Improving Collaborative Research Practices

Insights from knowledge exchange activities with UKPRP-funded consortia and networks

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UKPRP Prevention Research Partnership
Joint action for a healthier, fairer future

prevention research network

Prevention Research Network Interest Group

This report is based on findings from the knowledge exchange activities delivered by the UKPRP Prevention Research Network Interest Group: 'Improving Collaborative Research Practices'. It was written by the Interest Group co-leads:

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Executive Summary

This report investigates perceptions and case studies in what comprises 'good' inter/transdisciplinary research (ITDR) and identifies recommendations for improving the effectiveness of such collaborative research projects. It sets out the common challenges and captures the innovative ways research networks and consortia have been able to operationalise their ITDR projects. The study was funded by the UK Prevention Research Partnership (UKPRP) and prepared by the Prevention Research Network (PRN) Interest Group for 'Improving Collaborative Research' with contributions from members of the MatCHNet, PETRA, PHASE, GENIUS, ActEarly, GroundsWell, Kailo, VISION, SIPHER, and TRUUD research networks and consortia.

The study adopted a collective approach, reflecting on research through a series of workshops, meetings, focus groups, and a survey, involving in total 70 participants spanning diverse research project roles and viewpoints. Data collected in the workshops were analysed and synthesised using thematic analysis, and findings were then used to facilitate subsequent stages of an iterative knowledge exchange process. This report describes this phased study which was based on the Design Council's Double Diamond model for understanding complex problems and developing solutions, integrated with a '3-horizon' model to direct the knowledge discovery. The four phases enacted were:

- **Discover:** To understand broad challenges and solutions through a survey of UKPRP networks and consortia members.
- **Define:** To establish themes and discussion points through four meetings with members of networks and consortia and two focus group meetings with an advisory group.
- **Develop:** To identify targeted solutions at three workshops with academics and practitioners engaged in ITDR.
- **Deliver:** To provide insights and recommendations based on the analysis and synthesis of workshop data.

The study converged on nine key top-level themes, with further description of the many innovative processes, practices and tools that leaders, researchers, managers and support staff have piloted to improve ITDR projects and outcomes. Also described in the

report are the associated barriers and challenges encountered in their respective ITDR projects. The report comprises:

- **Section 1:** Introduces the UKPRP Prevention Research Network and PRN Interest Group.
- **Section 2:** Describes the implementation of the four-stage knowledge exchange process.
- **Section 3:** Outlines findings and recommendations for improving collaborative ITDR.

The recommendations are organised under nine headings to reflect the key themes, with sub-headings to reflect the multiple roles and the agency of stakeholders likely to be involved in future similar ITDR, and are intended to assist funders, universities and researchers to collectively improve research commissioning, planning and delivery. The nine recommendations are therefore proposed as guidelines for consideration by research funders, research institutions, and the research consortia and networks.

Summary of Recommendations

1	**Enhance funding models**	• **Funders:** Ensure funding allocations provision for partnership building, knowledge exchange, citizen engagement, coproduction and skills development. • **Funders:** Set guidelines for managing ITDR activities including permitting the use of flexible funds. • **Funders:** Establish transparent criteria and metrics to help reviewers evaluate ITDR grant applications.
2	**Build individual capabilities**	• **Institutions:** Build ITDR capabilities across academic and non-academic roles, defining soft skills learning and training programmes for researchers at all levels, research leaders, managers, and administrators. • **Institutions:** Equip doctoral students with skills needed to engage with collaborative projects. • **Funders:** Use the Research Excellence Framework (REF) to incentivise universities to enhance collaborative research capabilities.
3	**Create cohesive teams**	• **Consortia/Networks:** Innovate opportunities for team members to connect, share ideas, and produce academic outputs, with these opportunities funded in proposals. • **Consortia/Networks**: Project leaders should support collaboration and foster team cohesion at events and with activities tailored to meet the needs of multidisciplinary teams at each project stage.
4	**Shape future leaders**	• **Funders and Institutions:** Enhance capacity by creating academies or programmes focused on ITDR leadership. These should support current and aspiring leaders to develop skills for planning, implementing, and evaluating ITDR.
5	**Mobilise and integrate knowledge**	• **Consortia/Networks:** Recognise how to mobilise knowledge across disciplines and stakeholders, addressing challenges with dedicated resources, processes, and activities to bridge differences and facilitate knowledge exchange. • **Institutions:** Evaluate business models relying on fixed-term contracts for early career researchers (ECRs) and explore ways to incentivise retention for long-term, complex collaborative ITDR.

6	**Increase research agility**	• **Funders and Consortia/Networks:** Recognise risks associated with ITDR project complexities, such as aligning timescales across organisations and engaging multiple stakeholders. • **Funders:** Incorporate resource flexibility via contingency funds in funding calls to mitigate ITDR risks. • **Consortia/Networks:** Adopt agile project management approaches in ITDR practice.
7	**Drive innovation**	• **Funders:** Provision for flexible funds to encourage innovation, novel collaborations and new research directions, and fund project partners where this is essential to maximise transdisciplinary benefits. • **Institutions:** Emphasise interdisciplinarity in undergraduate, postgraduate, and ECR training and collaborate with funders and publishers to improve recognition of ITDR in high quality journals.
8	**Embed reflective practice and learning**	• **Consortia/Networks:** Integrate reflective practices into projects and commit to learning and continual improvement. • **Consortia/Networks:** Adopt reflective practice for collective evaluation of research purpose, effectiveness and impact, and to implement continual improvement of ITDR team practice. • **Consortia/Networks:** Create a safe, transparent environment for critical reflection where “what doesn’t work” and "near misses" are embraced as learning opportunities • **Consortia/Networks:** Project leadership should openly evaluate and report on ITDR research process, sharing insights and improvements in research practices.
9	**Improve stakeholder engagement and coproduction**	• **Consortia/Networks:** Collaborate with stakeholders to ensure language used in ITDR is accessible. • **Institutions and Consortia/Networks:** Establish ‘working groups’ to develop a collaborative approach to knowledge mobilisation, stakeholder engagement and knowledge transfer into policy spaces. • **Consortia/Networks:** Engage policy partners at an early stage to understand shared needs, motivations and clarify value exchange. • **Funders, Institutions and Consortia/Networks:** Create a knowledge base to inform future funding calls through joint workshops on coproduction. • **Consortia/Networks:** Embed consortia leadership positions for policy partners and engage early with communities to define collaboration roles, expectations and value exchange.

1.0. Introduction

1.1. UKPRP Prevention Research Network

The UK Prevention Research Partnership (UKPRP) Prevention Research Network (PRN) is a forum to share learning across key topics of mutual research interest. By exploring these experiences, and identifying common opportunities and challenges, the participant networks and consortia are seeking improved ways of working applicable to public health prevention research. The PRN has developed iteratively to respond to research practice needs with new topics of interest emerging over time. It is building a body of publicly available knowledge, methods, and tools, sharing this learning within this community and across the wider prevention research community.

What are UKPRP Networks and Consortia?

Each **UKPRP network** is an interdisciplinary community of researchers and stakeholders, centred around a broad primary prevention research challenge related to NCDs. These networks facilitate collaboration across various disciplines and user groups, enabling the exchange of expertise, scientific knowledge, and capabilities as they develop a shared vision for their respective NCD prevention challenges. A central goal of each network is to build future capacity in the UK to tackle NCD prevention challenges. The past and current UKPRP networks include:

- **GENIUS:** Build a community working towards a more health-promoting food and nutrition system in UK schools.
- **MatCHNet:** Lay the groundwork to develop research programmes to evaluate the impact of national policies on adverse child health outcomes.
- **PETRA:** Explore the relationships between trade policy and NCDs, focussing mainly on tobacco, alcohol and ultra-processed foods to determine how trade could improve health.
- **PHASE:** Deliver translational research that addresses the complex challenges faced by decision-makers in the prevention of non-communicable diseases.

Each **UKPRP consortium** is a novel partnership that brings together a diverse range of stakeholders across various academic disciplines to conduct interdisciplinary research focused on a specific challenge in the primary prevention of NCDs. UKPRP consortia develop research strategies in collaboration with users, such as policymakers, practitioners, civil society groups, health providers, and the public, who may also be part of the Consortium. This collaborative approach enables researchers to leverage a broad range of expertise to develop novel research into innovative, high-quality interventions capable of driving change at a population level. The past and current UKPRP consortia include:

- **ActEarly:** Improve the health and opportunities for children living in areas with high levels of child poverty; Bradford, West Yorkshire and Tower Hamlets, London by focusing on early life changes.
- **GroundsWell:** Drive community innovation applying systems science that maximise the contribution of Urban Green and Blue Space to the primary prevention of, and reduction of inequalities in, non-communicable diseases (NCDs) in urban settings.
- **Kailo:** Help local communities, young people and public service partnerships better understand and address the root causes (and wider determinants) of young people's mental health.
- **SIPHER:** Develop systems-based economic evaluation methods and tools to provide a common basis on which to appraise the effectiveness and costs and benefits of policy measures implemented in different sectors.
- **SPECTRUM:** Transform policy and practice to encourage and enable healthy environments and behaviours by investigating the commercial determinants of health and health inequalities and generating new evidence to inform the prevention of NCDs caused by unhealthy commodities.
- **TRUUD:** Change the way decisions are made about urban development to prevent NCDs in the future by working with key decision-makers, local communities, and advisors at a national, regional and city level to embed health in the system of urban decision-making.
- **VISION:** Reduce the violence that harms health by improving the measurement and analysis of data on violence.

1.2. PRN Interest Group: 'Improving Collaborative Research Practices'

This specific Interest Group for 'Improving Collaborative Research Practices' explores researcher perceptions and case studies in what comprises 'good' and improved inter/transdisciplinary research (ITDR). It provides an opportunity to share and reflect on how research teams can improve their research efficiency and effectiveness through changes in research management, processes and practice. The Interest Group has been led by researchers at University of Bristol who are also members of TRUUD (Tackling the Root causes Upstream of Unhealthy Urban Development). It includes an Advisory Panel comprising members of ActEarly, MatCHNet, SIPHER, SPECTRUM and VISION and contributions from UKPRP networks and consortia, funders and partners throughout the knowledge exchange process. The Interest Group has three core objectives:

1. **Improve team science:** Identify common challenges and the solutions networks and consortia have developed to operationalise their ITDR projects more effectively.
2. **Reflect on research:** Capture processes that researchers can adopt to continually improve research practices and outcomes through individual and collective reflection.
3. **Frame future ITDR:** Inform how funding bodies fund future ITDR and where universities and researchers could make improvements to research proposals and delivery plans.

