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Case Study Review of Interdisciplinary Research in Higher Education Institutions in England

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List of abbreviations

ACE	Aston Centre for Europe
AHRC	Arts and Humanities Research Council
CAS	Centre for Advanced Studies for the Arts and Social Sciences
CCISC	Centre for Critical Inquiry into Society and Culture
CEE	Centre for Energy and the Environment
CFL	Centre for Forensic Linguistics
CLaRA	Centre for Language Research at Aston
CRIS	Current Research Information Systems
DTC	Doctoral Training Centre
DTP	Doctoral Training Partnership
ECR	Early Career Researcher
EPSRC	Engineering and Physical Sciences Research Council
EU	European Union
HEFCE	Higher Education Funding Council for England
HEI	Higher Education Institution
HEIF	Higher Education Innovation Funding
HELIX	Healthcare Innovation Exchange Centre
HH	Health Humanities
IAS	Institute of Advanced Study
IDR	Interdisciplinary research
IHHN	International Health Humanities Network
InterLanD	Aston Centre for Interdisciplinary Research into Language and Diversity
LIDC	London International Development Centre
LSHTM	London School of Hygiene and Tropical Medicine
MMU	Manchester Metropolitan University
NAMRIP	Network for Antimicrobial Resistance and Infection Prevention
NHH	Nottingham Health Humanities
NHS	National Health Service
NNMHR	Northern Network for Medical Humanities Research

PVC	Pro Vice-Chancellor
QR	Quality-related
RAE	Research Assessment Exercise
RCA	Royal College of Art
RCUK	Research Councils UK
REF	Research Excellence Framework
SLSS	School of Languages and Social Sciences
UCL	University College London
UoA	Unit of Assessment
UK	United Kingdom
UNICAS	University of Nottingham Interdisciplinary Centre for Analytical Science
USRG	University Strategic Research Groups
VC	Vice-Chancellor
WRoCAH	White Rose College of the Arts and Humanities
WRUC	White Rose Research Consortium

Executive summary

Over the last decade, we have seen increased engagement, investment and interventions designed to grow, support and embed interdisciplinary research (IDR) in higher education institutions (HEIs) in England. This has resulted in a range of approaches being tested by funders, researchers and institutions. In this study, we consider the cases of 10 HEIs in England that take a variety of approaches to grow, sustain and embed IDR. The sample includes a range of institutions and considers different approaches, institution types, geographical locations and disciplinary spread.

Drivers for supporting IDR

HEIs are driven to support and encourage IDR by a range of factors. The following main drivers emerged from this study:

- A need to address complex societal challenges and solve practical problems

- A desire to access more diverse or larger funding streams

'What works'

HEIs undertake various approaches to organise and support IDR. The approaches outlined below are commonly employed across our sample.

Ways of organising IDR

The models used to organise and support IDR across our sample are diverse and include a combination of two or more of the following elements:

- Co-location of researchers

- Researcher networks across subject areas, departments or faculties

- Researcher-led ('bottom-up') and/or strategic institutional ('top-down') approaches

- A thematic or generic focus for IDR

- Support for high-quality research in general, not specifically for IDR

Ways of growing IDR

HEIs in the sample commonly use the following mechanisms to grow IDR:

(1) Internal seed funding or pump-priming grants are considered important for both conceptual development and building effective research teams. This early stage investment, which may or may not be specifically targeted to IDR, is often drawn from Higher Education Funding Council for England (HEFCE) grants to the institution (Quality-Related research funding and Higher Education Innovation Funding). Typically, the pump-priming grants are modest in size, flexible and competitive; moreover, they have been successful in supporting the development of high-quality projects and bids for substantial external funding.

(2) Networking events such as workshops, conferences and meetings, which encourage communication and collaboration between researchers from different disciplines, can

stimulate new interdisciplinary activity, particularly with continued interdisciplinary interactions over time.

(3) Training interdisciplinary researchers through dedicated Masters courses and interdisciplinary PhD projects is important to growing the IDR skills base and preparing the ground for future IDR.

Ways of sustaining IDR

Across the case studies, three factors emerged as central to sustaining IDR after the initial investment and support.

- **External funding**, often acquired with the help of internal seed funding or pump-priming initiatives, is the main source of continued funding for IDR.

- **A supportive interdisciplinary culture**, with measures like clear career paths and internal support for IDR centres and networks combined with factors like effective leadership and good relationships with other researchers, contributes greatly in sustaining IDR through keeping researchers motivated and engaged.

- **Practical support through institutional research services** provides facilitative administrative architecture and expertise to effectively target essential external funds and deliver internal investments.

Ways of embedding IDR in the institution

Institutions that seek to embed IDR within their research culture target their efforts at different institutional levels, which is reflected in the models of support chosen. Embedding can be more straightforward when faculties and departments are already geared towards conducting IDR. Institutional structures like interdisciplinary centres, strategic themes and interdisciplinary networks further embed IDR in institutions. Where this is not the case institutions specifically create IDR initiatives that cut across existing structures and facilitate IDR between departments and with external partners. In addition, key strategic leaders can help to embed IDR culture within institutions by increasing the visibility of IDR through strategic commitment and specific initiatives.

Policy considerations

The study highlights a number of policy considerations for different stakeholders as summarised below.

- A collaborative and supportive research environment where IDR is accepted as a legitimate and valuable activity is key for fostering and embedding IDR in an institution.

- It is important to build and maintain networks of motivated researchers. This is crucial for maintaining IDR capacity, and can be achieved by fostering an IDR-friendly institutional culture through interventions like networking events, support initiatives and favourable promotion policies. However, factors like team dynamics and personal rapport also contribute to researchers' motivation to conduct IDR.

- Co-location of different disciplines in one physical space is not a prerequisite of IDR. Nevertheless, a space, either physical or virtual, for the collision of ideas is

necessary. Opportunities to contact and talk to people from other disciplines is vital, and doing so face-to-face can sometimes be easier.

- Research teams with previous experience of working together have a greater chance of securing funding and delivering high-quality outputs. Seed funding or pump-priming grants could offer new IDR teams the opportunity to gain such experience.

- A dynamic and malleable support system that can respond to new needs can be an asset when trying to grow IDR. Such a system is more likely to maintain relevance to research interests of funders and researchers, particularly if both 'top-down' and 'bottom-up' approaches can be accommodated.

A variety of different strategies, models and tools can be employed successfully to support IDR in institutions. When choosing an approach or combination of approaches, institutions need to consider their own context, available infrastructure, research culture and flexibility to respond to new needs.

1 Introduction

While disciplinary modes of working provide a set of standards, frameworks, theories and methods within which new knowledge can be created[1], cross-pollination across disciplines can provide different ways of developing and applying knowledge[2] and offer holistic solutions to complex problems. Interdisciplinary research (IDR), typically, combines knowledge and/or methodological approaches from two or more disciplines to search for or to create new knowledge, technology, processes or art. Crucially, many major discoveries and breakthroughs have occurred at the boundaries between disciplines resulting in new fields of study, such as biochemistry, health economics, social psychology, development studies and informatics.

The challenge, however, is that interdisciplinarity is understood and defined in a variety of ways and, when considered alongside terms such as multidisciplinarity, pluridisciplinarity, cross-disciplinarity and transdisciplinarity, clarity is difficult to achieve[3]. Besides, researchers and professionals often use this terminology interchangeably, adding further complexity to the landscape. The fact that interdisciplinarity is complex, heterogeneous, dynamic and context-specific in nature also makes it difficult to define[4]. Nevertheless, the impact of differing terminology on IDR practice is as yet unclear.

Globally, many researchers and funders are pursuing IDR to tackle complex societal problems since monodisciplinary approaches may not always fully address these issues[4]. Analysis of the impact submissions to the UK's Research Excellence Framework (REF) exercise in 2014 found that 'a majority of the research underpinning societal impacts is multidisciplinary'[5]. Moreover, the belief that breaking out of the so-called 'disciplinary silos' facilitates knowledge production and innovation has led UK Research Funders including the Research Councils, Government Departments and charities to support IDR both in their individual capacities, and collaboratively (e.g. Newton Fund, Global Challenges Research Fund).

Funders have helped to legitimise and promote IDR in institutions by financially supporting it through challenge-based strategic funding calls or speculative 'response-mode' proposals[2]. In the UK, several funders have come together to establish centres such as the Francis Crick Institute (biomedical research) and the Farr Institutes (health informatics research) to provide an interdisciplinary environment for research. Moreover, the introduction of cross-research council funding mechanisms in 2007 has made interdisciplinary endeavours more feasible in the UK. Indeed, according to the UK Department for Business, Innovation and Skills, 'the

[1] Klein, J.T., 2008. Evaluation of interdisciplinary and transdisciplinary research: A literature review. *American Journal of Preventive Medicine*, 35, pp.S116–S123.

[2] Lyall, C., Bruce, A., Tait, J. and Meagher, L., 2011. *Interdisciplinary research journeys: Practical strategies for capturing creativity*. London: Bloomsbury Publishing.

[3] Nissani, N., 1997. Ten cheers for interdisciplinarity: The case for interdisciplinary knowledge and research. *The Social Science Journal,* 34, pp.201-216.

[4] Schmidt, J.C., 2008. Towards a philosophy of interdisciplinarity: An attempt to provide a classification and clarification. *Poiesis & Praxis: International Journal of Technology Assessment and Ethics of Science*, 5, pp.53–69.

[5] King's College London and Digital Science, 2015. *The nature, scale and beneficiaries of research impact: An initial analysis of Research Excellence Framework (REF) 2014 impact case studies*. Bristol: HEFCE.

UK's research landscape is increasingly complex and interdisciplinary'[6]. Nonetheless, whether IDR is adequately supported in the UK system is regularly discussed[7,8] – the UK Government's recent White Paper[9] (May 2016) makes proposals to improve support in this area.

Anecdotal evidence suggests that the pursuit and success of IDR in the UK is affected by drivers that incentivise and barriers that disincentivise participation – issues that we have explored in a parallel 'Landscape review of interdisciplinary research in the UK'[10]. Existing academic literature also sheds light on some generic barriers and facilitators. For example, research institutions with a supportive ethos, reward system and organisational structure are identified as providing a nurturing environment for IDR[11]. Cognitive and organisational factors, such as strong leadership, clear vision, good team communication, efficient knowledge networks, cross-disciplinary understanding, team size, closeness of disciplines, prior experience of collaboration and geographical difference between collaborators might also contribute to successful IDR[12,13].

In contrast, university departments that function as *de facto* disciplinary 'silos' and an education system geared towards specialisation in a single discipline have been highlighted as reinforcing monodisciplinarity[14]. Differences in disciplinary norms, jargon, concepts and methodological conventions can create difficulty in conducting and assessing IDR. Importantly, IDR often requires more time and effort to develop and can (dependent on the nature of the work) be more difficult to publish[15]. Thus, cultural, structural, organisational or social barriers may exist in the UK research landscape due to systemic biases and/or perceptions thereof.

To circumvent these barriers, and grow and sustain interdisciplinarity, Higher Education Institutions (HEIs) may adopt strategies to increase interdisciplinary communication,

[6] UK Department for Business, Innovation and Skills (BIS), 2014. *Our plan for growth: science and innovation (Cm. 8980)*. Available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/387780/PU1719_HMT_Science_.pdf

[7] UK Department for Business, Innovation and Skills (BIS), 2015. *A Review of the UK Research Councils by Paul Nurse: Consultation and Evidence Gathering*. Available at: https://www.gov.uk/government/uploads/system/uploads/attachment_ data/file/477930/BIS-15-633-ensuring-a-successful-UK-research-endeavour-consultation-and-evidence.pdf

[8] UK Department for Business, Innovation and Skills (BIS), 2014. Triennial Review of the Research Councils. London: BIS.

[9] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/523546/bis-16-265-success-as-a-knowledge-economy-web.pdf

[10] Technopolis and Science Policy Research Unit, University of Sussex, 2016. *Landscape review of interdisciplinary research in the UK*. Bristol: HEFCE and MRC.

[11] Broto, V.C., Gislason, M. and Ehlers, M.H., 2009. Practising interdisciplinarity in the interplay between disciplines: experiences of established researchers. *Environmental Science and Policy*, 12(7), pp.922-933.

[12] National Academies of Science, USA (NAS), 2010. *Facilitating Interdisciplinary Research*. Washington DC: National Academies Press.

[13] Choi, B.C.K. and Pak, A.W.P., 2007. Multidisciplinarity, interdisciplinarity and transdisciplinarity in health research, services, education and policy: 2. Promotors, barriers, and strategies of enhancement. *Clinical and Investigative Medicine*, 30(6), pp.224-232.

[14] Heberlein, T.A., 1988. Improving interdisciplinary research: integrating the social and natural sciences. *Society & natural resources*, 1(1), pp.5-16.

[15] Van Noorden, R., 2015. Interdisciplinary research by the numbers. *Nature*, 525(7569), pp. 306-307.

establish a supportive organisational culture, and recruit people with different backgrounds, disciplinary expertise and working methods[16,17]. Initiatives such as joint PhDs between different disciplines and discipline-hopping fellowships have proven effective in developing the requisite knowledge and skills to work confidently and effectively in an IDR environment[18]. Alongside the recruitment and development of interdisciplinary researchers, valuing and rewarding IDR in performance evaluations and promotions are often considered key to achieving 'buy in' from researchers and retaining them to work in the interdisciplinary space[19].

Although support for IDR has increased among both academics and research funders, the dynamics of interdisciplinary collaborations and therefore the most effective ways to grow and sustain them are not fully understood[20]. In addition, political and public demands for accountability and transparency in the use of taxpayers' money for research necessitates robust and reliable mechanisms for evaluating all types of research initiatives including IDR[21]. However, the complex, heterogeneous and uncertain nature of IDR and disparate value systems of disciplines make it difficult to define 'best practice' as well as the baseline for evaluation.

This research project, through exemplar case studies of effective efforts to grow, sustain and embed IDR, will provide a selection of tangible examples of 'what works' for the institutions, centres and researchers who took part in the study. However, it is important to remember that IDR is a context-specific and dynamic enterprise, and that lessons learned from this work should be applied contextually with some iteration if necessary.

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[16] Van Noorden, R., 2015. Interdisciplinary research by the numbers. *Nature*, 525(7569), pp. 306-307.

[17] Porter, A. and Rafols, I., 2009. Is science becoming more interdisciplinary? Measuring and mapping six research fields over time. *Scientometrics*, 81(3), pp.719-745.

[18] McLeish, T. and Strang, V., 2014. *Leading interdisciplinary research: transforming the academic landscape*. London: The Leadership Foundation for Higher Education.

[19] van Rijnsoever, F.J. and Hessels, L.K., 2011. Factors associated with disciplinary and interdisciplinary research collaboration. *Research Policy*, 40(3), pp.463-472.

[20] Siedlok, F., and Hibbert, P., 2014. The organization of interdisciplinary research: modes, drivers and barriers. *International Journal of Management Reviews*, 16(2), pp.194-210.

[21] Huutoniemi, K., 2010. Evaluating interdisciplinary research. In: Frodeman, R., Klein, J.T. and Mitcham, C. ed. *The Oxford Handbook of Interdisciplinarity*. Oxford: Oxford University Press, pp.309–320.

2 Approach

2.1 Scope

For the purpose of this study, any research activity involving more than one discipline (as identified by 'A review of the UK's interdisciplinary research using a citation-based approach'[22]) including interdisciplinary, multidisciplinary, transdisciplinary and cross-disciplinary research was included in the umbrella term 'IDR'.

This study covers HEIs in England and institutes/centres therein and focusses primarily on institutional approaches rather than individual projects.

2.2 Sample

The research sample consisted of 10 English HEIs with Higher Education Funding Council for England (HEFCE) funding that have used different approaches to support, embed and increase IDR. Cases were selected to ensure coverage of various institution types, models, disciplines and geographical locations (see **Table 1**).

Table 1 Case Study Institutions and their IDR Models

Institution	Model for organising IDR	Disciplinary mix
Royal College of Art (RCA)	Combination of strategic and investigator-led approaches	Art and Design
London School of Hygiene and Tropical Medicine (LSHTM)	Faculties built around research areas rather than disciplines; Research Centres	Statistics, social sciences, biological sciences, medicine
Nottingham Health Humanities (NHH)	Cross-faculty university network	All disciplines
University of Southampton	Cross-faculty Strategic Research Groups	All disciplines
Centre for Critical Inquiry into Society and Culture (CCISC, Aston University)	Cross-subject Research Centre	Humanities, social sciences
Institute of Advanced Study (IAS, Durham University)	Cross-faculty 'facilitator'	All disciplines

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[22] http://www.hefce.ac.uk/pubs/rereports/Year/2015/interdisc/Title,104883,en.html

Northumbria University and the Institute of the Humanities	Interdisciplinary themes and centres	All disciplines but a particular focus on humanities
White Rose University Consortium (WRUC)	Cross-university consortium	All disciplines
Manchester Metropolitan University (MMU)	Interdisciplinary themes and centres	All disciplines
Centre for Energy and the Environment (CEE, University of Exeter)	University-based Research and Consultancy Centre	Physics, mathematics, engineering, environmental sciences

Source: The authors

2.3 Method

We used case study methodology because it allows exploration of an issue or problem using a case as a specific illustration[23]. This qualitative approach can be adopted for one or more 'real-life, contemporary bounded systems' and hence was eminently useful for the purposes of this study.

Each of the ten case studies involved:

- Desk research to outline the wider context of the case study (e.g. type of institution, organisational structure, funding sources, historical context, etc.)

- Interviews with 1-8 strategic leaders (e.g. research support manager, pro Vice-Chancellor of Research, Centre Director/s, Departmental Heads) and/or researchers (e.g. Theme Leaders, IDR project participants) (for a full list see Appendix B)

- Collection of relevant and illustrative data regarding the outcome of a support mechanism/approach where available

The semi-structured interviews lasted approximately 60 minutes each and were conducted via telephone, Skype or in person. The semi-structured approach enabled systematic enquiry into each case, whilst still allowing interviewees to raise issues and make relevant points not captured by the interview template (see Appendix A).

After completion, individual studies (see Chapter 7) were compared and contrasted to identify commonalities and differences among approaches and contexts. This analysis is the basis of this report wherein we emphasise lessons learned and caveats regarding the adoption of particular approaches.

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[23] Creswell, J.W., 2013. *Qualitative inquiry and research design: Choosing among five approaches*. Sage publications.

3 Analysis and 'what works'

3.1 Why do institutions support IDR?

All the HEIs that we studied seek to support high-quality IDR either through IDR-specific approaches or general research support which accommodates the needs of different types of research. For instance, the University of Southampton supports IDR activity through defined University Strategic Research Groups (USRGs) and Institutes while the London School of Hygiene and Tropical Medicine (LSHTM) and White Rose University Consortium (WRUC) do not facilitate IDR separately from other types of research.

Two main drivers for institutional support for IDR emerged from this study. The first is to undertake research that addresses practical issues or societal challenges, which often defy traditional disciplinary boundaries, and require an interdisciplinary approach. The second major driver is accessing a wider variety of or larger external funding sources. Both drivers were also identified independently in the landscape review of the UK's IDR[24].

Institutional attitudes to IDR are articulated to varying degrees in strategy documents and initiatives. Some HEIs have a specific IDR strategy and IDR-specific support mechanisms, as in the Universities of Southampton and Nottingham. Others such as the LSHTM mention IDR in their strategy, but their support mechanisms foster research in general. IDR does not feature at all in the published research strategies of some HEIs like Northumbria University but this does not necessarily indicate a lack of support. The presence or absence of an IDR focus in the institutional strategy had no obvious influence on the institution's ability to foster IDR.

