University of Dundee

Sweeping away barriers to interdisciplinary research

X-Net; Idigo, Amaka; Khamseh, Ava; George, Charlotte; Ponting, Chris; Martin, Cristina

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SWEEPING AWAY BARRIERS
TO INTERDISCIPLINARY RESEARCH

RECOMMENDATIONS
BASED ON X-NET PROJECT OUTCOMES
MARCH 2024
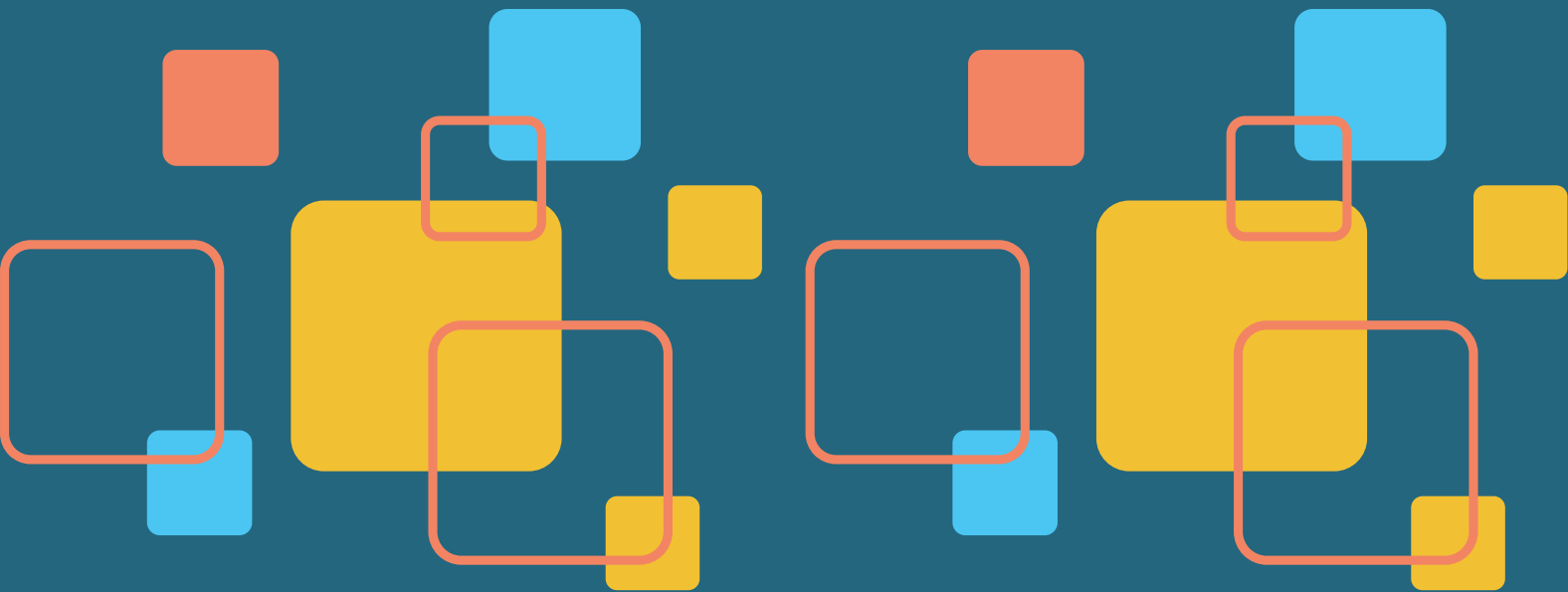
INTRODUCTION

Catalysing cross-disciplinary exchange is vital to propel scientific discovery into economic and societal impact. For science to give maximum benefit to UK society and economy, academic research requires root-and-branch reform that transcends individual disciplines.

UK researchers currently face daunting barriers when crossing disciplinary boundaries. Isolated within departmental silos, they find it difficult to excel across multiple disciplines. They struggle to integrate into unwelcoming research environments and are subjected to inequitable processes for evaluation and funding. Future Leaders Fellowship and PhD programmes have bulldozed barriers for some, yet many more, including those seeking to change discipline post-PhD, still face daunting career obstacles. Funders admit these barriers, but urgent and decisive action is needed to dismantle them.

