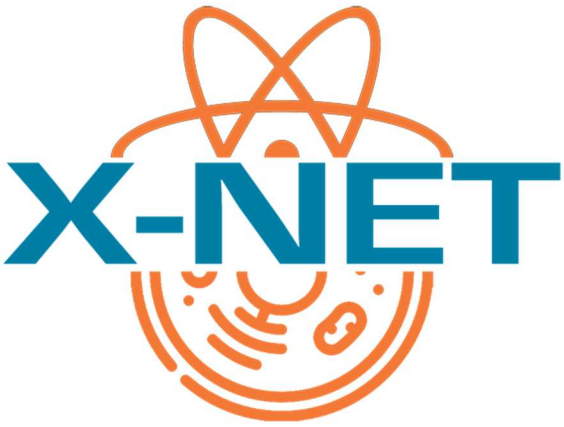


# PREPARING THE ROADMAP: "PRIORITISING CROSS-DISCIPLINARY TRAINING NEEDS WITH INDUSTRY"

## An X-Net workshop report

Report on outcomes of the workshop held on 19th Jan 2023 with industry participants

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# Introduction

This workshop was part of the X-Net's series of workshops to deliver on their goal to remove barriers for researchers crossing disciplines in the biomedical sciences.

**The main aims of this workshop were:**

i. explore how academia does, or does not, currently provide industry hires with sufficient interdisciplinary skills to perform roles in this sector, and
ii. via X-Net's future Roadmap, influence UKRI's future training strategy.

The workshop was designed around two themes and several key questions, and aimed to involve scientists from companies (big and SME) to present their views on what is required from academia to smooth the transition of staff from universities to interdisciplinary/multidisciplinary projects in industry. X-Net's goal was to include their input to X-Net's roadmap and thereby transfer industry's views to funders and policy makers. The two themes and associated key questions were:

I. **Understanding barriers to collaboration**

- How does industry work with academia? Are these partnerships more important in an interdisciplinary environment?
- How to strengthen links and promote industry-academia collaborations that are interdisciplinary?
- What are the main barriers (if any) to interdisciplinary industry-academia collaborations?
- Can interdisciplinary research help answer future industry-related grand challenges?

II. **Understanding industry requirements and the skills gap**

- What are the key skills required for industry?
- Industry recruitment preferences:
    - scientists with a background in one or else several disciplines?
    - scientists with laboratory- and/or analysis-based academic backgrounds?
- What are the main interdisciplinary skills missing in new recruits?
- What are the interdisciplinary training requirements in academia for future industry hires?
- Should academic training curricula be adapted to account for newly emerging technologies?

This report compiles the outcomes of the discussions and exercises during the workshop, and is structured around the two themes.

# Participants

- Bryn Roberts - **Roche:** SVP & Global Head of Data & Analytics
- David Humphreys – **UCB**: Senior Director, Head of New Modality Therapeutics
- Duncan Simpson - **Canon Medical Research Europe Ltd.**: R&D Partnerships and Projects
- Ken Scott – **University of Edinburgh, School of Informatics**: Business Development Manager
- Luke Williams - **Enara:** Director of Biology
- Madhuri Cherukumilli - **Boehringer Ingelheim:** Manager External Digital Innovation

- Malcom Skingle - **GlaxoSmithKline**: Director, Academic liaison
- Mhairi Towler – **Vivomotion**: founder and CEO
- Miika Ahdesmaki – **AstraZeneca:** Head of Bioinformatics and Data Science
- Nils Kölling – **Genomics plc.:** Manager of Therapeutics Data Science
- Rob Kitchen – **Novo Nordisk:** Director of Computational Biology
- Saverio Niccolini - **NEC Labs**: General Manager - Data Science and System Platform Research

Speaker:

- Prof. Rory Duncan - **Sheffield Hallam University**: Pro-Vice Chancellor (Research and Innovation)

**Please note:** There is a potential for bias in the workshop outcomes due to participant's particular specialisms (i.e. greater representation of data science and analytics).

# I. Understanding barriers to collaboration

## Invited speaker Prof Rory Duncan

The invited speaker, Prof. Rory Duncan, Pro-vice chancellor (Research and Innovation) at Sheffield Hallam University, and previously the UKRI Director of Talent and Skills, gave a 10 minute talk about the key challenges to R&D in the UK, and the importance of enhancing R&D through creating more porous career pathways between academia, industry and other sectors. To view the slides presented by Prof Duncan, see appendices.

The key points from his talk were:

- There is huge interest in understanding "How can we enable people to move flexibly between careers?" This was linked to an increase in funding being made available for research and innovation currently, and the fact that the UK academic system is not able to absorb the funding, and so we need people to work across different sectors. An additional 400,000 people in the UK are needed over the next 3 years working somewhere in research and innovation to absorb this funding. This gives scale to the challenge and opportunity.
- R&D People and Culture Strategy identified some challenges to R&D. Amongst these were challenges around:
    - careers in R&D not being attractive
    - unclear career pathways for many researchers
    - difficulties for people to flow between academia, industry and other sectors
    - barriers and costs for international researchers wanting to come to the UK
    - issues around EDI and making R&D for everyone
    - unhealthy work cultures, such as bullying, harassment and discrimination
- Rory spoke of the Research Excellence Framework (REF) and how it has been interpreted by academic institutions has meant that they value more traditional academic outputs (e.g. papers and patents). He views the REF as a barrier for people to move between different sectors as it promotes a very linear academic career by valuing traditional academic outputs,

which are hindered or slowed when you move out of academia, making it difficult for someone to come back to academia if they move out for a period of time.

- The UK trains around 100k PhD researchers at any one time, and the fact is that there will never be enough jobs in academia for those PhD students. There is a cultural problem where PhD students and a large proportion of their supervisors believe that doing a PhD is training to be an academic, and this is not correct. It is training to develop high level skills so they can contribute somewhere in the economy.
- Careers are changing and it will no longer be the norm to have a career in one sector only. Portfolio careers requiring different disciplines, skill sets, and mobility are the future. This is a big shift for the academic sector.
- Academic career pathways are very narrow and linear (UG to Masters, PhD, Postdoc, Fellowships and/or Permanent position) with limited opportunities to progress between these stages. However, if you extend this out to make the career pathways more porous between academia, industry and other sectors this allows for endless opportunities for people with high level skills to contribute somewhere. Knowledge, skills and ideas move with people, so moving people around between sectors is important for R&D.
- However, one barrier (among many) to a more porous career pathway is the pension system. Often pensions are predicated on long service in one sector, and this can inhibit people moving between sectors.
- Rory suggests some solutions to encourage a more porous career pathways in academia could include secondments and co-funded sponsored and supervised PhD studentships with industry partners. Secondments to industry in his experience are a low risk, low resistance move for people in their careers.

## Plenary discussion

The discussion that followed this talk included questions from the audience. The below outlines the main discussions and questions from the participants (initials indicated) and the answers from the speaker (S). Anything in [ ] is interpreted due to poor sound quality of the recording or added for clarification.

**BR:** Do Doctoral Training Centres, in particular the industrial doctoral centres, foster an increased movement of people between academia and industry?

> **S:** Yes. But there is a further challenge in retaining PhD students (EPSRC funded students in particular) as they are in high demand from industry and may not complete their PhD's. These students often get extra funding to try to retain them.