1.3. Report Structure

In Section 2, this report sets out the knowledge exchange process and activities conducted at each stage in the development of this 'Improving Collaborative Research Practices' Interest Group, including data gathering through surveys and focus groups. Section 3 recommends key areas for further exploration that could improve collaborative research practices, considering the roles and drivers for inter/transdisciplinary research (ITDR) teams, stakeholders and funders. The Appendices present the data from three workshops in which UKPRP network and consortia members, partners and funders were engaged in identifying common challenges and developing potential solutions across several themes and project life cycle stages.

2.0. Knowledge Exchange Process

The Double Diamond (Design Council, 2025) provided the basis for guiding the knowledge exchange process carried out by the Interest Group, as shown in Figure 1. This framework facilitated 'divergent thinking' to explore ITDR challenges more widely or deeply and 'convergent thinking' to identify key themes and insights and take focused action. The following sub-sections relate to the knowledge exchange stages displayed in Figure 1. The final output, 'issues and recommendations', are presented in Section 3.

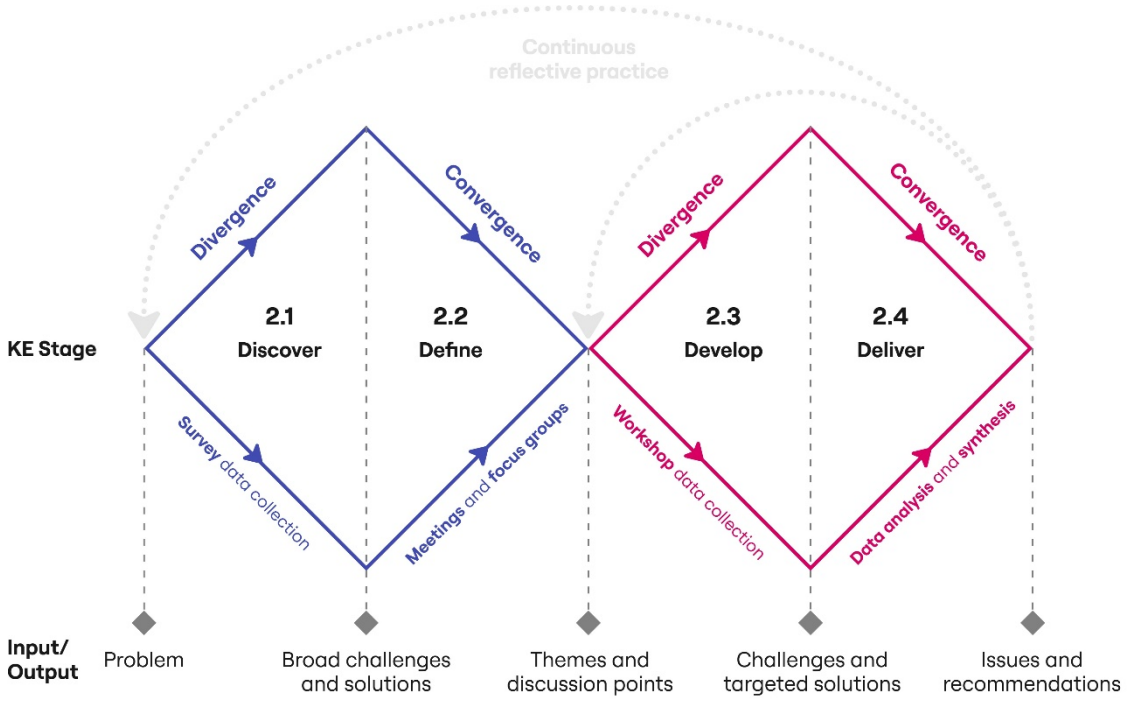


Figure 1. Double Diamond adapted for knowledge exchange process

2.1. Discover: Broad Challenges and Solutions

During this **'discover stage'** (see Figure 1), a **survey** was distributed to members of UKPRP consortia and networks, with the primary aim to understand the **challenges** faced when operationalising ITDR from a variety of viewpoints. There were 19 responses from members of ActEarly, GroundsWell, PETRA, MatCHNet, VISION, SIPHER, and TRUUD in the positions of project manager/coordinator, co-investigator, research fellow, researcher-

in-residence, communications and impact, and consultancy. The challenges spanned the life cycle of research activities including network and consortia building, managing interrelationships, and developing research impact. Example challenge areas included:

- 'engaging and collaborating with new stakeholders';
- 'integrating disparate forms of knowledge';
- 'dealing with conflicting values and expectations';
- 'managing interpersonal relationships';
- 'coping with uncertainty in data and projected outcomes'; and
- 'co-creating impactful interventions in complex problem situations'.

Equally important was the additional investigation to identify and record **potential solutions** to the challenges surfaced, including those solutions already piloted within the participating networks and consortia. Open-ended questions were used to discover:

1. ***Challenges*** that impeded research or collaboration.
2. ***Innovations*** in the use or development of new approaches, methods, or tools to help collaboration.
3. ***Agility*** in delivery as a need to change *research structures* (e.g. teams, partnerships, work packages) and/or the *research approach or methods* during the project life cycle.
4. ***Strategic awareness*** and the need to change or reconsider the top-level *project mission* itself, or the *aims or specific objectives* during the project life cycle.

2.2. Define: Themes and Discussion Points

During this second, convergence stage in the knowledge exchange process (Figure 1), a set of **meetings** was convened with representatives from the UKPRP-funded consortia and networks. Four meetings were held with individuals who had completed the survey from ActEarly, MatCHNet, PETRA and SIPHER, with an additional team member joining for both ActEarly and SIPHER. Each of the meetings followed a structure whereby exploratory questions were asked, probing in more detail the **challenges and solutions** emerging from specific respondent survey responses. This provided space to explore the **'discover stage'** survey responses across topics such as 'Systems Approaches', 'Coproduction', 'Data and Evaluation', 'Collaboration and Interdisciplinarity', and 'Managing Budgets'. In this way participants were encouraged to identify more detailed topics as questions,

challenges, possible solutions, and preferred outcomes (see Figure 2). Following this, two **focus groups** were convened with members of the PRN Interest Group's Advisory Panel to prioritise **themes** to take forward for further exploration and analysis in workshops as the third **'develop stage'** in the knowledge exchange process (see section 0).

The workshop **themes** were selected based on (i) frequency of occurrence across focus groups, and (ii) one or more representatives from the Advisory Panel indicating the significance of a topic. More detailed **discussion points** for each theme were developed by the PRN Interest Group based on notes from the meetings and focus groups as well as relevant data from survey responses.

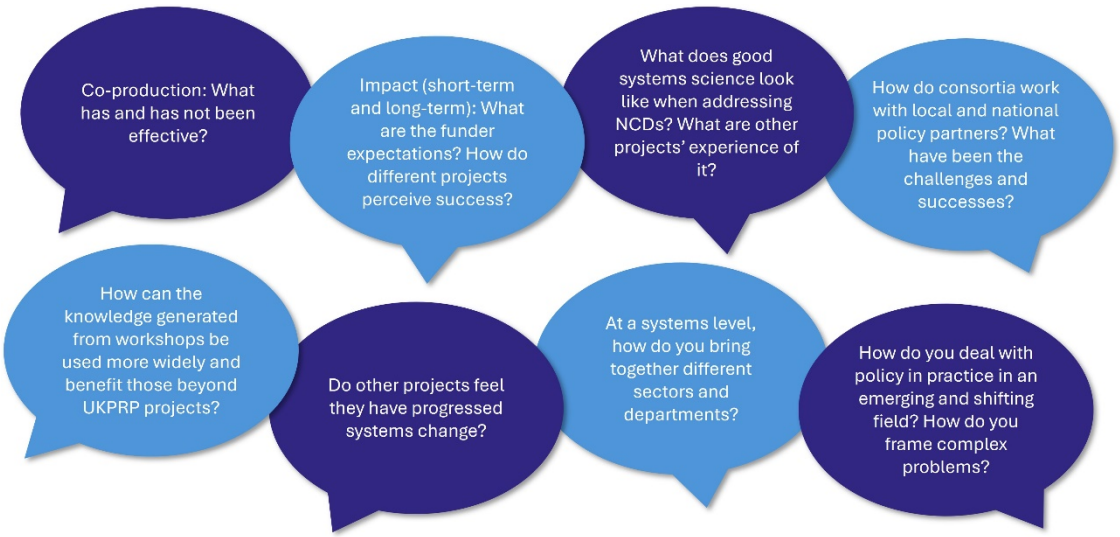


Figure 2. Example of questions emerging from 'define stage' meetings

In summary, the meetings and focus groups combined input from a diverse mix of members, roles and viewpoints drawn from several UKPRP consortia and networks, and through this facilitated process, the knowledge exchange converged on a specific set of **themes** to analyse in the **'develop stage'** workshops (see below).

2.3. Develop: Targeted Solutions

Having defined and prioritised the key **themes** as outlined in Section 2.2, this next stage facilitated 'divergent' thinking about possible **targeted solutions**. This PRN Interest Group convened **online and in-person workshops** with 39 stakeholders in variety of roles and positions to innovate new solutions and explore the transferability of solutions already piloted amongst UKPRP networks and consortia.

Figure 3 shows the different stakeholder groups represented in the workshops, including: 23% early career researchers (i.e. research associates and PhD students); 20% senior researchers; 17% lecturers/senior lecturers, including several work package leads; and 14% professors, most of whom were directors of their respective ITDR projects. There was also some representation from non-academic staff in ITDR projects, including programme managers (8%) and professional services (3%). Furthermore, there was participation from ITDR research funders (9%), such as the Medical Research Council and Wellcome Trust and policy/research partners (6%).

