct advice was therefore described as patchy. Another interviewee recognised a potential burden on the technical workforce if they were not given the appropriate training and support. One senior technician told us:

"If you asked anyone about it they'd go, 'Oh, it goes without saying,' but actually that's not that helpful in terms of how we approach things and how we equip people to deal with those kind of situations. I think the university is trying to look at that now in a more structured way, particularly around mental health first aiders and things like that. It's very much in an early stage."

Contribution of the technical workforce to research and innovation

Contribution to innovation

All interviewees held that the technical workforce played a supporting role in fostering innovation. Some senior technical staff led aspects of the innovative practice where they held high-level expertise or theoretical knowledge.

The technical workforce's main reported role in innovation was developing new protocols, procedures or code to support research. A number of examples were provided in interviews. As one example, a technical staff member was instrumental in designing and producing new methods to measure fluorescence in plants. Other examples included the designing and developing of a new online safety process and new demonstration methods for scientific processes to large audiences. Technical staff would also be continuously monitoring health and safety requirements for new procedures, for example researching new antidotes for various poisons being used, as well as finding effective ways to eliminate acid spills.

The technical workforce's roles in creating new uses for existing equipment or technology were also cited. Several examples were provided where technical staff adapted equipment, such as adapting equipment for use in planes and redesigning bolts to take the strains associated with wind turbine operations. A Facility Manager told us:

"In our atmospheric chemistry labs … they have to adapt analytical equipment to work on a plane … [which] … samples the air and gets real-time data for analysis and being able to do that requires a lot of technical skills… That's an example where without those practical technical skills you wouldn't be able to do the research that is hugely successful for this department."

In one art and design facility, a member of the technical staff developed a new technique in fabrication that made a new art installation by an academic possible. This involved finding an additional use for a piece of equipment that the organisation had invested in. Please see the example case study in Box 2:

Box 2: Innovation example 1
The organisation had invested in a plasma cutter three years ago, which helped them save time and reduce cost when producing metal sculptures. Previously the process would have taken the organisation one day to produce by welding but since buying the plasma cutter they are able to cut from a steel sheet. Therefore, the kit enables the organisation to sculpt faster, more efficiently and at scale. The technician there has furthermore used this tool to develop a process where a sub-frame can be built for artists working with ceramics.

"So by having a machine, he'd realised that he could make parts that he could then build, like a sub-frame from, in a less obvious traditional method. So the sub-frame is hidden by the ceramics, and therefore doesn't affect the aesthetic so much, of the sculpture, but the sculpture couldn't be in existence without it."

Several interviewees highlighted the contribution the technical workforce made in creating novel uses of software and technology to improve services, increase efficiencies or contribute to research development. Most of those interviewed quoted examples of technical specialists producing new code, for example for condition monitoring software and to help operate imaging equipment. Few seem to have had formal training in this – they just solved the problems presented to them.

The development of an effective infrastructure by designing, and working with manufacturers to commission new hardware was seen as being essential to the success of research projects. For example, at one institution four of the technical staff collaborated with a large engineering company in building a thermal management facility. The interviewee acknowledged that academics were unable to build such a facility as they do not have the technical and specialist knowledge. Therefore, the technical workforce worked with academics to apply the theoretical knowledge gained from academic input. The project lead said:

"I always like to say that the technical workforce bridge that gap between the theory and the practical reality."

New infrastructure could often enable huge savings to be made and, in turn, lead to new grants to be awarded and further research being undertaken. An example has been provided in Box 3:

Box 3: Innovation example 2
At one university, the technical workforce supported academic staff to develop temperature-controlled cabinets for a particular project. This resulted in the university saving money, but the researchers also managed to bring in additional funding since the new cabinets opened up opportunities for further work.

"One of our workshop technicians in our mechanical and manufacturing area. There was a, the academics and the researchers were doing a project and he basically designed and commissioned 83 thousand-watt free-face heater temperature-control cabinets for them to do their research in. And actually saved the university around £132 000. But also enabled the laser department to win a grant from the Energy Technologies Institute. So basically he did the infrastructure to do the experiments that they wanted which didn't previously exist or you'd have to spend a fortune to do it."

However, interviewees at this university also acknowledged that the specialist knowledge of technical staff was not recognised as contributing to successful research grant bids (this theme is developed further below). Consequently, the central contribution of the technical workforce in this case was not formally recognised and nothing systematic existed to reward them for their contribution to innovation:

"I think it's a good example of where the academics have gone to the technician because they know they are the specialist in that area. But I'm not sure that was then formally recognized as it came from the technical, you know, I think that recognition of how well … I don't think the technicians always get that recognition in those areas."

While the evidence shows the technical workforce often played a crucial role in innovation, the technical workforce did not always self-define as innovators, although one technical staff member was responsible for setting up and running a successful biotechnology start-up. Many did not make a connection between their day-to-day work and innovative practice.

Recognition of the contribution towards innovation was inconsistent across institutions and, in many cases, dependent on how Principal Investigators address the technical workforce's involvement. For example, some institutions perceived the technical workforce in a supporting role, while some Principal Investigators saw the technical workforce as crucial to research and innovation as over time they accumulate a high level of expertise and knowledge. There is, therefore, an expectation that innovation will happen because of that expertise. However, one interviewee from a university observed that the technical workforce's expertise is not acknowledged at all and academic expertise is:

"I think it's a mixture. I think, partly, the technical workforce won't know they're doing it, because it's their job to innovate … so they wouldn't necessarily know that you could get some IP for that. Then equally, there's this

culture, isn't there, where it's like, 'Well, you're just the technician, you're just the hired help, so we don't need to acknowledge you.' That's the reality."