These conclusions come from widespread consultations with early career researchers, industry scientists and key opinion leaders.

"The exciting aspect of being an interdisciplinary researcher is the opportunity to tackle complex problems and grand challenges that inherently require the collaboration of various skills and disciplines. The primary challenge currently lies in the fact that most institutions do not provide a natural home for these researchers."

Prof Georgios Leontidis
Director of the
Interdisciplinary Centre for
Data & Artificial Intelligence
University of Aberdeen

Interdisciplinary Research Definition

"Interdisciplinary research is understood to achieve outcomes (including new approaches) that could not be achieved within the framework of a single discipline. Interdisciplinary research features significant interaction between two or more disciplines and/or moves beyond established disciplinary foundations in applying or integrating research approaches from other disciplines."

UK's Research Excellence Framework
(REF 2021 Interdisciplinary Advisory Panel final report)

X-Net is an interdisciplinary research network whose main aim is to understand barriers to interdisciplinary research, before offering solutions to overcome them.

X-Net recommends a 13-step programme of targeted multi-level interventions drawn from evidence gathered by the network in 2022-2023. The 13 interventions would deeply weave interdisciplinarity into UK scientific research culture and free the flow of ideas and expertise across traditional disciplinary boundaries and sectors.

Three sets of recommendations are provided highlighting the need to:

INCREASE MOBILITY

NURTURE ENVIRONMENTS

EVALUATE EQUITABLY

"For interdisciplinary research to succeed, we need to come together from different disciplines and bring our different ideas to everything we try to do. It's good to spend time learning those disciplines separately, but our work become richer if they continuously overlap and we get inputs and thoughts from other people."

Alice Pyne PhD
Senior lecturer, FLF
University of Sheffield
X-Net Talk
November 2022

"If researchers are not working together, it creates reputational damage and this leads to mistrust and less inclination to engage in future!"

Anonymous contributor
X-Net PPI workshop
August 2022

RECOMMENDATIONS
SUMMARY

INCREASE MOBILITY

1. Enable short-term pivot fellowships at any career level.

2. Introduce UK-wide fellowships to fast-track talented researchers across poorly permeable disciplinary boundaries.

3. Incentivise team science & network building by actively providing 'first step' training opportunities.

4. Promote active co-supervision of early career researchers or technicians working on interdisciplinary projects by investigators from different disciplines.

NURTURE ENVIRONMENTS

5. Build cohorts of researchers and sustain them with networking and mentoring events.

6. Draw up a code of conduct to outline responsibilities and expectations for collaborations.

7. Promote training in interdisciplinarity for all researchers about the advantages, challenges, and values of interdisciplinary collaboration.

8. Extend continuous training opportunities, currently limited to doctoral students.

EVALUATE EQUITABLY

9. Prioritise funding to interdisciplinary projects when panel scores are tied.

10. Recognise and allow for longer timeframes required for interdisciplinary training and outcomes.

11. Assess the team and interdisciplinary science commitment in collaborative applications.

12. Enable flexibility of authorship ordering to remove ingrained bias.

13. Convene funding panels with interdisciplinary members in proportion to the interdisciplinary proposals assessed.

INCREASE MOBILITY
ACROSS DISCIPLINES & SECTORS

Interdisciplinarity and team science should be deeply embedded in all scientific cultures to normalise the flow of people and knowledge across disciplines and sectors.

The added complexity of interdisciplinary research demands additional time be given and instability requires increased entry points and communication between disciplines at all career levels.

X-Net

INCREASE MOBILITY
ACROSS DISCIPLINES & SECTORS

Recommendation 1
UKRI should offer short "Pivot Fellowships" at any career level. These 6-12 month secondments would catalyse collaboration, innovation and transfer of culture and skills across disciplines, at all career stages and bi-directionally between academia and industry. They would deliver long-term research impact and personal development whilst giving equitable access accounting for individuals' personal circumstances. Fellows would benefit from being brought together as a cohort, akin to the FLF devnet (see recommendation 5).