3.2 'What works'

HEIs use a variety of approaches to organise and support IDR depending on their specific circumstances and requirements. No one approach guarantees success, but some commonalities can be observed between the types of approaches employed, as discussed below. Typically, HEIs adopt an underlying strategy or 'model' to support IDR in addition to specific instruments to stimulate new IDR, sustain existing IDR and embed IDR within their institution. If objectives are not met satisfactorily or obstacles are encountered, these IDR 'models' and/or support mechanisms tend to undergo iterations or are replaced.

In this section, we discuss 'what works' in terms of underlying models and specific instruments to stimulate, sustain and embed IDR.

3.2.1 Ways of organising IDR

Although the models for organising and supporting IDR are diverse, the HEIs in our sample frequently incorporate two or more of the following approaches:

(1) Co-location of researchers in the same place

(2) Researcher networks across subject areas, departments or faculties

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[24] Technopolis and Science Policy Research Unit, University of Sussex, 2016. *Landscape review of interdisciplinary research in the UK*. Bristol: HEFCE and MRC.

(3) Researcher-led and/or strategic institutional approaches

(4) A thematic or generic focus for IDR

(5) Support for research in general, not specifically for IDR

When considering these approaches, the following points should be remembered:

3.2.1.1 Co-location offers advantages but is not necessary for IDR

Having researchers from different disciplines under the same roof (co-location), for example in an institute, is expected to promote interdisciplinary working because of increased opportunities to mix formally and informally with experts from different disciplines[25,26]. Indeed, greater geographical distance between collaborators reduces the chances of success because coordination becomes more expensive and time-consuming, and more efforts are required to maintain contact with partners[27,28]. Institutes, research centres or specialist institutions, in turn, have the ability to be agile and open, thus making it easier to change the institutional culture, if and when necessary[25]. Once established, the culture tends to attract like-minded people to the institution, thus perpetuating a dynamic, supportive and open environment. Moreover, centres/institutes whose focus is on topics rather than disciplines, have more freedom to recruit staff from outside their discipline compared to traditional discipline-based university departments. Among our sample, we found that co-location conferred an advantage to institutions like the University of Exeter's Centre for Energy and the Environment (CEE), Royal College of Art (RCA) and LSHTM.

However, co-location is not a necessity. Its main advantage is the creation of a community of practice, which can also be managed in alternative ways such as 'virtual' or 'nomadic' networks. Nottingham Health Humanities (NHH) and the Centre for Critical Inquiry into Society and Culture (CCISC, Aston University) are good examples of this model but similar community networks exist in almost all the other cases. In such models, network members are usually situated in disciplinary departments and faculties, but are also affiliated to thematic centres and networks sitting across one or several institutions. The voluntary nature of centre/network membership makes it easier for researchers to join, potentially leading to greater engagement. However, leaving is equally easy, hence motivated researchers are required to sustain 'loose' networks and centres. Added benefits of this model are low overhead costs and the flexibility to adapt or abandon the structure if necessary.

3.2.1.2 Flexible systems that accommodate both researcher- and institution-led approaches work well

IDR can be researcher-led (i.e. 'bottom-up') or institution-led (i.e. 'top-down'). NHH exemplifies the former, while the Manchester Metropolitan University (MMU) is an example of

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[25] https://wellcome.ac.uk/sites/default/files/wtp060066.pdf

[26] http://www.theguardian.com/higher-education-network/blog/2013/mar/15/interdisciplinary-academic-universities-research

[27] Choi, B.C.K. and Pak, A.W.P., 2007. Multidisciplinarity, interdisciplinarity and transdisciplinarity in health research, services, education and policy: 2. Promotors, barriers, and strategies of enhancement. *Clinical and Investigative Medicine*, 30(6), pp.224-232.

[28] Cummings, J.N. and Kiesler, S., 2008. Who collaborates successfully? Prior experience reduces collaboration barriers in distributed interdisciplinary research. *Proceedings of the 2008 ACM conference on Computer supported cooperative work*, pp.437-446.

the latter. Some HEIs have effectively combined both approaches. For instance, the RCA supports academic- and student-driven projects but also undertakes strategic action to foster a strong research culture, build on existing strengths and explore new opportunities for collaboration and funding. The LSHTM considers suggestions from both researchers and management for new school centres. Similarly, the University of Southampton, Northumbria University and the Institute of Advanced Study (IAS, Durham University) foster IDR through themes recommended by researchers and selected by management and/or senior academics, thus combining a 'top-down' institutional strategy with researcher input. Conversely, the CCISC uses a researcher-led 'bottom-up' approach with flexible systems which are constantly reviewed.

The majority of our interviewees felt that IDR which is structured around the research interests of researchers, i.e. bottom-up, is more likely to encourage participation in IDR. However, interviewees from the University of Southampton saw their university's 'top-down' approach, which includes specific initiatives and explicit commitment to support IDR, as very important for fighting researcher inertia against interdisciplinary ways of working. Despite this lack of consensus, it was almost universally acknowledged that top-down initiatives that are 'forced' on researchers fail. What seems to work well in several cases, regardless of approach, is a dynamic and flexible system that is able to facilitate different types of IDR and can respond to new needs. Such a system has the potential to remain fit-for-purpose over a longer period, and typically combines complementary institution- and researcher-led approaches.

3.2.1.3   Both thematic and generic support for IDR can be effective

Many institutions included in our study organise at least part of their IDR activities around themes – through research networks, centres or institutes. Only the RCA and WRUC do not seem to adopt a thematic approach – they focus on fostering high-quality research, regardless of whether it is IDR or not. This does not seem to affect either their capacity to conduct IDR or indeed the quality of their research.

Strategic themes also act as instruments to foster IDR. For example, the IAS's strategy of stimulating IDR around an annual research theme with broad relevance across different faculties has proved to be a very effective and inclusive instrument for stimulating original and creative research in both disciplinary and interdisciplinary contexts.

Similarly, strategic themes that cut across the traditional disciplinary structures of HEIs can provide a focus for interdisciplinary endeavour and help to build research capacity in new areas. Frequently, they mirror funders' research priorities, such as grand challenges or topical subjects like antimicrobial resistance, energy and smart cities in order to access more diverse and/or larger funding sources. A thematic approach may somewhat restrict the types of IDR undertaken, but in combination with institutional support, it can help to create hubs of activity, which can be built upon until they reach critical mass. For instance, sustained activity and growth of strategic thematic groups has led to the creation of research centres at the University of Southampton.

3.2.1.4   Alternative models can also be successful

Among our case studies, we found three examples of specific units that 'facilitate' IDR: the IAS, WRUC and the London International Development Centre (LIDC; this is partly funded by the LSHTM). Each of these units facilitates collaborations for a slightly different purpose, but in the process also fosters IDR. The IAS fosters internationalisation and IDR at Durham

University; the WRUC supports collaborations between the Universities of Leeds, Sheffield and York; whereas the LIDC fosters international development research across five HEIs in London. Despite different aims, these units have certain similarities. They are typically small (less than 10 staff) and offer advice, networking opportunities, proposal-writing support and sometimes small grants. We term this model as the 'facilitator' model.

In addition to the 'facilitator' model, we came across the 'consultancy' model, an alternative funding model for IDR. While most of the establishments in this study are supported primarily by HEFCE, Research Council and charity funding, the CEE raises most of its funds from external sources through research and consultancy work, mainly for local authorities. Thus, it is a good example of how research expertise can be sustained long term without relying exclusively on the dual support system (HEFCE and Research Council funding) for research.

In summary, the various aspects of IDR models should be considered when creating support structures for IDR. Specifically, the context and strategic aims should be considered carefully. Equally, institutions should consult researchers before introducing a new model for IDR.

3.2.2   *Approaches to stimulate and grow IDR*

Of the identified approaches, the following consistently work well for stimulating and growing IDR:

3.2.2.1   Seed funds or pump-priming funds

In terms of stimulating IDR, the most common and perhaps effective instruments are seed (corn)-funding and pump-priming schemes. Typically, these schemes offer small grants of £3,000 to £15,000 for initial groundwork such as team building, proof-of-principle tests and proposal writing, following an internal competition. Core institutional funds including quality-related (QR) research funding and Higher Education Innovation Funding (HEIF) from HEFCE are generally allocated for this purpose. The underlying objective of this investment is to grow research capacity and acquire more external funding. Thus, potentially high returns from small investments drive HEIs to allocate seed funding for new IDR projects.

Added benefits of seed funding grants might include the establishment of new interdisciplinary networks and skills development for early career researchers (ECRs), including those in project management and budget management, who are charged with managing pump-priming grants. In the long term, sustained funding and enhanced research capacity might lead to research centres or institutes. This opinion is corroborated by evidence from our landscape review[29] wherein strategic leaders from HEIs mentioned a 'funding ladder' moving from seed funding (over the short term) to securing an external project grant (medium term) and culminating in the establishment of a research centre (long term).

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[29] Technopolis and Science Policy Research Unit, University of Sussex, 2016. *Landscape review of interdisciplinary research in the UK*. Bristol: HEFCE and MRC.

3.2.2.2 Networking

Basic support for establishing knowledge networks and interdisciplinary understanding to enable the exchange of ideas is a known requirement of successful IDR[30,31,32]. Therefore, most HEIs try to increase opportunities for interdisciplinary interactions through networking events such as seminars, conferences and workshops around specific themes or funding calls. Similar events are organised to develop external networks with other institutions or non-academic partners.

Some institutions have successfully developed long-term connections and networks. For example, the IAS maintains an international network of former visiting Fellows. Being a small specialist institution, the RCA has successfully built networks with other local institutions such as Imperial College London to access expertise that is not available in-house. The LIDC, which facilitates collaborations among five Bloomsbury colleges – LSHTM, Birkbeck, Royal Veterinary College, School of Oriental and African Studies, and the Institute of Education – adopts a similar approach.

3.2.2.3 Training future interdisciplinary researchers

Training new interdisciplinary researchers can help to stimulate and grow IDR in existing and emerging areas. Teaching students to be interdisciplinary early on prepares them for an interdisciplinary career in the future. To that end, some institutions develop taught courses or doctoral programmes that are interdisciplinary. For example, the RCA has recently launched five new interdisciplinary MScs and plans to add more courses in the coming years to enhance research capacity in new and emerging interdisciplinary areas. Similarly, the WRUC Doctoral Training Centres/Partnerships and Studentship Networks train future researchers using the co-supervision model. In this model, each student has supervisors from two different universities and, frequently, from two different disciplines. Anecdotal evidence suggests that co-supervision can also help to build relationships between the supervisors who may then embark on their own IDR projects.

3.2.3 Approaches to support and sustain IDR

Institutions are well aware that stimulating new IDR activity is insufficient to achieve successful IDR. IDR needs to be supported and sustained through adequate funding and infrastructure as well as a supportive research culture. This can be achieved in the following ways:

3.2.3.1 Maintaining motivated and engaged communities

Sustaining research areas within institutions requires researchers who are motivated by IDR and engaged by their research topic. Over the long term, a critical mass of researchers may also be required. Therefore, institutions need to ensure that institutional structures as well as culture are supportive towards IDR. Structural factors such as the availability of viable career paths, physical or virtual networking spaces and other support mechanisms, and cultural

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[30] National Academies of Science, USA (NAS), 2010. *Facilitating Interdisciplinary Research*, Washington DC, National Academies Press.

[31] Choi, B.C.K. and Pak, A.W.P., 2007. Multidisciplinarity, interdisciplinarity and transdisciplinarity in health research, services, education and policy: 2. Promotors, barriers, and strategies of enhancement. *Clinical and Investigative Medicine*, 30(6), pp.224-232.

[32] Bammer, G., 2012. Strengthening Interdisciplinary Research: What it is, what it does, how it does it and how it is supported.

factors such as appreciation for IDR, good team rapport and effective leadership can encourage researchers to continue to pursue IDR. Ultimately, researchers will remain motivated and engaged if institutions can demonstrate that IDR is desirable and supported within their structures, and researchers' interests are accommodated in their strategy for IDR. By doing so, institutions can keep the research and associated structures relevant to researchers' needs, thus motivating researchers to continue conducting IDR.

3.2.3.2 Securing external funding

Across our sample, the main approach for sustaining emerging IDR activity originating from seed funding or networking mechanisms is to secure grants from external funders such as the Research Councils, the EU and charities. HEIs are usually unable to provide the same level of funding. Hence, promising IDR projects may have to be put on hold if external funding is not secured.

Acquiring external funding is the second step on the aforementioned 'funding ladder', the first step of which is seed funding (Section 3.2.2.1). External grants help to sustain research capacity in an area, thus paving the way for further growth and strengthening of IDR expertise.

3.2.3.3 General institutional support

Institutions frequently channel general support for IDR through their Research Offices or Departmental Research Co-ordinators. This support may be specifically tailored to IDR or available for research in general, and can include help with writing bids for external funding, maintaining active researcher networks and organising networking events. Other types of institutional support include small grants for travel or organising events, and administrative or project management support. Travel grants can help to bring a geographically dispersed team together (as in the case of the WRUC), whilst event grants help researchers to make new contacts. Administrative or project management support not only frees up researchers' time but also facilitates project delivery, particularly if the researchers in question have no previous experience of IDR or collaborative working. In addition, Research Offices often provide short training courses for IDR-related skills training which are valuable for researcher development.

3.2.4 Approaches to embed IDR

Across our case studies, institutions use one or more of the following approaches to embed IDR within their structures:

3.2.4.1 Building institutional structures geared towards IDR

IDR can be embedded at different levels including the departmental and institutional levels. Embedding IDR becomes easier when IDR is part of the basic structure, for example in thematic research institutes, centres or networks. Here, IDR is part of the research culture and hence firmly embedded within the infrastructure. Such institutional infrastructure also helps to embed IDR throughout the institution as it legitimises and showcases IDR activity. For instance, NHH is a network of researchers from different faculties of the University of Nottingham with interests in the cross-section between health and the humanities. Having achieved a critical mass of researchers and attracted over £6 million of research funding, it became a research priority area of the university in 2015, thus further embedding IDR in the wider university structures. Similarly, faculties at the LSHTM are not set up along disciplinary

lines so as to foster interdisciplinary public health research, which helps to embed IDR in the institutional culture.

3.2.4.2 IDR approaches that cut across institutional structures

Institutional approaches to IDR, including the particular model, its role in institutional strategies and specific initiatives, all help to embed IDR within the institutional structures and culture. Institution-wide approaches, such as the University of Southampton's cross-faculty Research Institutes and Groups, ensure that the IDR initiatives are not isolated but rather form a part of the institution. Initiatives that facilitate IDR with external partners and across existing institutional structures like departments and faculties are particularly useful in this regard.

3.2.4.3 Key staff as part of IDR initiatives

Involvement of key staff such as strategic leaders and research managers in the implementation of IDR-related strategies and initiatives helps to increase the visibility of IDR in the institution and embed it in the research structures and culture. Support from strategic leaders can motivate researchers to undertake IDR. Examples of this approach are the WRUC, where Vice-Chancellors (VCs) and pro Vice-Chancellors (PVCs) of all participating institutions are part of the consortium's Executive Management Board, and the IAS, where directors come from all three faculties of Durham University. At the University of Southampton, there is a chain of command from the PVC Research to USRG and institute Research Coordinators which ensures the implementation of IDR-related policies, research programmes and initiatives at different levels, thus embedding IDR throughout the university's research structures.

3.2.5 A good fit of personal, structural and institutional factors fosters successful IDR

In general, clear support structures and mechanisms combined with able leadership and accountability at the strategic and project management levels lead to successful IDR. In addition, researchers need the freedom to pick their own projects and organise themselves internally. Personal qualities of the team leader and team members, such as trustworthiness, rigour and vision, were also universally acknowledged to be vital for success across the sample. A vibrant research environment with a collaborative and supportive atmosphere, which also encourages the development of junior researchers is also instrumental. All the HEIs in this study recognised that interdisciplinary researchers need more time for team building, developing an interdisciplinary understanding and calibrating expectations of a project. Hence, they were open to investing in the time and space required to build IDR capacity. Ultimately, institutions are good at IDR because their researchers are motivated and they provide adequate incubation support for IDR projects and culture. That is, better complementarity between the different support structures results in better support for IDR.

Many of these themes including the importance of leadership and a supportive environment have also emerged from other recent studies of IDR[33,34,35].

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[33] Technopolis and Science Policy Research Unit, University of Sussex, 2016. *Landscape review of interdisciplinary research in the UK*. Bristol: HEFCE and MRC.

[34] The British Academy, 2016. *Crossing paths: Interdisciplinary institutions, careers, education and applications*. London: British Academy.

[35] https://wellcome.ac.uk/sites/default/files/wtp060066.pdf

3.3 Lessons learned

In addition to highlighting 'what works', the case studies also highlighted some general messages that institutions ought to consider when supporting IDR.

3.3.1 A specific IDR focus in institutional strategy documents is not essential

The role of IDR in institutional strategies was not uniform across our sample. Some HEIs had elaborate IDR-oriented strategies, whereas others did not mention IDR at all. An IDR strategy helps to embed it in an institution, provided the strategy is communicated effectively to researchers. We observed that strategies were effective when accompanied by explicit actions that conveyed their message. In addition, IDR can be successfully supported without an explicit IDR strategy, for example through the WRUC where IDR is a means to increase inter-university collaboration, rather than an 'end' in itself.

3.3.2 IDR should not be 'forced'

Many of our interviewees reported that formulaic and prescriptive institutional approaches for supporting IDR fail. Some of these researchers had previously worked in other institutions and supplied anecdotal evidence that 'forced' IDR activity was counter-productive because of a disconnect with the interests of researchers. Conversely, a researcher-led approach to IDR keeps researchers motivated because they feel free to pursue their own research interests, which may not be the case in HEIs with a rigid strategic approach. This statement was particularly emphasised when we encountered bottom-up, investigator-led models of organising IDR, for example, at the CCISC (Aston University) and NHH (University of Nottingham). However, this was also a feature of more structured models such as those adopted by the University of Southampton and the IAS (Durham University), which conduct research around specific themes on the basis of consultation (IAS) or competition (Southampton) among researchers. In contrast, the RCA shows that supporting an investigator-led culture with a strategic 'facilitating' approach towards encouraging IDR in specific areas can galvanise existing strengths whilst developing capacity in new areas.

3.3.3 Pre-established networks or previous experience of working together offer a competitive advantage

Alliances established through interdisciplinary networks or previous experience of working together in a team can offer a competitive advantage against competing, ad-hoc interdisciplinary teams when applying for IDR funding. This is because collaborators who have already worked together or know each other will have established structures and trust within the team meaning there will be less lag time in starting the project. Moreover, they can demonstrate the ability to work together effectively and hence funders are likely to have greater confidence in the team. Seed(corn) or pump-priming funding schemes could be useful mechanisms for providing researchers the opportunity to gain initial experience of working with each other.

3.3.4 REF impact case studies are good ways to showcase IDR

Many HEIs felt that REF impact case studies were a useful way for showcasing IDR. Some institutions and researchers felt that they legitimise IDR within institutions and thus can help change institutional culture. On the other hand, researchers' attitudes to cross-referral of research outputs across REF panels was ambivalent. Our participants did not see an impact of this process on the manner in which research outputs were selected by their department.

3.3.5 Researchers can create their own culture

Academics from NHH (University of Nottingham) put forward an interesting idea – that networks can create their own culture to make IDR activity dynamic, innovative and rewarding. Once academics start working with others outside their discipline, they tend to find IDR rewarding and exciting because of its potential to drive forward solutions to practical problems, resulting in continued motivation to conduct IDR. A democratic ethos and mentoring of ECRs can help sustain a network and associated research into the future.