Although there were some differences between interviewees in interpreting concepts of innovation relating to the technical workforce, there was consensus that innovation by technical staff was expected and is necessary for institutions to undertake novel research. In terms of output, the technical workforce supported an infrastructure that enabled innovation.

Therefore, many interviewees said further consideration was needed on the most appropriate ways to recognise this contribution. Even where some informal or formal recognition was in place, not all technical staff were recognised. In some cases, the onus was placed on technical staff to complete an administrative process which formally recorded their contribution. Some technical staff did not feel the level of administration necessary was proportional to the amount of recognition they would receive. A Senior Technician told us:

"It's a very bureaucratic thing. I mean, I find if I personally think somebody in my work does extremely well and I want to give them a small bonus at the end of the year, it's almost impossible to do that. We were in a situation where a lot of technicians weren't even put forward *[for promotion]* before three years ago, simply because the success rate was so slow, people just didn't even bother anymore. Because they just thought 'What's the point?' I think we've gone through that change."

Some interviewees described the following schemes that their institutions put in place to start addressing this lack of recognition for innovation:

i. **A reward scheme** where technical staff are both recognised and rewarded through promotion or monetary gain for their involvement in innovation. For example, one institute has an annual awards system to formally acknowledge the work done by staff, including the technical workforce. A Technical Centre Manager told us:

"We also have award schemes for innovation, which are in various areas including the three Rs, for the animal facility, and technicians will often be awarded prizes for work they've done, innovation of techniques towards the three Rs. And then we also have translation awards, which are looking at groups doing different innovations, and nominees are publicised, so everybody recognises those winning technicians."

ii. Building knowledge on **capturing intellectual property** and having patents in place to ensure innovative ideas and approaches are protected widely across all universities and commercial businesses. A Vice Chancellor told us:

"We're developing with the technical managers, like, a piece, a communication, I guess, programme around what IP is, what technicians should be looking for, you know. So, we are trying to acknowledge that here."

iii. **Networking groups**, where the technical workforce are able to come together and share experiences. This would involve mirroring conferences ran for academic work for the technical workforce as well as collaborations between academic and technical staff. This helps bring the work the technical workforce do to the forefront and empowers the technical workforce to promote their work and educate others about the advancements that they have made. One university representative told us:

"No one really knew what the technicians did. And jokingly, a lot of people probably said 'Well that's a good way to be, isn't it? Because no one knows where to find us', but actually in truth,

that was just absolute nonsense. And I have to say, we got a lot of support from the vice chancellor and from the registrar in setting up a network which is for the technical workforce. So it's the technician's networking agenda."

iv. To **formally name technical staff as authors** in published journal articles where research is based on innovations developed in conjunction with or entirely by technical staff. This is crucial, since such publications would not be possible without data collection in research and the technical workforce is essential in monitoring this process, as described in the following section. A Principal Investigator commented:

"The most formal way will be generally publication and being either named as an author on there if people have contributed intellectually to that or at least acknowledged if their work has contributed towards it. So, we push for acknowledgement for authorship for technicians."

Contribution to experimental design and quality

Experimental design

Many interviewees said the technical workforce's advice on experimental design was sought by researchers and academics, particularly if it is an area of expertise for a member of technical staff. One technical project lead said:

"I think where technicians contribute significantly is in advising experimental setups to get consistent results. It's all very well having a wonderful idea, but an experiment is pointless if you can't reproduce it to pick the report up five years down the line and re-run the experiment. You should be able to get the same results and I know the technicians contribute significantly to that."

Five interviewees said the technical workforce advised on experimental design for academic staff and students because they understood the limits of the equipment in the laboratory. This advice covered the initial design of experiments, allowing researchers to operationalise their ideas, as well as suitable use of equipment and ensuring standard operating procedures were used. This might be said to be stress-testing the research of Principal Investigators. One Centre Manager told us:

"Where I would expect the technicians to have a significant input is in the actual experimental set-up being capable of delivering what is expected or to say, 'this won't deliver what you're expecting and it can't because...' What people then do with their data is another question."

The advice on experimental methods was supported by the technical workforce's in-depth, specialised knowledge of equipment and methods. The level and depth of advice provided increased with the grade of technical staff. Such contributions were not always recognised outside of the research teams of which technical staff were part.

Data quality and integrity

Overall, interviewees highlighted that the technical workforce play a critical role in ensuring high-quality, reproducible data collection. The technical workforce did this in a number of ways.

First, interviewees explained that the technical workforce "set the tone" in a laboratory environment for all aspects of the research process. This included, for example, producing good quality test samples, standards and controls, consistently reproducible methodologies and informal quality assurance for data analysis. As noted already, technical staff teach undergraduates and PhD students the theory and practice of a range of analytical techniques. Interviewees also said that since the technical workforce are specialists in dealing with machinery, they are responsible for managing access to complex or expensive machinery. Technical staff demonstrate standard operating procedures for this equipment to new academics or interdisciplinary teams unfamiliar with the apparatus. One interviewee told us:

“We've been doing mass spectrometry in the proteomics lab and obviously…….the technicians are highly trained individuals on a technology that barely anyone else is able to do and obviously by analysing the examples, I mean, I guess in NMR *[Nuclear Magnetic Resonance]* it's exactly the same thing. You are already providing innovation by using state of the art technologies. If you can't analyse the samples by NMR and mass spectrometry there is no innovation.”