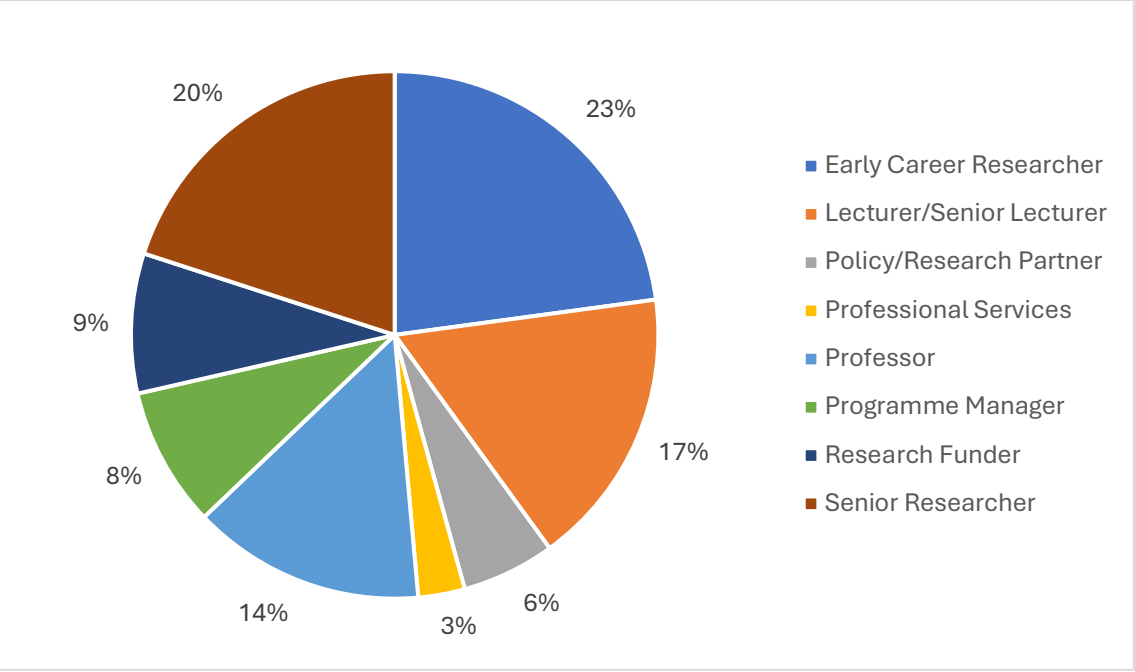


Figure 3. Pie chart showing stakeholder groups engaged in workshops

This **'develop stage'** initially built on the **themes and discussion points** identified in the **'define stage'** through two online workshops. These were designed to collectively reflect on **targeted solutions** to:

1. Building and sustaining ITDR capacity.
2. Enhance learning and continual improvement in ITDR.

They aimed to bring together a variety of perspectives and experiences to stimulate learning and lead to creative strategies to improve future ITDR and funding models.

Within each workshop, the Three Horizons[1] was used to frame and guide thinking, supported by an interactive Miro board. Participants were asked initially to reflect in small break-out groups on their experiences and discuss the key challenges raised in the focus groups before moving on to explore solutions as pragmatic steps towards the preferred future. The process reflected on the current state of ITDR experiences (Horizon 1) with the key themes from the focus groups as an input. The participants then identified their idealised future for ITDR (Horizon 3), and finally explored possible solutions in terms of the pragmatic steps (Horizon 2) that could improve current research practices and reach the envisioned future of 'where do we want to be?'. Figure 4 represents these steps and Figure 7 in Appendix D demonstrates the application of the Three Horizons framework in an online workshop.

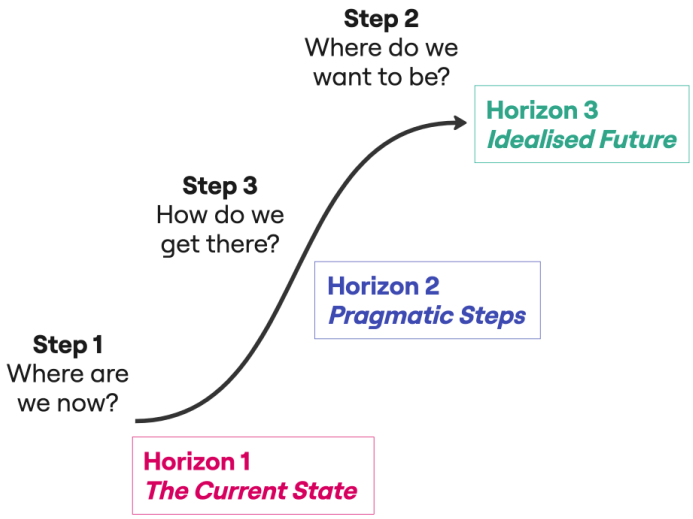


Figure 4. Three Horizons workshops steps

[1] The authors designed the workshops based on Bill Sharpe's (2020) Three Horizons framework to structure the discussions.

Workshop 1: Building and Sustaining ITDR Capacity

Building and sustaining research capacity was judged by participants to be critical to driving momentum on 3-to-5-year ITDR projects and empowering the research team members. This was seen to be particularly salient when new research approaches, methodologies, and tools, such as systems thinking and coproduction, are seen as key to delivery. The themes and discussion points targeted in the workshop are described in Table 1.

Table 1. Themes and discussion points in Building and Sustaining ITDR Capacity workshop

Theme	Discussion Points
1. Transforming Collaborative Research Practices	• Project infrastructures and approaches to help build capacity and continually improve collective team-based research. • The role of project leaders to build and integrate research capacity across academic and institutional boundaries. • Measures research institutions and funders can take to enable more effective collaborative research.
2. Sustaining an Inter/Transdisciplinary Research Team	• The role of managers/leaders to maintain interest and retain team members on long-term, large-scale projects. This reflects a need to counter the risk that researchers may seek new work before project completion. • Funding models designed to encourage retention, ensure outputs are completed, and sustain impacts beyond the project end date.
3. Knowledge Management, Integration, and Mobilisation between Diverse Stakeholders	• Knowledge management actions to embed and share knowledge across an academic-stakeholder research partnership. • Resilience built into large-scale research consortia, including retention, and sharing of knowledge and relationships. • Knowledge mobilisation measures to be taken to bring knowledge into the practitioner and policy space.

Workshop 2: Learning and Continual Improvement in ITDR

A reflective approach that emphasises learning and continual improvement was identified as a key challenge area, with the potential for reflective practice to provide regular feedback and deliver continual improvements in ITDR praxis. Participants believed there is potential for 'real-time' course correction to improve research management across collaborations, coproduction, project agility and knowledge integration. The themes and discussion points addressed under this second workshop are defined in Table 2.

Table 2. Themes and discussion points in Learning and Continual Improvement in ITDR workshop

Theme	Discussion Points
4. Agility of the Research Process	• Reflective practices to challenge aspects of the project infrastructure, approach, and processes defined in the proposal. • Revisiting our direction of research and expected outcomes (e.g., through Theory of Change) in light of new findings and unanticipated changes to policy or personnel. • Bid criteria to accommodate flexibility in research direction, considering potential changes during the project lifecycle.
5. Transparency and Inclusivity	• Willingness to share new learning and findings with other ITDR teams and funders. • The value of reflecting on, and learning from, the messy parts of research, and whether we perceive these as failures or opportunities for improving ITDR. • Consideration of who is included and excluded from research, and how to make it a more inclusive.
6. Continual Improvement Practices	• Approaches to learning and continual improvement of research practices at scales of personal, interpersonal, interdisciplinary, and transdisciplinary, including open systems approaches to evaluation (e.g., unintended consequences) and from other sectors. • Reflecting on whether we have the right values to address complex societal issues: whether we are setting the right missions to deliver beneficial impact, and whether we are operationalising these efficiently and effectively.

Workshop 3: Developing a Reflective 'Team Science' Approach to ITDR

In addition to the two online workshops, an in-person workshop was held at the UKPRP Conference in Edinburgh in November 2023. It set out to explore challenges and solutions related to various stages of an ITDR project life cycle by exchanging knowledge from different viewpoints. The life cycle stages are highlighted in Figure 5. We define 'research enterprise' as comprising the extended network comprising both University-based researchers, leaders, managers and support staff, including advisory boards; and spanning across organisational boundaries to include external organisations and individuals e.g., policy makers, industry partners, and communities, who are engaged in providing resources in whatever form (data, information, access to personnel and other assets, research time, finance and expertise) to facilitate the collaborative research and its translation into impact, whether potential (outputs) or realised (outcomes).

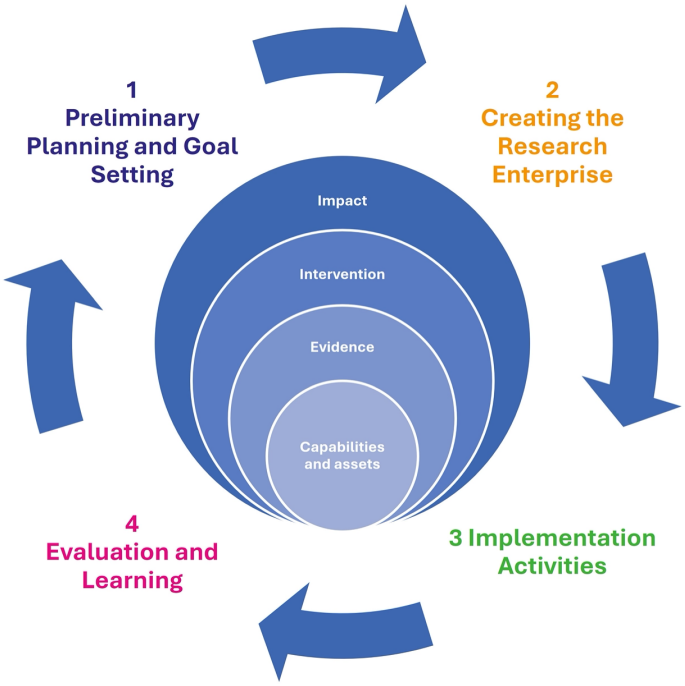


Figure 5. ITDR project life cycle stages for workshop

A total of 27 academics and practitioners attended the in-person workshop. They were all engaged in ITDR projects and were assembled as four groups, each prompted by a set of challenge-based questions to discuss related to each of the four life cycle stages as shown in Table 3.