3.3.6 Long-term investments in centres help to sustain research expertise

The Helen Hamlyn Centre for Design at the RCA and the CEE demonstrate the scope for building and sustaining research expertise in a specialist area through long-term investment, a sustained IDR culture and independence. The Helen Hamlyn Centre is core funded by an endowment from the Helen Hamlyn Trust allowing the centre significant autonomy, and has helped the RCA retain and build on core research capacity in the field of inclusive design. Similarly, the CEE is mainly funded from local authority grants which has helped it to retain a degree of autonomy as well as expertise in energy and sustainability research.

4 Conclusions and policy considerations

In our research, we encountered differing approaches and models to organise IDR, some of which are long established and embedded, while others are currently being introduced. The majority of approaches to stimulating, sustaining and embedding IDR within the study received positive feedback from researchers and strategic leaders alike.

It is notable that our sample does not contain examples of failed approaches, although some participants do reflect on adapting their activities to make them more effective. In some institutions, the success or failure of individual projects was evaluated against expected outcomes, but interventions were not formally evaluated as a whole. Thus, judgements about their success were, as a result, largely intuitive. We also identified a lack of institutional memory in some cases.

Based on our observations, we highlight the following points that might be considered when developing policy or interventions to promote IDR activity:

- Availability of internal funds for gestation of projects is a tried and tested approach that has been successful in stimulating and growing IDR in several different institutions. However, sustaining IDR activity requires continued funding, which will generally necessitate securing external funds.

- A collaborative and supportive research environment where IDR is accepted as a legitimate and valuable activity is very important for fostering and embedding IDR in an institution.

- Building and sustaining networks of motivated researchers is important for maintaining IDR capacity. Networking events can help with the former, but sustaining the networks will depend on personal rapport and opportunities to meet and/or work together.

- Co-location of different disciplines in one physical space is not a prerequisite of IDR. Nevertheless, a space, either physical or virtual, for the collision of ideas is necessary. Opportunities to contact and talk to people from other disciplines is vital, and doing so face-to-face can sometimes be easier.

- Researchers' previous experience of working together greatly increases the chances of securing funding and delivering high-quality outputs. Seed(corn) funding or pump-priming schemes could provide researchers the opportunities to gain this initial experience.

- Specialist institutions might benefit greatly from building long-term external collaborations with other institutions to acquire expertise that is not available in-house.

- A dynamic and malleable system for supporting IDR or, in fact, research in general, can be an advantage. It can help to respond to new needs and to maintain relevance to the research interests of funders and researchers.

- Our cases show that there is room for both top-down and bottom-up approaches to grow and support IDR. However, a top-down approach will need buy-in from academics while bottom-up approaches will need institutional support to remain successful in the long run.

5   Case studies

5.1   Royal College of Art, London

Key points:

- A strategic approach complemented by an investigator-led approach that fosters a strong research culture, builds on existing strengths, and explores new opportunities

- Recognises strengths and gaps in knowledge/expertise and makes the necessary intellectual/interdisciplinary contacts internally and externally, including establishing centres in partnership with other institutions

- The Helen Hamlyn Centre for Design is a good example of building and sustaining research expertise in a specialist area through long-term investment, a sustained interdisciplinary culture and independence.

5.1.1   The institution

The Royal College of Art's first incarnation was as the Government School of Design in 1837[36]. Following the Great Exhibition of 1851, art was incorporated into its curriculum in addition to design and, since 1896, the institution has been known as the Royal College of Art (RCA). Over the years, it has built a reputation as one of the world's leading universities for art and design, boasting alumni such as Barbara Hepworth, Henry Moore, Peter Black, David Hockney, Ridley and Tony Scott, Zandra Rhodes, James Dyson, Christopher Bailey and Tracey Emin[36].

In REF 2014, the RCA performed well with 37% of its research ranked as 'world leading' and 40% of research rated as 'internationally excellent'[37]. Overall, this represented a 12% increase compared to the Research Assessment Exercise (RAE) 2008 results. One submission was made to one Unit of Assessment (UoA) and 65% of eligible staff were submitted to REF 2014, more than by any other university of art and design.

The RCA is split into six schools: architecture, communication, design, fine art, humanities, and material, which are based on campuses in the Kensington and Battersea areas of London; the Helen Hamlyn Centre for Design is also part of the college, based in the Battersea campus. Around 1400 postgraduate students study at the institution for MA, MPhil, and PhD degrees. The proportion of public funding, mainly from HEFCE and the Research Councils, has been decreasing consistently in the last five years, and currently accounts for only 33% of total research funding[38]. In 2015/16, the college received £12.7 million from HEFCE for teaching and research, of which £2.4 million was QR research funding[39].

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[36] http://www.rca.ac.uk/more/our-history/college-history/history-1837-2013/

[37] http://www.rca.ac.uk/news-and-events/news/britains-leading-specialist-art-design-university/

[38] Royal College of Art. Annual Report and Accounts 2014/15.

[39] http://www.hefce.ac.uk/pubs/year/2015/201505/

5.1.2 IDR and the institution

IDR has become an important part of the RCA's research strategy[40]. With a long history of research in interdisciplinary areas like vehicle and engineering design, it is seeking to support a culture and environment in which IDR can flourish. Recent research projects have ranged from the radical redesign of the NHS emergency ambulance and life-saving healthcare innovations to autonomous vehicles and practice-based research in fine arts, critical writing, performance, architecture, fashion and photography[41].

The RCA has a record of achieving societal and cultural impacts informed by IDR which can be seen from the seven impact case studies submitted to REF 2014[42]. The case studies included disciplines as distinct as design, clinical medicine, psychology, business, media, engineering, computer science and journalism. The research was funded by Arts and Humanities Research Council (AHRC), Engineering and Physical Sciences Research Council (EPSRC), Research Councils UK (RCUK) and the Wellcome Trust, reinforcing the interdisciplinary nature of the projects which included design for patient safety, inclusive design within design, industry and education, and enhancing industrial capability to innovate in vehicle design.

5.1.3 Model for organising IDR

IDR at the RCA was initially academic and in some areas student driven. This curiosity-driven approach is now complemented by an increasing strategic focus in this area and the expansion of the college's research support team. The post of Director of Research & Innovation, recently created, leads an integrated support team for research and knowledge exchange. This strategic approach complements the investigator-led approach, allowing coordinated action to stimulate and sustain IDR through fostering a strong research culture, building on existing strengths, exploring new opportunities and effective funding.

5.1.4 Interventions, their implementation and results

5.1.4.1 Stimulating and growing IDR

The RCA has actively grown its IDR capacity internally and through collaboration in order to compete more effectively for Research Council funding. In order to achieve this the RCA has pursued joint bids with institutions such as Imperial College London and the Kensington museums focussing on projects with far-reaching societal impact that combine the collaborators' disciplinary strengths[43]. The research management team supports this activity in a range of ways including sandpits (a specific funding mechanism involving an intensively facilitated workshop resulting in applications and funding awards) for RCA researchers in response to specific funding calls or societal challenges, building internal interdisciplinary links. Some internal QR research funds are allocated for seed funding, which researchers can use to build interdisciplinary teams, develop external networks and create IDR proposals[44]. However, there is no specific funding allocation towards these kinds of activities.

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[40] Royal College of Art. Research and Knowledge Exchange Strategy 2012.

[41] http://www.rca.ac.uk/news-and-events/news/britains-leading-specialist-art-design-university/

[42] http://impact.ref.ac.uk/CaseStudies/Results.aspx?HEI=3

[43] Personal Communication, Dr Emma Wakelin.

[44] Royal College of Art. Strategic Plan 2011-16.

Due to the RCA's reputation for excellence, organisations ranging from Microsoft Research and Transport for London to the Royal Borough of Greenwich and FutureCity/St James are happy to work alongside the RCA's researchers in long- or short-term partnerships[45].

The HEFCE-funded HELIX (Healthcare Innovation Exchange) Centre, which opened in January 2015, is one such collaboration between the RCA and Imperial College London[46]. The aim is to stimulate research that leads to real medical breakthroughs by embedding a design team in St Mary's Hospital in London, and promoting collision between 'people-centred design and scientific rigour'. HELIX brings designers and engineers in direct contact with front-line medicine, patients and clinicians. This allows the team to respond quickly to complex healthcare issues and for patients to innovate, accelerating the translation of ideas into products, processes and services with a common goal – improving public health.

The RCA also seeks to support and stimulate IDR by embedding it in the curriculum. Interdisciplinary MA programmes such as Vehicle Design (run for 40 years) and Innovation Design Engineering (available as a joint MA+MSc with Imperial College London) have long been at the core of the RCA's growth strategy for IDR. As Dr Emma Wakelin, Director of Research and Innovation comments, "We can grow and sustain IDR in existing and emerging areas by training the interdisciplinary researchers of tomorrow". Currently, 24 MA programmes are offered of which five new programmes (including Service Design, Interior Design, Information Design) have been launched since 2010 following a strategic push to grow international student numbers[47]. The RCA has expanded the range of disciplines and areas of specialisation covered by the MAs over five years to better reflect and influence thinking and research in art and design practice and research. They place emphasis on 'specialist education with interdisciplinary experiences' equipping students with relevant professional knowledge and skills, particularly in areas like design thinking, entrepreneurship, design for social need and sustainable design[47].

Informal learning also supports students' interdisciplinary development. Originally started five years ago as an experiment in response to students' demand for more cross-college collaboration, a week of interdisciplinary workshops and activities – AcrossRCA – has been rolled into the RCA teaching calendar[48]. A platform for students to meet and interact with peers outside their curriculum alongside external university partners, AcrossRCA, is now a mainstay of the student year and has involved a wide range of collaborators including Imperial College London, UK Sport, the National Gallery and international universities. The initiative has grown considerably since its inception, showcasing increasing numbers of projects and attracting more diverse partners.

5.1.4.2 Supporting and sustaining IDR

The RCA supports and sustains IDR through a range of activities supporting a strong research culture, continuing investment in successful interventions and taking a diverse approach to funding. This includes the HELIX centre described earlier, their innovation hub and the Helen Hamlyn Centre for Design.

InnovationRCA, encourages and supports entrepreneurship and the commercialisation of innovations. In the 10 years since its establishment, InnovationRCA has incubated and

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[45] Royal College of Art. Annual Report and Accounts 2014/15.

[46] http://www.helixcentre.com

[47] Royal College of Art. Strategic Plan 2011-16.

[48] http://www.rca.ac.uk/news-and-events/news/acrossrca-2015-fosters-interdisciplinary-collaboration/

launched 26 graduate start-ups out of which 14 are already trading. RCA start-ups generated a combined turnover of over £7.3 million in the financial year 2014-15 and have created over 400 jobs.

The newly founded Tata Consultancy Services-RCA Design Innovation Lab is the latest interdisciplinary, industrial collaboration combining design thinking, technology and business. The lab will conduct research and develop patentable products in addition to providing commercialisation support in the form of drop-in clinics, intellectual property workshops, networking meet-ups and entrepreneurship events.

In contrast to these support facilities, the Helen Hamlyn Centre for Design, based at the university's Battersea campus, has been conducting inclusive and interdisciplinary research since the 1990s[49]. The centre is core funded by an endowment from the Helen Hamlyn Trust allowing significant autonomy. Crucially, the centre is built on an earlier partnership between the Helen Hamlyn Trust and the RCA – the DesignAge. This initial collaboration helped to build an active, motivated and internationally recognised research base with a focus on the needs of older people. By establishing the Helen Hamlyn Centre for Design in 1999, the RCA retained research capacity in this area, building its reputation through drawing in innovative approaches such as inclusive design. Currently, the research is organised into three labs: age and ability, healthcare, and work and city. Each lab works with a wide range of business partners and academics from across the disciplines. The centre also runs its own doctoral study programme and offers interdisciplinary workshops and Helen Hamlyn Design Awards for creative people-centred design to RCA students regardless of their discipline[50].

By taking a strategic approach towards more sustainable funding for research, the RCA reduced the proportion of its research budget drawn from public funding (grants) from 65% to 33% within the timeframe of the last strategic plan (2011-2016)[51]. During this period, the RCA made proactive efforts to diversify its funding streams to protect itself from the risk of over-reliance on a single funding source and to achieve greater autonomy. This 'mixed economy' model strikes a balance between funding from traditional public sector sources, trusts, foundations and businesses[52].

5.1.4.3 Embedding IDR within the institution

Placing IDR at the core of the RCA's research has helped the institution to embed IDR within the institutional structures and culture. The college's research and knowledge exchange strategy supports this, by encouraging interdisciplinary collaboration internally and with other institutions, businesses and third sector bodies, opening up funding opportunities and enhancing impact[52]. The RCA has made a commitment to the institutional importance of IDR, supporting the active interdisciplinarians and providing an institutional push to individuals and projects to collaborate across disciplines, sectors and college functions by implementing strategic and focussed approaches including:

- Developing a central strategy

- Developing institutional infrastructure

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[49] http://www.rca.ac.uk/research-innovation/helen-hamlyn-centre/about/helen_hamlyn_centre_for_design_history/

[50] http://www.rca.ac.uk/research-innovation/helen-hamlyn-centre/helen_hamlyn_student_programme/

[51] Royal College of Art. Annual Report and Accounts 2014/15.

[52] Royal College of Art. Research and Knowledge Exchange Strategy 2012.

- Enhancing capacity and expertise in research and proposal writing

- Encouraging external and internal interdisciplinary collaborations

- Pursuing societal impact and funding support

For example, staff from across the RCA's six schools and the Helen Hamlyn Centre for Design recently collaborated with colleagues from Imperial College London and a number of other London HEIs to prepare a bid for the RCUK-InnovateUK Urban Living call.

5.1.5 Lessons learned

The Helen Hamlyn Centre for Design demonstrates the scope for building and sustaining research expertise in a specialist area through long-term investment, a sustained IDR culture and independence. The RCA is building on this experience through the HELIX centre which seeks to embed IDR outside the university environment. The RCA IDR experience suggests that supporting an investigator-led culture with a strategic approach towards encouraging, sustaining and embedding IDR in an institution can galvanise existing strengths whilst developing capacity in new areas.

In big projects, smaller institutions like the RCA, can be overshadowed by larger partners[53]. It is important to ensure that the contributions of smaller institutions are embedded within the work at an early stage, adequately resourced and adequately recognised.

Practice-based research that generates outputs which are not traditional publications is common among designers and fine artists. While research assessment and funders seek to accommodate this, there can sometimes be uncertainty on the part of the researcher and institutions as to how such research will be viewed and evaluated.

5.1.6 'What works'

At the RCA, the combination of an investigator-led approach and a coordinated institutional approach is working well. Importantly, the institution seeks to recognise strengths and gaps in knowledge/expertise and make the necessary intellectual/interdisciplinary contacts internally and externally. The RCA recognises that for IDR to flourish, all disciplines need to invest time for understanding and developing a shared language[53]. Providing the time and space for researchers, students and partners to build the links through resources of different types, including funding, supports the potential for productive collaboration. Alongside this, research partners, be they academic or from another sector, need time to calibrate their expectations of a project prior to making their commitment. RCA's seed funding allows for a gestation period at this exploratory stage.

5.1.7 Future strategy for IDR

Owing to the success of the existing centres, the RCA hopes to establish further centres for subjects such as robotics, computer science and intelligent mobility whilst growing its student population[53]. By building on existing strengths such as vehicle design, inclusive design and people-centred design, they aim to develop core expertise in emerging areas and use it to develop the designers of tomorrow. As the RCA's IDR activities expand, needs for other types of disciplinary expertise, e.g. engineering or computer science, are being identified. Working with experts in such areas in other institutions has worked on a project-by-project

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[53] Personal Communication, Christie Walker, Research Manager.

basis, but building centres around thematic areas will require that expertise to be embedded within the institution. Additional academic appointments of experts from other disciplines will be sought in the future.

RCA will also continue to support IDR culture outside the dedicated centres by providing more informal and formal networking opportunities and exploring the value of developmental training in additional skills for established academics. Alongside this, the college is revising its progression and reward policies to recognise staff contributions, including those in IDR, more effectively. Ultimately, the RCA wishes to position itself as the premier institution for postgraduate art and design education, research and knowledge transfer while consolidating its research strengths and building closer links to industry[54].

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[54] Royal College of Art. Strategic Plan 2011-2016.

5.2 London School of Hygiene and Tropical Medicine

> *Key points:*
> - Small specialised institution focussing on public health and tropical medicine; naturally inclined to interdisciplinarity, so attracts researchers with an inclination towards IDR
> - IDR is common and accounts for a significant amount of the research conducted; half of the departments are interdisciplinary
> - Fosters research around specific themes and in collaboration with other institutions, rather than IDR specifically

5.2.1 The institution

The London School of Hygiene and Tropical Medicine (LSHTM) was founded in 1899 at the Seamen's Hospital Society's branch hospital at the Royal Albert Dock. In 1924 it was granted a Royal Charter, thus officially becoming the London School of Hygiene and Tropical Medicine[55]. The LSHTM specialises in public health and tropical medicine, and includes researchers from many different disciplines.

The school provides master's as well as research degrees, with the latter including MPhil, PhD and DrPH[56]. In 2015/16, there were 651 master's and 447 research students based in London, with an additional 3000 distance learning students[57]. The school's income from research grants and contracts was £92.2 million in academic year 2014/15 with charities (both UK and non-UK) and UK government departments and health authorities accounting for £52.6 million of this funding. The remaining funding was provided by the UK Research Councils, the European Commission, industry, commerce and other UK, EU and non-EU sources. HECFE allocated £3.3 million for teaching and £18.3 million for research to the LSHTM in 2015/16[58].

In REF 2014, the LSHTM submitted to two UoAs[59]. Overall, it had a large volume of world leading research in Public Health, Health Services and Primary Care, and a particularly good performance in terms of impact[60,61]. A total of 295 staff submitted to the REF from LSHTM, with an equal number of male and female researchers.

5.2.2 IDR and the institution

Public health is a field which brings different disciplines together and hence is seen as naturally interdisciplinary. This is reflected in the eclectic mix of subjects and disciplines

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[55] http://timeline.lshtm.ac.uk

[56] http://www.lshtm.ac.uk/study/index.html

[57] London School of Hygiene and Tropical Medicine, 2016. Annual Report 2015.

[58] http://www.hefce.ac.uk/pubs/year/2015/201505/

[59] http://results.ref.ac.uk/Results/ByHei/136

[60] http://www.lshtm.ac.uk/newsevents/news/2014/ref_2014.html

[61] http://results.ref.ac.uk/Results/ByHei/136/Impact

across LSHTM, with researchers coming from a wide variety of fields including medicine, economics, laboratory sciences, sociology and history.

That the school focusses on public health issues rather than single disciplines is evident in its setup, which includes three faculties: epidemiology and population health, infectious and tropical diseases, and public health and policy. About half of the departments within these faculties are multidisciplinary. Moreover, as the school is a small, specialised institution, it collaborates extensively across departments and faculties and also seeks external collaborations to engage disciplines that are not available in-house.

5.2.3   Model for organising IDR

At the LSHTM, IDR seems to occur organically, due to the school's inherently interdisciplinary nature, the co-location of researchers from different disciplines in departments and a strong common research focus. In addition, institutional structures are geared towards encouraging research across the school's faculties and with other institutions more generally. There are two main mechanisms for this, school centres and the London International Development Centre (LIDC). These allow researchers to remain in their respective faculties and institutions whilst collaborating under the aegis of the school centres or the LIDC. There are currently 14 school centres, all of which include researchers from at least two of the school's faculties[62] and in some cases from other institutions. The school centres facilitate networking among researchers with shared interests and receive administrative support from two LSHTM staff. In contrast, the LIDC is a result of collaboration between five London institutions including LSHTM to facilitate research in international development. All centres are intentionally kept flexible in order to maintain strong faculties and departments.