Second, some interviewees suggested that the technical workforce use their specialist knowledge to formally report or provide feedback on the quality of data produced by academics and postgraduate students. This role was more common amongst technical staff at Grades 6 to 8. Queries and clarifications from peer review processes are sometimes resolved by the technical workforce, especially if the researchers have moved on. The technical workforce was often perceived by interviewees as the “go to” people with regards to data checks and were commonly the first to identify data issues. One university representative said:

“They know that they're the only person that can really say if that data's gone off, Then they will make sure they get involved in writing the paper, reviewing the manuscript and making sure what is being described is correct.”

Third, some interviewees said technical staff at Grade 6 and above sometimes conducted investigations for Principal Investigators when challenging issues with data collection emerged. The technical workforce’s expertise and knowledge of research processes was therefore important in research planning and design: the technical workforce helped untangle problems with data and provided effective, timely solutions.

Finally, interviewees highlighted the technical workforce’s central role in maintaining equipment, particularly in ensuring data quality and integrity by maintaining, regulating, calibrating and replacing hardware as appropriate.

Thus the technical workforce’s contribution led to higher quality, reproducible data. Several interviewees noted that research was increasingly interdisciplinary, leading to increased data sharing between specialists across a range of different disciplines. As these colleagues may be less skilled or experienced in recognising errors in data produced by unfamiliar methods, the checks provided by the technical workforce to ensure data quality increase in importance. It is both beneficial and fundamental to have a consistent member of an interdisciplinary research team that has the specialist theoretical and practical knowledge of underlying data.

While all interviewees agreed that senior technical staff played a critical role ensuring data integrity and reproducibility, the technical workforce were not always acknowledged, recognised or cited for their contribution. The analysis of person specifications referred to earlier highlighted that the responsibilities of technical staff at Grade 6 and above sometimes included undertaking specialised technical aspects of specified research as a member of a research group. The evidence from the interviews did not commonly find technical staff designing and creating experiments and associated systems and protocols to support the delivery of research objectives, but some evidence of these responsibilities was present. However, interviewees said acknowledgement of the technical workforce's contributions in published outputs was variable, even when research could not be conducted without the input of technical staff.

Referencing the technical workforce in research grants

The extent to which the technical workforce was named and costed in research grant applications varied by institution and departmental author. The technical workforce was classed as an overhead by many whereas slightly fewer named the technical job roles in specific bids. The small number of interviewees who named the technical workforce did so for two main reasons: the institution's technical team had a reputation and/or highly specialist skills or knowledge they could leverage to add value; or an institutional policy existed which directed the cost of technical staff to be presented. A Facility Manager told us:

"The model we work on is that all research grants that go out of the institution, go out of the department, have technician time put on them in terms of a pooled technician rate to provide the funds for, to use a phrase, the proverbial well-funded lab to make sure the NMR service is supported, the mass-spec service, and the micro-analysis. All of that costs money, we need income, so therefore we put some pooled technician rate on. There's obviously overheads that go with that and being the science department, they're significantly more and actually built into ….the system that we use to cost research proposals."

Academics were, in the main, responsible for drafting and submitting research grant applications. Several interviewees said it was at academics' discretion whether the technical workforce was named in grant applications. As illustrated in the quote below from a Facility Manager, the process for including the technical workforce in grants was informal for some, where resource is booked through management structures, and universities cover the direct allocated costs.

"Well, it's generally the academic, applying for the grant, in consultation with the head of department or dean. They need to know whether they've got that technician's time because it might be [the case that] there isn't a technician available. So they may go to the technical manager who line manage all the technicians to ask [for resource]."

While some Grade 6 and 7 technical staff were referenced due to their specialist knowledge, many interviewees felt the technical workforce were under-valued in bids or, at worst, not costed at all. In the main, Grade 3 and 4 technical staff were those excluded for two reasons. First, several interviewees commented that the cost requirements, templates or scoring systems used by funding bodies did not explicitly account for the technical workforce's time. Second, a few interviewees stated that Principal Investigators feared inclusion of cost lines for technical staff hours would make their bid less competitive compared to institutions that did not account for technical staff time, or included their time only as a low-cost administrative overhead. The two quotes below are from a Principal Investigator and a Centre Manager:

"I do know from anecdotal experience that often PIs will look to cut some of the numbers on a grant application, in the perception that they need to, and often it's those sorts of things or technical support or data support, those sorts of

things that get cut because it's something they think they can probably cover elsewhere."

"I mean, the PIs in my department have meetings which I go to as well, and there is talk around that, well we can't cost this into that because they won't pay that much for it. That is a conversation that happens quite a lot. I suspect that there are some people who would think, I'm much more likely to get it if I come in slightly cheaper and we'll find a way to deliver".

Some interviewees believed that funders were unrealistic with their budgets. However, inaccurate totals for true overhead costs in bids led some interviewees to perceive research as loss-making for universities.

As noted above, several interviewees described the crucial role funding bodies play in the scoring design of their grant selection process. These interviewees generally felt that some funders did not create the space within their tender invitations to account for the technical workforce's expertise and knowledge. Consequently, a few universities were investing in new equipment for research grants but not costing adequate time to develop the skills required to use this equipment, nor the training time necessary for technical staff to teach others in research teams how to use it. A few interviewees suggested funders could help Principal Investigators reflect true costs in their bids by changes to the design of bid documentation and the associated structural requirements for funding. Some also felt influence should be exerted to change views on how the technical workforce's contributions are reflected in the bidding process. A university representative told us:

"I do find when you do go for grants, and there's a named technician in there and this person has a CV of, you know, published twenty papers in the last five years, it actually always looks very beneficial. So, I do think you need to change that people who really contribute to research should be on the paper because it will help getting funding for them as well."