Table 3. ITDR life cycle stages and related questions for workshop participants

Life Cycle Stage	Prompts/Questions
1. Preliminary Planning and Goal Setting	• How and when should research leaders engage a suitable mix of disciplines, expertise, and diversity of stakeholders to address mission and goals? • To what extent should funding rules, calls and reviews seek to enable or constrain inter/transdisciplinary research? • What measures should research institutions and funders put in place to incentivise collaborative research practice? • To what extent is ITDR constrained or enabled pre-existing partnerships and networks?
2. Creating the Research Enterprise	• How can research leaders build capacity and resilience into a large-scale and long-term ITDR project? • What actions are needed to grow effective and impactful stakeholder participation? • To what extent does an open, egalitarian, and collaborative research culture support ITDR? • What steps can be enacted to build shared values, norms, and language across an ITDR partnership?
3. Implementation Activities	• What approaches, toolsets and actions are effective in efforts to mobilise, integrate and utilise knowledge in practitioner and policy spaces? • What challenges and barriers have you experienced when seeking to implement ITDR? • How can coproduction with a diverse range of stakeholders (e.g., policy makers, industry partners, and communities) be incentivised? • What aspects of inter/transdisciplinary research are the main drivers of change, and which lead to innovations?
4. Evaluation and Learning	• Have you experienced continual improvement learning or reflective practices in your research and to what effect? • To what extent can individual and collective reflective practices improve ways of working in ITDR? • How effective are current evaluation approaches for research enterprises, e.g. evaluating complex public health interventions? • How effective are current processes of governance at delivering research accountability vis-à-vis delivery of mission and goals?

2.4. Deliver: Recommendations

At this final **'deliver stage'** of the knowledge exchange process (see Figure 1), data collected in the workshops were analysed and synthesised by this report's authors (Newberry and Rosenberg) to produce a series of interconnected issues to resolve and a set of correlated recommendations intended to address these. When reviewing the workshop data (see Appendices), the future visions and significant challenges were identified across the themes and ITDR project life cycle stages. These were characterised under headings following a thematic analysis process[2] and these were then linked to the proposed solutions generated in the workshops and during the wider knowledge exchange process. From these, a set of recommendations was synthesised which are presented in Section 3. These have been organised to reflect the different viewpoints and agency of stakeholders collaborating as UKPRP consortia and networks, conceptualised as the wider ITDR enterprise.

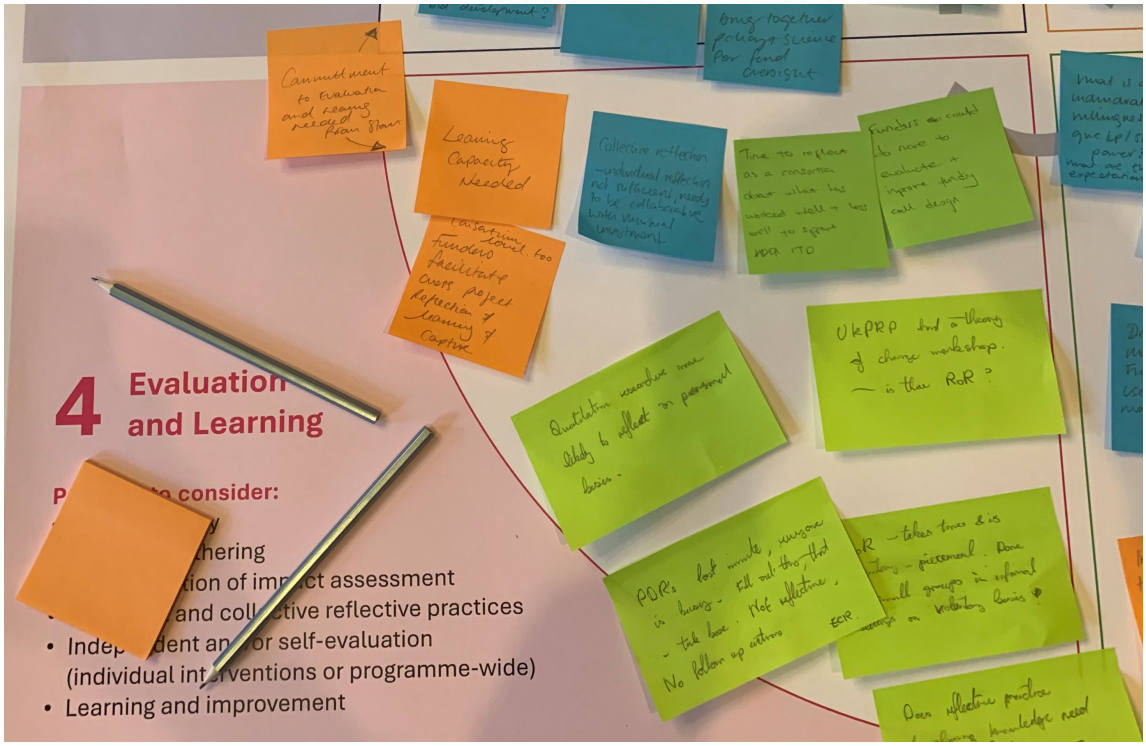
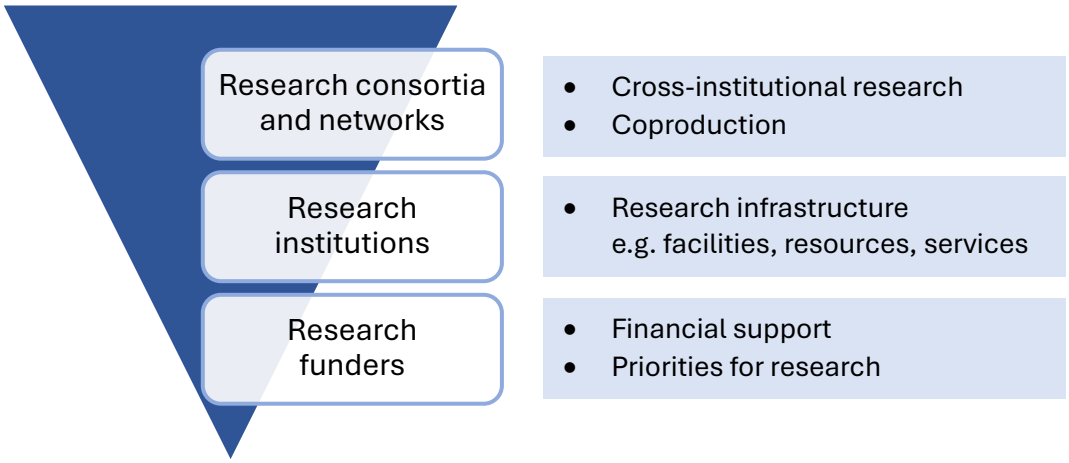


Figure 6. Participant sticky notes from workshop 3

[2] This thematic analysis was conducted by the authors following the process set out by Maguire and Delahunt (2017). The thematic analysis was combined within the three-horizon framework model in order to identify the interconnections between current challenges and barriers facing ITDR practitioners, the proposed solutions, and the desired improved future ITDR research environment the workshop participants envisioned.

3.0. Recommendations

Based on the analysis and synthesis of workshop data (see Appendices), a series of interconnected recommendations are proposed to improve collaborative research practices. These are targeted for consideration by different ITDR stakeholders including **research funders**, **research institutions**, and **research consortia and networks**.



Nine recommendation areas and the stakeholders targeted are highlighted in Table 4 and described in detail in the following subsections. Across these nine areas, there are a total of **25 recommendations** (see 'Summary of Recommendations' on page 3 for breakdown).

Table 4. Recommendation areas and target stakeholders

No	Recommendation Area	Target Stakeholders
1	Enhance funding models	• Funders
2	Building individual capabilities	• Funders • Institutions
3	Create cohesive teams	• Consortia/networks
4	Shape future leaders	• Funders • Institutions
5	Mobilise and integrate knowledge	• Institutions • Consortia/networks
6	Increase research agility	• Funders • Consortia/networks
7	Drive innovation	• Funders • Institutions
8	Embed reflective practice and learning	• Consortia/networks
9	Improve stakeholder engagement and coproduction	• Funders • Institutions • Consortia/networks

3.1. Enhance Funding Models

A traditional research funding model *sequentially* funds the research (the development of knowledge, a concept, product, policy or process), and as research outputs mature, e.g. through Technology Readiness Levels, supplementary follow-on funding is provided to transfer or exchange knowledge or otherwise accelerate impact and achieve societally beneficial outcomes. ITDR, such as that funded by UKPRP, however comprises large-scale projects that last multiple years, span a range of institutions and academic disciplines, all of which brings significant additional risks from dependencies on new relationships and research uncertainties into the research project. There is also an expectation that outputs are co-produced, and impact planning and knowledge exchange is affected *concurrently* within the timeframe of the research, such that long-term societal impacts are sustained beyond the project life cycle. Planning for and providing the diversity of resources for these more complex ITDR projects, and to do this in a timely and flexible manner throughout the research process, is therefore a key challenge for efficient and effective ITDR. A significant issue raised across all workshops and focus groups was a lack of flexibility in current funding models needed to resource a range of underpinning and impact-oriented activities that are integrated within and ITDR project.

Recommendations

Review funding models for large ITDR grants to consider how these could more effectively support and incentivise the range of additional activities required to underpin effective ITDR and establish what flexibilities could be permitted when managing an ITDR research grant. Examples of these additional ITDR activities include building and sustaining new partnerships; knowledge exchange and impact planning; fostering relationships with wider stakeholders including renumerating citizens and charity organisations for their participation in coproduction; and training to address ITDR skills and knowledge gaps, e.g. in systems thinking, facilitating coproduction, knowledge exchange, policy innovation and design. Funding guidelines could either require research bids to plan and allocate transparently the resources needed to support ITDR, or alternatively provision for a range of such activities to be managed by a consortium within a flexible ITDR development fund. Alongside this, research funders should develop relevant criteria and metrics against which to assess ITDR grant applications and their delivery.

3.2. Build Individual Capabilities

Many researchers, particularly ECRs, have limited or no experience of working on ITDR projects and have largely researched in a specialist unidisciplinary field. This means that individuals may lack knowledge, behaviours and skills for ITDR. For example, understanding or being able to apply systems thinking can be an important component of tackling complex problems in ITDR. Additionally, while there may be an expectation for ECRs to be immediately productive on a project, evidence presented through the workshops and focus groups is that there is often a lack of training to develop the capabilities ECRs need to build the confidence to engage across disciplines. These issues can lead to a feeling of 'imposter syndrome', particularly when an individual is uncertain of how and where their knowledge and skills fit into a large ITDR project.