5.2.4   Interventions, their implementation and results

5.2.4.1   Stimulating and growing IDR

As mentioned already, a significant amount of research at the LSHTM is interdisciplinary in nature and school centres foster cross-faculty research including IDR. Research focuses for school centres can be suggested by the management team as well as researchers, with the latter suggesting the majority of themes. Moreover, school centres have to span at least two of the three school faculties. Centres convene informal meetings, seminars and workshops, and also maintain their own websites. In this way, they create networks between researchers, who then work together and collectively bid for grants. Currently, there are centres for specific diseases, such as malaria and tuberculosis, and for specific methodologies[62]. The size of membership varies between the centres. For instance, one of the larger centres, the Malaria Centre, has about 160 members.

The LIDC is a distinct initiative dedicated to fostering IDR on international development across institutions, including the LSHTM. It was founded on the premise that international development, like health, also lends itself to interdisciplinarity by the very nature of the complex real-world problems addressed. The centre is established under a formal agreement between the five Bloomsbury colleges of the University of London – the LSHTM, Birkbeck, the Royal Veterinary College, the School of Oriental and African Studies, and the Institute of Education (which has recently merged with UCL)[63], with each institution providing an annual

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[62] http://www.lshtm.ac.uk/research/schoolcentres/index.html

[63] http://www.lidc.org.uk

core funding of £10,000. The remaining costs are shared proportionally by the five institutions according to the benefits, financial and otherwise, which they receive as a result of centre facilitation. Since 2008, the LIDC has facilitated IDR projects worth £15 million in income for its colleges through 48 intercollegiate grants from development donors. During this time, the LSHTM itself has received a total of £3.4 million of income through facilitation by the LIDC. The LIDC has only six staff and offers IDR skills events to its members in colleges. It also fulfils a brokerage role, maintaining a searchable database of members' interests, and organising meetings between researchers to develop grant proposals and courses. LIDC membership is free and open to academics and postgraduate students from its member colleges. It has 2000 current members of which 680 are from the LSHTM.

5.2.4.2 Supporting and sustaining IDR

Support for researchers and centres is at the core of the LSHTM's strategy for sustaining research, including IDR. Supporting ECRs is seen as crucial for enabling them to develop in their own discipline as well as learn to engage with other disciplines. To support career progression of interdisciplinary researchers, the LSHTM has specifically ensured that the promotions committee includes representatives from a range of disciplines. Promotion criteria are flexible in order to account for differences in outputs such as different publication patterns among researchers from different disciplines.

School centres receive ongoing support from the LSHTM for researchers interested in their focus area, once they have been approved and set up. In the beginning, all school centres had to raise their own resources to keep them running. After the school realised how well they functioned, annual funding of £3,000 to £15,000 has recently been allocated for each centre. In addition, two LSHTM staff provide administrative support to all centres. New school centres are opened if a critical mass of researchers is interested in a topic, the Senate is supportive and the management team approves. In this way, new and upcoming areas of research can be supported.

The LIDC supports inter-collegiate researcher networks and provides IDR skills training. This includes helping researchers to find a common language for collaboration, for example by organising presentations where researchers can explain their work and approaches to researchers from other disciplines. In order to sustain new initiatives, the centre's research support staff maintains contact with participants to keep initiatives moving forward.

5.2.4.3 Embedding IDR within the institution

IDR is inherently embedded within LSHTM due to its strong commitment to global health, including its mission statement 'improving health worldwide', which draws researchers from many different fields together very effectively[64]. This focus tends to attract researchers who are interested in solving real-world issues and creating impact, rather than strictly disciplinary research. Hence, the school has a community of researchers not only from a variety of disciplines, but also with a willingness to work across disciplinary boundaries. Consequently, IDR has become the norm at the school in addition to disciplinary research, rather than the exception.

Both the school centres and the LIDC, have strong links to the LSHTM as an institution. The school centres have become embedded deeper within the school's structure over time, leading to additional funding support from the school, as described previously. The LIDC,

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[64] http://www.lshtm.ac.uk

being an intercollegiate institution, mainly provides research project development support to researchers from its five parent institutions. It has recently facilitated a major grant to employ new research staff in member colleges for particular IDR projects. These staff have helped to further embed IDR within individual institutions, as well as strengthen the interdisciplinary links between them. As a result of earlier LIDC facilitation, the LSHTM now develops IDR collaborations with partners like the Royal Veterinary College and the School of Oriental and African Studies, for example around agriculture and health interactions, without the need for LIDC involvement.

5.2.5 Lessons learned

The LSHTM has found that having a strong mission, as described above, strengthens IDR in the institution as the mission helps to attract researchers with an inherent interest to work across disciplines.

The strategy of setting up networks around common areas of interest rather than specific calls for funding, both within school centres and the LIDC, has proved to be a successful way for acquiring funds. Alliances and connections that are already well established through these networks offer a competitive advantage against competing, ad-hoc interdisciplinary teams when applying for IDR funding, as collaborators will already have established structures and trust within the team.

As an interviewee from LIDC noted, IDR initiatives can only be sustained if there is sustained interest from researchers, and especially if initiatives have formal 'champions'. The LIDC provides continuity and support to these champions. To have strong champions, the LIDC aims to increase the pool of interested researchers beyond the 'usual suspects' through networking events and a broader agenda.

In terms of the REF, the LSHTM found impact case studies to be a useful way for showcasing its research, especially because impact is one of the institution's main goals. The LSHTM submitted to two UoAs, clinical medicine and public health. The latter was seen as particularly receptive to IDR. In addition, submissions were influenced by disciplinary perceptions. For example, the cross-referral option was used for historians, but not for social scientists, as it was perceived not to be beneficial for the latter.

5.2.6 'What works'

Having a vibrant research environment has worked well for fostering IDR at the LSHTM. This includes a collaborative and supportive atmosphere, encouraging the development of junior members of staff, mentoring them and linking up with peers elsewhere. Both the school centre and LIDC models have turned out to work well in general, and they have been sustained over a period of time. The cross-institutional setup of the LIDC works well because all the institutions involved are indeed small, specialised schools, leading to little internal competition. Doing this kind of inter-collegiate work will likely be more difficult when larger institutions are involved, since they may have groups with very similar capabilities.

5.2.7 Future strategy for IDR

The LSHTM plans to grow its research, including IDR, in the future. Its 2012-2017 research strategy aims to enhance multidisciplinary interactions, both within the school and with

partners[65]. A major focus for IDR in the near future in terms of laboratory research will be infections and pathogens. For this purpose, the LSHTM and University College London have jointly set up the Bloomsbury Research Institute which brings together various laboratories and which will develop collaborations with other relevant disciplines, such as epidemiology. The Bloomsbury Research Institute is expected to further expand the interdisciplinary activity within the school.

This is one of the school centres which will continue to be supported, along with the LIDC, in order to grow IDR further.

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[65] London School of Hygiene and Tropical Medicine, 2012. Excellence in Public & Global Health Strategy 2012-17.

5.3 Nottingham Health Humanities, University of Nottingham

Key points:

- Bottom-up initiative started by researchers at the University of Nottingham, now an international and local network and a research priority area at the university

- 'Nomadic' network with members based in their respective faculties and connected via interpersonal contacts, events and meetings in varying premises

- Focus on collaboration instead of competition, development of junior researchers, sharing successes in a democratic way and connection to local health care settings contribute to the network's success

5.3.1   The institution

The field of health humanities (HH) began at the University of Nottingham, and is supported by a global and a local network. The global HH network is a virtual one, with a dedicated website as well as annual conferences. Hundreds of researchers now work in HH, and over 350 of them are part of the global network. The local network at the University of Nottingham, known as Nottingham Health Humanities (NHH), consists of a network of 70-80 researchers across various faculties.

NHH is an integral part of the University of Nottingham. The university was established as a civic college in 1881, became a university with the award of the Royal Charter in 1948 and has since grown to include two additional campuses in China and Malaysia. The UK campus consists of five faculties: Arts, Engineering, Medicine and Health Services, Science and Social Sciences[66]. In 2013/14, the university had 32,893 undergraduate and 9,564 postgraduate students. The total income from research grants and contracts was £119 million in 2014/15, the biggest contribution of which came from the research councils (£43.5 million) followed by the UK local and central government, health and health authorities (£20.4 million). The remaining income came from UK-based charities, UK industry and corporations, the EU and other sources. For 2015/16, the university received £30 million for teaching and £49 million for research from HEFCE[67].

The university submitted 32 returns in 29 of the 36 UoAs in REF 2014, underlining the wide variety of research undertaken[68]. More than 80% of the university's research was ranked as 'world-leading' or 'internationally excellent'. All NHH researchers were submitted to REF through their respective faculties.

5.3.2   IDR and the institution

HH is inherently interdisciplinary as its researchers investigate how healthcare can be informed and transformed, and how physical and mental health and well-being can be enhanced, by applied arts and humanities[69].

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[66] http://www.nottingham.ac.uk/departments/byfaculty.aspx

[67] http://www.hefce.ac.uk/pubs/year/2015/201505/

[68] http://results.ref.ac.uk/Results/ByHei/165

[69] http://www.healthhumanities.org/nottingham_health_humanities/view/home

The university's Global Strategy 2020 defines its research themes: cultures and communication, digital futures, health and wellbeing, sustainable societies and transformative technologies[70]. Each of these themes is led by a university professor and contains multiple research priority areas, 31 in total, that draw together academic expertise across different disciplines. NHH features here, and hence has received funding from this scheme.

NHH also receives support from the Centre for Advanced Studies for the Arts and Social Sciences (CAS) and the University of Nottingham Interdisciplinary Centre for Analytical Science (UNICAS). Both CAS and UNICAS are part of the university's 13 Research and Knowledge Transfer Priority Groups, which have been established to increase the visibility of the university's research, to attract funding as well as high-quality researchers, and to promote interdisciplinary collaborations of international quality.

CAS was established in 2010 with over £3 million initial funding from the University of Nottingham. One of the centre's key ambitions is to promote interdisciplinarity and serve as a bridge between researchers from the faculties of Arts and Social Sciences[71]. It assists researchers in research and business development through its funding office.

5.3.3   Model for organising IDR

NHH is a research priority area under the global research theme 'Cultures and Communication' and is also supported by CAS[72]. NHH takes the form of a network, with members employed by their respective faculties rather than a dedicated centre. All NHH researchers work on various research projects, not all of which are NHH projects. Members describe NHH as a 'nomadic' network; although they do meet in person, there is no dedicated space – they use different rooms in the university or coffee shops. The network has very flexible and fluid management structures. Management is taken on by a team of NHH members who provide culture management, leadership and interpersonal support. NHH consists of 70 to 80 members across the university, and encompasses researchers from the health sciences, arts, humanities, social sciences and natural sciences. NHH members are also part of the global HH network.

5.3.4   Interventions, their implementation and results

5.3.4.1   Stimulating and growing IDR

Professor Paul Crawford of NHH was awarded the world's first chair in HH in 2009 and insisted on the use of the term 'health humanities'. This was followed by a seminal paper on HH in 2010, establishing the term, arguing for its necessity and distinguishing the concept from medical humanities[73]. While medical humanities have focussed mainly on medical care given by physicians and their education, HH encompass all forms of healthcare, and widens the focus to include allied health professionals, nurses, patients and carers as well as non-medical, charitable or informal care.

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[70] https://www.nottingham.ac.uk/about/documents/uon-global-strategy-2020.pdf

[71] http://nottingham.ac.uk/cas/index.aspx

[72] https://www.nottingham.ac.uk/research/global-research-themes/cultures-and-communication.aspx

[73] Crawford, P. et al., 2010. Health humanities: the future of medical humanities? *Mental Health Review Journal*, 15(3), pp. 4-10.

Professor Crawford has been instrumental in growing the field, both at Nottingham and beyond, by identifying individuals from different disciplines interested in the cross-section between health disciplines and arts and humanities. This included health practitioners, which helped to establish connections between the University of Nottingham and local health care providers, nursing homes and the NHS. These connections create unique opportunities for NHH researchers to conduct their research in healthcare settings.

An annual international HH conference was established early in the field's history, with the first conference taking place in Nottingham in 2010. Subsequently, funding was acquired from the AHRC (2011-2013) to build the International Health Humanities Network (IHHN).

UNICAS, a university structure which supports interdisciplinarity, has also been important in developing NHH. UNICAS holds several sandpit events throughout the academic year, where researchers get to briefly present their research, network and find collaborators. Researchers can apply for funding of up to £15,000 for interdisciplinary research projects resulting from these sandpit events[74]. This mechanism has produced highly successful research projects including 'AncientBiotics', in which NHH researcher Dr Lee, from the School of English, and microbiologist Dr Harrison came together to test an eye salve recipe from a 10th century book, with astonishing results in terms of its effectiveness in killing resistant bacteria[75].

5.3.4.2   Supporting and sustaining IDR

The university's existing research support structures, including CAS[76] which helped to launch the NHH through a showcase in 2013, support IDR activity in HH. After the initial AHRC grant to set up the IHHN ended, the critical mass of researchers in HH at Nottingham was large enough to drive the field forward. The researchers achieved this through maintaining the network and acquiring funding for their research with successful, quality applications effectively making a case for the impact of the field. The 'Creative Practice as Mutual Recovery' project, which has received £1.2 million of AHRC funding between 2013-2018[77], is an example of success in this area. Led by Professor Crawford with the University of Nottingham as the lead research organisation the project includes collaborators as diverse as the Royal College of Music and the Chelsea and Westminster Hospital NHS Foundation Trust. It involves the disciplines of arts, humanities, social sciences, health and medical sciences as well as approaches from the natural sciences such as randomised controlled trials and laboratory experiments.

NHH Members saw that the key to success in sustaining HH was a focus on team building and the creation of interested and engaged communities. They achieved this by providing coaching, networking and workshop opportunities and generally keeping conversations going. The challenges in sustaining NHH are due to its setup as a network where all members are employed by their respective faculties, meaning they have to balance their responsibilities to both their own faculty as well as NHH. The spirit of collaboration is at the heart of the network and is very important in achieving a community, where researchers are

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[74] http://www.nottingham.ac.uk/fabs/rgs/equipment/unicas/events.aspx

[75] University of Nottingham, 2015. AncientBiotics.

[76] http://www.healthhumanities.org/nottingham_health_humanities/view/home

[77] http://www.ahrc.ac.uk/newsevents/news/showcasingcommunity/,
http://gtr.rcuk.ac.uk/projects?ref=AH/K003364/1

willing to put a significant amount of energy into driving NHH forward, in addition to their duties to the faculties. Members also stressed the importance of building up and supporting future HH researchers, both in Nottingham and elsewhere, to sustain the field.

5.3.4.3 Embedding IDR within the institution

In 2015, NHH became a research priority area for the University of Nottingham[78]. This was driven by HH researchers, on the ground, who had effectively created a critical mass within the discipline and successfully attracted research funding. The NHH research priority area is led by Professor Paul Crawford and Dr Anna Greenwood, who are themselves from two different faculties, Medicine and Health Sciences and Arts, respectively. Like other research priority areas, NHH receives funding from the University of Nottingham, which is used to support the network's research culture through seminars, workshops and sandpits. NHH also receives support from CAS, and NHH researchers take part in the sandpit events organised by UNICAS as described earlier. Sandpit events are one mechanism for helping to grow NHH, establishing new collaborations and providing initial funding for them; by taking part NHH researchers further integrate NHH within the university.

5.3.5 Lessons learned

NHH members believe that the network's focus on collaboration instead of competition, by developing junior researchers and sharing successes in a democratic way, is crucial to the success of the network. It creates a culture where researchers are willing to spend time and energy in doing IDR while being simultaneously responsible for research in their own faculties. This is also important for retaining researchers in NHH as membership of the network is voluntary. In the absence of more formal structures, the importance of individuals and their personalities to the network's success should also be recognised.

In terms of effecting cultural change, Professor Crawford stated that rather than changing the pre-existing cultures in the disciplines that contribute to HH, the field of HH created its very own culture. This culture is then apparent in how and what kind of research is conducted, and in turn in the influence HH has on healthcare, health and well-being.

NHH members see the different forms of support given by the University of Nottingham as very important to growing NHH, and the university itself as advanced in its mission to support IDR. However, they noted that the university has to comply with the REF, where researchers submit within UoAs. They perceived IDR not to be substantially or sufficiently part of the REF and felt that it reinforced the stereotype of a lone researcher in a narrowly defined discipline. Interviewed NHH members felt that this was not conducive to IDR and hindered the development of NHH and IDR more widely.

5.3.6 'What works'

What began as the field of HH with a few individuals in 2008, has grown to include hundreds of international researchers with over 350 researchers in the global network, including over 70 from the University of Nottingham. NHH researchers are involved in a range of IDR which has attracted more than £6 million of funding from prestigious funding bodies[78].

For NHH, the concept of a 'nomadic' network worked well, with researchers as part of their respective faculties, but connected to NHH via interpersonal contacts and events. Members believe that the successful management of the network is down to the personalities of those

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[78] http://www.healthhumanities.org/nottingham_health_humanities/view/home

involved. Support from the university via CAS and UNICAS, including sandpits, and the establishment and funding of HH as a research priority area all helped to grow and embed NHH. NHH thrives as a network without a formal physical space due to the enthusiasm and partnerships that it creates through its focus on research collaboration.

While Nottingham has the highest number of HH researchers in a single institution, the success of NHH has meant that the field is also being embedded in other institutions. One such example is the health humanities centre at the University College of London, which was established in 2015 and will start to offer an MA course in HH in the academic year 2016/17[79].

5.3.7 Future strategy for IDR

NHH members stated that their major goal is to achieve collaborative success for HH, both within the University of Nottingham and beyond. An important part of achieving this is to develop junior researchers by coaching and supporting them to become part of the field's success. In Professor Crawford's words: "We build others to build us".

The university has included IDR in its global strategy through its five research themes that tackle global challenges, explicitly embedding IDR in the institution's future strategy. By introducing research priority areas for each of the five themes, the university aims to use creative interdisciplinary approaches to deliver excellent research[80].

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[79] https://www.ucl.ac.uk/health-humanities

[80] https://www.nottingham.ac.uk/research/global-research-themes/index.aspx

5.4   University of Southampton

Key points:

- IDR is focussed in University Strategic Research Groups (USRGs) and University Strategic Research Institutes organised around key societal challenges.
- USRGs are bottom-up interdisciplinary networks of researchers that are built around a particular research theme, and are allocated pump-priming funds and coordination support for up to five years.
- University Strategic Research Institutes attract a more significant funding commitment than USRGs and are built around the university's research peaks of excellence.
- Success of this model lies in a clear structure with able leadership and accountability in combination with the freedom for groups to organise themselves internally.

5.4.1   The institution

The University of Southampton is a research-intensive university and founding member of the Russell Group. It has its origins in the Hartley Institution which was established for the study and advancement of the sciences in 1862[81]. The university was awarded a royal charter in 1952, completing its transition to a fully-fledged university.

The university comprises 31 academic units grouped into eight faculties across seven campuses including one in Malaysia. In 2014/15, 23,795 students were enrolled at the university for undergraduate (16,150) and postgraduate (7645) qualifications[82].

Over 97% of the university's research was assessed as 'world leading' or 'internationally excellent' in REF 2014[83]. Its research income for 2015/16 is in excess of £100 million with HEFCE contributing £45.4 million[84]. In addition, it received £17.9 million for teaching in 2015/16.