Most interviewees said that typically grant applications are written and submitted by Principal Investigators who are academics. In the view of interviewees, further thought and attention was needed as to whether system change would afford technical staff the opportunity to write or contribute to grant applications if they were the best person to do so.

Recruitment, progression and career development

Recruitment issues

A key underlying concern for many interviewees was an ageing workforce and how to create a suitable pipeline to replace lost expertise and avoid a skills shortage.

The technical workforce has traditionally remained in a technical role for their whole career, and also moved less frequently between institutions than academic staff. Some interviewees explained that technical roles were niche, and specialising (for example on specific machinery) made it harder to find roles elsewhere. Other interviewees indicated that location was a prominent factor, and equivalent roles were much more difficult to find outside of cities.

The evidence suggests two broad groups of the technical workforce, with corresponding differences in their background and prior training.

- Typically, those employed at Grades 2, 3 and 4 were less likely to have a university education and more likely to be on, or have completed, an apprenticeship.
- Those employed at Grade 5 and above had an undergraduate degree; and it was becoming increasingly common for many have PhDs.

This distinction led to three main issues for early career technical staff:

1. Those at Grades 2-3 were more likely to lack some academic and/or theoretical underpinning in the subject knowledge related to their technical work.
5. Not all apprenticeship or other vocational training programmes were deemed adequate to teach this theoretical knowledge.
6. Some graduates and postgraduates take Grade 4-6 technical roles to provide a stepping stone into other careers or into a postdoctoral role, rather than a longer-term position in the technical workforce.

The extent to which these three issues manifested varied between institutions. However some interviewees were concerned that using technical roles as a stepping stone to other careers resulted in a high turnover of staff and limited the opportunities for the technical workforce to become specialists, for example in certain analytical machinery. Higher turnover of staff plus barriers to progression for lower grade technical staff were given as reasons for difficulties in replacing an ageing workforce. An HR representative commented:

“I've already got one who's asked for flexible retirement, another one who's planning their retirement, and when they go there's no one coming up behind them to replace their 30 plus years’ knowledge.”

Nevertheless, most interviewees said the total number of technical staff in institutions had increased or stayed the same. Interviewees said one reason was that expansion and investment in new technology required technical expertise.

However, some institutions retained the same number of employees in the technical workforce despite increases in the number of academics and PhD students. This increased the workload for the technical workforce. One university representative explained:

“We've got a manufacturing group that's expanded massively in the last few years, and there's a lot of technical staff that's needed for that expansion. We've got *[a new building]* that's been built for life sciences and medical school so that's going to be a new building that's going to have new technical staff.”

On a positive note, an interviewee at a university said academic environments were attractive because they offered more flexibility to staff compared to commercial companies:

“I'm used to them being snapped up by Google and Microsoft. But then, having people that want to come out of that environment and back into the university, because they just want … the flexibility and things that a university life offers you, and the interesting conversations that you have on a day to day basis.”

Some interviewees said certain academic disciplines found it easier to recruit the technical workforce. For example, science graduates were supposedly easier to recruit as the talent pool was larger. However, graduates and postgraduates had some reported skills gaps. Some interviewees said it took years for graduates to build up practical problem-solving skills which they lacked. PhD and postdoctoral recruits often had the required technical skills but often perceived technical roles as a support function, making these roles unattractive. For example, one interviewee identified that psychology postgraduates wanted to become academics rather than join the technical workforce:

"We generally struggle within our department to recruit the technical workforce who have a psychology background, believe it or not. PhD students generally don't want to be a technician they want to go on, be an academic. From within our team we've got people from bioscience background, computer science, and we tend to find it, perhaps it's slightly easier to recruit at grade 5 because those roles tend to require skills that are more widely accessible."

Some interviewees felt the skills and competencies required for technical roles were not always clear from the outset which also stymied good recruitment. While higher-graded technical roles may be specialist (one institution was exploring the feasibility of dual-speciality technical roles), interviewees indicated that there is a perception these roles are second class to academia. As noted later, the lack of progression routes from lower grades also compounded recruitment issues in some cases.

Diversity and inclusion

Most interviews said the lower-grade technical workforce came from a white and working-class background, apart from in London where ethnic diversity in the workforce was representative of a culturally diverse city. The undergraduate recruitment route for the technical workforce at Grades 5 and 6 means more of this group has middle-class backgrounds and is more reflective of the graduate population. Some interviewees said the technical workforce reflected the demography around the institution and the wider student body as individuals did not tend to move geographically for low to mid-paying jobs. A Facility Manager told us:

"The technical workforce is more reflective of the city, than the academic. So we felt like, you know, it is a white mix here, but [city] is a very white place, so I think, it is reflective of that local population, and we think it's more working class in the technical work force."

Many of the technical workforce in biology subjects were women; by comparison few women were found in the engineering technical workforce. The lack of flexible working was mentioned by one institution as a possible reason for the underrepresentation of women in the technical workforce.

Most institutions have put actions in place to address the lack of diversity among the technical workforce. The most prominent approaches discussed were:

1. **Trainee and apprenticeship pathways** – To address the ageing population and high turnover at higher grades, some interviewees stated that their institutions worked with local education providers and ran their own schemes offering apprenticeships to train young learners. There was interest from all institutions around apprenticeships and four very good schemes already in existence (see Apprenticeships and training below). The scope for collaboration in this context is significant.
2. **Athena Swan programme –** managed by the UK Equality Challenge Unit, the network recognises and celebrates good practices in higher education and research institutions towards the advancement of gender equality and representation. This enables universities to draw on resources and approaches that encourage women to apply for technical roles.
3. **Outreach work –** One interviewee reported that their institution had staff who worked with local schools and was part of the teacher science network. Technical staff in this institution go into schools with a range of kit and run science sessions to promote the roles of technical staff. In a similar fashion, this institution proactively works with a local education provider to host a range of events to

promote the role of technical staff. This kind of work is rarely evaluated for its impact on recruitment.