**MS:** Agreed with everything that Rory said, and mentioned the increasing numbers of visiting chairs in both directions in their company, as well as several schemes (Immunology Catalyst) that allow academics to work with them and share all their platforms and tools. The company doesn't own the IP of their outputs but they do [catalyse] their science. The people who have the skills and talk the language of the other sector are always the ones to get their names on the new [organograms] first, and academics don't realise that. Industry can force people to work together and force porosity, because they pay their wages, whereas in academia it's the opposite because of self-interest. We all know innovation occurs at the boundaries between those interfaces. We [industry] have different approaches on how we address the barriers and challenges to porosity.

**S:** Agreed with MS statement, and included that this issue of porosity sits very high on agendas at the moment, but that it was mildly dispiriting that they've been talking about this challenge for a long time but never really cracked it.

**MS:** continued to discuss challenges around funding that comes from a single fund, and how someone who spans several research councils [as an evaluator] has remit issues when it comes to evaluating funding bids. This works against trying to force people across those boundaries.

**DS:** Mentioned that the diagram Rory showed of porous career pathways in and out of academia was not complex enough, and was missing the research support roles that many PhD and post-docs may find themselves in. Research support is a rich and interesting sector that requires people with high level skills (e.g. analytical ability, knowledge of how research is run, etc). Another point was made around interdisciplinary skills and teamwork being vital in the academic career track and how that's increasing. Undergraduate degrees are becoming more collaborative in response, however, PhD training remains an individual task. This is for sensible reasons, such as challenges in assessing individual contributions in a group. However, they still have to go through that filter of the individual researcher for 3 or 4 years even if we are training them up to do teamwork in the end.

**S:** There has been a shift in the way PhD students in the UK are trained. They receive wider training and speak to people outside of their own projects as well, which is a positive shift.

**SN:** From experience people don't traverse the divide [between academia and industry] several times in their career. The more you move backward and forward the more knowledge you gain, so this should be incentivised more. If there were more incentives to keep on doing this throughout academic careers we would probably see even more collaborative research.

**S:** Agreed, more incentives are needed for those who want to do this. However, we haven't considered the risk of moving between industries, and that people need stability in their lives. Most people are generally risk averse, and that is why he is a big fan of secondments because they allow people to have a safety net in existing jobs whilst experiencing another working culture.

**MT:** Agreed with the idea that PhD training was to develop high level skills and to contribute to the economy in different ways, rather than for academic careers only. There is a need for a cultural shift in academia and a change in mind-sets to one where leaving academia is not viewed as a failure. This also helps get away from that linear academic career path. Also, resonated with the way the different sectors disseminate their work, and how going into different sectors allows people to take different skills with them.

**S:** Agreed with the view that leaving academia is not a failure, but that a lot of people still don't see it that way. Statistically, academia is the alternative career path. There are lot of social media posts that show how disgruntled people are with academia, but actually if they had been better equipped at the beginning they would realise that leaving academia is probably going to be the best thing they've ever done. Additionally, issues around bullying and harassment in academia, and other poor working cultures, are partly driven by the fact that academia is so close and people have only ever seen one way of working. If you open that up to other working cultures, it has to be a priority.

**LW:** Wanted to pick up on two points around how academics want to publish high impact papers, preferably as first author, but also about the fact that patents in the REF are also really important, but that this was never really a focus of academics in their experience. In their experience in collaborations [with academia] patents and IP are very valuable to industry, but the academic partner is more interested in when they are going to get their first paper out of the collaboration. Do you think people are undervaluing patents within academia and forgetting about that? Or does the REF fundamentally undervalue them?

> **S:** There's quite a lot in the UK Innovation Strategy about that. There are a very small number of UK universities who are absolutely outstanding at commercialising their research activity. There is generally a misunderstanding about what innovation is. There's a misunderstanding that research happens in some bright sparks lab in a university, and innovation happens in business, and that's total rubbish. There's huge amount of innovation in universities. Much more research happens in business than in universities, and that really surprises academics. We have to really learn from places which are doing this well, try to disseminate that out across the sector, because we simply cannot succeed and we cannot absorb or spend the money which is available if we keep in the siloed system that we're currently in.

**LW:** Agreed that there are significant barriers to getting innovation out of universities, and that we can learn a lot from other countries like the US, in particular the east coast, who are very successful at this.

## Lowering barriers to collaborations (and strengthening links)

Participants were split up into smaller break out groups to discuss:

1. One key challenge or barrier (if any) to interdisciplinary industry-academia collaborations (or links between them)
2. One change that would strengthen links between industry and academia, and/or enable collaborations.

The outcomes were recorded in a Padlet (see appendices), which are summarised below and grouped into key challenges and changes.

**One key challenge or barrier (if any) to interdisciplinary industry-academia collaborations:**

- **Intellectual property:**
  - IP restriction / negotiation
  - IPR Rules: IPR protection requires a lot of negotiation between academia and university
- **Cultural differences:**
  - A self-imposed barrier is the academic convincing the best post graduates that the best career for them is in academia. We all know that this is not true. Academics should be more open minded to career choices available to students.
  - Academics are scared of losing focus on their own line of research.

- Academics do not share their industry contacts with other academics as they fear losing them.
- Culture/working model - differing styles of collaborating and communicating. Aligning on priorities.

- **Time and resources:**
  - Freeing up time and budget on all sides to define and establish the research.
  - Contracting time-lines
  - Project Based Funding: Post Docs aren't available to work on industry funded research unless it lasts for at least a year. Existing postdocs are funded by a project and can't spend 3-6 months on a 'side' project.

**One change that would strengthen links between industry and academia, and/or enable collaborations:**

- **Learn from/use existing models of best practice:**
  - Consortium model of sharing what is going on in academic labs with industry with a view to collaboration in overlapping areas (e.g. Division of Signal Transduction Therapy University of Dundee).
  - Fee-for-service model and flexibility to group leaders to collaborate with industry partners quickly.
  - Learn from universities with good tech transfer departments.
  - Employ more consultants who have moved sectors to share their success stories.
  - Individual research councils have great schemes which promote porosity. These should be shared across research councils and not badged as being from a single Research Council. E.g. PIPS from BBSRC and Prosperity Partnerships from EPSRC are both models of best practice in my opinion [MS].
  - Promote the use of the Lambert agreements for more rapid negotiations.
  - IP: Open Innovation models relax the focus on IP and seem to enable many research projects.
- **Training:**
  - Offer training through professional development on how to establish collaborations.
  - Placing more value on developing holistic researchers: more value placed on developing more holistic researchers through PhDs/Post-docs, preparing them for industry and collaboration.
- **Secondments:**
  - Plan funding for secondments (both ways): proper funding for secondment (e.g., in projects, as part of PhDs), sometime the entity seconding his staff thinks of "losing" them and then do not allocate money.

## Plenary discussion

This was followed by a group plenary discussion around the key challenges and solutions to interdisciplinary industry-academia collaborations. The below summarises the main discussions from the participants (initials indicated). Anything in [ ] is interpreted due to poor sound quality, or added for clarification.

> **Facilitator:** Outlined the challenges around IP and asked if anyone wanted to expand on the challenges they've faced with IP in academic collaborations.

**BR:** The UK, despite being challenging, is much easier than some other countries [to collaborate with]. So an example would be Germany, where we've pretty much stopped doing academic collaborations because it's impossible, or very, very expensive. So with the global perspective, the UK is actually reasonably well positioned here, even though it takes time and energy.

> **Facilitator:** Asked in addition to problems with IP, some groups had highlighted the issue with the contracting time lines, and asked if anyone wanted to expand on that challenge in particular.