Recommendations

> "Training in ITDR for academics (particularly ECRs) and non-academics delivered through an official project fund."
>
> Workshop 1

Universities that intend to bid for ITDR grants should develop a framework for building ITDR capabilities amongst academic and non-academic staff. The framework could set out learning pathways that apply to different roles in ITDR, such as postdoctoral researchers, research leaders and managers, and project administrators. These could contain specific training programmes and modules to develop the hard and soft skills required for each role, of which there would be cross-over. For example, topics could include ITDR methods (e.g. complex systems evaluation), managing large interdisciplinary teams, collaborating with external partners, supporting and sustaining interpersonal relationships, and cross-institutional budget management. Universities and research institutes should also consider how to equip PhD students with the right skills and behaviours for making the transition from individual research projects to more complex, collaborative projects. The Research Excellence Framework (REF) could then assess the ability of universities to develop both individual and team capabilities for ITDR.

3.3. Create Cohesive Teams

Individual capabilities are important, but to harness them effectively, people must be able to work well together and to span organisational boundaries. Building trust and interpersonal relationships are essential to team cohesion and to achieve diverse project objectives, and these can be supported by effective leadership and governance structures (see 3.4). However, an intrinsic feature of ITDR is that people work across different geographic locations and institutions, and this can present major barriers to building trust and relationships. It reduces how frequently team members see each other in person and relies more heavily on people meeting at scheduled events. It can also be difficult to maintain relationships when there are personnel changes within the core project team and partner organisations. Furthermore, external forces in academia cause disciplinary separation and a lack of team cohesion, i.e. career pathways that incentivise single disciplinary research and journals that reinforce this by limiting the scope of what are acceptable papers towards unidisciplinary.

> "Working across different geographic locations hinders team cohesion and interpersonal relationships."
>
> Workshop 1

Recommendations

Consortia and networks should create spaces and opportunities for team members to connect with one another, share ideas and learning, produce academic outputs, and explore future research directions, e.g. monthly writing retreats. These opportunities should be outlined in the original proposal and enabled by transparent project funding. The purpose of these events, where they take place, and how they are structured should be developed by project leaders and managers and tailored to the needs of the multidisciplinary team at different stages of the project life cycle. While training delivered by universities would embed the necessary ITDR capabilities (see 3.2), taking pragmatic steps to facilitate collaboration at the project-level would support the development of a cohesive team.

3.4. Shape Future Leaders

> "Strong leadership and buy-in from the whole team are key to building relationships and trust."
>
> Workshop 3

Large-scale ITDR face a twin-track challenge of complex research programmes with diverse content, delivered by large teams that may be geographically dispersed and hence become fragmented. For example, there can be disconnections within and between work packages, and management hierarchies can silo research, hinder collaboration and muddle accountability. Top-down governance structures may also disempower ECRs as the changing views of project decision-makers can force them to shift direction. Furthermore, different time allocations for Project Lead/Co-Is and ECRs can be a challenge to effective leadership, training and mentoring. For example, a Co-I with a low time allocation may not have the capacity to contribute to the ITDR, support full-time ECRs that they line manage. In addition, should a Project Lead or Co-I leave a project, this can also result in ECRs being "abandoned".

Recommendations

ITDR projects need governance structures and leadership that empower research teams and individuals with a clear research direction and resourcing. Research funders could seek to increase the capacity of the UK research community to deliver ITDR by creating academies/programmes that focus on academic leadership in ITDR. These programmes could bring together current and aspiring leaders in ITDR to exchange knowledge, share best practice, and develop leadership skills and processes related to planning, implementing and evaluating ITDR and working with external stakeholders. Experienced researchers, senior academics and project managers could benefit substantially from a structured programme, including peer-to-peer learning, that improves their ability to lead interdisciplinary teams to achieve diverse research objectives and maximise impact on policy and practice. These could also provide a safe and trusting environment for research leaders to support one another throughout their ITDR projects in which they are able to share challenges and offer potential solutions peer-to-peer.

3.5. Mobilise and Integrate Knowledge

There can be significant differences in disciplinary norms, methods, data, and language across disciplines, practitioners and stakeholders, as well as what is considered high quality evidence in each field. These differences present challenges for how individuals and teams communicate with each other and mobilise and synthesise knowledge: all essential for ITDR teams tackling complex problems. Sometimes these differences are not appropriately acknowledged, leading to team members and stakeholders withdrawing from those discussions where they believe they are not able to engage or contribute in a meaningful way given their needs, ways of knowing, their knowledge and language. Yet ITDR projects rarely have defined boundary-spanning processes or roles that work across these siloes and bring disciplines and stakeholders together. Without efforts to broker knowledge and bridge differences, divides can open between disciplines operating with different forms of knowledge and ways of knowing (ontological and epistemological divides). Evidence from the workshops indicates that this issue can add to a sense of 'imposter syndrome', power imbalances, and undermine confidence in collaboration. Moreover, as recorded in the workshop evidence (Appendices A to C), there can be a high turnover of researchers due to fixed-term contracts. Without ongoing job security, researchers seek out new work that may start before the end of their contract, and as they leave, project-based knowledge (tacit and explicit), project investments in building ITDR coproduction are lost from the project along with the academic skills.

Recommendations

Research consortia and networks should recognise when there is a need to mobilise knowledge from across different disciplines and stakeholder groups, should explicitly recognise the challenges in this form of ITDR collaborative working, and respond with resources, processes and activities to bridge differences and broker knowledge exchange. This could include engaging or building dedicated expertise in knowledge mobilisation and brokering, developing collaborative language and mental models to support ITDR, and should include leadership and resourcing of such activities concurrently with the technical workstreams. Research institutions should investigate and evaluate the efficiency of business models that depend on insecure, fixed-term ECR contracts, and how better to incentivise the retention of research teams for the duration of long-term, complex ITDR projects.

3.6. Increase Research Agility

There is a tendency for teams applying for ITDR funding to create overly optimistic research proposals that, in turn, increase the expectations of funding bodies. This optimism bias results in a significant time pressure for ITDR projects to meet deadlines and achieve ambitious deliverables. Furthermore, while working with key stakeholders is essential to delivery, they are not always available when needed, which can delay progress and compounds the risk of optimism bias. It can also be affected by key contacts changing in stakeholder organisations. These problems often exist within a rigid project structure dictated by the original proposal and a model of steady, fixed rate resource allocation that further inhibits agility.

Recommendations

Consortia and networks and research funders should recognise the class of risks associated with the additional complexities in ITDR projects, including how to align project timescales across multiple organisations; the need to mobilise knowledge and engage multiple stakeholders; and the requirements both to co-produce outputs and generate and evaluate societal benefits. Recommendations from the workshop participants, include permitting the use of contingency funds to fill resource gaps and respond to unknowable additional resource needs. Furthermore, if funding calls incorporated more resource flexibility, and consortia adopted more agile project management approaches in ITDR practice, then contingency funds could be spent proactively to identify, investigate and mitigate risks (e.g. pilot studies, sprints, staff training and support for innovation) rather than reacting retrospectively.

> "Open discretionary call within the programme that acts as an emergency fund to respond proactively to emerging issues."
>
> Workshop 2

3.7. Drive Innovation

Collaboration between a mix of disciplines in ITDR provides significant opportunities for innovation in methods, tools and approaches to meet different needs and challenges: this should be seen as a principal goal and benefit from adopting ITDR approaches. However, interdisciplinary innovation is inhibited by a range of factors. Firstly, the workshop data identifies a separation of disciplines during education and learning as having an adverse impact on creativity; something that starts at an early age and continues into higher education. Hence, when researchers begin working in ITDR, they may not have the knowhow and access to tools for the collaborative working practices that are important for cross-disciplinary innovation. Moreover, the publishing model of most journals directs research into disciplinary siloes, again acting as a drag on developing and sharing inter- and transdisciplinary innovations.

> "Scarcity status of academia discourages interdisciplinary working between 'competing' disciplines."
>
> Workshop 3

A second interrelated issue in academia identified in the workshop data is that of a 'scarcity mindset', wherein academics possessing relatively rare and therefore valuable skills, personal research networks and knowledge feel incentivised to reserve these intellectual capitals to support their own unidisciplinary work and publications. In such scenarios they may perceive themselves in competition within and across disciplines and so pull away from collaborations if this risks their personal knowledgebase being challenged or dispersed, e.g. sharing or challenging rare disciplinary knowledge or personal research networks makes them less valuable and therefore reduces personal kudos and value as a researcher. With this view, there is relatively less to be gained from interdisciplinary working. It encourages a 'reversion to type' unidisciplinary research model that is safer, less innovative, and easier to publish. Finally, although innovation from interdisciplinary working could be driven by individuals, and could be encouraged from a management side, giving ECRs fixed instructions, research methodologies and processes to follow again limits the potential for innovation.

Recommendations

Additional funds are often used to address resourcing issues, but these could instead be targeted towards innovations that add value by extending the research beyond a narrowly defined project scope, to explore and generate new ideas, methods, and tools. Funding sources could be developed to support consortium members develop innovative proposals, offsetting the additional costs and higher risks, e.g. for materials, expertise, software, and venue hire. These could enrich the overall project, lead to new research directions and collaborations and explore opportunities as these arise during the core research process. Such a fund could even be shared with project partners when opportunities arise to maximise the benefits of transdisciplinary collaboration. Efficient and effective research management processes and funding rules would be needed to support this transformation, i.e. processes to develop and evaluate proposals should be made relatively straightforward given the time pressures already faced, and there should be a pre-defined approach to manage a portfolio of risks and rewards.

To support innovation more broadly, academia also needs to switch from 'scarcity' and 'competitive' mindsets to ones where researchers are encouraged to share and generate those ideas that are only possible through interdisciplinary collaboration. Research institutions should also place a greater general emphasis on interdisciplinarity in higher education at undergraduate and postgraduate degree training and throughout ECR training, and, along with research funders, work with publishers to improve recognition of ITDR in high quality journals.