Career pathways and promotion

Typically, representatives reported difficulties in achieving career advancement for technical staff due to the promotion structure within universities. Interviewees said that the roles of technical staff are graded and once technical staff reach the top of their occupational grade, they can advance in one of two ways: applying for a vacant position at a higher grade; or through a regrading of their current role. Many interviewees said regrading was a rare occurrence, and also that not many roles are advertised for Grades 3 to 6. The latter was supported by the short review of job adverts for technical posts. The grading system differed from that for academic positions in which the individual's experiences, skills and outputs led to career progression. The key distinction was therefore what was assessed for promotion. The technical workforce occupies a specific role regardless of the corpus of skills and experience they build up in that role over time, whereas career progression for academic staff recognised skills and experiences gained in the role. A Research Manager summed this up:

“You can't do it just by taking on more responsibilities and slowly evolving the job, it has to be a regrading. So unlike the academics who can, kind of, build up milestones and papers and talks and things to help them get up there, it's the job's (that is) graded, not the person.”

One HR representative also commented that the relationship between the grading system, competencies and promotion based on skills and experience is unclear for many:

“I think a lot of technicians look at academic promotions and they see that, you know, you get your lecturer job, and then do your work, and you get promoted to senior lecturer. You do … more work, you get promoted to reader, and they are sat there, on the grade 4 going, 'It doesn't matter what I do. I'm not going to get promoted.”

There appears to be a gap in promotion from entry level (Grades 1-3) to Grades 5/6. Those employed at Grades 3 and 4 have difficulty progressing for one main reason. There is rarely an opportunity to gain experience of higher-grade responsibilities through, for example, secondments or placements before applying for promoted posts.

Some interviewees also observed that at the higher occupational grades (Grade 6 upwards), promotion required either moving from a technical to a management role, or a shift into a more academic or research-based role. Another representative observed that the technical workforce’s career pathway was like the grading structure of the Armed Forces or Police Service[10] in the way that increased responsibility and specialist skills did not automatically enable progression. Another interviewee said the technical workforce could progress through salary scales if appropriate opportunities existed, based on business need.

A small number of institutions introduced a new promotional pathway that emphasised specialist knowledge and skills in progression. A number of institutions also mentioned the introduction of the Technician Commitment which is designed to

[10] In the case of the Police, those successfully completing law and procedure qualifications can be promoted if a suitable opportunity is available. https://www.college.police.uk/career-learning/career-development/national-police-promotion-framework

address limits in the promotional and CPD opportunities open to the technical workforce. This initiative was welcomed by many of those concerned by the lack of a coherent progression pathway and the risk this poses to replacing lost expertise as more senior technical staff retire.

One institution described promotional pathways for their technical workforce that used existing HERA progression and recognition framework (discussed earlier). Others felt, however, that there was a glass ceiling in place for the technical workforce so that they could not usually progress beyond Grades 5 and 6 unless they moved into a managerial role. None of the institutions making these comments identified any formal route for progression which was felt to be a key factor in retaining the technical workforce in the longer term. One laboratory manager told us:

“Our technical family seems to end at grade 6. So technical managers are on our management and specialist family, which will allow them to be a 7. And this might work with the Technician Commitment – to open that glass ceiling up because we do have technical specialists and real specialists who you know, should be on those higher grades.”

Many institutions offered recognition in other ways, such as awards and one-off bonuses to acknowledge the technical workforce’s commitment to their role and the university. One interviewee reported that their institution was extremely supportive and encouraged the technical workforce to professionalise their role by joining the Science Council. Senior staff became mentors to the technical workforce to help them become chartered scientists. This is currently funded by the institution. Other interviewees explained how professional and specialist qualifications are being offered to the technical workforce to further their knowledge and ability to apply for new positions. However, these processes were not always applied consistently between an institution's faculties. In addition, these progression routes may take the technical workforce into other roles as opposed to recognition (and remuneration) for applying their high levels of technical expertise, and remaining in the technical workforce.

Apprenticeship schemes for training

As already noted, interviewees suggested that trainee and apprenticeship schemes could be used to encourage involvement in technical research and to address diversity and inclusion issues (although apprenticeship schemes were uncommon within institutions). One institution highly valued their apprenticeship scheme in bringing in trained technical staff and felt it helped diversify the range of experiences and skills of the technical workforce. It also provided local communities opportunities. This university representative told us:

“Most of our technical workforce have come through either an apprenticeship programme, or they've come through undergraduate programmes and moved up through their degrees and qualified that way. We have a few that are, sort of, high degree level holders, you know, been researchers and so forth. So, quite a diverse group of skill sets and disciplines.”

However, a couple of institutions with apprenticeship programmes struggled to recruit young people with the right enthusiasm and underlying academic skills suitable for technical work at Grades 2 and 3. They also recognised challenges to recruiting older applicants who were not willing to be employed with the low pay that come with apprenticeship schemes and the restrictive promotion opportunities that exist. One institution had a university-wide programme labelled as apprenticeships across different subjects (mechanical, electronic, aeronautical). However, a lack of progression for these apprentices was reported, as there was no formalised training programme in place. They suggested that many of the apprentices at their institution either stayed as an apprentice for too long or left their role at Grade 3.