**MS:** Doesn't think the time lines are as bad as people might pretend. Sometimes it's because relatively junior people in universities negotiating these things, so they're rabbits in the headlights. That's because they don't get paid as well as some other people [who are] contracting jobs outside of TTO's. On the positive side of things, the use of the Lambert agreements has saved his team hours of negotiations. They're not perfect, but they are a good starting point, and it's easy to justify why you are adopting the Lambert principles. You just need to agree upfront which rules you're going with. Adds that he's used the Lambert agreement in Germany with success, although other rules in Germany make it more complex and expensive.

> **Facilitator:** On the positive side, others also mentioned models that could help with IP [and other challenges]. Is there anything else that might reduce the barriers around IP?

**MS:** You need to be open and transparent about what IP you're talking about. From experience of a very successful Open Science consortium between GSK [GlaxoSmithKline], the Wellcome Trust, and other companies; when there is underpinning research which isn't proprietary that's great. You need to have a very open and transparent conversation at the outset as to who owns what. Sometimes Universities are a little bit unrealistic as to what their contribution is in the whole of the IP jigsaw.

**BR:** Referring to an example of an industrial doctoral centre they [Roche] set up with Oxford and 20 other companies; arriving at an open innovation model helped us move forward, and it only took 18 months to get the IP master agreements in place. In the grand scheme of things it was reasonably successful. On their third round of funding, 13-14 years in, they have never failed a single patent from any project. Yet again, it shows sometimes disproportionate emphasis on things that are quite infrequent.

**MS:** commented that BR said upfront that is was open, and that's exactly right.

> **Facilitator:** There were a lot of comments around the academic cultural barriers in the Padlet, and the word 'fear' comes through a lot (e.g. fear of losing their industry contacts or

their career in academia). Would anyone like to comment on those barriers or possible solutions to the cultural barriers to collaboration?

**DS:** Commented that it was an interesting thought. An academic might worry about losing control. From experience, suggesting to an academic from a small university to collaborate with a big company or a big university, often they will say that they [the big company or university] will take control and they won't have any part in it anymore. To an extent they could either be a part of something big, or they could just soldier on by themselves and never get anywhere. DS also asked the other participants if they had noticed that during the pandemic and during lockdown, a huge amount of academics decided they were going to spin out companies. Maybe it was because collaborations became harder, but it's not always the right or the appropriate thing to do. Again, its academics feeling that they need to keep control of things, it's an anti-collaborative instinct that is there. Had others experienced that?

**Facilitator:** from the comments in the Padlet there is a suggestion that perhaps a solution to some of these cultural issues is training. Maybe academics need some training to understand why spin offs aren't always appropriate. There was a suggestion around training on how to actually establish these collaborations, and maybe that will also lower the fear academics have of losing control. Involving industry partners in that training may also be necessary.

**Facilitator:** Other challenges that came up were around the budgets and funding. The issue of who has the budget and where does it lie? Any further comments? [No comments given].

**Facilitator:** In summary, a lot of the challenges and changes that could be made are centring on this IP issue and the time it takes to set up agreements. There was also a discussion around the need to be more open. Solutions or positive changes would be to follow good practice that are already in place like the Lambert agreements or Open Innovation models. Around the challenge of changing the research culture; these are big questions that HE is currently grappling with, and the suggestions around improving the training and understanding of academics [for collaborations], as well as making secondments easier and more available will all help.

## Summary of outcomes for section I

For the theme of "Understanding barriers to collaboration", the following summarizes some of the key outcomes from the discussions above in relation to the key questions asked by X-Net:

**How does industry work with academia? Are these partnerships more important in an interdisciplinary environment?**

Rory Duncan's talk highlighted the need for more porous career paths between academia and industry and other sectors for R&D to thrive and to be able to absorb the funding being made available. To increase porosity between sectors, there needs to be more work done in increasing security for those moving between sectors through more secondments, considering implications of pensions, and encouraging more co-funded and co-supervised PhD studentships with industry. There were also many challenges to this discussed, such as the impact the REF has on how academia values

traditional outputs, and the need for a shift in mind-sets away from viewing leaving academia as a failure. Other broader issues of the research culture and environments outlined in the R&D People and Culture Strategy were also discussed.

**What are the main barriers (if any) to interdisciplinary industry-academia collaborations?**

The key barriers were around issues with agreeing on IP, cultural differences and mind-sets of academics who may fear losing control or direction, and issues around funding and resources (time resources and limits on post-docs freedom to move). Other challenges discussed by Rory Duncan are around how academia values traditional academic outputs and the REF may indeed hinder porous careers as this hinders traditional academic career progression. There were also issues around maintaining security for those who want to move, and the need to reduce the risk for individuals.

**How to strengthen links and promote industry-academia collaborations that are interdisciplinary?**

Ways to strengthen collaborations and links included using or learning from existing models of best practice, in particular open science models, as a way to improve issues around IP. Examples of the Lambert agreement and Open Innovation models were given. Other solutions to cultural barriers were around more training for academics on establishing collaborations, and the need to change mind-set away from viewing leaving academia as a failure to one of success. The need for more holistic training of PhD and post-docs, moving towards team working rather than an individualistic training focus, was also discussed. Secondments and joint PhD studentships were also seen as a good way to enhance industry-academia collaborations and to enable the porosity for career pathways into and out of academia.

Rory Duncan mentioned that the REF is likely to change what is being valued going forward to allow for more varied research outputs to be included, enabling more movement between sectors and back into academia without the fear of losing your value in academia.

**Can interdisciplinary research help answer future industry-related grand challenges?**

This question was not addressed directly, but there were several comments that innovation happened at the interface of disciplines and sectors.

# II. Understanding industry requirements and the skills gap

## Industry requirements and preferences

Participants were asked to discuss the following questions, and post their ideas individually onto a Padlet (see Appendices), considering hard skills or soft skills that they require in new recruits:

- What key skills do you value the most in new recruits?
- Preferences for other key characteristics (i.e. data science or lab based skills)

The activity was not run as expected, as the participants found the activity difficult to respond to as their requirements were very different and it was not clear what the 'hard skills' or 'soft skills' meant. Instead, we continued with a broader discussion around skills requirements, and some participants chose to post skills to the Padlet as well.

Due to the issue around this activity, the Padlet was not fully utilised (6/12 participants contributed). However, for hard skills there was a strong indication for the need for data science, software and programming skills, AI and machine learning (though please be aware of potential for bias in this outcome due to the specialisms of participants). This also came up in discussions. For soft skills there were several posts on ability to work collaboratively and as part of a team, problem solving skills and being able to progress projects for delivery, as well as strategic and leadership skills (being able to ask for help and seeking other views).

## Plenary discussion

The following summarises the main discussions from the participants (initials indicated). Anything in [ ] is interpreted due to poor sound quality, or added for clarification.

**MS:** commented that the question was a bit naïve and mentioned that the ABPI skills gap analysis showed 80 different job types. To over generalise this is difficult as they run a bi-annual survey because these things come and go depending on market forces. However, based on who was on the call everyone is going to say they need data skills, visualization, etc. Every single job needs that, robotics automation. It seems a bit over general.

> **Facilitator:** MS made a very good point, and one that we can take further in discussion. It may be more relevant in that case to have a discussion around when you are hiring new recruits, is there anything in particular they're lacking?