> "Funders and Pro VC Research to lobby for academic publishing system that allows ITDR research to be published in good journals."
>
> Workshop 3

3.8. Embed Reflective Practice and Learning

> "Positivity bias in evaluation and challenges left unshared due to a fear of being wrong."
>
> Workshop 3

Individual and collective reflective practice are essential to the continual improvement of ITDR and in the workshops stated as a "need to do, not a nice to do" activity. While it can be facilitated through research-on-research, this takes time and a commitment that is not always available. Evidence from the workshops indicates that it is often only carried out on a voluntary basis by small groups, though research consortia have been successful in receiving research funding for meta-level research-on-research activities (Black *et al* 2023). Yet to generate the most valuable learning opportunities, reflective practice requires the full engagement of team members at different levels of seniority working, across different functional areas of the project, and from individual to whole-team scales. For many projects, reflective practice is absent or lacks a specific framework, methodology or toolset, as well as being considered a secondary activity that is then under-utilised and under-resourced. These factors result in a piecemeal approach that impedes continuous learning and improvement in ITDR practice or delivering 'course corrections' and improvements at an individual workstream or project-level vis-à-vis the project mission and goals. This is frequently compounded by a reluctance to share failures and coupled with a tendency to present failures in a positive light – either across disciplines or with the wider ITDR community – since discovering and reporting 'what doesn't work' may be perceived to reflect badly on projects or individuals. This is also reinforced by a research bias towards only publishing predominantly good outcomes, i.e. 'what works'.

Recommendations

> "Annual retreat for team members and community stakeholders to engage in activities and reflect collectively."
>
> Workshop 2

Large-scale research consortia should explore how to gain value from embedding reflective practices in a research project, both structurally and culturally, to improve the effectiveness and efficiency of the specific research enterprise itself *and* wider ITDR practices in the academic sector. From the outset there should be a clearly articulated commitment to learning and continual improvement, and proposals should build reflective practice into funding applications as a deliverable or an essential way of working. Guided by reflective practice frameworks, such as double and triple-loop learning or a holistic governance framework that incorporates research accountability, teams and individuals should periodically question: 1) their understanding of the research purpose: this should include researcher motivation, values and the selected research mission (axiology) to evaluate the extent to which the proposed research is able to deliver value, impact and intended outcomes; and, 2) to explore how the effectiveness of how planned research is being delivered (its epistemology) and how the design of interventions can best attain the intended mission impacts and outcomes. To do this effectively, dedicated time and space should be allocated for individual and collective reflection (e.g. an annual retreat or periodic project reviews).

In addition, 'what doesn't work' and 'near misses' should be embraced as important learning opportunities. There will be a need to create a safe and transparent environment for critical reflection, such that researchers and their leadership can engage productively with uncomfortable findings, and individuals and research teams can grow and improve their research practices. To this end, project leaders should set an example by openly reporting reflections on their research process, identifying research challenges, and sharing what has been learned and where it has been possible to improve research practices.

3.9. Improve Stakeholder Engagement and Coproduction

Workshop participants identified several barriers to effective stakeholder engagement and coproduction in ITDR. For example, evidence presented in the workshops indicated that the value exchange between a research project and its potential partners cannot always be clearly understood or articulated at the outset. Such a collaboration needs to be incentivised, but without knowing exactly what the benefits will be, potential partners cannot make a fully informed decision on how much resource to put in, who from their organisation is best placed to engage or whether it is worth their time and effort at all. At the same time, it may be difficult for consortia to identify partner and stakeholder benefits in the early stages of a research project while there are many uncertainties and moving parts. This 'Catch-22' situation, and the associated uncertainties, make it challenging to engage stakeholders and mobilise their unique situational awareness until outputs and outcomes from a research collaboration can be better defined.

Furthermore, significant time needs to be spent on developing shared language and understanding the needs and motivations of stakeholders in order to clarify the nature of any value exchange. Once a partnership has been formed, considerable work must go into sustaining a strong and fair relationship and an equitable value exchange. Finally, in situations where stakeholders gain little direct value from the research there is a risk of exploitation and researcher extraction of knowledge. Typically, this could include coproduction with the public or third sector when there is a lack of budget or flexibility in funding rules to permit the renumeration of citizens or the voluntary sector for their time.

Recommendations

As a process, coproduction is best delivered iteratively as a purposeful engagement, ideally built around long-term stakeholder relationships that are then able to cocreate research aims and delivery processes. It is important that researchers work with stakeholders to ensure ITDR language is accessible and engaging. Additionally, the workshop participants (see Appendix A, Theme 3) advocated convening 'working groups' to build a collaborative epistemological approach and to contextualise coproduction for the range of project stakeholders, from policy communities through to citizen groups. For example, this should include developing a knowledge mobilisation framework for ITDR projects, outlining how to prepare and initiate work with stakeholders, and how to effectively and efficiently transfer knowledge into a policy space where it can deliver impact. Engaging policy partners in consortium leadership positions can also strengthen relationships between academic and public/private sector organisations and hence increase the coproduction potential of embedded researchers. To this end, ITDR teams could run workshops with policy partners and other stakeholders at an early stage of the project planning stages to understand shared needs and motivations, and to clarify what value exchanges could reasonably be expected, e.g. the relevance of the proposed academic research to policy and how best to align research and stakeholder needs to form strong case for collaboration.

> "Create opportunities to understand stakeholders' needs and motivations and contextualise coproduction for different stakeholders."
>
> Workshop 3

Joint training workshops for funders and ITDR teams would help to develop detailed knowledge and case studies on the practicalities of coproduction and inform requirements in future funding calls. This could include defining what research outputs public advisors, third-party mediators, and community researchers and participants are permitted to prepare, alongside a set of accountable funding rules and permitted budgeting flexibilities. It is finally recommended that consortia and networks begin community engagement early to ensure stakeholder funding allocations are sufficient to build capacity and pay for coproduction time where other forms of value exchange are not adequate. Research consortia and networks should then be more able to define roles and responsibilities of external stakeholders with explicit detail on compensation and expected outputs from coproduction.

Conclusion

The UKPRP portfolio of co-funded Networks and Consortia exemplifies the opportunities for researchers to operate collaboratively within larger teams to address complex societal problems, and to transcend traditional disciplinary and organisational boundaries. The findings from this investigation demonstrates the diverse challenges and roles for researchers when collaborating with public, third and private sector practitioners and policymakers. The report also highlights the pivotal role Universities as leading research institutions can play in fostering team-based research and science; specifically in building a civic mindset and the leadership capabilities to collaborate effectively across multiple disciplines and deliver societal value and impact.

Underpinning the report is a comprehensive exploration of what constitutes effective inter/transdisciplinary research (ITDR), highlighting common challenges and showcasing the innovative strategies employed by the various UKPRP-funded Consortia and Networks.

Through a structured, collaborative knowledge exchange process grounded in established design and futures thinking frameworks, the project engaged a diverse group of 70 stakeholders to generate practical insights and document solutions for improving ITDR.

The report presents twenty-five interconnected recommendations under nine key themes. Each recommendation aims to guide research funders, institutions and leaders towards more effective approaches for commissioning, planning and delivering collaborative ITDR projects.

Taken as a whole, these recommendations comprise ***a call for collective action from research funders, institutions, and leaders***. Together, these recommendations form a practical agenda for change aimed at improving collaborative research practice. It is important to note our belief that no single recommendation is sufficient in isolation; a holistic approach is therefore being proposed.

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Appendices: Workshop Data

These appendices present data collected across the three workshops. Some data have been reworded where this aids clarification. Otherwise, the data have been presented verbatim. For Workshops 1 and 2, the data related to the Horizon 1 and Horizon 2 mapping (current state of ITDR experiences and potential to improve current research practices respectively) are organised as challenges and solutions. These include untested potential solutions as well as those previously piloted by ITDR teams and funders. Exemplars are provided, though no formal or independent evaluation of these has been possible under the work programme for this report. The Horizon 3 vision statements that were defined by participants in Workshops 1 and 2 are also presented for the six themes covered.

Appendix A: Workshop 1: Building and Sustaining ITDR Capacity

Theme 1: Transforming Collaborative Research Practices

Horizon 3 – Vision

- An open, egalitarian research culture that invites people to ask questions.
- Clear inter- and transdisciplinary leadership positions.
- Inter- and transdisciplinary post-doctoral programmes set up through collaborations between institutions to create a new generation of ITD researchers.

Horizon 1 – Challenges	Horizon 2 – Solutions
• Budget constraints for training and support, crucially for ECRs. • Different time allocations for Project Leads and ECRs (e.g. 5% vs 100% FTE) is a challenge for training/mentoring. • Difficult transition from being a specialist to a generalist in ITDR. • 'Imposter syndrome' entering a new discipline and large team, particularly for ECRs. • Skills and knowledge gaps, particularly in key areas for ITDR (e.g. systems approach). • Time pressure to meet deadlines and deliverables reduces ability to reflect.	• Training in ITDR for academics (particularly ECRs) and non-academics delivered through an official project fund. • Consultation with stakeholders to identify appropriate resource allocation. • Offer a "buddying" system for inducting and integrating new team members. • Peer reviews in teams that are cross-disciplinary. • Set out realistic expectations for longer timescales for ITDR. • Collaborative, boundary spanning papers and ongoing iterative peer reviews.

Theme 2: Sustaining an Inter/Transdisciplinary Research Team

Horizon 3 – Vision

- A secure work environment for research staff who have time built in to contribute to building capabilities across the team.
- Journals and publishing models that value and reward ITDR and are open to diverse contributions.
- A Research Excellence Framework (REF) that values ITDR and can cope with the diverse and cross-disciplinary work, so that work can be published to audiences that would not normally access these ideas.

Horizon 1 – Challenges	Horizon 2 – Solutions
• Fixed-term contracts lead to a higher turnover of ECRs, losing skills and knowledge from projects. • Overly optimistic research proposals increase expectations of funding bodies and ability to achieve deliverables. • Working across different geographic locations hinders team cohesion and interpersonal relationships. • Difficulty maintaining relationships with changing personnel within core project team and policy partners. • Lack of well-defined roles to work across disciplines and bring them together.	• Support for fellowships and placements that extend skills. • Cost time into research contracts for researcher development (e.g. grant writing). • Create formal opportunities for building connections across ITDR teams and sharing ideas, learning, and updates. • Workshops with senior academics to discuss further career plans. • Funded resources for research adjacent staff to facilitate ITDR effectively. • Flexible, large group fund where budget can be kept aside for required expertise or capacity (e.g. NIHR). • Recognise the value of ITDR team members and support their promotion.