"It is very valuable to industry when academia produces interdisciplinarians with the skills and experiences required to work in, and lead, multidisciplinary agile project and product teams."

Prof Bryn Roberts
Roche SVP, Global Head of Data and Analytics
<u>X-Net Industry Workshop</u>
January 2023

Recommendation 2
UKRI should introduce a prestigious UK-wide Fellowship whose purpose is to fast-track talented researchers across poorly permeable disciplinary boundaries. Once across these boundaries Fellows would be well positioned to take their next career step, for example as a UKRI Future Leader Fellow. One example is Edinburgh's MRC-funded Cross-disciplinary Post-doctoral Fellowship (XDF) programme, a 4-year deep-training model successfully redeploying scientists with analytical skills from physics and mathematics into biomedicine.

"There has been a lot of focus recently on the best ways to bring people together to promote innovation and discovery. Diverse, multidisciplinary, international teams are critical in so many aspects of science."

Katalin Kariko PhD
Nobel Prize in Physiology or Medicine 2023

INCREASE MOBILITY
ACROSS DISCIPLINES & SECTORS

Recommendation 3
UKRI should encourage network building and incentivise team science by actively catalysing 'first step' training opportunities. This would be through promoting hackathons, interdisciplinary workshops, summer schools and essay-writing competitions.

Recommendation 4
UKRI should champion good practice for early career researchers or technicians working on interdisciplinary grant projects to choose co-supervisors or mentors from different disciplines. This will catalyse new training opportunities.

WITHOUT ACTION

Knowledge and innovation transfer across disciplines remains the exception rather than the rule, and scientific progress continues to be hindered by outdated institutional structures. Scientific hostility to unlooked-for skills continues unchecked. Investments in interdisciplinary research struggle to form productive networks. Transformative scientific discovery is severely compromised.

"A cultural shift is required to place more value on interdisciplinary research by funding bodies, training programmes and individual researchers."

Anonymous respondent
X-Net workshop
"Overcoming barriers to cross-disciplinary research"
July 2022

"As an interdisciplinarian, I think it is really helpful to have mentoring that helps one to be guided through how interdisciplinary research works and what are some of its obstacles."

Anonymous respondent
X-Net survey
August 2022

NURTURE ENVIRONMENTS
ACROSS DISCIPLINES & SECTORS

Interdisciplinary researchers are often not supported by host institutions, and are misunderstood by single disciplinary researchers.

Sustainable interdisciplinary research investment requires training of all researchers in effective collaborative working and equipping of interdisciplinarians with tools for resilience.

X-Net

Recommendation 5
UKRI to incentivise cohort building for funded interdisciplinary researchers and alumni, sustaining them with networking and mentoring events. This will build strong communities across institutions, and disseminate strategies for navigating barriers in the research landscape as best practice in interdisciplinarity is fragmentary and rarely incentivised. Cohort schemes are lacking in the critical career gap between the Doctoral Training Centres and the Future Leaders Fellows Development Network.

"Very little support when crossing disciplines. Rather, much greater support of researchers/research in single disciplines. There is a culture of neglect towards cross-disciplinary researchers rather than a conscious bias against them."

Anonymous respondent
X-Net survey
August 2022

Recommendation 6
UKRI should require collaborators in any interdisciplinary research project to establish a code of conduct outlining the responsibilities and expectations of its researchers. This code seeks to ensure fairness and respect, and to give career benefit across all team members. Its principles would focus on how the best science is achieved when ideas, expertise and knowledge are exchanged unconditionally. This code would minimise misunderstanding between research cultures and fields, and make explicit to all the rewards of team science.

"In collaborations, respect is crucial, making sure that people will be treated fairly, especially when it comes to publishing."