Other institutions wanted to support apprenticeships but cited insufficient resources in place to dedicate to the training and development needed. One representative was concerned that the investment in apprentices was lost when they moved on to other jobs. Other representatives highlight the role institutions have in providing apprenticeships as a civic duty, although operationally it is difficult to execute due to lack of resources and the time it takes to set up such schemes.

However, most institutions were interested in apprenticeships and a few already had recognised (i.e. validated) apprenticeships in place. It was perceived that apprenticeships had the potential to increase diversity amongst the technical workforce and to (eventually) fill the skills shortages, both now and in the face of retirement of senior technical staff.

3 Recommended actions

How might universities and Wellcome and other funders respond?

It would be tempting to suggest major systems change should flow from this research. However, Wellcome does not employ a large technical workforce directly and there are other organisations such as UKRI, the Science Council and universities themselves that are already doing excellent work in this area. We should not replicate the work of the Technician Commitment. Our response is based on two issues directly relevant to Wellcome's work:

1. Wellcome has a strategic aim to encourage better research culture and more effective research teams, ensuring that the technical workforce is reflected properly in decision making, training programmes and reward systems.
2. In the future, Wellcome will be tasking grant recipients and centres with hard, multidisciplinary problems that will require new tools and techniques and novel uses of old ones. We need to ensure that the sector has the capacity to deliver our strategy as it develops, which includes all the technical specialists within research groups.

We therefore identify four specific challenges that universities and Wellcome and other funders should consider acting upon and some proposed actions for each. All are scalable and progress on just one of them would be a major step forward. Challenge 2 is probably the most easily deliverable in the short to medium term.

Challenge 1: The technical workforce's role in research is not well defined and often underestimated. Without a clear identity within a research team, it will be hard to recruit, train and formally recognise the technical experts needed for the future.

Proposed actions:

i. Develop Wellcome's future institutes and centres as "centres of excellence" in recruiting, retaining and managing technical staff. Scope out the development of a skills framework that builds in diversity from the start. Draw on models such as the Global Skills Framework for a Digital Age[11], the Technician Commitment, the National Technician Development Centre and the wider university sector. Develop a simple common language for skills and competencies that can be reflected in research funding assessment, institutional workforce planning, recruitment and staff development.

ii.

iii. Wellcome to extend this rapidly into their Africa and Asia programmes to provide a global perspective.

Challenge 2: The technical workforce is not routinely engaged in decision making in research funding or acknowledged in research outputs.

Proposed actions:

i. Change eligibility to apply for funding to routinely include technical staff as leads (including computing and data science specialists).

ii. Work out how to give credit to grant applications that name technical experts, in the same way that named researchers are credited.

iii. Explore processes that will ensure grant applications are consistently given credit for costing appropriate technical staff time including training provided on new equipment.

iv. Make it a requirement that technical staff are credited for their contributions in published outputs (e.g. using the CASRAI CRediT or Contributor Roles Taxonomy system[12]) and monitor this as part of institutional / team assurance.

Challenge 3: There is clear evidence of limited diversity in the technical workforce.

Proposed actions:

i. Pilot cross-institute/centre approaches that support diversity in recruitment.

ii. Build diversity for technical staff into assurance across funders.

[11] https://www.sfia-online.org/en

[12] https://casrai.org/credit/

Challenge 4: Progression from entry-level to senior grades is often unclear.

Proposed actions:

i. Undertake an options appraisal with four to five institutions on ways to bridge the gap or transition between Grades 1-3 and Grades 5-6 and above.
ii. Pilot cross-institute/centre approaches that support ability for technical staff to transition to different research teams.
iii. Build progression for technical staff into assurance across funders.

Most research teams told us they would not want a radical rethink of research grants and systems and processes in the short term. They would need time to respond, especially in the current climate. Many of the institutions are already making changes to the terms and conditions for the technical workforce.

We would like to thank all the interviewees that gave their time so generously to the project. Our impression of the sector is that we have an impressive array of talent well able to innovate in the way the country needs. We just need to make sure that the systems and structures in place support the whole research team, including the technical workforce, to work at their best.

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John Higton, Research Director, CFE

Dr Rupal Patel, Research Manager, CFE

Michelle Hansel, Senior Research Executive, CFE

Nariah Francis, Senior Research Executive, CFE

David Merrett, Research Executive, CFE

Mark Ellis, Policy Advisor, Wellcome Trust

Appendix A: List of participating institutions

1. Cardiff University
2. Cranfield University
3. The Francis Crick Institute
4. Durham University
5. The Proteus Interdisciplinary Research Collaboration
6. University of Essex
7. University of Glasgow
8. The Gurdon Institute, Cambridge
9. Newcastle University
10. John Innes Centre
11. University of Liverpool
12. Loughborough University
13. University of Nottingham
14. Wellcome Sanger Institute
15. University of Sheffield
16. University of Sunderland
17. Sainsbury Wellcome Centre for Neural Circuits and Behaviour
18. University of East Anglia (UEA)
19. University of Warwick
20. Wellcome Centre for Human Genetics, Oxford
21. University of York

Appendix B: Interview questions

Each interview was approximately 1 hour 30 minutes long, with 1 to 3 individuals all asked the following 11 questions:

1. How do you define a technician in your organisation?
2. Describe any examples of the technical workforce teaching either undergraduates, PhD students, postdocs or Principal Investigators within the organisation.
3. Can you think of ways that the technical workforce directly contribute to wellbeing within the team?
4. Do the technical workforce contribute to innovation in any way within the team?
5. What role does the technical workforce have in ensuring the quality and integrity of experimental data (either postgraduate or undergraduate)?
6. Explain how the technical workforce's time is costed into bids and grants for research and undergraduate teaching.
7. Do you think that the total head count of the technical workforce in your organisation has increased or decreased in the last ten years? What is the reason for any changes?
8. What is the scope for promotion and/or recognition for the technical workforce in your organisation? Is this something you are looking to change? If so, how?
9. National data suggests that the technical workforce in universities is not diverse in terms of ethnicity and indices of deprivation. Is this something you recognise? Are you taking/thinking of taking any action to address this?
10. What is your level of interest in apprenticeship schemes for training new members of the technical workforce?