Theme 3: Knowledge Management, Integration, and Mobilisation between Diverse Stakeholders

Horizon 3 – Vision

- Strong academic collaboration working toward a common purpose without institutional or disciplinary divides.
- A good understanding between research teams and partners about how they work together, acknowledging that this evolves over time.
- Shared language and practices that dissolve disciplinary boundaries and help team members to understand the breadth of research across a project.
- Language in ITDR that is accessible for a wide range of stakeholders to utilise across policy and practice.
- International collaboration enabled by an understanding of others' language, culture, and values.
- Storytelling over time.

Horizon 1 – Challenges	Horizon 2 – Solutions
• Integration of disciplinary norms, methods, knowledge, language, data, and what is considered high quality evidence (e.g. systematic reviews are new to some disciplines). • Inability to pay for citizen coproduction reduces community engagement. • Difficulty clarifying roles, terms, and goals causes delays. • Lack of transdisciplinary journals means research is published to siloed audiences (e.g. public health, urban planning, engineering).	• Glossary of terms shared across disciplines. • Work with stakeholders to ensure ITDR language is accessible and engaging. • Form a working group to build a collaborative epistemological approach. • Rules and facilities that permit lump sum payments to third sector organisation to manage payments to public for coproduction. • Be explicit in bid about requirement for community mediators, peer researchers and coproduction: joint training for funders and researchers to understand what this would look like. • Provide clear definitions of public advisor/stakeholder researchers, including their roles, how they will be reimbursed, and what outputs they can co-produce. • Policy partners in consortium leadership position can strengthen relationship between organisations and increase potential of embedded researchers. • Knowledge mobilisation framework outlining how to prepare and initiate work with stakeholders and how to move knowledge into a policy space where it can be utilised.

Appendix B: Workshop 2: Learning and Continual Improvement in ITDR

Theme 4: Agility of the Research Process

Horizon 3 – Vision

- ITDR projects that are adaptable to unanticipated internal and external changes.
- Timescales that enable the research problem to be identified and understood in depth.
- A funding model that is more outcome-focused and less target-driven for ITDR.
- Journals that truly take ITDR papers.

Horizon 1 – Challenges	Horizon 2 – Solutions
• Rigid approach to project/programme based on original proposal. • Working across different sectors and organisations with many stakeholders can delay progress. • Stakeholder interaction can lead to work and evaluation beyond the project brief and scope. • How do we value agility and flexibility to produce 'better' outputs and deliver impact with plans at the outset? • How is value gained across all programmes captured? • Change of key contacts in stakeholder organisation can impact relationship and slow momentum. • ECRs following fixed instructions and processes can lead to a lack of innovation.	• Regularly and iteratively review Theory of Change. • Open discretionary call within the programme that acts as an emergency fund to respond proactively to emerging issues (e.g. Consortium Innovation Fund). These could be reported to the funder as successes. • Consortium Innovation Fund shared with stakeholders (e.g. GroundsWell pilot with external partners). • Harnessing a multidisciplinary team should provide the opportunity to conduct research with a greater variety of methods. • Researcher-in-residence role (e.g. TRUUD researcher in Bristol City Council) increases agility of the research process in that it provides the opportunity to “live in both worlds” and develop new approaches, tools, and outputs that are not predetermined.

Theme 5: Transparency and Inclusivity

Horizon 3 – Vision

- ITDR projects that have the means of sharing power equally.
- Clear examples of the value of ITDR to encourage public involvement with equal power sharing.
- Communication in meetings and conferences that uses transparent and inclusive language and explains things clearly.
- A funding model that is inclusive, including funding for public engagement.
- ITDR teams that do not assume each other are experts in all areas and communicate in plain language.

Horizon 1 – Challenges	Horizon 2 – Solutions
• Reluctance to share failures that may reflect badly on projects or individuals, coupled with a tendency to present these in too positive a light, which may also be reinforced by research bias towards publishing good outcomes. • Not only a reluctance to share across disciplines, but the inability to bring learning together. • In terms of inclusivity, funders' requirements for lived experience expertise can result in barriers to ITDR. • People want to work in ITDR but there is a lack of structures to support this, e.g. methods, publishing, separated learning from an early point of education.	• Failures, and 'near misses' should be embraced and seen as learning opportunities, i.e. knowledge of what doesn't work is useful, shareable knowledge. • Annual reporting to reflect on the research process, including failures. • Route mapping between organisations to identify research needs and how they align with strategic needs – building business cases. • Make value exchanges clear and transparent. • Fund coproduction with the public. • Opportunities for local authorities to bid directly for research funding and lead projects, e.g. Shaping Places for Healthier Lives programme run jointly by the Local Government Association and the Health Foundation and Health Determinants Research Collaborations (NIHR-funded).

Theme 6: Continual Improvement Practices

Horizon 3 – Vision

- Time to develop ITDR processes and reflective practices.
- Time to consider methods, ethics, and epistemology and how to engage across disciplines.
- ITDR teams that have feedback loops in terms of communication and learning.

Horizon 1 – Challenges	Horizon 2 – Solutions
• No specific framework for continuous learning and improvement. • Breakdown of transfer in meaning between academic disciplines (a perlocution-illocution type problem).	• Create a forum for teams/work packages to ask the rest of the consortium for advice on how to handle challenges. • Regularly share roles and responsibilities within teams. • Writing retreats: an example was given of the TRUUD consortium project running open, welcoming and accessible writing retreats. • Annual retreat for team members and community stakeholders to engage in activities and reflect collectively (e.g. GroundsWell focused on the theme of coproduction in mixed groups of expertise and disciplines, addressing language barriers and considering impact, including from community stakeholders' point of view). • Develop a collaborative glossary (e.g. VISION, in prototype stage) • Improve communication between disciplines by surfacing implicit assumptions

Appendix C: Workshop 3: Developing a Reflective 'Team Science' Approach to Inter/Transdisciplinary Research

Stage 1: Preliminary Planning and Goal Setting

During the first stage of this workshop, participants considered the goal setting and preliminary planning aspects of an ITDR project comprising activities such as: interpreting the funding call requirements; undertaking bid development; setting the project mission and objectives; managing project uncertainty, complexity and risk; establishing project governance structures; network building; and planning review and evaluation processes.

Challenges	Solutions
• Lack of time and funding towards bid development to foster new collaborations, build relationships, enable creative thinking and facilitate co-creation of the proposal. • Rigid methodological expectations in funders and/or reviewers, means that reviews of ITDR grants may focus on own single discipline, thereby devaluing proposed ITDR principles and practices and reducing chances of highly ITDR projects being funded. • Path dependency in collaborative bids to pre-existing networks. • Differences in norms, language, and methodologies across disciplines. • Scarcity status of academia discourages interdisciplinary working between 'competing' disciplines. • Measures and performance metrics rarely identified and agreed on upfront.	• Community participation from the start, facilitated by integrated funding for capacity building. • Pay community organisations for engagement and coproduction (e.g. ActEarly's Bromley-by-Bow and Copper case studies) and embed this in the bid. • Guidance to help with input and timelines for bid applications. • Funders could offer a 'lead-in' period at the start of the project to support ITDR colleagues to build relationships and a shared language. • Provide funding and long lead in times for the bid development. • As an iterative process, discuss and revise who needs to be involved in the project with initially identified stakeholders. • Funders could create time to innovate their processes and architecture. • Governance that brings together policy and science for fund oversight. • Commit to learning and evaluation from the start. • The 2-stage UKPRP set-up phase was essential for bringing ITDR teams together.

Stage 2: Creating the Research Enterprise

Participants considered aspects such as: detailed planning and refinement; social and managerial processes; growing a stakeholder network; building and sustaining a team; shared values, norms, and language; navigating cultural differences; spanning institutional structures and disciplinary siloes; delegation of roles and accountability; recruitment; and incentive frameworks.

Challenges	Solutions
• Little or no training in ITDR methods for researchers. • Expectation that ECRs can hit the ground running with ITDR. • Promotion largely aligned with disciplinary excellence. • Disciplinary separation and lack of collaboration is driven by career pathways that incentivise single disciplinary research and reinforced by journals and their scope of acceptable papers. • Disconnections within work packages, hierarchies, governance, and accountability. • Governance structure risks disempowering ECRs and requires them to be flexible and shift direction as decision-makers change their views. • 'Missing' Co-Is are a challenge and ECRs can be 'abandoned' if Project Leads leave. • Assumptions about base knowledge and norms can exclude people, particularly ECRs (e.g. during internal presentations). • Language and institutional processes can be inaccessible and barrier to interaction. • Building trust within the team is critical for success but takes time.	• Funders could require capacity building (for ECRs) to be costed in to develop skills and competencies in ITDR. • Take a systems approach to understanding purpose, disciplinary contributions, and deficiencies (consider "enterprise governance"). • Exchange knowledge and ideas and build relationships across disciplines, institutions, and sites through in-person meetings and writing retreats specifically designed for these purposes. • Promotion should reward ability to work across disciplines. • Dependencies between work packages should be made explicit and requires design and planning. • Maintain 'situation awareness' across the consortium whereby everyone knows how they fit in and what their contribution is. • Consortium members should have a specified role and tasks, rather than just be a 'name'. • Set ground rules regarding publications and outputs early to manage expectations. • Democratisation: shared leadership, voice, and voting. • Communications should be actively managed with rules around email etiquette and expectations. • Explicit processes for decision-making. • Strong leadership and buy-in from the whole team are key to building relationships and trust.

Stage 3: Implementation Activities

Participants considered aspects such as: evidence gathering and analysis; integrating knowledge, methods, and tools; stakeholder engagement; design and systems thinking; coproduction and co-creation; piloting and experimentation; behaviour change and transition; knowledge exchange and mobilisation.