Prof Dame Carol Robinson
Director of the Kavli INsD, Oxford
Founder of OMass Therapeutics Ltd.
X-Net Talk
August 2023
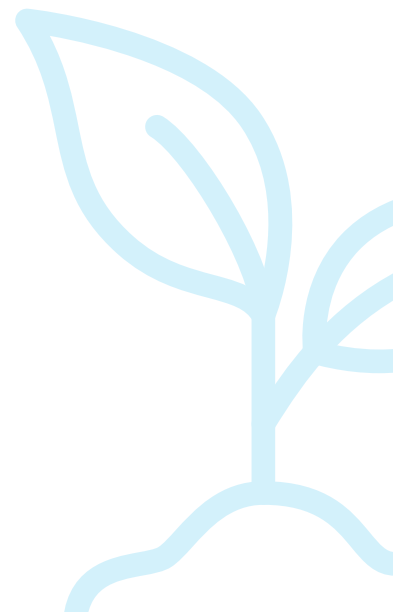
NURTURE ENVIRONMENTS
ACROSS DISCIPLINES & SECTORS

Recommendation 7
UKRI should encourage host institutions to train researchers in the advantages, challenges and values of interdisciplinary collaboration. Training should cover: jargon, culture, misconceptions, good/ bad practice, communication approaches, project management, leadership and learning methods.

Recommendation 8
UKRI should extend any training opportunity currently limited to doctoral students to postdoctoral researchers and technicians. Learning is life-long: all career levels benefit from continuous training and diversity in experience.

WITHOUT ACTION

Interdisciplinary researchers are left to navigate the turbulent academic system alone without support networks or mentorship. Environmental support is haphazard, varying greatly by department and institution. Interdisciplinary researchers still face research cultures hostile to their interrogative innovation. The transformative potential of interdisciplinary researchers is rarely attained.

X-Net survey: 80% of the respondents thought that additional training is required when crossing disciplines.

"Working in a multidisciplinary environment is necessary in our industry; for me, a basic understanding of other disciplines is necessary but perhaps the biggest hurdle is time".

Anonymous respondent
X-Net survey
August 2022

"More flexible and better designed training programs would be a useful step towards relieving some of the pressures faced by early career researchers, who are the 'engine room' of UK academic research... Researchers should receive wider training and be made much more aware of opportunities outside academia, because skilled researchers are required elsewhere in the RDI landscape and beyond."

Sir Paul Nurse
Independent Review of the UK's Research Development and Innovation Organisational Landscape
2023

EQUITABLE & SUSTAINABLE
EVALUATION & FUNDING

Interdisciplinary careers often follow non-traditional winding routes.

Inequity arises from track records and evaluation metrics being unfairly compared to more traditional 'linear' career paths.

Interdisciplinary science needs time and opportunity to fail, as a necessary step towards ultimate success.

X-Net

EQUITABLE & SUSTAINABLE
EVALUATION & FUNDING

Recommendation 9
UKRI funding panels should give priority to interdisciplinary projects when panel scores are tied.

Recommendation 10
UKRI Funding panels should recalibrate expectations of interdisciplinary researchers due to the longer timescales needed for their research trajectory. Periods of delayed output due to the journey taken when retraining should be expected.

Recommendation 11
UKRI investigators and teams should be assessed on evidence of how they have encouraged interdisciplinary and team science, including patient and public involvement and engagement. Use the narrative CV to evidence researchers' attitudes and contributions to team science. Ensure this is evidenced by examples of real world situations, e.g. how a team cohered or overcame a barrier, and how the individual contributed to that solution.

"Interdisciplinary research peer review is difficult because of double jeopardy when being judged and unhelpful tribal attitude about the use of specific language. We miss opportunities for grants and publishing because of this."

Prof Ewan Birney
Director EMBL-EBI
Deputy Director General EMBL
X-Net Talk
October 2022

"You work twice as hard, you get half the credit. As an interdisciplinary scientist by training I feel deeply betrayed by the system. I am aware of my unique skillset. I'm just realising that it may get me stuck in the same career level forever if the evaluation system doesn't change."

Anonymous respondent
X-Net survey
August 2022

"Science comes from good team work in academia or industry. Perhaps it is more difficult to find in academia because it can be a competitive environment for individuals – let's try to make it less so!"