5.4.2   IDR and the institution

Southampton started to develop a strategy for IDR in 2003 in response to the Research Councils' increasing support for bigger and longer collaborative projects that address societal needs[85]. Since then IDR has become a key feature of research at Southampton. One of the six core objectives of the Research and Enterprise Strategy through to 2018 is to 'enhance interdisciplinary impact'[86]. This push for IDR led to the university submitting 68 interdisciplinary impact case studies to REF 2014 covering 22 UoAs[87]. Thus, the University of

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[81] http://www.southampton.ac.uk/

[82] https://www.hesa.ac.uk/free-statistics

[83] http://www.southampton.ac.uk/news/2014/12/18-world-leading-research-status.page

[84] http://www.hefce.ac.uk/pubs/year/2015/201504/

[85] http://www.southampton.ac.uk/interdisciplinary/news/2014/11/25_new_usrgs_announced.page

[86] Personal communication, Mylène Ployaert, Head of Research Funding Development, Research & Innovation Services, University of Southampton.

[87] http://impact.ref.ac.uk/CaseStudies/Results.aspx?HEI=170

Southampton has a long-term, established approach to IDR that has been successful in creating impact.

5.4.3   Model for organising IDR

IDR at the University of Southampton is focussed in the seven USRGs and four strategic research institutes which act as hubs of IDR activity. These hubs sit across faculties and are organised around grand challenges, which act as catalysts for growing interdisciplinary networks and collaborations between researchers from different faculties and academic units. Current USRGs include groups on antimicrobial resistance, clean carbon, autonomous systems and the water, imaging, population health, energy and food nexus. In parallel, the university has launched the Institute for Life Sciences, Southampton Marine and Maritime Institute, Zepler Institute and Web Science Institute since 2010[88].

An IDR Strategy Group, a sub-group of the Research and Enterprise Executive Committee, oversees the development and management of the IDR strategy and portfolio. The group is chaired by the PVC Research and Enterprise and brings together the directors of institutes and chairs of the USRGs. Central funds including HEFCE (HEIF) funds are used to support the institutes and USRGs. The key features of the institutes and USRGs are:

- Virtual (except for the Zepler Institute) and hence administratively relatively lightweight

- New activity 'from the bottom up' is encouraged and enabled

- All 'members' retain their core posts and income derived from interdisciplinary activities in their faculties

- New interdisciplinary opportunities are created through strategic funding allocation

5.4.4   Interventions, their implementation and results

5.4.4.1   Stimulating and growing IDR

IDR activity at the University of Southampton is largely driven by motivated researchers who wish to extend their work outside their disciplinary areas and develop game-changing solutions to societal challenges. The USRGs provide a mechanism whereby these researchers can engage with one or more research themes of interest. Each USRG receives £10,000 of pump-priming funds annually for three years, with an optional extension of a further two years, and one day a week of administrative support. The aim is to tap the potential of faculty-based researchers to develop new approaches for addressing emerging global challenges through interdisciplinary working. The five-year cap on funding and coordinator support frees resources for new groups and allows both old and new themes to evolve. For example, the existing USRG on Energy recently evolved to one with a focus on Clean Carbon.

Some USRGs have grown to a critical mass of interdisciplinary research activities that have justified the creation of University Strategic Research Institutes such as the Southampton Marine and Maritime Institute and the Institute for Life Sciences[88]. Each institute has a five-

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[88] http://www.southampton.ac.uk/research/centres.page

year business plan and can employ a different approach to build its reach and activities. For example, the Institute for Life Sciences has successfully appointed a number of outstanding 'career track' Research Fellows in strategically important areas within faculties. A similar approach is being used in the funding of PhD studentships to help join activities across the faculties. The university has used HEIF funds to provide each Institute with an annual Research Collaboration Stimulus Fund, to pump-prime new ventures and to stimulate interactions with business, government and industry.

Each USRG is led by a chair or a core group of co-chairs who may be supported by an advisory group comprising academics from the relevant stakeholder faculties. Each USRG has its own way of working. Nevertheless, all USRGs also fulfil networking and coordinating roles using approaches such as regular discussions, seminars or away-days. A mailing list and web site are also maintained for each group. Membership of USRGs and participation in IDR projects is also collected for submission in REF impact cases studies.

Initially, Southampton's research culture posed challenges to IDR because of, for example, inertia from academics used to working within disciplinary boundaries, but the availability of networking platforms and pump-priming funds has helped to change attitudes and culture over time. There is increased interest and impetus to grow new IDR areas. In fact, demand for seed funds has increased to such an extent that, for the last two years, funds have been allocated by competition, thus selecting the best new IDR areas/teams. This approach allows research focuses to evolve with time.

The success of the USRGs is monitored through annual reports from USRG chairs and feedback from IDR coordinators. The criteria for success are based on the initial USRG proposal which sets out the aims and objectives of the group. Performance indicators include recruitment of new members, profile-raising activities, funding secured, publications, intellectual property, new infrastructure, impact and other deliverables. However, a realistic flexibility is built into the assessment process so that the result is not a tick-box exercise. The research coordinators report on operational issues and team dynamics. The IDR Strategy Group monitors overall progress and, ultimately, lack of progress, meaning the non-delivery of promised outcomes, leads to discontinuation of funding and support to a USRG.

5.4.4.2 Supporting and sustaining IDR

Although long-term financial stability of a USRG is completely dependent on gaining external funding, the university provides crucial support for IDR through the provision of infrastructure and research support services. Strategic Research Institutes are one such infrastructural instrument to capitalise upon successful USRGs and critical mass in areas of excellence. To that end, the institutes receive funding for a director (usually a senior academic from one of the university's faculties) and one or two full-time support staff, as well as targeted investments to strengthen the university's academic position in the chosen areas of activity.

The Research and Innovation Services staff support the institutes and USRGs in preparing external funding bids, maintaining an active researcher network and distributing pump-priming funds. They play a key role in informing, engaging and motivating researchers by promoting the benefits of IDR.

Mentoring and development of postdoctoral researchers is another key strategy for sustaining IDR. Efforts are made so that the interdisciplinary way of working becomes attractive for ECRs and their future career prospects. An interesting example is the Network for Anti-Microbial Resistance and Infection Prevention (NAMRIP) where the chair has regular

meetings with postdoctoral researchers to help them with career development. They are encouraged to attend conferences, be adventurous and rigorous, and build expertise in new areas. Moreover, ECRs are deliberately encouraged to apply, as the primary investigator, for pump-priming grants, which gives them experience of drawing up and being responsible for a budget (around £20,000), managing staff, and leading a project. ECRs in NAMRIP have found this tremendously useful as it sets them apart from other ECRs when applying for longer-term jobs. It also helps to build capacity and expertise within the area, making it sustainable over a longer period.

In 2012/13, ECRs at the university formed the Southampton Interdisciplinary Research Forum to bridge traditional disciplines and create synergies between them to contribute to understanding and alleviating societal challenges. The forum held two annual conferences to promote communication among junior researchers on interdisciplinary topics. This group's function has since been taken over by the Institute for Learning Innovation and Development, the university's staff development unit[89]. IDR is also supported in the Centres of Doctoral Training.

5.4.4.3 Embedding IDR within the institution

IDR is embedded deeply in Southampton's research culture owing to the university's drive for impact and tackling real-world challenges in an interdisciplinary way. The research strategy (Vision 2020) also relies heavily on IDR to support future growth and competitiveness[90]. This is delivered by a research management structure which embeds interdisciplinarity within the institution:

- The PVC for Research and Enterprise provides the signals that IDR is strategically important

- The directors of the institutes and the chairs of the USRGs are responsible for driving the IDR strategy and establishing interdisciplinary communities of researchers

- Leaders of the Focus Areas, which are strategic areas of activity that overlap across the USRGs, are responsible for developing and establishing distinctive long-term research programmes

- The IDR research coordinators are embedded in the institutes and USRGs and motivate, inform and support interdisciplinary researchers

A number of communication tools, including an 'interdisciplinary blog'[91] which presents the latest news, discussions and opportunities for IDR across the university, help to promote the university's IDR activity internally and externally. Moreover, the leaders and members of the institutes and USRGs, who are also rooted in their respective faculties, help to embed IDR across the university.

5.4.5 Lessons learned

While the institute and USRG models have been successful in growing IDR at the university, there are several lessons to be learned from their implementation and evolution over the years. The first is that initiative at the university management level and explicit commitment

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[89] http://www.southampton.ac.uk/professional-development

[90] University of Southampton, 2014. A connected university: Vision 2020 (strategy document).

[91] http://www.southampton.ac.uk/interdisciplinary/blog.page

to supporting IDR is very important for fighting researcher inertia against interdisciplinary ways of working. In the case of Southampton, this also includes the systems of attributing academic credit and finance to faculties and individuals. By tagging academics' membership of institutes and USRGs and acknowledging the impact of their interdisciplinary activity, e.g. through REF impact case studies, the university was able to change how faculties viewed IDR. Once academics started working with others outside their disciplines, they found IDR rewarding and exciting because of its potential to drive forward solutions to practical problems, resulting in continued motivation to conduct IDR. The university's encouragement of IDR by promoting viable career options for ECRs is aimed at sustaining this change into the future.

According to Professor Timothy Leighton, the chair of NAMRIP, moving from monodisciplinary to interdisciplinary ways of conducting research also requires some courage from researchers to take risks and investigate new research problems, since their tendency is to become experts in increasingly smaller areas that are as close as possible to their PhD training. Over-specialisation is unhelpful, because to tackle real-world and industrial problems, researchers need to be 'problem solvers' rather than 'solution sellers'. His view is that the USRG model provides support for new ideas and allows researchers to remove the shackles of disciplines and talk to new people.

He adds that it is not enough to just get people from different disciplines to work together. Fostering a community in which researchers acquire knowledge and learn new approaches from working with other disciplines results in genuinely innovative thinking and ground-breaking ideas. This approach leads to game-changing solutions, not just incremental changes.

While IDR is centre-stage in the university strategy, experience from the USRG model suggests that the delivery of the research strategy depends greatly on key strategic leaders such as the PVC, particularly their vision, leadership and interpretation of the strategy. For example, the capping of pump-priming funds at five years was a decision at the PVC level. Thus, how a strategy is implemented appears to be more important than the content itself.

5.4.6 'What works'

The USRG model has worked very well for the university over a long time. It has stimulated activity in various IDR areas leading to more external research funding and impact. This has led to sustained activity and growth in specific areas leading to the establishment of research institutes in some instances.

The £10,000 pump-priming fund has worked incredibly well for growing IDR even though it is a relatively small amount. When used optimally, it becomes the initial investment that attracts more funds. For example, in its first year, NAMRIP has grown to £5 million from the initial £10,000 grant. The funds have helped to explore opportunities and ideas, and the administrative support proved vital for keeping track of finances, communication (twitter, blog, etc.) and general administration, leaving researchers free to conduct IDR. Small, quick projects are also useful to accelerate translation from fundamental research to impact. For example, a new pump-priming project will test the effectiveness of NAMRIP's first commercial product, StarStream (manufactured by Ultrawave Ltd.), for cleaning wounds, hands and acute hospital wards.

In terms of what works generally for building and sustaining IDR at an institution, Professor Timothy Leighton states that there are three crucial factors: personal rapport and trust,

leadership, and continuity of funding. Team members need to be able to get along and trust each other. They also should be motivated, engaged and well led. Personal qualities of the leader such as trustworthiness, rigour and vision are also vital for success.

What has worked well for interdisciplinary researchers at Southampton is a clear structure with able leadership and accountability in combination with the freedom to organise themselves internally. The right leader, once chosen, has to be trusted to deliver. In addition, encouraging researchers from all career stages to work together also seems to be important for successful IDR. On the one hand, having senior, experienced members makes it easier to attract funding, while on the other hand, ECRs help to carry the research area forward, thus making it more sustainable.

Conversely, the institutes impact the university in other subtle ways. Firstly, they are a focus for communication of the university's IDR strengths and critical mass. Second, they are a route by which industrial and commercial strategic partnerships can be developed, as they can provide a 'one-stop-shop' for initial and ongoing engagement. Third, in being led full-time by senior academics who all have significant external profiles, they are a mechanism for ensuring visibility and galvanising opportunities which simply would not be possible through a more dispersed set of activities and individuals.

5.4.7   Future strategy for IDR

Southampton prides itself on being a leading research-intensive university with a reputation for excellent and diverse IDR. The university wishes to build on this reputation and has promised continued support and development for interdisciplinary institutes and research networks[92]. To that end, the university will make efforts to unlock new funding sources, invest in new infrastructure, better exploit existing infrastructure and develop fruitful external partnerships, enabling overall growth and competitiveness. On the other hand, the university plans to disinvest in those disciplines where investment in staff and facilities is unlikely to lead to internationally competitive research[93].

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[92] http://www.southampton.ac.uk/news/2014/12/18-world-leading-research-status.page

[93] University of Southampton, 2014. A connected university: Vision 2020 (strategy document).

5.5 Centre for Critical Inquiry into Society and Culture, Aston University

> *Key points:*
>
> - IDR at the CCISC stems from the concrete research interests of the participants and relies on researchers to drive it forward.
>
> - CCISC is organised in thematic clusters. The clusters are continually reviewed and adapted when needed, to ensure they remain relevant and productive.
>
> - Administrative and financial support enables the initiatives from researchers to go further, for example in preparation of bids for external funding.

5.5.1 The institution

The Centre for Critical Inquiry into Society and Culture (CCISC) is part of the School of Languages and Social Sciences (SLSS) at Aston University in Birmingham. Aston was founded in 1895, becoming a university in 1966, and has since developed a reputation for high-quality teaching and strong links to industry, government and commerce[94]. The university offers both taught and research degrees to about 8000 undergraduate and 2000 postgraduate students[95]. The SLSS is one among four academic schools with the others being business, engineering and applied science, and life and health sciences.

Aston received £12.8 million for teaching and research in 2015/16 from HEFCE[96] and 78% of its research was rated as world leading and internationally excellent in REF 2014. CCISC researchers are affiliated both to the centre and the SLSS, hence they were not submitted to the REF independently, but through the school under two panels – 'Area Studies' and 'Modern Languages and Linguistics'. 81% of research submitted to 'Area Studies' and 62% of research submitted to 'Modern Languages and Linguistics' was rated as world leading or internationally excellent.

5.5.2 IDR and the institution

The CCISC was established to 'create a bridge between research, policy, and professional practice and facilitate inventive IDR which contributes to public understanding of major social issues, scrutinises the evidence base for policy and practice, and expands the policy options under debate'[97]. The CCISC receives funding and administrative support from the SLSS which is described as a 'multi-lingual, multi- and inter-disciplinary community, working across the Humanities, Arts and Social Sciences'[98]. Thus, interdisciplinarity plays a central role at both the school and centre levels.

IDR is also promoted at the university level and features in the university's research strategy[99], which states a desire to increase translational research with impact, be more

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[94] http://www.aston.ac.uk/

[95] http://www.aston.ac.uk/study/undergraduate/schliaison/faqs/

[96] http://www.hefce.ac.uk/pubs/year/2015/201505/

[97] http://www.aston.ac.uk/lss/research/research-centres/ccisc/about/

[98] http://www.aston.ac.uk/lss/research/

[99] http://www.aston.ac.uk/research/strategy/

collaborative and interdisciplinary, develop staff, and establish a supportive research environment and culture. Indeed, opportunities for collaboration across departments and academic disciplines are facilitated by the university's compact campus. The university's IDR was showcased in 25 REF impact case studies of which five were submitted to the aforementioned panels.

5.5.3   Model for organising IDR

The CCISC is essentially a 'virtual' centre with 47 current members and eight affiliated research students. The researchers are from different academic subject groups within the SLSS such as English Language and Linguistics, Modern languages, Translation Studies, Sociology, Social and Public Policy, Politics and Psychology. They collaborate to write bids and conduct research under the aegis of CCISC in addition to their work within the school. Internally, CCISC is organised around six 'clusters' each with a nominal head to drive activities. These six clusters are discourse and communication; gender, sexualities and the body; power, inequality and justice; religion, ethnicity and nationhood; social movements and social change; and state, business and society. This structure is flexible with room for clusters to be added or removed as and when necessary.

The CCISC is one of four research centres at the SLSS, which have been established to bring together academics from different subject groups to conduct research on particular interdisciplinary areas of interest (Figure 1) e.g. language research (CLaRA) or European Politics and Society (ACE). As already mentioned, academics remain affiliated to their school and subject group while also being affiliated to one or more centres.

Figure 1 The position of interdisciplinary research centres at the SLSS

Source: http://www.aston.ac.uk/lss/research/research-centres/
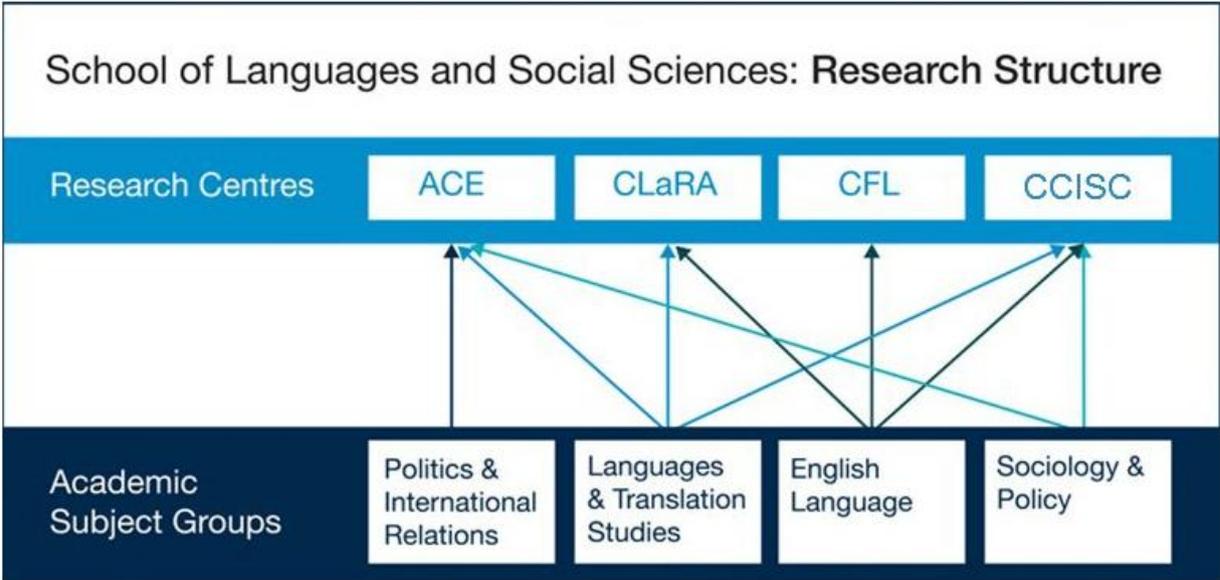
5.5.4 Interventions, their implementation and results

5.5.4.1 Stimulating and growing IDR

CCISC traces its origins to a previous interdisciplinary research centre, the Aston Centre for Interdisciplinary Research into Language and Diversity (InterLanD), which was established in 2009. The structure of the centre was adapted to reflect changes in staffing, specifically an increase in sociology and policy members, and in 2015 the CCISC was established. There was a rebalancing of the subject areas: sociology and public policy became more prominent, whereas the effective presence of languages, communication studies and business decreased.