Challenges	Solutions
• Not resourcing knowledge brokering and integration. • Challenge for ECRs to understand landscape of research funding and plan their career. • ITDR is still siloed and excludes other factors and actors. Where is the boundary and 'system in focus'? • How do ITDR teams know if they are talking to the 'right' people in organisations (e.g. the 'right' team and level of seniority)? • Difficult to establish payment systems for coproduction activities. • Understanding what evidence is needed to inform and/or support policy.	• Training for consortium and relevant stakeholders in how to communicate results effectively. • Create opportunities to understand stakeholders' needs and motivations and contextualise coproduction for different stakeholders (e.g. framework developed with Greater Manchester Combined Authority). • Acknowledge and engage ECR knowledge and experiences. • Initial workshops to ensure a common and shared understanding on research outcomes. Critical to the relationship between work strands and how they combine to achieve outcomes. • Model dynamics and drivers and/or simulate impact of policy decisions but be aware of bias and assumptions of what is not included. • Incentivise participation using creative methods (e.g. Lego, rich pictures, and forum theatre). This can also be democratising. • Incentivising policymaker engagement is most effective when there is a concrete project to give them. • Workshops for local authorities to address their reality and provide core training on how academia works and why it is relevant to them. • Policy: recognising, knowing, and understanding what 'windows of opportunity' to effect change are. • Researchers embedded into services to influence in an integrated and bottom-up way.

Challenges	Solutions
	• Purposeful engagement and coproduction that has clear asks, pays for time, and forms long-term relationships. • Establish a decision-making framework that new team members can be introduced to. • ‘Evaluation clinic’ delivered by academics for local authorities can provide methods and evaluation support and facilitate stakeholder engagement and impact.

Stage 4: Evaluation and Learning

Participants considered aspects such as: accountability; evidence gathering; coproduction of impact assessment; individual and collective reflective practices; independent and/or self-evaluation (individual interventions or programme-wide); and learning and improvement.

Challenges	Solutions
• Positivity bias in evaluation and challenges left unshared due to a fear of being wrong. • Continual evaluation and learning under-utilised and under-resourced. • Reflective practice is a *need* to do, not a nice to do. • Individual reflection is insufficient – collective reflection is required. • Research-on-research takes time and is piecemeal. It is often done on a voluntary basis by small groups.	• Leadership that encourages honest reporting of challenges. • Build in transdisciplinary reflective practice into funding applications as a deliverable or essential way of working. • Be critical and uncomfortable so that you can grow as a researcher (e.g. Wellcome Race Reflections Training). • Meta-evaluation that looks at what has and hasn't worked well and uncommon non-traditional impacts using multiple forms of data capture (e.g. ActEarly). • Develop a systems framework for governance which incorporates research accountability, and in the related work stream, reflection and reflective practice is the way of working (e.g. GroundsWell). • Leadership training (e.g. Collective Leadership for Scotland, now discontinued). • Translational grants for ECRs: ECRs who can/wish to continue leftover/potential future research directions. • Funders and Pro VC Research to lobby for academic publishing system that allows ITDR research to be published in good journals. • Opportunities to evaluate and improve funding call design.

Appendix D: Workshop Canvases

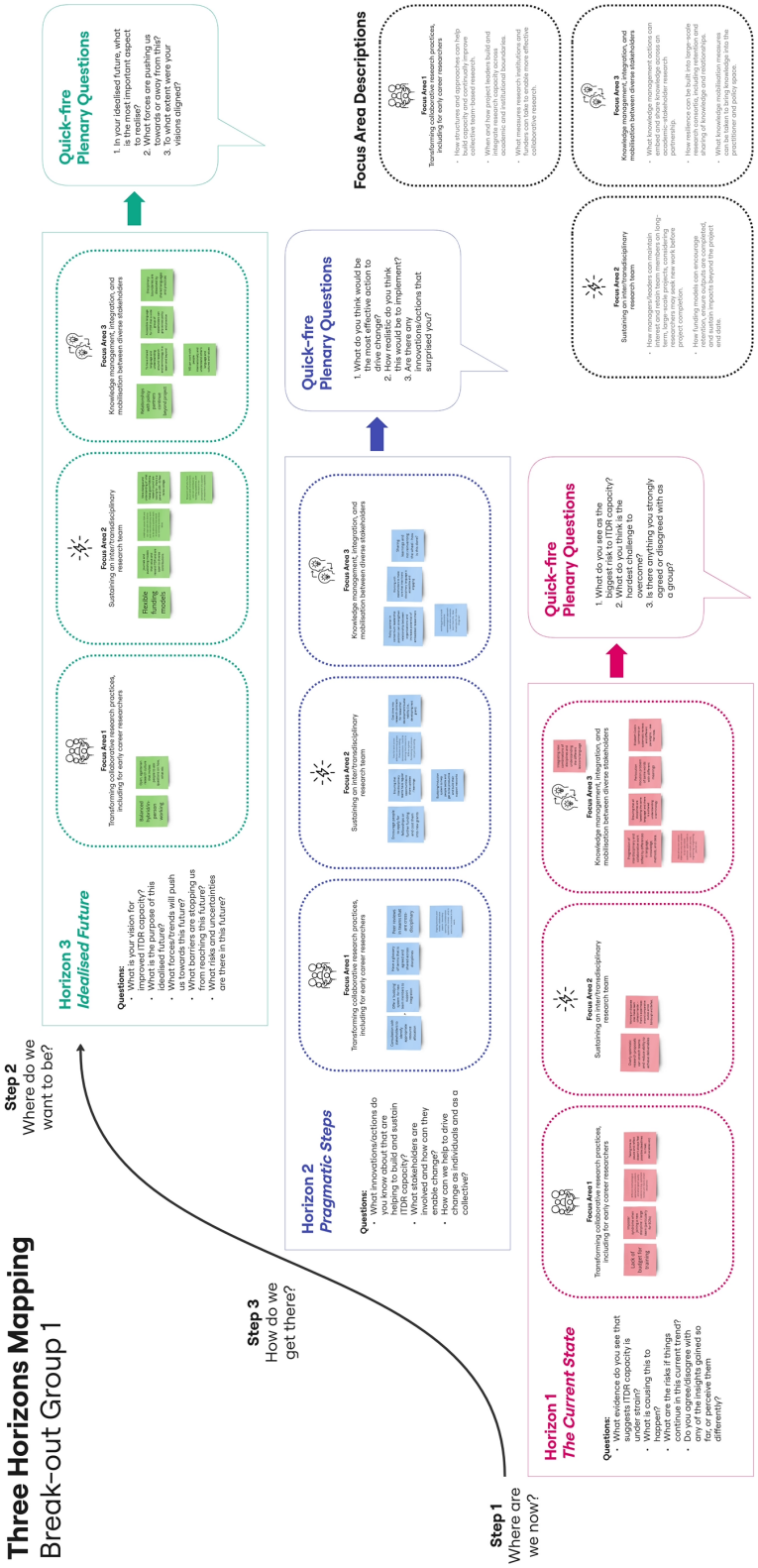

Figure 7. Three Horizons online workshop canvas (example from Workshop 1)

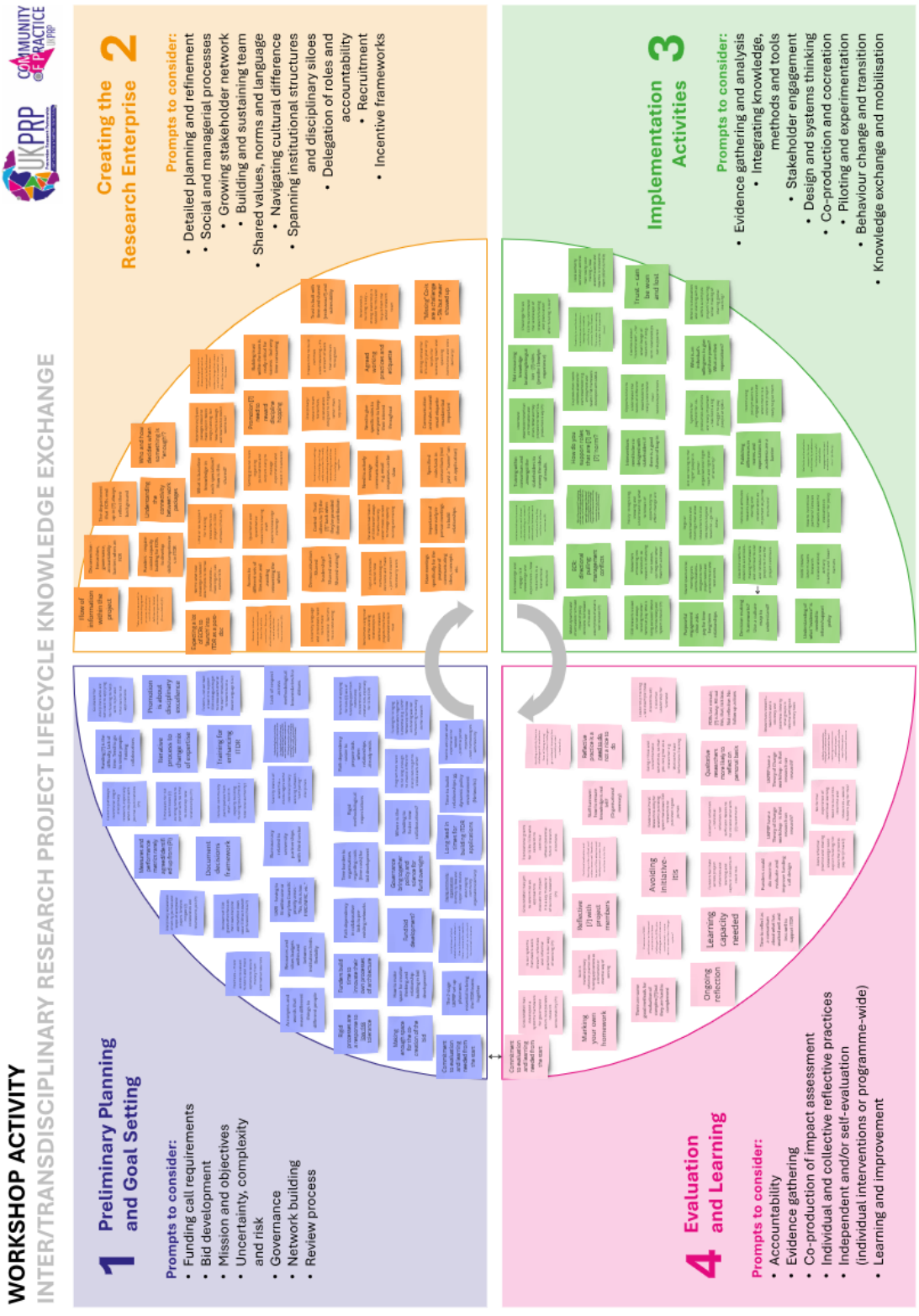

Figure 8. ITDR project life cycle workshop canvas with digitised sticky notes