- 1 = not much
- 10 = we already have a successful apprenticeship programme

11. In relation to innovation, culture or teaching, is there anything else you want to add?

Appendix C: List of roles for participating interviewees

Participating interviewees had the following roles or job titles:

1. Departmental Operations Manager
2. Laboratory Manager
3. Senior Technician in Chemistry
4. HR representative
5. Lecturer
6. Technical Operations Manager
7. Technician Commitment Manager
8. Core Facility Manager
9. Professor
10. Director of Research and Innovation
11. Technical Service Manager
12. Research Development Manager
13. Faculty Research Manager
14. Facilities Manager
15. Vice Chancellor

Appendix D: Coding framework

Description	Number of interviews	Number of references
1. Wider roles and responsibilities of technicians		
1.1. Definition of technician		
1.1.1 DEFINITIONS		
Teaching role	17	46
Support academics deliver research	17	34
Varied role	14	27
Dealing with analytical machinery or software	13	25
Experimental role – lab or computer based	11	20
Specialist knowledge	7	17
Include IT and engineers in definition	9	11
Quality assurance	4	9
Calibration and maintenance checks	3	5
Managing stock, finances and budgets of new equipment	4	4
Higher grades – management	3	3
Professional background	3	3
Project management	1	1
Theoretical input	1	1
1.1.2 Perceptions of definition		

Difficult to define as cuts across structure	11	16
Key role for delivering research	8	13
Perception lower skill repetitive role	9	12
Redefine the role of “technician”	4	9
1.1.3 Challenges in defining role		
Technician cuts across family structure of roles	7	11
Changes in the role	4	7
Language – teaching or demonstration	4	5
Higher grades blur with postdoc roles	3	3
Computing is a grey area, not quite technical not quite academic	2	3
Grading does not always allow promotion purely on technical ability	1	2
1.2 EXAMPLES OF TEACHING SUPPORT		
1.2.1 Teaching undergraduates		
Pastoral support	6	14
Design and administer practicals	7	12
Lectures	5	11
Guest speaker – specialism	1	2
Field trips	1	1
1.2.2 Teaching postgraduates		
Technical instruction of equipment	16	41
Teaching modules (inductions, seminars, MSc, e-learning)	9	21

Do not teach but demonstrate techniques	7	17
Teaching standard operating procedures on complex analytical machines	9	14
Health and safety	5	10
Mentoring	6	7
External training courses	2	4
Analysis of raw data and quality assurance	2	3
1.2.3 Outcomes of teaching role		
Safe working practices	3	8
Acknowledgements in dissertations	1	3
Practical learning from experience	3	3
1.3 CONTRIBUTION TO WELLBEING		
1.3.1 Current approaches to student or staff wellbeing		
Informal pastoral role	16	42
Health and safety training	14	29
Daily contact with students	14	26
Flag if noticed during their job – all staff responsibility	8	15
Training is offered to technical staff	7	12
Wellbeing activities	4	12
Provide consistency	5	7
Reduces burden on academic staff	4	7

Network	4	6
Sensitive to idea development	1	3
1.3.2 Perceptions of approaches to student wellbeing		
More approachable than academic staff – not assessing students	9	19
Continuity of staff (rapport)	4	7
Value of technician Increasing	3	4
Sense of meaningful engagement	3	4
Some won't flag issues to Principal Investigators	3	3
Undervalue their support role	1	2
Contribution of support is invisible	2	2
1.3.3 Future changes or approaches		
Training to spot signs	3	3
Formal processes to flag wellbeing issues outside the PI structure	2	2
Under review	1	1
1.4 ROLE OF INTERVIEWEE	12	38
2 Changing roles and workplace: Composition of technicians		
2.1 HEAD COUNT OF TECHNICIANS		
2.1.1 Trends		
Increased	10	14
Stayed the same	7	10
Decreased	5	7

Fluctuations	3	5
2.1.2 Reasons for increase		
University has grown so more technicians needed	5	7
Knowledge is required at university	6	6
Specialising in core facilities	2	2
Reputation of the organisation	1	2
Investment in new technology	1	1
9-5 and flexibility	1	1
2.1.3 Reasons for decrease		
Technical support replaced by postdocs	4	10
Retirement	4	4
Competitive pay	2	4
Streamlined processes	1	4
Research area is no longer a priority	1	2
More expensive	1	2
2.1.4 Reasons stayed the same		
Workload is going up though population is stable	4	6
Working more efficiently	1	2
2.1.5 Reasons for fluctuations		
Churn	1	3
2.2 DIVERSITY OF TECHNICIANS		

2.2.1 Extent of diversity		
No or limited mix	12	27
Positive mix	4	8
Difficult to tell, called different roles	2	2
2.2.2 Reasons for lack of diversity		
Reflective of geographical area	6	10
Increased entry requirements	3	8
Missing data	4	7
Insufficient salary for overseas candidates	2	3
2.2.3 Actions to address diversity		
Apprenticeship pathways	9	24
Outreach work to younger students	5	7
Identify issues	4	5
Changes to recruitment policy	2	3
Collect quality EDI data first	2	3
Traineeship	1	1
Local education budgets	1	1
Women in high performance computing	1	1
Diversity champions	1	1
Flexible working	1	1
2.2.4 Reasons for diversity		