As the new centre was starting out, a 'bottom-up' model was chosen, focussing on concrete research interests of potential participants. The process of establishing the CCSIC was kicked off with an open meeting where agreement was reached to establish six thematic clusters, each led by a nominal head. As interdisciplinary collaboration tends to be highly contextualised around project-based or activity-based activities, each cluster is allowed to work according to the needs and interests of the researchers involved. Clusters are expected to meet on a regular basis and cross-cluster collaboration is encouraged but the initiative rests with the cluster heads.

CCISC funding is given to initiatives that have the potential to lead to value-added impacts. This may include external events to facilitate networking, applications for external funding – submitted in the name of CCISC – and activities aimed to generate what the Research Councils define as 'impact'. The cluster heads meet on a regular basis and the clusters are constantly reviewed. Changes are only made if they are in line with the interest of the 'grassroots' participants and if they are deemed necessary to enhance outcomes. Outcomes are monitored to make sure that people 'keep busy' but there is no attempt to regulate the *process* within the clusters. The aim is to create an infrastructure that allows people who might not ordinarily work together in normal academic structures to work together if they choose to.

The success of the centre's initiatives such as interdisciplinary networking events has not been evaluated in absolute terms, but there are signs of positive change. Applications for funding have been submitted and subsequently shortlisted, which has encouraged involvement in interdisciplinary projects. Without the money and meeting opportunities provided by the centre, the same IDR projects may not have come about.

5.5.4.2 Supporting and sustaining IDR

At the CCISC, IDR is sustained mainly from external funds and the ideas generated through the cluster network. Around £250,000 worth of external funds have been captured by centre members from funders such as the UK Research Councils, UK charities and the EU[100].

The school provides a limited amount of funding for events and administrative support (0.5 full-time equivalent) for the CCISC. In turn, the CCISC provides an infrastructure where people can work across disciplines if they want to. The CCISC also provides funding to support grant proposals for IDR. Recently, money was provided for advisory board costs (such as travel expenses) for a Leverhulme Trust grant application. This funding was awarded to optimise the chances of the bid after an internal peer review determined that the

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[100] CCISC data.

research project was of high quality. The application itself helped to bind the academics together and bring them closer as a team.

5.5.4.3 Embedding IDR within the institution

IDR is the main purpose of the CCISC and is reflected in its structure. Embedding the CCISC and other centres within the traditional school structure is expected to prevent isolation of both the interdisciplinary and monodisciplinary academics from each other. To further embed the interdisciplinary way of working in the institution, the CCISC plans to build on the already emerging 'green shoots' of new IDR collaborations. Ultimately, the long-term embedding of IDR is expected to be achieved through the continued hard work of the researchers involved.

5.5.5 Lessons learned

CCISC members feel that the organisation of interdisciplinary work has to be founded in the interests of the researchers themselves, and should be allowed to grow organically with concrete projects. This is particularly important at the beginning of the process but also as a general principle. The CCSIC has not existed long, but based on previous experience, participants have decided to avoid a more 'formulaic' approach that risks spending resources on 'dead structures' that do not cohere with the material interests of the researchers or the institution.

The bottom-up model of the CCISC puts the onus on individual clusters and researchers to drive the work. The participating researchers' main affiliation is still with the subject groups and they may decide to prioritise their more traditional mono-disciplinary work. Thus, there are cases where a lack of common interests or initiative will lead to 'dead clusters' without any meaningful collaborative activity. Within the CCISC, such situations are addressed by continually reviewing the clusters to ensure that they remain relevant to members' research interests and have the potential for interdisciplinary work. Thus, the implication is that the constant review of existing structures and flexibility to re-organise clusters is vital. Overall, CCSIC has more 'live' clusters than 'dead' ones and the approach is believed to work.

There have been other activities that have been less successful. For example, some interdisciplinary networking events were poorly attended and some interdisciplinary initiatives did not attract sufficient interest. Inadequate publicity of events and initiatives probably resulted in the low participation. This was seen as a commonly occurring issue within academia and not specifically attributable to the interdisciplinary nature of the work or to the way in which the CCISC is organised.

5.5.6 'What works'

A researcher-led 'bottom-up' approach with flexible systems which are constantly reviewed seems to work well in the case of the CCISC. It creates a dynamic, flexible system that is able to facilitate different types of IDR and can respond to new needs. IDR based around concrete research interests and ideas for collaboration that come from the participants themselves seems to work best. This model has the potential to remain dynamic and fit-for-purpose over a longer period. Besides, it is also less expensive than establishing a more administratively structured centre, which will hopefully result in more money being channelled into IDR.

Inversely, "formulaic approaches that start with structures are not advisable", according to Dr Gary Fooks, co-Director of the CCISC, as they risk being disconnected from the interests of the researchers and institutions they are meant to support.

Finally, monetary and administrative support from the school is also vital for the CCISC. It is clearly felt that the support has allowed a number of events and initiatives to go ahead, which would not have otherwise.

5.5.7   Future strategy for IDR

The CCISC exists solely to undertake IDR. It has a flexible organisational structure that may ensure its long-term sustainability in the event of changes in research interests and needs. However, in different circumstances, the organisational model and/or the research focus of the centre may change following a review of the mission. Ideally, a reorganisation would be accompanied by more money to underpin more collaboration, and a consistent deployment of the current process, i.e. after knowing the requirements for IDR and the in-house capabilities. CCISC staff plan to continue working hard within the current approach and expect the centre's IDR to grow dynamically as a result.

5.6 Institute of Advanced Study, Durham University

Key points:

- A 'research incubation space' that facilitates and nurtures IDR across the university's departments and schools as well as with external partners and international academics.
- Stimulates interdisciplinary discourse around an annual research theme and offers fellowships to visiting researchers.
- Provides a central location to hold interdisciplinary conversations, and a wealth of experience to draw on when conceptualising and conducting IDR.

5.6.1 The institution

Based at Durham University, the Institute of Advanced Study (IAS) is an ideas-based institute that brings together researchers who wish to engage in IDR, irrespective of their own discipline and the discipline/s they want to work with. It encourages internal and external interdisciplinary collaborations to examine themes of major intellectual, scientific, political and practical significance, helps to build research capacity, and provides a forum for decision makers and academic experts to discuss policy issues.

Durham has been a leading centre of learning since the 7th Century and the site of England's third university – after Oxford and Cambridge – since 1832. It remains a research-intensive university and is a member of the Russell Group.

The university comprises 25 departments or schools grouped into three faculties (Arts and Humanities, Science, and Social Science and Health) and nine research institutes of which the IAS is one. The university's students (totalling 17,595 in 2014/15[101]) belong to one of 16 colleges, which offer distinctive residential and educational communities, where they can gain new experiences, develop skills and build networks.

Over 83% of the university's research was assessed as 'world leading' or 'internationally excellent' in REF 2014 based on 23 submissions across 22 UoAs[102]. In 2015/16, the university received £24.9 million and £7.2 million from HEFCE for research and teaching respectively[103].

5.6.2 IDR and the institution

The IAS provides the 'space', both intellectual and physical, for disciplines to interact. It is the major 'facilitator' of IDR at Durham University and has an ongoing commitment to support and foster interdisciplinary collaboration. The university does not incentivise IDR over other types of research, but values interdisciplinary and multidisciplinary approaches because of their potential to break new intellectual ground; to respond to international, national and local research agendas; and to access different funding sources. This attitude is reflected in the core institutional values[104]. A push for collaborations with external partners, such as

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[101] https://www.hesa.ac.uk/free-statistics

[102] https://www.dur.ac.uk/research/showcase/ref/

[103] http://www.hefce.ac.uk/pubs/year/2015/201504/

[104] https://www.dur.ac.uk/about/strategy/

businesses, Research Councils, spin-out companies, non-governmental organisations and public-sector bodies, also drives IDR at Durham. Durham achieves this through participation in networks like the N8 Research Partnership, a consortium of eight research-intensive universities in the north of England.

Staff feel that Durham University is particularly good at conducting and fostering IDR. Being a small university with a collegiate structure is seen as an advantage since it makes contacts between disciplines easier. In addition, many of the university's research institutes and centres have an interdisciplinary focus, and alternative structures for facilitating IDR such as the Bio-X network, an initiative to encourage collaborations between the biosciences and other disciplines, are also used. The quality and range of the university's IDR was reflected in the 62 interdisciplinary impact case studies submitted to REF 2014, which covered 20 UoAs[105].

5.6.3 Model for organising IDR

As already mentioned, the IAS acts as a 'facilitator' of IDR at Durham University. It does so by fostering research activity across the university's 25 departments and schools, and recruiting international fellows to come and work at Durham. The institute occupies a building within the university campus with dedicated, single-occupancy office space and several networking spaces. It is funded by the university and run by a directorate consisting of an executive director and one co-director from each of the university's three faculties – Science, Social Science and Health, and Arts and Humanities (three in total). The directors are supported by a small team of administrative staff and an advisory council whose members help to promote the institute's work and advise on new research themes and the institute's academic calendar.

5.6.4 Interventions, their implementation and results

5.6.4.1 Stimulating and growing IDR

The IAS has two mechanisms for stimulating interdisciplinary discourse: annual research themes and fellowship schemes. In addition, it facilitates research conversations, provides seed funding to grow IDR, and engages with the university's postgraduate population. The institute also showcases its work and Durham's IDR more broadly to the general public through events such as the Durham Book Festival and public panel discussions with distinguished experts in London.

The IAS's core activities are organised around an annual thematic priority that generates intellectual debate and stimulates original thought. The themes tend to be broad, open to interpretation from different conceptual and disciplinary perspectives, and responsive to Durham's research strengths. Any individual, research group, or department can propose a theme, and the final selection is made following consultation with the departments and advisory council considering the theme's interdisciplinary appeal and its ability to contribute to ground-breaking research. Previous themes have included Modelling, Being Human, Water, Futures, Time, Light, Emergence and Evidence[106]. The upcoming themes are Scale (2016/17) and Structure (2017/18).

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[105] http://impact.ref.ac.uk/CaseStudies/Results.aspx?HEI=114

[106] https://www.dur.ac.uk/ias/themes/

This annual research theme is at the heart of the IAS's three-year Research Incubation Strategy, wherein the first year is developmental. At this stage, a programme of activities is mapped out and fellows are nominated. The second year involves theme-based activities such as workshops, public lectures, symposia and panel discussions, and collaborations between international fellows and Durham academics. Finally, the third year involves follow-on activity to sustain IDR initiated in the second year.

The IAS runs two main fellowship schemes. Under the IAS Fellowship Scheme, the IAS annually recruits two cohorts of up to ten international fellows for three months each to contribute to the annual research theme[107]. IAS fellows live in one of the university's colleges and get the time and space to develop their ideas, forge strong links with at least one department, and deliver public lectures and seminars. They are expected to undertake a collaborative piece of work with a Durham academic(s), such as a joint publication or proposal.

The newer Durham International Fellowships for Research and Enterprise scheme, which is cofunded by Durham University and the EU, is administered by the IAS and offers both junior (for 1-3 years) and senior fellowships (for six weeks to six months) geared towards building international networks to address problems of global significance[108]. These fellowships encourage collaboration with the university's thematic institutes and research centres. The senior fellowships are also available to policy makers and practitioners across all subjects. These fellows are usually accommodated within the colleges, giving them a sense of community and enabling interdisciplinary discussions and relationships to develop.

The IAS also facilitates multiple IDR projects outside the annual research theme. It works closely with faculties, departments and other interdisciplinary units to identify and nurture interdisciplinary research ventures, providing foundational/advisory support to any IDR activity. Over and above facilitating researcher-led interdisciplinary initiatives, it also helps the University Research Committee to develop and advance strategic initiatives. To this end, the institute holds workshops, conferences, seminar series, lecture series and meetings[109].

The university has a Seedcorn Research Fund, funded from core funds, which provides grants of up to £15,000 for pump-priming inter- and multi-disciplinary research. A small amount of seedcorn funding is also available for activities like initial meetings with external collaborators.

Durham's research postgraduates are also encouraged to engage with the institute's work[110]. By providing research postgraduates the unique opportunity to meet and exchange ideas with leading international scholars, the IAS hopes to expose students to the benefits and challenges of IDR early in their careers. To that end, the institute provides small grants for interdisciplinary postgraduate events such as lectures and workshops. It also publishes Kaleidoscope, a peer-reviewed, interdisciplinary journal edited by postgraduate researchers, which is aimed at fostering international communication between postgraduates in different disciplines[111].

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[107] https://www.dur.ac.uk/ias/fellows/iasfellows/

[108] https://www.dur.ac.uk/ias/diferens/

[109] https://www.dur.ac.uk/ias/participate/seedcornresearchsupport/

[110] https://www.dur.ac.uk/ias/postgraduates/

[111] http://community.dur.ac.uk/editor.kaleidoscope/index.php/kaleidoscope/index/

5.6.4.2 Supporting and sustaining IDR

Supporting the IDR 'facilitator' model at Durham involves two mechanisms: (1) core financial support for the IAS and (2) interventions to sustain research initiated through IAS activities. The university covers most of the IAS's core costs and its continued engagement with the IAS is attributable to the institute's consistent success in attracting the best researchers to Durham[112]. Nevertheless, due to competing demands on university funds, this support cannot be taken for granted.

Sustaining IDR activity following initial seedcorn funding depends to a large extent on acquiring external funding. Durham has been particularly successful in attracting both project-based and strategic funding from charity funders such as the Wellcome Trust, Leverhulme Trust and health charities. The EU and UK Research Councils are also major funders. In one case, EPSRC funding for the Multidisciplinary Centre for Doctoral Training in Energy has helped to support IDR in the Durham Energy Institute. However, Research Council grant applications can sometimes pose problems because research projects may not fit in with funder requirements. Besides, funders' budget allocations and priorities are prone to change at short notice. Importantly, not all grant proposals will be funded, resulting in many interesting initiatives petering out due to lack of sustained support.

The IAS allocates a small amount of core resource to support and sustain follow-on activity from annual research themes. This support is offered to secure a sustained programme of research, with priority given to efforts for acquiring external funding.

The institute provides meeting/seminar space and facilitates 'research conversations' between researchers who wish to apply for or those who have successfully applied for the university's Seedcorn Research Fund[113]. When available, office space is provided to researchers and visiting academics. In addition, IAS directors are all experienced interdisciplinary researchers, and can offer colleagues across the university expert advice and support at different project stages.

The IAS also offers financial and in-kind support for high-calibre projects within and between disciplines that require support beyond departmental or faculty level, regardless of whether they are linked to the annual theme[114]. However, projects need to demonstrate contribution to either research excellence or capacity development in a new or underexplored field of research. Activities might include grant applications, collaborative networks, writing projects, dissemination ventures, etc.

The IAS also provides training courses and workshops on interdisciplinarity and IDR for policy makers, academics and postgraduates, to improve understanding of the nature of interdisciplinarity and the challenges and benefits of conducting IDR. It has collaborated extensively with funding bodies and learned societies in seeking effective ways to evaluate IDR, and has published some practical guidelines for peer reviewers, emerging from this collaboration[115].

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[112] https://www.dur.ac.uk/ias/fellowships/

[113] https://www.dur.ac.uk/ias/participate/seedcornresearchsupport/

[114] https://www.dur.ac.uk/ias/participate/networksupport/

[115] Strang, V. and McLeish, T., 2015. *Evaluating Interdisciplinary Research: a practical guide,* Durham: Institute of Advanced Study.

5.6.4.3 Embedding IDR within the institution

The IAS was established in 2006 to pursue an internationalisation agenda as part of Durham University's 175th anniversary celebrations. Since then, its role in fostering IDR has increased. The university's continued commitment to the IAS and IDR has been instrumental in embedding IDR in its institutional culture.

Since the IAS acts as a 'facilitator' between departments, building links and providing resources for stimulating and supporting IDR, it remains close to the university's interdisciplinary projects rather than being an isolated 'ivory tower'. The IAS model has been working for almost a decade and many of its interdisciplinary initiatives have been sustained over the years, placing both the IAS and its activities at the heart of the university's IDR activity. For example, IAS's International Fellows are embedded in the university's colleges and departments and, later, international collaborations are maintained via its extended College of Fellows. In addition, the IAS Directorate includes co-directors from all three faculties, thus creating direct links between the IAS and the disciplinary university structures. Departments, institutes and centres nominate IAS fellows, and also peer-review applications. In these ways, faculties, departments, institutes/centres and colleges remain closely involved in IAS activities, ensuring the embedment of IDR in Durham's organisational infrastructure. Furthermore, the IAS building is located centrally within the campus and provides a physical location for interdisciplinary exchanges, embedding IDR within the university's physical infrastructure.

5.6.5 Lessons learned

The IAS presents an interesting model for stimulating IDR within a university because its main role is facilitating, not conducting, IDR. Besides, in its ten years of existence, several lessons have been learned.

Firstly, not all 'research conversations' will lead to projects and/or achieve long-term sustainability. Small grants like those offered by the Seedcorn Research Fund are extremely useful in this regard because initial groundwork such as proof-of-principle studies can be conducted before major funding is sought, and the loss of time and money can be kept to a minimum if the project fails.

Secondly, although fellows are expected to engage with the wider university and departments, this does not happen in every case. Having a stronger focus on collaboration within the fellowship schemes is expected to remedy this. In addition, making people aware that the fellowship schemes are a mechanism for departments to invite researchers they want to work with to Durham will help to embed both the schemes and the fellows more closely within the departments.

Thirdly, quantifying the IAS's contribution as a facilitator of IDR is very difficult. A major percentage of its activities are qualitative and their benefits are also complex and often indirect. The institute uses indicators and outputs like the number of grants won, case studies of collaborations and outputs from fellows in its annual and quinquennial reports, but research facilitation activities are not tracked in detail. Also many of the IAS's activities are aimed at communicating Durham's value externally – the indirect (reputational and fiscal) benefits of these are impossible to pin down. Nonetheless, there is a need for proper qualitative analysis of the IAS's contribution to the university to justify its existence in the face of internal competition for university funds.

Finally, strategic leaders at Durham found that a reputation for conducting high-quality IDR and an IDR-friendly environment was instrumental in the awarding and then renewing of the EU grant. Support structures for IDR and signals from the university management that they are neither overly preoccupied with the REF nor risk averse, and understand that IDR takes longer and may be difficult to evaluate, have contributed greatly to the supportive environment for IDR.

5.6.6 'What works'

Several factors have contributed to the IAS's success in stimulating and supporting IDR at Durham. Firstly, Durham is a small university with an ability to be agile. The size of the university makes it easier to come across researchers from other disciplines, and there is a culture of openness among the researchers who coalesce rapidly around interesting ideas. This environment attracts like-minded people to Durham, thus perpetuating its unique institutional culture. Secondly, the collegiate structure of the university, wherein students, academics and IAS fellows are associated with a college, allows further cross-talk between disciplines and helps to build communities of interdisciplinary researchers. Thirdly, because of the 'bottom-up', researcher-led approach to IDR, researchers are highly motivated because they feel free to pursue their own research interests, which may not be the case in universities with a 'top-down', strategic approach.

The IAS not only runs activities to facilitate interdisciplinary discussions, but also provides a physical space at the centre of the university for people to do this in, and a wealth of experience to draw on when conceptualising and conducting IDR. In this way, the IAS provides a research incubation space that nurtures research through all its different stages. The annual research theme has proved to be a very effective and inclusive instrument for stimulating original and creative research in both disciplinary and interdisciplinary contexts. Complementing this are the fellowship schemes that have established a thriving community of scholars of national and international standing, and the seedcorn funds that support initial exploratory and innovative research. All these approaches allow incremental growth of new and existing research areas by researchers who are given the freedom to pursue their ideas, which has boosted the quality and volume of Durham University's IDR.