**MS:** When it comes to data, academics treat their data sources very differently to industry. We have to compartmentalise our data, it has to be date stamped, and it has to be interoperable. We have to be able to use it. Often with software development in academia it'll just stay in the lab because they can't be bothered to polish it to make it so that it can be used by others. That's the major difference.

**RK:** I would wholeheartedly agree with that. I think standardisation and coding standards, CI/CD Standards, FAIR (findable, accessible, interoperable and reusable) standards are not something that we tend to see strongly in candidates coming in from academia.

**MS:** We're actually thinking of putting in all of our studentships, irrespective of the discipline, a box that says we don't expect you to be FDA regulated but we do expect you to have certain data standards. If you want to join industry in future you're going to have to have this. It's going to be like report writing or public speaking, it's going to be one of things you need or you won't get a job.

**RK:** In the recruitment search process, candidates that come to us with a clearly active GitHub portfolio are much easier to quickly evaluate in terms of that specific requirement. Showing both the willingness to contribute to open source software as well as the desire to show off what they can do. I don't know if that's universally encouraged or acknowledged in universities? It really does make a big impact on the first impression to me.

**LW:** Mentioned that they saw a very nice job advert recently that said if your CV isn't just your GitHub you're probably not right for this role.

**RK:** With the caveat that this comes from a very data science-centric recruitment requirement. The other thing is people coming from hard core data science and statistics, part of the challenge for us is that we want people who can communicate the value and impact of their work to non-specialists. Looking at [graph] data science, it's challenging to hire people who have the ability to translate what they're doing to a lay audience.

**MS:** Many of the [participants] on this call are looking for the high-end real AI machine learning, data visualization people. But irrespective of your scientific discipline, data sets are getting bigger and you need to be able to analyse and statistically analyse [data] more and more. Everybody will need at least to be able to talk the language of the AI machine learning person, and know what is possible.

> **Facilitator:** On that we have a question in the chat. Is there a preference towards depth or breadth of technical skills, in the context of AI and data analysis?

**BR:** I think both phenotypes are important. The ability to actually bring those two together in a team [is important], so you have both breadth and depth working very smoothly together.

**RK:** It also depends on the job level as well. I think the higher you go, the broader you get.

> **Facilitator:** When you're hiring you recruits from academia, what level do they tend to come into you from? Is it PhD level or beyond that?

**BR and SN:** Both agreed usually Post-doc level is recruited.

> **Facilitator:** And is that because PhD students don't have these very technical skills yet, and that takes time to develop?

**BR:** I think they just don't have such a strong portfolio of application. They may have the skills but the majority we would like to see who've applied their skills within a domain of interest to us.

**MS:** Sometimes you want the person who's got a very strong non-IT scientific discipline, and you want them to CPD (continued professional development) into being able to speak the language. We haven't mentioned apprenticeships, which we use a lot in this space, so you get loyal people trained up to a level where they can communicate with our machine learning people.

**RK:** mentioned Novo Nordisk also uses Postdoc fellowships, who will then more often than not come in at the end of their fellowship to work with the company.

> **Facilitator:** It seems that there's an emphasis on those with data analysis backgrounds rather than lab based in the biomedical industries?

**BR:** I think it's a mixture for us. We have 2 broad phenotypes, those from a computational background who have to learn life science and health care; and those that come from a life science and health care and they have to learn the computational side. Both are really important to put together an interdisciplinary team. I think one that may emphasise this I put [in Padlet]: curiosity in continuous learning. In 5 years' time, whatever skills and knowledge they have will have evolved. We

continue to evolve throughout the career. So people who are really curious and show their ability and interest to learning are super important to us.

> **Facilitator:** If somebody comes with interdisciplinary skills to the table already, would they be a step ahead already? If academia has produced these interdisciplinarians to start with, would that make them more valuable to you?

**BR:** Generally yes. I don't know if most universities do this, but PhD students working as teams, have they worked in a scrum environment? Have they been a scrum master? Have they examples of leading a project? All these types of things would be very advantageous.

**SN:** I think interdisciplinarity is very important. If you come from a computational side, you need to learn the life science part, and vice versa. So somebody coming having a knowledge of both, maybe it might not be that deep, but understanding both for sure has an advantage in many of the applications that we post.

> **Facilitator:** We've discussed broadly the main skills that you are looking for when you are recruiting and your preferences around whether those are lab based or not, and also the interdisciplinary aspects of them. Thank you all for your contributions.

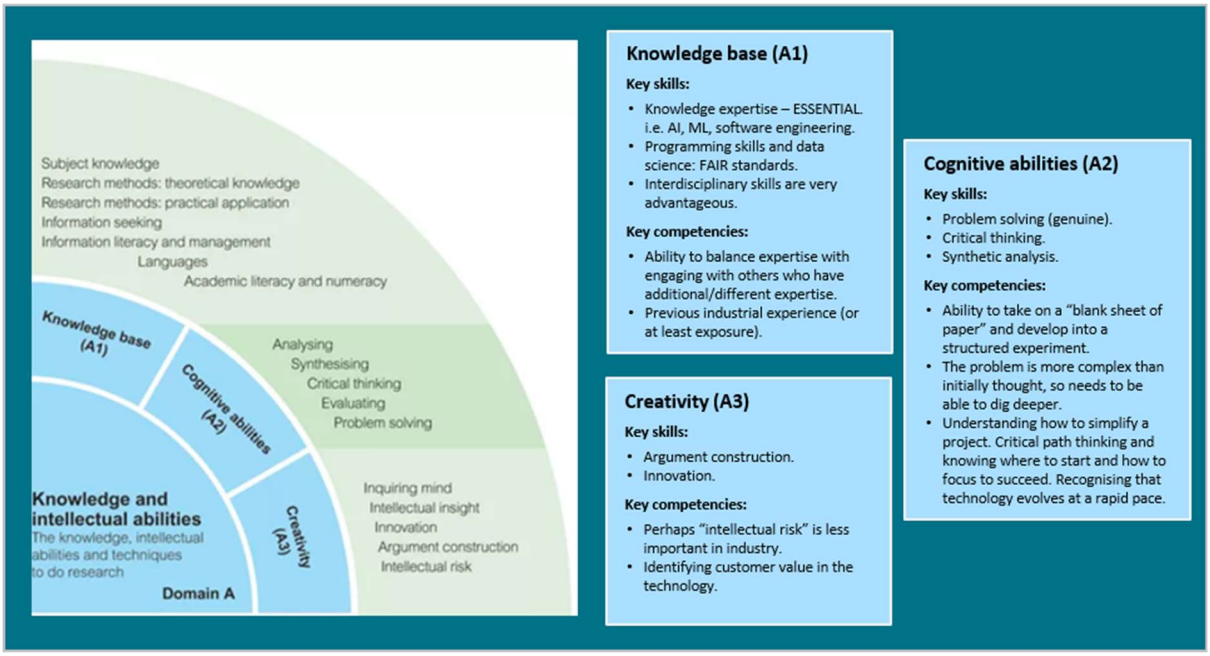
## Understanding the skills gap

The Vitae Researcher Development Framework (Vitae, 2010) provides a useful framework that can be used to compare what skills researchers typically develop, and what skills or competencies industry requires. The RDF provides key knowledge, behaviours and attributes that are developed or acquired through, or used in, the broader contexts of being a researcher and provides a common language for skills development that researchers will be familiar with. These can be used to map core competencies required in industry onto academic research skills, and highlight where these are missing or could be improved. This can also then help researchers prepare for transition into industry.