Prof Dame Carol Robinson
Director of the Kavli INsD, Oxford
Founder of OMass Therapeutics Ltd.
X-Net Talk
August 2023

EQUITABLE & SUSTAINABLE
EVALUATION & FUNDING

Recommendation 12
UKRI should ensure that authors with equal input in grant proposals or manuscripts can be presented in any order. This would overcome ingrained bias within traditional publication cultures.

Recommendation 13
All funding panels should contain interdisciplinary members in proportion to the fraction of interdisciplinary proposals being assessed, and alongside independent observers who can report on fairness and consistency. These changes will increase the voice and experience of interdisciplinary researchers in the decision making process.

WITHOUT ACTION

Interdisciplinary researchers still face inappropriate evaluation metrics that do not capture their potential for innovation or impact. Interdisciplinary researchers' failure to acquire funding leads to attrition from academic leadership positions. In turn, this jeopardises the training of future skills required if UK is to cement its place as a science and technology superpower.

"The main form of hostility experienced by me as an interdisciplinary researcher has been at the level of applying for independent/faculty positions and promotions, where interdisciplinary research can be valued less than research within a 'core' discipline. There is also the perennial issue of authorship order on major research publications that combine contributions from different disciplines".

Anonymous respondent
X-Net workshop "Overcoming barriers to cross-disciplinary research"
July 2022

Among the barriers to interdisciplinary research determined in the X-Net workshop "Overcoming barriers to cross-disciplinary research", the negative perception of 'Jack of all trades, master of none' was highlighted by numerous participants, with implications in how interdisciplinary researchers are assessed by different evaluation panels.

X-Net workshop "Overcoming barriers to cross-disciplinary research"
July 2022
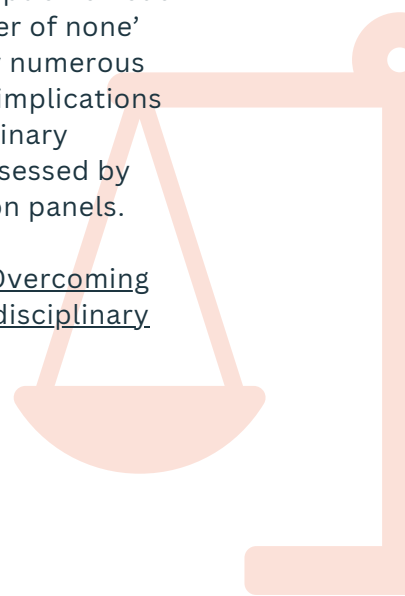
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Interdisciplinary researchers are often not supported by host institutions, and are misunderstood by single disciplinary researchers. Sustainability of interdisciplinary research investment requires training of all researchers in effective collaborative working and equipping of interdisciplinarians with tools for resilience.

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PROJECT STEERING GROUP

Amaka Idigo, U. Edinburgh
Ava Khamseh, U. Edinburgh
Charlotte George, U. Oxford
Chris Ponting, U. Edinburgh

Cristina Martin, U. Edinburgh
David Sims, U. Oxford
Desiree Tennant, U. Oxford
Dmitry Finkelberg, U. Dundee
Duncan Sproul, U. Edinburgh

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Helen Nickerson
Hugh Warden
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Jennifer Anderson
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Luke Williams
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Mark Leake
Martin Christlieb
Mary Muers
Mhairi Towler
Nils Kölling
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Rob Kitchen
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MRC Molecular Haematology Unit — UNIVERSITY OF OXFORD

Disclaimer: the views and conclusions expressed by X-Net are those of the network and do not necessarily reflect the official position of project collaborators.

Reports from the activities carried out by X-Net.

- **X-Net workshop** "Overcoming barriers to cross-disciplinary research"
- **X-Net survey** "Overcoming barriers to cross-disciplinary research"
- **X-Net PPI workshop** "Creating & Nurturing Diverse Teams for Effective Biomedical Science"
- **X-Net Industry Workshop** "Preparing the roadmap: prioritising cross-disciplinary training needs with industry"

For more information please contact X-Net:

🌐 https://x-net.bio

▶️ @X-net2022

✉️ info@x-net.bio

in X-Net Interdisciplinary Research Network

𝕏 @XNetbio

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