Gender - flexible working	1	1
3 Contribution of technicians towards innovation, research and team cohesion		
3.1 INNOVATION		
3.1.1 Types of innovation		
New protocols and procedures	14	19
Novel uses of current technology	11	17
Impact and product development	10	13
Business development	6	9
Wider innovation outside university	4	9
Discovery science papers	3	8
Seeking department collaboration	5	8
Software development	4	7
New design and builds	6	7
To generate new work streams	5	6
Managing patents	5	5
Cost saving	1	1
3.1.2 Perceptions of innovation		
Part of day-to-day role	4	6
Do not realise they're creating innovation	3	6
Attributes to hierarchy – innovation comes from academics	4	5

Importance of keeping up to date	5	5
Machinery – supporting people coming into the institution	3	4
Unfunded work	3	3
Lack of understanding of capturing intellectual property	1	1
Do not advertise technological expertise	1	1
3.1.3 Approaches and support		
Built in capacity to encourage innovative activity	6	6
Rewards for entrepreneurship	3	4
Training	3	3
Subject specific CPD in innovation	1	1
3.2 EXPERIMENTAL DATA		
3.2.1 Approaches to enhance quality and integrity		
Peer review, data checks, quality assurance	14	37
Contribution to experimental design	8	15
Managing equipment that produces results for research	9	14
High quality training to all users of the technology	9	14
Untangle data problems when asked and identify problems by researching the literature	3	7
Collaborative approach to problem solving	3	5
Training incoming international researchers in consistent approaches	3	3
Replication	2	3

1 to 1 support to practise the technique until you get it right	2	2
Cross departmental working	1	1
3.2.2 Challenges		
No acknowledgements – undervalued	3	7
High volume – cannot check everything	1	4
Culture set up by PI who determines the level of technicians' involvement	1	2
Poor communication	1	2
Hierarchy issues – not their role	1	1
3.2.3 Outcomes of support or approach		
Reproducible research	4	5
3.2.4 Future changes		
Work more closely with technician communities	2	2
More focus on research integrity	1	1
3.3 BIDS AND GRANTS		
3.3.1 Approaches		
Acknowledge technician contribution	11	41
Not costed in bids	11	24
Names / posts costed into bids	8	20
Costed in the overhead but not a named resource	10	16
Costed in to improve quality of bids	8	13

Bids produced without consultation on the true costs of technical support	4	13
Cutting time or reducing cost due to competitive bids but realistic	5	11
University guidelines	7	10
Refer to new posts created	3	4
Some element of flexibility and autonomy among technicians	3	3
Technicians avoid overhead costs	2	2
Hierarchy	1	2
Involvement of technicians is increasing	1	2
3.3.2 Perceptions of approaches		
Inclusion of technicians in bids	8	18
How can value of technicians be showcased	4	10
Need to include technical staff to save costs for the university	2	3
Costing in bids illustrates expertise or credibility to the funder	3	3
Not clear if the pressure on price is the university or the grant funder	3	3
Difficult balancing costs and budgets	2	2
Grant process can encourage cheaper proposals due to scoring	1	1
3.3.3 Impact or consequences of approaches		
Full cost recovery for all technical support in grants	3	
Technicians seek job security elsewhere	1	
Named expert technical specialists encouraged by funders	1	

Grants assessed on training provided to new postdocs and PhD students on new equipment by technicians	1	
No temptation to cost in a postdoc when you need a highly trained technician	1	
4 Qualifications held and progressions amongst technicians		
4.1 CAREER PATHWAY		
4.1.1 Promotion approaches		
Recognition of technicians' work	19	76
Limited promotion route for technical jobs – only research and teaching	18	49
Training and development opportunities	14	23
Move across to management for promotion	11	22
Introduction of new level structures for specialist route	6	18
Bonus scheme	10	15
Technicality of role and contribution to research	7	11
Same as academics	3	5
Limited opportunity to move between labs	3	4
Expansion of role	2	3
Given opportunities to teach	2	2
4.1.2 Perception of approaches		
Challenges with training and development	5	16
Technical specialists should be given development opportunities due to expert knowledge	8	15

Faults with bonus scheme	5	14
Lack of recognition	6	13
Low pay	5	11
Lack of effective workforce planning to retain and recruit the best	5	10
Keen for technicians to progress	8	10
Should be recognised in journal articles	6	9
Disparities between grades of technicians and PhD	3	7
Staff shortages	3	4
Managing time and resources	1	2
4.1.3 Requirements or support needed		
Policies on authorship on papers	8	12
Job security for technicians	6	9
Professional registration for technicians	2	3
Encouraging progression to management	1	3
Protected training time	2	2
Effective ways of sharing experiences	1	1
4.1.4 Qualifications and experiences held by technicians		
Academic background	4	6
Mixed background	1	2
Industry background	1	1
4.2 APPRENTICESHIP SCHEMES FOR TRAINING		

4.2.1 Outcomes of implementing schemes		
Challenges to recruiting suitable candidates	4	14
Issues with developing an apprenticeship scheme	4	10
Explanation	5	7
Recruitment of new personnel	4	7
Addressing development and innovation issues	2	2
Lack of progress following apprenticeship	1	1
4.2.3 Barriers to implementation		
Feasibility	3	7

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**Wellcome Trust, 215 Euston Road,
London NW1 2BE, UK
T +44 (0)20 7611 8888, F +44 (0)20 7611 8545,
E contact@wellcome.ac.uk, wellcome.ac.uk**