Participants were split up into two groups to discuss one half of the RDF and to fill out the key skills required and to clarify those in a Padlet. There was a focus on broad skills, and an acknowledgement that this would be a fairly rapid assessment of key skills required and where those might be lacking.

The following shows the group Padlet outcomes, one domain at a time, as well as plenary discussions around the skills required in each domain.

## RDF domain A: Knowledge and intellectual abilities




**Plenary discussion of Domain A**

**BR:** [For A1] it was pretty clear at the beginning that subject matter, knowledge, and expertise was essential for every role. Obviously it is different for different roles. Particularly in our domain, more data and an informatics related, the languages include programming languages not just spoken languages. And then we also highlighted previous industrial experiences of a great benefit. So maybe an internship or an industrial project, or something during studies, would build confidence that this person was perhaps motivated in the right way, they understood what they were getting into, had some evidence to show of working in industry. The other one links to the ability to frame arguments and interact with others who have perhaps a different position.

**KS:** [For A2 - when asked to clarify "genuine" problem solving] He put in the word genuine because MS had raised the topic of problem solving skills, but not along the lines of how people get coached in Oxford or Cambridge on how to pass an interview. As opposed to giving the right talk at the interview, actually demonstrating how they can approach and solve a problem in a way that can't really be mimicked in the training for your next job interview.

**RK:** [For A3] clarified that 'intellectual risk' is perhaps more for senior scientists. Not sure intellectual risk was the right description for it, and not sure how to separate it from creativity.

**SN:** [added for domain A2] Critical thinking was key, and that the problem can be more complex than initially thought. Some people come straight from universities and they think they've understood the problem and go straight into solutions, where sometimes the problem is more complicated than that.

**LW:** [added for domain A2] I think there's an additional piece here as well, which is the ability to really simplify a project and to identify in a very focused way what is the one experiment, or what is

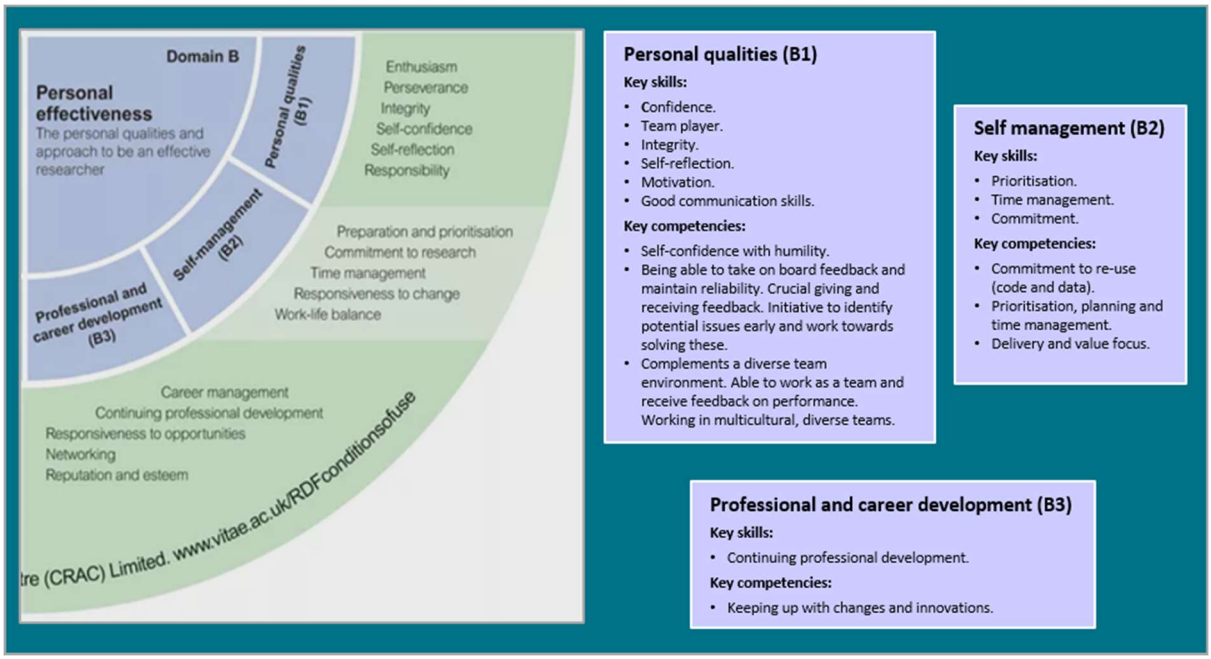
the smallest set of experiments you're going to be able to achieve to progress your project. We talk a lot about having a fail fast mentality, which is what experiment will I do first that's going to be able to kill this, or what is the minimum amount of data that I need to gather to help me make my decision about what avenue to progress down. Often this is very different from an academic mind-set. Many problems that we face there are 10 different ways that you could gather additional information, and a load of different experiments you could do, and often the academic mind-set might be we could do all of them, and they'll all be interesting, and they could all lead to new avenues of research. Particularly within drug development within biotech it'd be much better to pick one and really drive at it as fast as possible, and to have that focus.

**Facilitator:** This is almost the converse of understanding complexity is trying to not make it too complicated?

**SN:** I really think they are together. So there is one realization that the problem is more complex than you thought. But then, can you blend out the known important thing so focus really on what allows you to either succeed or fail early.

**KS and LW:** commented this is called critical path thinking in project management, and it's the ability to identify the critical path and where to start.

## RDF Domain B: Personal effectiveness




**Plenary discussion of domain B**

**RK:** [For B2] commented that delivery and value focus is attached to critical path discussion in domain A.

**SN:** [For B3] commented that professional development is showing that they care about being up to date with the latest changes, because they will experience so many changes. 5 years ago they didn't think that ChatGPT would come and revolutionize everything [for example].

**LW:** [For domain B] asked if there was anything about giving and receiving feedback? Academics have a little bit more of a hierarchical mind-set, and then can react quite negatively to feedback from more senior members of teams, and struggle to give feedback to more senior people. They are not necessarily used to that, and it's something he really encourages within his teams. It falls into the personal development, but it's also about supporting other people's development and being invested in their ability to grow and taking part in that through giving them the feedback that they need.

**BR:** commented that they did talk about that but felt that it fitted in the top left quadrant [domain D] with mentoring. **SN** agreed.

**Facilitator:** Suggested that there's also a personal quality in there, and being able to take on board feedback [added it to B1 after general agreement].

**RK:** commented that it is subtly different and agreed with LW that it's not reflected in the RDF. It's part of the development progress to be able to articulate this with a manager or a colleague and being able to make sensible decisions.

**KS:** It's balancing someone being a team player without being a maverick. It's a fine line between being an independent thinking maverick type guy who can offer alternative perspectives and just being a pain in the backside.