5.6.7 Future strategy for IDR

Durham University is currently developing a new research strategy which is due to be made public in summer 2016[116]. The current research strategy (2010-2020) focusses on developing research quality in individual disciplines with a view to meeting REF-related targets such as international excellence, outstanding impact and top 10% ranking in each discipline[117]. Herein, IDR is seen as a way to address complex and real-world problems. IDR and structures for supporting it are expected to be strategic objectives in the new strategy. To that end, more integration between the IAS and the University Research Office, and better engagement with and from departments and ECRs is envisaged.

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[116] https://www.dur.ac.uk/about/strategy/

[117]

https://issuu.com/communicationsoffice/docs/dustrategy20102020?mode=embed&layout=http%3A%2F%2Fskin.issuu.com%2Fv%2Flight%2Flayout.xml&showFlipBtn=true

5.7 Northumbria University and the Institute of the Humanities

Key points:

- Northumbria University is investing in eight thematic IDR areas. This is enabled by increased QR funding enabled by REF 2014 results.
- Researchers at the Humanities Department are already engaged in IDR internally and externally and through participation in networks across the north of England.
- The Institute of the Humanities, one of the eight areas, is now recruiting and preparing for its official launch in September 2016.

5.7.1 The institution

Northumbria University can trace its roots to the Rutherford College, founded in 1880. A former polytechnic, it gained university status in 1992. The university comprises 20 academic departments across three campuses – two in Newcastle City Centre and one in London.

Northumbria University improved its results in REF 2014 compared to the previous RAE in 2008, tripling its share of research judged to be 'world leading' and 'internationally excellent' and doubling the volume of research submitted[118]. In total, 29% of the research-active staff were included in 16 REF submissions across 15 UoAs[119].

In 2015/16, the university received £6.5 million and £10.4 million from HEFCE for research and teaching respectively[120]. With a strong focus on students (22,705 undergraduate and 4370 postgraduate students in 2014/15[121]) and business partnerships, the university is investing in its research capacity and aims to become one of the top 30 universities in the UK by 2030.

5.7.2 IDR and the institution

The university sees investment in IDR as a way to address pressing societal questions and further improve its academic standing and reputation. As more and more funders emphasise the importance of IDR, and provide grants for interdisciplinary work, the focus towards interdisciplinary working must increase. This is reflected in the 23 interdisciplinary impact case studies submitted to REF 2014, including 12 to main Panel D (Arts and Humanities).

Northumbria University has always supported interdisciplinary and innovative ways of working; they are fundamental aspects of many research collaborations. While the current University Strategy (2013-2018)[122] does not specifically mention IDR, it is very much part of the university's plans for the future and will be reflected in future strategy documents. The additional QR funding awarded to Northumbria University on the basis of the REF 2014

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[118] https://www.northumbria.ac.uk/about-us/news-events/news/2014/12/northumbria-powers-ahead/

[119] http://results.ref.ac.uk/Results/ByHei/68

[120] http://www.hefce.ac.uk/pubs/year/2015/201504/

[121] https://www.hesa.ac.uk/free-statistics

[122] https://www.northumbria.ac.uk/about-us/our-vision/

results is being invested to further strengthen the university's research profile, with a particular emphasis on IDR.

5.7.3   Model for organising IDR

The university's IDR is focussed around eight themes, each addressing some of today's fundamental questions and societal challenges. They are: Bioeconomy; Digital Living; Extreme Environments; Future Engineering; Humanities; Integrated Health and Social Care; Environmental and Global Justice; and Critically Aware Design Innovation[123]. The final themes were chosen through an internal competition and assessment. Research groups within the university proposed IDR themes across different departments and faculties. Applicants were interviewed and asked to explain their proposal in more detail to demonstrate how the proposed theme would fulfil the objectives of the investment.

All themes have three-year plans outlining potential projects, a work plan and expected outputs. The university believes that this time scale allows the themes to demonstrate success, which will be determined on criteria such as:

- High-quality published articles, books and other academic outputs

- Growth of international collaborations

- Alignment with funder themes and IDR approaches to societal challenges leading to increased external funding (e.g. from Research Councils, charities, EU or industry)

- Wider impact on society and the economy in line with the impact agenda at Research Council UK (RCUK) and REF level

- Furthering research-informed teaching

In this case study, we particularly focus on the Humanities theme, which will be implemented through the establishment of the Institute of the Humanities. The role of the institute is to:

> *"Explore – in a cross-disciplinary way – the many facets of what it is to be 'human': including the types of political formation and identity; the rituals of cultural memory; the impulses towards settlement and diaspora; the forms of artistic and creative self-representation; and the modes of communicative interaction and literary expression that make human beings what they are."[124]*

This is a university-wide initiative bringing together expertise from the Departments of Humanities, Arts, and Media and Communication Design in the Faculty of Arts, Design and Social Sciences.

5.7.4   Interventions, their implementation and results

5.7.4.1   Stimulating and growing IDR

At Northumbria, a number of avenues are open to establish interdisciplinary working relationships: departmental networks, regional networks and external partnerships. The Humanities Department contains a range of subject areas: English, History, American

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[123] https://www.northumbria.ac.uk/research/

[124] https://www.northumbria.ac.uk/research/research-themes/theme-5/

Studies, Creative Writing and Linguistics. Working across disciplines is considered standard practice within the department, and the growth of the institute is expected to allow this approach to be further embedded as inter-departmental collaboration grows. At the level of individual research groups, coordinators have a role to play in identifying opportunities to connect researchers across and between research groups and to foster collaborative working.

The university is represented in several regional networks. The Northern Network for Medical Humanities Research (NNMHR) is one such interdisciplinary network that acts as a hub for bringing medical humanities researchers into contact with other professions. It brings together eight universities across the north of England and Scotland[125]. For universities in the North East, this has helped to raise awareness of available funding sources (e.g. the Wellcome Trust) and has led to several concrete project proposals.

'Further North' is another initiative, co-led by Professor Ysanne Holt from Northumbria University, which brings researchers from the north of England and Scotland together. In 2014, a two-day conference was held at the university about the experience and representations of so-called 'marginal' or 'at edge' locations in the north of England and Scotland[126]. It had an inter-disciplinary focus on cultural forms and creative expression, and considered ways in which enhanced communication and collaboration could be used to develop interdisciplinary partnerships in the north as well as 'further north' in Europe.

The university's capacity for interdisciplinary working is enhanced by the recruitment of researchers with experience from outside academia. This puts the university in a particularly strong position to understand and work with external partners and other collaborators. Examples include individuals who have worked in the cultural and creative sectors, local and national arts organisations and government bodies.

A Visiting Scholars scheme awarding three-year Fellowships to nominated external researchers on the basis of a proposal has helped to grow IDR at Northumbria. Applicants have to demonstrate a desire to work with researchers in different disciplines. The Fellowships also involve postgraduate teaching, and thereby bring an element of IDR into the training of young researchers. Alongside this initiative, a number of Vice-Chancellor Research Fellowships also seek to embed talented researchers within existing research groups to stimulate new avenues of enquiry and innovative approaches.

5.7.4.2 Supporting and sustaining IDR

The university provides support for IDR at several levels. A number of central services and localised faculty teams work together to support academics in pursuing research funding and managing projects. This includes: a dedicated centralised Research and Business Services Department assisting with all aspects of research funding and REF preparation; support from Human Resources in staff training and recruitment; and localised faculty teams assisting with grant management and events planning.

In addition, the eight interdisciplinary themes are supported with QR funding. For example, the Institute of the Humanities is funded by a grant from the university, made possible by its increase in QR funding, to create an institute that is specific to the humanities. It focusses on

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[125] http://nnmh.org.uk/

[126] https://www.northumbria.ac.uk/about-us/news-events/events/2014/09/further-north/

five strategic areas: Memory, Heritage and Identity; Transnationalism and Societal Change; Digital Humanities; Medical/Health Humanities; and American Studies[127]. The institute is situated in a dedicated physical space at the university, with access to meeting spaces and equipment to stimulate research across the breadth of humanities disciplines. This in turn will help bring about a cultural change whereby IDR becomes a more natural part of the research culture.

5.7.4.3 Embedding IDR within the institution

The eight cross-cutting IDR themes are expected to embed IDR in the research culture and across departments. Another approach to embed and evidence the growth in IDR will be to improve the university's research information systems. Forthcoming upgrades and the development of new internal systems will enable the university to record and report on IDR in a much more comprehensive way, and evidence the growth in research and funding coming from the strategic investments.

5.7.5 Lessons learned

Northumbria University is still at a relatively early stage in the process of implementing the interdisciplinary themes. Through the process of deciding on and implementing the themes, a number of positive lessons have been learned. The themes arose by asking leaders in the university's academic community to submit proposals to the university on areas of excellence for future investment that would improve on REF 2014 performance and stimulate high quality interdisciplinary research. This 'bottom-up' approach stimulated activity and discussion across diverse research areas with the academic community identifying the key external challenges and the strengths where the university could respond to them. This approach also increased awareness of IDR across the university more generally, and it was felt that the approach enabled academic staff to have a significant influence on the future direction of the university's research strategy.

In this way, IDR is not imposed institutionally, but comes from different faculties, departments and staff working together on areas of common interest. The university believes that this, in turn, will produce high quality research and outputs for individuals and REF UoAs, as well as strengthen the work of others through new approaches and perspectives. It is believed that the value of IDR can be clearly demonstrated through the higher quality outputs it produces and funding it attracts. The themes themselves will seek to embed a culture where interdisciplinary working will become the new norm as the next REF approaches.

5.7.6 'What works'

In the context of the Humanities theme, giving researchers the space to think about their projects is key to successfully growing IDR. It is important to avoid forced interdisciplinarity, and measures that do not enable the level of collaboration and discussion required. Imposing strict deadlines for projects and stipulating which approaches should be taken would not be helpful in stimulating IDR.

Secondly, events such as seminars and institutional away-days that allow researchers to meet and discuss research have consistently proven to be valuable for growing IDR. It is also important to raise awareness of other collaborators and partnership opportunities to facilitate collaboration across disciplines and departments.

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[127] https://www.northumbria.ac.uk/research/research-themes/theme-5/

For Northumbria University, a crucial element in promoting IDR at institutional level is getting the right balance between 'top-down' and 'bottom-up' approaches. The PVC Research and Innovation has championed IDR over the last two years, but has built on the existing ambitions and excellence of academic staff in the organisation. In this way a partnership between the executive and the academic staff base has been cultivated, which allows a wide input into the direction of the university's research strategy.

Forthcoming upgrades to internal financial administration systems and investment in a Current Research Information System (CRIS) is expected to enable a much more comprehensive picture of IDR taking place at the university to be formed, and enable comprehensive reporting on areas of emerging activity.

5.7.7 Future strategy for IDR

Northumbria University is now implementing a series of IDR initiatives and recruiting staff with an interdisciplinary profile for the Institute of the Humanities[128] and other themes. These appointees will also help shape the thematic priorities of the institute. Communication and marketing will be important aspects of the institute's future success: this includes close communication with key stakeholders and external funders, and marketing the future research and teaching offer. The institute is expected to be fully operational in September 2016.

More generally, the university sees the growth of IDR as a critical element of its research strategy. By identifying specific themes that can tackle challenges of societal importance, the university expects to have a focus for investment, a platform to create an environment that attracts and retains academic staff while fostering collaboration across the institution, and a means of delivering a distinctive research profile. Finally, the university believes that an IDR approach is successful only if it is underpinned by excellence in individual disciplines and hence it will continue to pursue high-quality monodisciplinary research.

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[128] https://jobs.theguardian.com/job/6300197/vice-chancellor-s-research-fellow-in-humanities-2-posts-3-years-fixed-term/?TrackID=8

5.8   White Rose University Consortium

> *Key points:*
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> - A consortium of the Yorkshire-based universities of Leeds, Sheffield and York that facilitates collaborations to add value to the universities' individual strengths.
> - Employs three main instruments to foster collaborations: Seed Funds, Doctoral Training Centres/Partnerships and Studentship Networks.
> - Doctoral Training Centres/Partnerships and Studentship Networks can help to stimulate IDR among PhD supervisors as well as students.

5.8.1   The institution

The White Rose University Consortium (WRUC) was established in 1997 between the Yorkshire-based research-intensive Russell Group universities of Leeds, Sheffield and York to add value to their individual strengths through partnership activity in research, enterprise, innovation, and learning and teaching. Working with a range of partners from the private and public sector, regionally, nationally and internationally, funds totalling over £150 million have been secured by the universities[129].

Among the three partner universities of the WRUC, York is the youngest, having only been founded in 1963, while the Universities of Leeds and Sheffield have existed since 1904 and 1905 respectively. York is also the smallest in terms of turnover and student numbers with 16,835 undergraduate and postgraduate students in 2014/15 compared to 31,030 and 27,195 in Leeds and Sheffield respectively[130]. In total, the universities received £62.8 million (£28.7, £24.9 and £9.2 million for Leeds, Sheffield and York respectively) for teaching and £109.2 million (£43.8, £42.7 and £22.7 million respectively) for research in 2015/16 from HEFCE[131].

The consortium featured in the 'environment templates' submitted to REF 2014 by each university as a source of support and funding for collaboration. The universities submitted a total of 92 returns across 35 UoAs for REF 2014, and over 80% of the research submitted by each university was graded as 'world leading' or 'internationally excellent'[132].

5.8.2   IDR and the institution

The WRUC's role is to ensure effective collaboration between the universities of Leeds, Sheffield and York. To this end, it facilitates and supports member universities to secure funding and resources to pursue their research, teaching and innovation objectives by mobilising their combined research capabilities and expertise. A key objective of the WRUC is to seize opportunities offered within the national and international science and innovation space by securing initiatives that benefit the universities.

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[129] http://www.whiterose.ac.uk/about/

[130] https://www.hesa.ac.uk/free-statistics

[131] http://www.hefce.ac.uk/pubs/year/2015/201504/

[132] http://results.ref.ac.uk

The WRUC's purpose is to develop projects that involve participation from each of the member universities rather than IDR per se. Nevertheless, a significant amount of projects initiated under the aegis of the WRUC are interdisciplinary. The research strategies of all member universities explicitly articulate a desire to grow interdisciplinary activity within their institutions which is reflected in the applications for IDR support to the WRUC[133,134,135].

5.8.3   Model for organising IDR

The WRUC does not have a model specifically for fostering IDR. IDR is only one type of research supported by the WRUC's collaboration agenda. The collaborative initiative drives partnerships between the three universities' departments and research strengths, creating new opportunities for IDR. The interdisciplinary approach is driven by the nature of the research question.

A key ingredient for the success of the consortium is its close working relationship with academics and strategic leaders at the three universities[136]. For instance, there is an Executive Management Board consisting of VCs and PVCs from the universities, and a Research and Innovation PVC Group and Teaching and Learning PVC Group, which meet regularly and contribute to the working of the WRUC.

The WRUC has a core team: a Director, Project Development Managers, European Public Affairs Director and administrator[137]. All staff are mobile and work closely with colleagues from each of the three member universities. Individual projects have separate management structures and staff spread across all three universities, depending on institutional involvement with the projects.

5.8.4   Interventions, their implementation and results

5.8.4.1   Stimulating and growing IDR

The WRUC employs three main mechanisms that contribute to growing IDR within the participating universities: (1) The White Rose Collaboration Fund, (2) Doctoral Training Centres and Partnerships (DTCs and DTPs), and (3) Studentship Networks.

The White Rose Collaboration Fund has operated since 2008 and is designed to support collaborations across the three participating universities. Two competition rounds are held every year, in the spring and autumn, to award between £8,000 and £11,000 each to four projects, bringing the total number of projects funded to eight per year[138]. Initially, only one round was held. Since then, the Executive Board has provided more funds to expand the initiative owing to the fund's success in supporting emerging activities.

The fund supports projects with the potential to develop national and international links, and to give rise to larger, strategic initiatives across the universities. Preference is given to areas with no existing White Rose collaborations or to existing areas of collaboration with significant funding opportunities. Applicants need to demonstrate how collaborating across

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[133] https://strategy.leeds.ac.uk/downloads/strategic_plan2015.pdf

[134] https://www.york.ac.uk/staff/research/governance/strategy/

[135] https://www.sheffield.ac.uk/ourplan/wp-content/uploads/2015/12/TUOS-Strategic-Plan.pdf

[136] http://www.whiterose.ac.uk/our-governance/

[137] http://www.whiterose.ac.uk/the-team/

[138] http://www.whiterose.ac.uk/collaboration-fund/

the three universities will add significant value and why the proposed project is timely. Applications must include a minimum of two participants each from all three universities (at least six participants), with a lead academic/university taking overall responsibility of the project. ECRs are especially encouraged to apply.

A Project Development Manager from the WRUC team is assigned to each project to assist researchers in securing further funding and achieving their goals. Each collaboration gets a project page on the WRUC website, which helps to disseminate the project's activities and outcomes, and to demonstrate the project's success to potential funders. Costs of inception events, stakeholder engagement, travel costs, workshops, dissemination and other project activities are covered under the grants, but academic staff costs and other indirect costs are not.

Participants have to provide progress reports at six and 12 months into the funding and the collaboration's success is measured against short-, medium- and long-term outputs outlined in the original proposal.

The second route to increased IDR is through the DTCs and DTPs, which frequently have a strategic interdisciplinary objective. For this case study, we interviewed the directors of two such initiatives: The White Rose Social Science Doctoral Training Centre, accredited by the Economic and Social Research Council in 2011[139], and The White Rose College of the Arts and Humanities (WRoCAH) funded by the AHRC since 2014 (£19 million funding)[140].

Both investigator-led and student-led projects are funded through the DTPs and DTCs, and events like sandpit workshops and conferences are used to stimulate new ideas and/or partnerships. The DTC/DTP structure fits in with the universities' IDR policies and is used as a way to build capacity for securing more Research Council funding. Therefore, IDR in the DTCs/DTPs is built around thematic funding calls that often mirror the IDR themes of the Research Councils. A wide range of activities is offered, including professional training courses, seminars, summer schools and workshops to equip doctoral students with the skills required to work in disciplinary and interdisciplinary environments. DTC/DTP structures and activities allow development of academic/non-academic networks and partnerships as well as a common research culture with a strong focus on interdisciplinary and inter-institutional engagement. Success of the IDR projects is measured against the original bid with a notional threshold across defined criteria. Annual reports and student feedback are also used to evaluate the projects.

Since 2005, PhD studentships have been awarded through Studentship Networks funded by the three universities to promote collaboration across the three institutions[141]. Interdisciplinary proposals are specifically encouraged. PhD students are co-supervised by one academic each from two different participating universities. Three studentships are allocated per research network. All students work within a related area and benefit from belonging to an integrated community working on a larger initiative. The networks are competitive and are built around strategic annual themes selected by the PVCs for Research. Themes may also relate to one or more DTCs and DTPs. This mechanism has

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[139] http://wrdtc.ac.uk

[140] http://www.whiterose.ac.uk/news/arts-and-humanities-studentship-networks/

[141] http://www.whiterose.ac.uk/studentships/

fostered interdisciplinary collaborations among the supervisors as well as students over the years.

Over and above these formal mechanisms, White Rose staff look for external funding opportunities that might fit the WRUC model. They examine whether there is added value in applying under the aegis of the WRUC. Typically, the interesting funding calls tend to be interdisciplinary.

5.8.4.2 Supporting and sustaining IDR

The consortium's core team is sustained through funding from the universities of Leeds, Sheffield and York. In addition, the universities also invest in the Collaboration Fund, Studentship Networks, and institutional match-funding on large-scale initiatives. They also bear the office, management and administration costs for the DTCs/DTPs. Current and past WRUC initiatives have also received investment from the Research Councils and HEFCE.