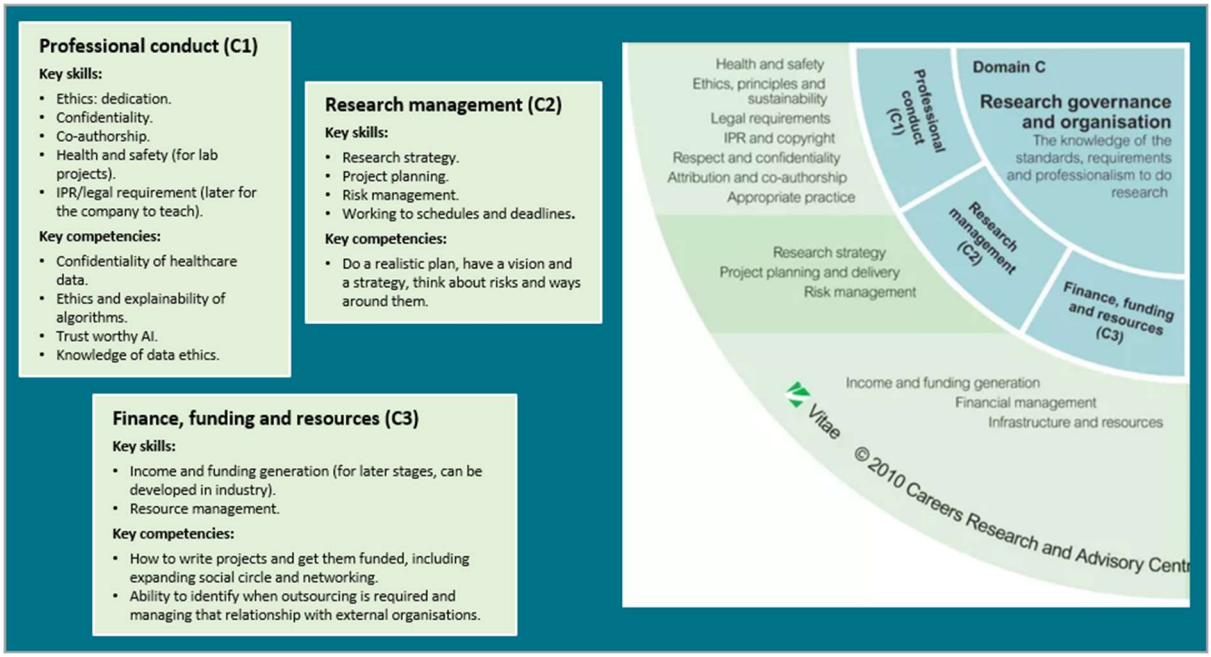
**Facilitator** added team player under B1 to capture the discussion, but **RK** commented that it was also in D1. **Facilitator** acknowledged some skills cross over domains and also placed it below the RDF as a skill that didn't quite fit into the RDF in one place only.

**BR:** commented there's also an important 360 [degree] nature, both giving and receiving feedback.

**RK:** It's similar to intellectual integrity, curiosity or openness. Having the initiative to identify potential issues early, either with the science or with the mechanism or the mentorship approach, or any of these things. It comes a little bit down to self-confidence.

**Facilitator** included under B1 self-reflection and integrity as a personal quality.

## RDF Domain C: Research governance and organisation




**Plenary discussion on domain C**

**SN:** [For C3] commented that income and funding generation was probably more for a later career stage but they wanted to highlight it, though it's not something that they would look for in [early career] stages.

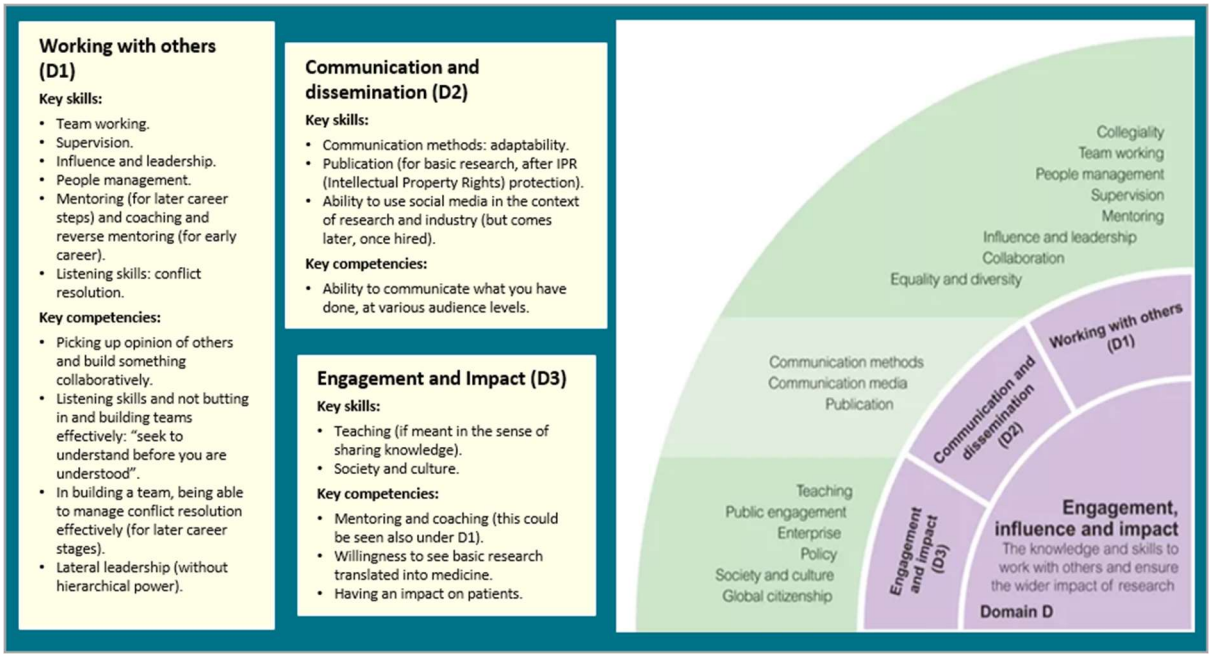
**RK:** [For C3] commented that having come himself from academia, and something they see in academics coming into the company, is that they use a lot of outsourced CRO's (contract research organizations) and identifying outsourced organizations is super important for tasks that we may not have the bandwidth to do in house. Knowing when, and where, and how to identify a CRO to shunt some work to is super important, and that doesn't often come naturally to people.

**LW:** Agreed with RK. Thinking about the textbook academic: there's this thing you know things about, I could do all of these things, and I will take my project through from start to finish. LW tries to push a mentality about only doing the things that they are world leading at, and if they don't really do that better than anyone else, then have a CRO do it for them.

**RK:** mentioned that they also need to be able to hold them to account. So managing the relationship [with the CRO] is useful.

**Facilitator** added to C3 resource management, and included the ability to identify when outsourcing is required and managing that relationship with external organisations.

## RDF Domain D: Engagement, influence and impact




**Plenary discussion on domain D**

**BR:** [For D1] wanted to be explicit and add coaching and mentoring as they are slightly different, and more appropriate to early career scientists, because mentoring is typically for more experienced [scientists]. Although, there is also reverse mentoring where junior people mentor people in specific technologies or areas of research.

**MS:** agreed that reverse mentoring was pretty effective.

**KS:** [For D1] wanted to add in something about listening skills. Some people are really good at it and know when to listen to people and not butt in, get their own point expressed, and can understand before they open their mouths. Could be in personal effectiveness [domain B] or working with others [domain D], but it needs to be in there as in his experience it's been the essential difference between someone who can develop and build a team, and someone who can't.

**RK:** [For D1] commented that conflict resolution, and understanding when and where to push back or offer strong opinions is important. This comes with experience, and it's not something a junior person would be expected to do.

**Facilitator** added listening skills and conflict resolution to D1 to capture these comments.

**RK:** [For D2] mentioned that a lot of people that come to us are surprised that in industry we are interested in publishing.

**BR:** also wanted to include something around ability to use social media in the context of research and the professional environment in D2. **SN** said that they discussed communication through social media, but it was not something they look at in the beginning for people being hired, so they did not highlight it.

**MS:** picked up on RK's comment on publication, and that academics are often surprised by this. Looking at the full weighted citation impact (FWCI) for most pharma companies it's usually at least as good as, if not better, than the academics they're collaborating with. When universities work with big pharma their FWCI actually doubles, it's 2-3 times more. MS has done this time and time again for different universities he's been to as an exercise in SciVal, and thinks it should be publicised more.

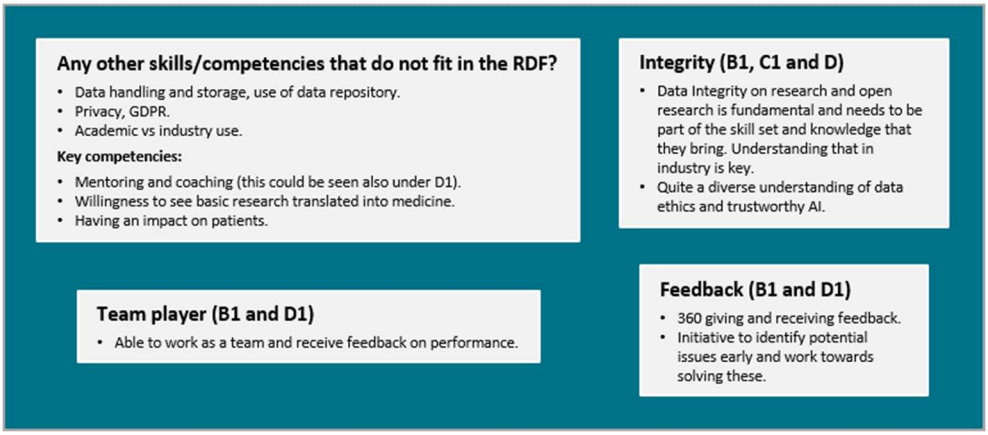
**Facilitator:** commented that the publication skills isn't just knowing how to publish but is about understanding that in industry this skill is still very much used and results in higher impact publications.

**MS:** commented that they do have higher impact because they only publish when they have something to say, rather than to get their next grant. It's a difference. This also links into the data integrity discussion, as industry needs to be able to reproduce what the academic publishes, and if they don't have standards on how they got there it's very difficult to replicate the science.

**BR:** also wanted to include areas that are rapidly evolving, such as the social implications and trustworthiness of AI, and that this fits in with ethics, explainable algorithms and so on [domain C1]. We see quite a diverse understanding and experience in that space.

**Facilitator** included integrity at the bottom as it fits in both domain D and B and C1, including a diverse understanding of trustworthy AI.

## Skills that do not fit into the RDF easily




## Summary of outcomes for section II

For the theme of "Understanding industry requirements and the skills gap", the following summarises some of the key outcomes from the discussions above in relation to the key questions asked by X-Net:

**What are the key skills required for industry? Industry recruitment preferences: scientists with a background in one or else several disciplines? Scientists with laboratory- and/or analysis-based academic backgrounds?**

Many of the discussions centred on the need for data and computational skills, as well as programming and AI, and that this was likely to increase as data becomes larger and more complex in all areas of research. The need for high data standards, and showing that the standards of data were such that they could be re-used and were interoperable were important. Integrity was a common theme, and the integrity of the data and science was essential. GitHub was also mentioned as a key skill that could set applicants apart. Team working and ability to work in interdisciplinary teams was a key skill, and this included several other skills around taking on board feedback and listening to others as well. Communication and being able to communicate complex information to a lay audience was discussed, and use of publications as well to disseminate science. Problem solving skills and critical path analysis (knowing where to start) for the most efficient solutions was also desirable. Generally, industry tended to hire from the Post-doc level as they are better able to show application of these skills in key domains for industry. Funding Fellowships and PhD-studentships were also mentioned as a mechanism to train and recruit researchers from academia with the right skill sets.

There was no preference for people with backgrounds in one or the other discipline, but there was a need for those recruits to be able and open to learning about the other side to be able to work effectively in interdisciplinary teams. It is also possible to train someone up to gain these interdisciplinary understanding and skills on the job.

**What are the main interdisciplinary skills missing in new recruits? What are the interdisciplinary training requirements in academia for future industry hires?**

From the skills gap analysis, there were further discussions around key skills and competencies. Of these, those that were missing were around the need for integrity of the data and showing high standards for data to ensure reusability. Team work was also discussed as an area that could be enhanced, with particular skills around listening and taking on board feedback being particularly difficult to find. Problem solving had to show 'genuine' problem solving, linking this to critical path analysis and not over complicating a problem and being able to solve these efficiently and minimally. The ability to know when to outsource to other organisations was also mentioned, and this was not something that academics are used to thinking about as they want to do it all themselves. Future training needs are therefore likely to be linked to data standards and integrity, team working and professional development using feedback effectively, genuine problem solving and critical path analysis.

**Should academic training curricula be adapted to account for newly emerging technologies?**
This was not addressed directly, but the emergence of ChatGPT, machine learning and AI was mentioned several times as an emerging technology, and one that requires people with expertise in these areas more and more.

# Appendices

## Slides presented by Prof Rory Duncan

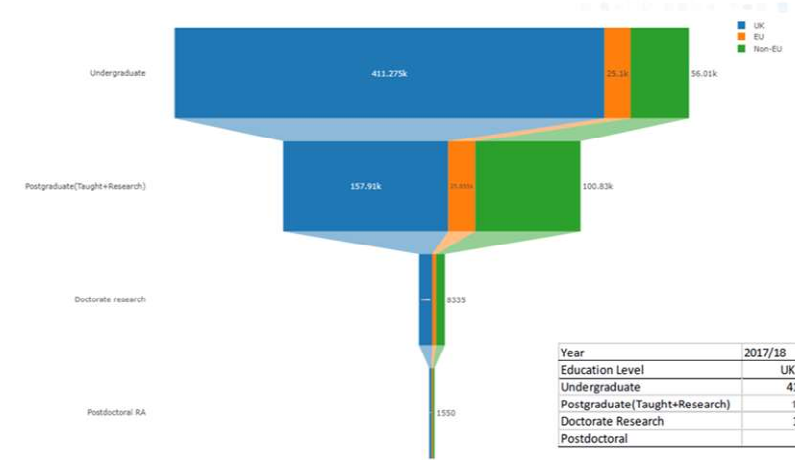
### Flux and opportunities


### People and Culture: Some challenges in R&D

- The UK R&D Roadmap articulated a range of challenges present in the R&D

| | | |
|---|---|---|
| Careers in R&D are not as attractive as they could be. | There is an **unclear career pathway** for many technicians, graduates, early stage researchers and those re-entering research after a break. | It is difficult for people to **flow between academia, industry**, the public sector and charities, or to move creatively between research and development roles. |
| There are **barriers and costs for international** researchers and entrepreneurs wanting to come and work in the UK. | Attracting, developing, and retaining **diverse people** in R&D – making R&D for everyone. | Some parts of R&D exhibit features of an unhealthy work culture, including **evidence of bullying, harassment and discrimination**. |

## Graduates : In 2017/18, 492K graduated with an undergraduate degree, 284K with a postgraduate among which 25K with a doctorate research.

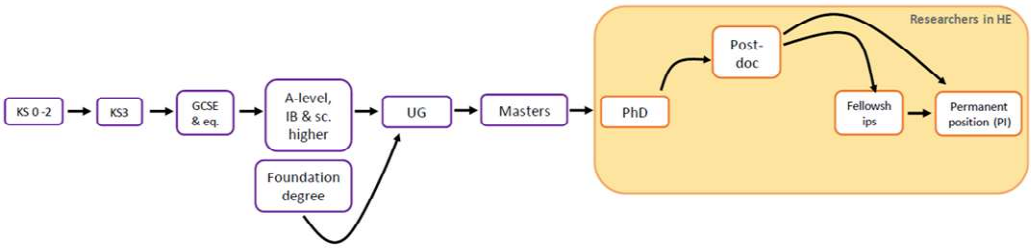



| Year | 2017/18 | | | |
|---|---|---|---|---|
| Education Level | UK | EU | Non-EU | Total |
| Undergraduate | 411,275 | 25,100 | 56,010 | 492,385 |
| Postgraduate(Taught+Research) | 157,910 | 25,855 | 100,830 | 284,595 |
| Doctorate Research | 12,820 | 3,695 | 8,335 | 24,850 |
| Postdoctoral | 2,335 | 1,230 | 1,545 | 5,110 |

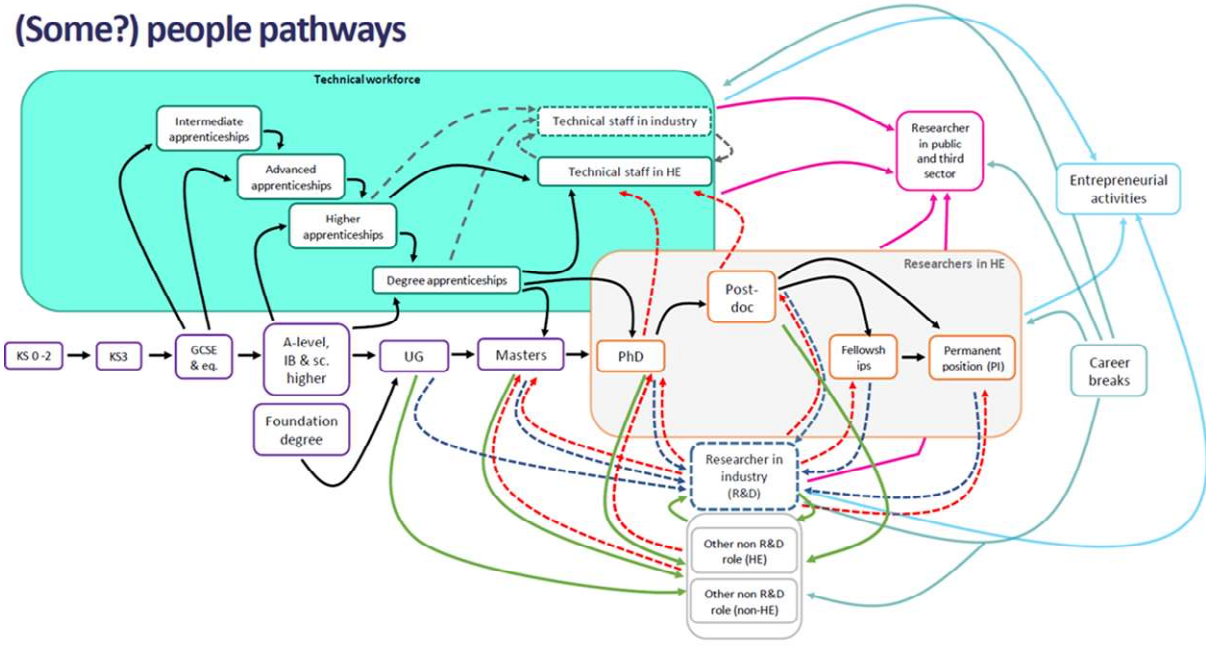
*Data Source : HESA student 17/18*
*Due to rounding, Total might not matched HESA published data*

Data collated by UKRI analysis

## (Some?) people pathways




Slide prepared by Kaliani Gupta, UKRI




Slide prepared by Kaliani Gupta, UKRI

# Lowering barriers to collaborations group outputs

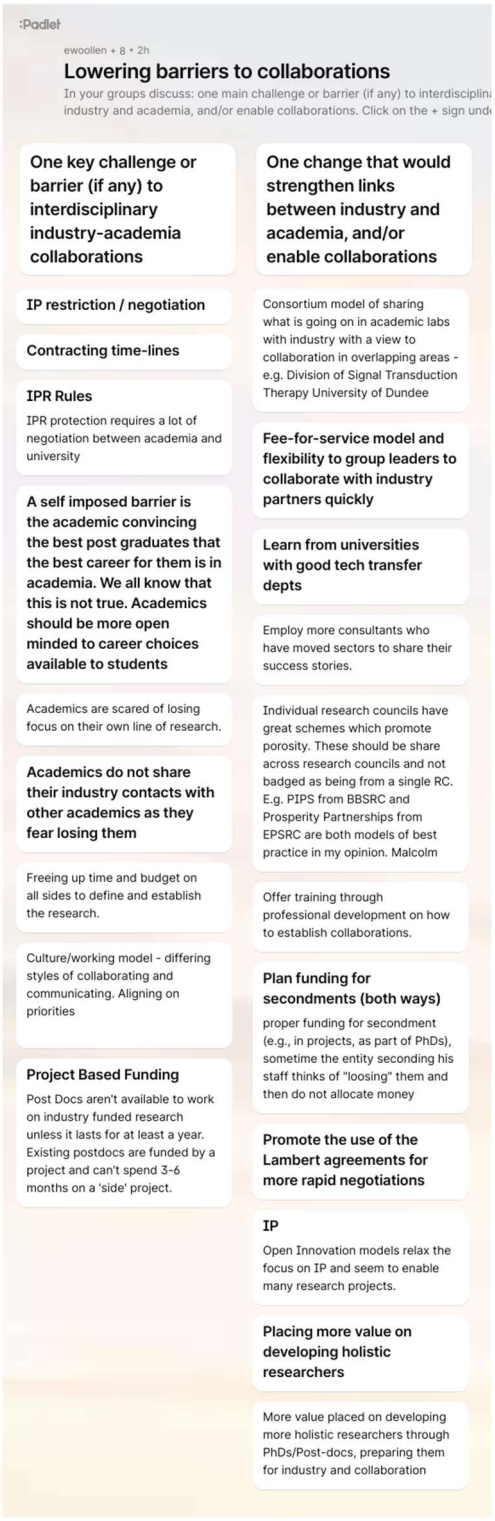



**Fig. 1:** Image of the Padlet group outputs from the exercise on lowering barriers to collaborations.

## Industry requirements and preferences - Padlet


**Fig. 2:** Image of the Padlet output for the discussion/activity on what skills are most valued in new recruits. Left side is hard skills and right side is soft skills (though note this distinction was highlighted as being less helpful when company's requirements varied significantly). Only 6 out of 12 industry participants contributed to this padlet.

## Blog: interdisciplinary research needs porosity, by Emily Woollen

Below, you can find the link to the blog written by Emily Woollen from the IAD (University of Edinburgh) about the importance of porosity for interdisciplinarians when crossing sectors: industry, academia and others. Emily worked as an interdisciplinarian for many years and more recently, as an Academic Developer for the University of Edinburgh. Her understanding of the issues related to crossing disciplines is prominent and this is why the evaluation about interdisciplinary research that she makes in her blog is very interesting.

https://blogs.ed.ac.uk/iad4researchers/2023/03/23/interdisciplinary-research-needs-porosity/