Research projects initiated through the Collaboration Fund typically have the aim of securing external investments for which WRUC staff can provide assistance.

The DTCs/DTPs also support IDR through training courses and travel bursaries for students and supervisors to travel across universities. A large training budget is available which is largely student demand-led and more focussed on cross-institutional aspects of working.

5.8.4.3 Embedding IDR within the institution

The WRUC's long history and track record of varied projects has helped to create a collaborative environment and embed a culture of collaboration in all three member institutions. The following activities have helped to further embed IDR within the institutions:

- Collaborative working across three universities and different disciplines
- Cross-departmental and cross-disciplinary networks and communities of practice
- Studentship networks
- Support of WRUC staff
- Governance structure that includes representatives of all three universities
- Universities' support of DTC/DTPs
- University strategies

5.8.5 Lessons learned

Although the WRUC does not support IDR specifically, its well-honed expertise in building and managing collaborations offers many lessons that could be incorporated in IDR collaborations. The White Rose's initiatives have demonstrated their efficacy in bringing together people who might not normally work together. In addition, they have encouraged IDR by bringing different skills together to solve a problem. However, experience also shows that it is important to determine the added value of a collaboration at the outset so that there is a visible and defined purpose to it.

The DTCs/DTPs have made a massive difference to the IDR activity within the individual universities and have proven to be a great way of fostering collaboration within and across universities. They have increased the vibrancy and volume of interdisciplinary conversations.

Establishing an intellectual case for a DTC or DTP by adopting thematic priorities is a strategy that works well for stimulating IDR and increasing opportunities for interdisciplinary working. Identifying institutional strengths, consulting students on their needs and experiences, and dovetailing these with funders' priorities makes choosing the most appropriate interdisciplinary themes easier. It also ensures relevance to all the three aforementioned stakeholder groups and establishes coherence and consistency in the DTC/DTP model.

DTC/DTP structures can be strategic opportunities rather than an administrative burden through effective workload allocation and valuing people who lead training pathways. There is a need for a better co-supervision model that can cut across the different university accounting systems. In addition, the WRUC's cross-institutional funds can help to maintain the networks and communities of practice that emerge from DTC/DTP structures and are important for IDR.

5.8.6 'What works'

The WRUC promotes IDR to academics as well as students through three distinct approaches to increasing collaborations (see Section 1.4.1). The WRUC brand is not pushed as an independent identity to the REF or funders but as a super-identity of the constituent universities. The consortium's history and long track record of successful partnerships is seen positively by funders and gives them more confidence that a project will be managed and delivered well.

The consortium's reach across three universities which are within easy travelling distance of each other provides access to a larger pool of researchers and expertise than is available within one institution. Moreover, the proximity of the universities and previous interactions makes it easier to maintain long-term formal and informal relationships between and among academics, PhD students and WRUC staff. These relationships help to build a level of comfort and trust that makes it easier for people to work together and rapidly unite around new research themes.

The Collaboration Fund grants for pilot work have been extremely successful in building research capacity and supporting proposal writing for larger external grants. Researchers state that support from a WRUC project manager who is knowledgeable about research activity in all three member institutions can also help in recruiting the right expertise to the team, pitching for more money and delivering the promised outputs. Moreover, the end of project evaluation can be a supportive process for some researchers in that it encourages follow-on work and experiential learning, developing the researchers' skills.

5.8.7 Future strategy for IDR

The consortium's facilitation of collaborations across the three universities is expected to continue to foster IDR, but there is no specific strategy for IDR. In contrast, the DTC/DTPs are looking to develop better co-supervision and resource allocation models across the consortium and engage more with external partners like arts organisations and local community groups. Sustainability of networks and communities of practice is expected to be another strategic objective. In summary, the WRUC will continue to enable partnerships between the three universities, playing to their strengths and adding value to their research, teaching and innovation.

5.9 Manchester Metropolitan University

> *Key points:*
> - MMU sees IDR as a key part of its strategy and is now implementing a new, simpler structure with disciplinary research centres complemented by thematic IDR networks.
> - Researchers and centre leaders play a key role in initiating and developing IDR initiatives and projects in collaboration with internal and external partners.
> - Researchers at MMU see increasing opportunities to do IDR through internal support from the university and external funding and partnerships.

5.9.1 The institution

The origins of Manchester Metropolitan University (MMU) go back to the nineteenth century, when a series of schools and colleges for technology, design, commerce, education and 'domestic science' were founded. Manchester Polytechnic was established in 1970 before gaining university status as The Metropolitan University in 1992[142].

The university is divided into eight faculties with a total of 38 academic departments and schools across campuses in Manchester and Cheshire. It is predominantly a teaching university with 25,810 undergraduate and 5545 postgraduate students in 2014/15[143] as well as 1539 academic staff.

In REF 2014, 60% of outputs submitted by MMU were rated 'world leading' or 'internationally excellent'. MMU achieved an increase of 15% in QR funding on the basis of these results compared to the previous RAE in 2008. In 2015/16, the university received £15.3 million and £5.9 million from HEFCE for research and teaching respectively[144].

5.9.2 IDR and the institution

MMU strongly supports the development of IDR. While it is felt that the REF pulls in the direction of organising research (roughly) along disciplinary lines, this is balanced by a desire to do research into society's problems and challenges which requires IDR approaches.

In the recent 'Research & Knowledge Exchange Strategy' (May 2015), IDR is listed as one of the key underpinning principles: 'Supporting interdisciplinary research and knowledge exchange is crucial if contemporary social challenges are to be addressed and resolved' (p. 5). It is further underlined by a strategic objective to 'focus' on challenges facing businesses, governments and society, where IDR is seen to play a key role. To this end, the university committed to "review existing research groups, centres, institutes and knowledge exchange activities to determine strategic fit and potential for interdisciplinary collaboration" (p. 7)[145].

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[142] http://www2.mmu.ac.uk/about/history/

[143] https://www.hesa.ac.uk/free-statistics

[144] http://www.hefce.ac.uk/pubs/year/2015/201504/

[145] https://www2.mmu.ac.uk/media/mmuacuk/content/documents/research/10410-RKE-Strategy-Communication_May2015.pdf

MMU also sees a close connection between IDR and collaboration with stakeholders from outside academia. In strategic terms, IDR is closely related to knowledge exchange and in practice the university is actively seeking to work with users and other stakeholders to develop research and solve problems.

5.9.3 Model for organising IDR

The way in which research is organised within the university has been simplified to make it more manageable and focussed.

The new structure consists of 12 University Research Centres focussed on areas of strength as confirmed by the REF 2014 results. The 12 centres are regrouped in four areas similar to the REF Main Panels: Arts and Humanities (two centres), Education, Business and Social Sciences (three centres), Health and Social Care (four), Science and Engineering (three). While many of these research centres are co-determinous with departments and disciplines, they do have a mandate to work beyond these boundaries and across structures.

In addition to the University Research Centres, MMU has recently (at the end of 2015) introduced a set of five cross-cutting research networks in areas such as Dementia and Ageing, Childhood and Youth, Crime and Wellbeing, and Place. These networks exist purely to do IDR and are the university's prime vehicle for addressing societal challenges. Among other things, the networks will be able to respond to calls from the government's new Global Challenges Research Fund.

5.9.4 Interventions, their implementation and results

5.9.4.1 Stimulating and growing IDR

Much of the concrete support for IDR and IDR activities originates from the research centres and interdisciplinary networks, based on a research budget from the university. Although many centres are focussed on disciplinary areas, they have a remit to collaborate among themselves to create interdisciplinary activities.

The research centre leaders, active researchers in the areas concerned, have a high degree of latitude to decide on their centre's activities within an overall mandate. For example, the centres and networks can fund travel to conferences and exhibitions or pump-prime new research initiatives and establish links with external bodies. In some centres, the support is very much oriented towards funding bids, for example to the Wellcome Trust, Leverhulme Trust, the UK Research Councils and potentially to the EU's Horizon 2020 programme. Another key activity is networking events initiated at the centre level such as 'speed dating' with researchers from different parts of the university.

The university also offers funding for ECRs: the 'Research Accelerator Grant' is a small 'pump-priming' grant of up to £8,000 for exploratory research and development of skills to apply for external funding. A condition for the grant is that it informs a larger external grant application within 18 months[146].

5.9.4.2 Supporting and sustaining IDR

Much of the university's support concerns research in its broadest sense but also more specifically underpins efforts to sustain IDR. Cultural change is happening across the

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[146] http://www.mmu.ac.uk/staff/fundingopportunities/researcher-accelerator.php

university, where the drive to improve the quality of research in general is connected to an increased focus on IDR. In terms of career development, the pattern is the same: there are no specific provisions for IDR but results are celebrated and rewarded by the university and researchers who do high-quality interdisciplinary work are promoted based on the results of their work. The university does not offer training specifically for IDR but researchers can use general training and conference budgets for this purpose.

Overall, there are few specific measures to support and sustain IDR but there is a general sense among management and staff that IDR is expected and rewarded by the university.

5.9.4.3 Embedding IDR within the institution

MMU has taken steps to stimulate, grow and support interdisciplinarity. The university is on a long-term journey but Director of Research and Enterprise at MMU, David Raper[147], does not believe 'embedding' has yet been fully achieved. In this sense, he believes that the university is in a similar situation to many others.

5.9.5   Lessons learned

It is still too early to draw lessons from the recently introduced research centres and networks. The research centres have been in operation for little over a year and the networks only for a few months. Generally, the university assesses IDR in the same way as other research. However, there is a recognition that the success from IDR – in terms of citations for example – can take longer time to manifest itself[148]. The impact of IDR – especially when it includes non-academic partners – can also take different forms and hence, the university is considering whether criteria for judging IDR should also be adjusted.

Experiences in the area of Arts and Health have illustrated the often evolutionary nature of interdisciplinary work. Here, a small 'utilitarian' assignment for the NHS to develop a short guidance document led to a subsequent £1.3m project on Dementia and Imagination funded by the AHRC. In turn, it is now possible that a new research institute will be established to further develop work in this area. This experience shows that building and maintaining relationships – inside as well as outside academia – is a long-term activity that can provide unforeseen opportunities for interdisciplinary working.

5.9.6   'What works'

In the experience of MMU researchers, what works to promote IDR is first and foremost providing opportunities for people to get together: "For me, it's really simple: getting people speaking together in the same room. It doesn't even have to be in the same room, it can be over Skype – it usually is over Skype come to think of it – but that's it." (MMU researcher). Networking events that include external participants is also seen as an example of good practice as it can help establish a wide range of relationships.

In contrast, it is felt that trying to force or mandate researchers to do IDR will not work. There is an implicit expectation that researchers in certain roles (e.g. centre leaders) should develop interdisciplinary activities and projects but this is not mandated by the institution. To a large extent, concrete IDR activities are driven by research staff who develop activities they

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[147] Professor Raper returned to his substantive post as Professor of Environmental Science at MMU in the spring of 2016.

[148] Van Noorden, R., 2015. Interdisciplinary research by the numbers. *Nature*, *525*, 306–307. http://doi.org/10.1038/525306a.

find interesting and important – even when this is outside their formal teaching and research duties.

The institution can, however, provide positive incentives. It is felt that when grants such as PhD studentships are awarded, applications which include several disciplinary perspectives are positively reviewed by the university and possibly have a better chance of success. In this way, the university provides a powerful, though not explicitly stated, incentive for researchers to choose an IDR route.

5.9.7 Future strategy for IDR

The new institutional structure organised around University Research Centres and the research networks is expected go some way towards stimulating and supporting IDR within the university. The next steps in this process will be aimed at further strengthening IDR within the university structure and culture. First, the university will ensure that the interdisciplinary networks are supported and able to grow. Secondly, it intends to develop a general 'themed approach'. In the long run, IDR is expected to be embedded in everything the university does. This is required to enable the university to respond to grand challenges in the future.

At an operational level, the continued pursuit of concrete projects and grant funding is seen as an important part of future strategy. In addition, university staff see opportunities to expand other types of activities. One example is open training with participation from both external audiences and academics. Such events have been run in the field of Arts for Health, and have proven to be very successful in terms of attracting audiences and establishing relationships. Another example is the potential for multi-institutional transdisciplinary research units. Inspired by the Canadian Hexagram network[149], a potential collaboration with Salford University, the Royal Northern College of Music and the University of Manchester on themes such as Future Technologies is currently being explored. This would also allow the city of Manchester as a whole to put forward bids in interdisciplinary areas.

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[149] http://www.hexagram.ca/en/about/

5.10 Centre for Energy and the Environment, University of Exeter

Key points:

- The CEE is part of a long-term research partnership with local authorities and public sector organisations who provide the centre's core funding.
- The co-location in one office of six CEE staff with expertise in engineering, physics, mathematics, architecture and business is seen as essential to the centre's way of working.
- The CEE's work involves tackling a wide variety of applied research projects for its partners – the nature of the work is an important motivator for staff.
- The CEE has conducted IDR for decades and also helps initiate IDR in other departments across the university.

5.10.1 The institution

The Centre for Energy and the Environment (CEE) is a research group within the University of Exeter. The centre coordinates the South West Energy and Environment Group, which includes local district and county councils and the local NHS hospital trust and police authority. Following the oil crisis in 1973, the local authorities saw the need to investigate alternative energy sources. Under the leadership of Physics Professor Gerald Fowler, the Energy Study Unit was formed in 1977 to address these issues[150]. The unit was formed as a collaboration between the university and the local authorities and started with three researchers. In the mid-1990s, the unit became the CEE, which currently has a staff of five research fellows and a head of centre[151]. The centre is part of the Engineering Department in the College of Engineering, Mathematics and Physical Sciences[152].

The University of Exeter emerged from the Schools of Art and Science which were founded in 1851, receiving its charter and thus full university status in 1955. In addition to the College of Engineering, Mathematics and Physical Sciences, the university consists of the Business School, the Medical School, the College of Humanities, the College of Life and Environmental Sciences and the College of Social Sciences and International Studies. At the end of 2015, the university had 17,425 undergraduate and 3849 postgraduate students[153]. The university received £11.1 million for teaching and £22.9 million for research in 2015/16 from HEFCE and submitted 25 returns to 24 UoAs for REF 2014[154,155].

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[150] Preist, T. and Norton, T., 2013. *The Centre for Energy and the Environment – A Short History*, Exeter: Centre for Energy and the Environment.

[151] Centre for Energy and the Environment (2015) Annual Report 2015.

[152] http://emps.exeter.ac.uk/engineering/research/

[153] http://www.exeter.ac.uk/about/facts/studentnumberssummary/

[154] http://www.hefce.ac.uk/pubs/year/2015/201505/

[155] http://results.ref.ac.uk/Results/ByHei/117

5.10.2 IDR and the institution

Since its inception the CEE has always had an interdisciplinary team[156]. The centre's focus is on assisting its partners in tackling challenges related to energy and the built environment. Its researchers have backgrounds in engineering, physics, mathematics, architecture and business. The centre's research on the impact of future climate on the built environment is one of the university's REF impact case studies.

5.10.3 Model for organising IDR

Members of the CEE are co-located in an office on campus, thus the centre provides a physical location for its researchers. The centre generates its own funding and, although the university reimburses it for teaching contributions to undergraduate Physics courses, it receives no additional funding from the university[157].

The CEE receives core funding from the members of the South West Energy and Environment Group, who also commissions additional projects. This setup, which takes the form of a long-term research partnership, is unique. Partners (individually or jointly) and the centre collaborate at the very beginning of a project to define the problem and then work together iteratively through all stages of the project. The centre has a high impact at the local level through projects such as the design of the country's first 'zero-carbon-in-use passivhaus climate-change-ready school' in Exeter[158].

In addition, the centre raises funds through research grants, for example from the EPSRC, consultancy work and contract research for external partners. Due to its setup, the centre concentrates on activities that generate income and therefore has a bias towards applied rather than fundamental research.

5.10.4 Interventions, their implementation and results

5.10.4.1 Stimulating and growing IDR

The driving force behind the establishment of the CEE was the personal commitment of Professor Gerald Fowler[159]. Fluctuations in public sector funding over time have led to the size of the centre varying between two and eight full-time staff. While expansion is always an option, this is currently difficult as the research the centre undertakes depends largely on funding for the public sector and supportive national policy regarding energy and the built environment. While in the near term the centre is concentrating on sustaining itself rather than growing, it continues to initiate IDR with researchers in various disciplines across the University of Exeter.

A long history of conducting IDR makes the CEE well placed to foster IDR. Its unique access to local authorities and other partner organisations enables the centre to effectively initiate and facilitate external partnerships for various disciplines at the university. This contribution is valued by the university. In many cases, the centre's initiatives and interventions lead to IDR projects. For example, in one case, an initiative led to a collaboration between the centre, the local NHS and the university's medical school. The CEE's close connection to

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[156] http://emps.exeter.ac.uk/engineering/research/cee/

[157] http://emps.exeter.ac.uk/engineering/research/cee/teaching/

[158] http://www.montgomery.devon.sch.uk

[159] Preist, T. and Norton, T., 2013. *The Centre for Energy and the Environment – A Short History*, Exeter: Centre for Energy and the Environment.

local councils, the local NHS and the local police authority enable it to bring questions from practitioners into the academic context of the university. The focus on practical problems is seen as a driver for conducting IDR. There have also been instances where the centre facilitates collaboration for colleagues at the university, without taking part in the project itself. For example, the CEE facilitated one project between local authorities and the university which involved researchers from the geography and mathematics departments. Thus the University of Exeter benefits from the local connections and IDR experience of the CEE.

5.10.4.2 Supporting and sustaining IDR

As mentioned above, the CEE needs to generate its own income to sustain itself. The centre has managed to sustain itself for 38 years because the public sector partners that contribute a large part of its funds continue to see benefits from their investment and therefore continue to support the CEE. The centre's multidisciplinary expertise can be applied to a wide variety of topics, including planning, carbon reduction, renewable energy, building design and waste management. This breadth helps drive demand for the centre's expertise and supports IDR through a common focus on solving challenges.

However, due to budget cuts and restructuring of local councils, the number of organisations belonging to the South West Energy and Environment Group, and therefore supporting the centre, has declined. In order to compensate for this change, centre staff have been increasingly active in doing consultancy work and contract research.

The centre also benefits from retaining highly qualified and motivated staff. Staff cite the common focus on big problems and challenges, working for the public good and the variety of relevant and applied tasks to which researchers are able to contribute as being important motivational factors.

5.10.4.3 Embedding IDR within the institution

As previously mentioned, IDR is inherent to the CEE because the centre was set up with an interdisciplinary team and has conducted IDR ever since. The centre is part of the College of Engineering, Mathematics and Physical Sciences and thus is fully embedded in the university's structure. Staff come from different disciplines and collaborate with researchers from various disciplines at the university, such as medicine and geography. Because of its long history of conducting IDR, its strong ties to local organisations and its close connection with the university, the CEE helps to initiate IDR in the university. Consequently, IDR is more strongly embedded in the university as a whole.

5.10.5 Lessons learned

Through its long existence, the CEE has always focussed on solving specific research questions for its partner organisations. This focus is seen as a core strength of the centre, as it leads to highly motivated staff and sustained IDR. In contrast, the university historically supported IDR in more broadly defined themes. This approach made it difficult to achieve coherence within the themes and to determine when a thematic area should be consolidated or closed. The university is now taking an approach similar to that of the centre and within its research portfolio now supports IDR by bringing together teams for more specific questions or challenges with appropriate resources for a finite period.

5.10.6 'What works'

The co-location of researchers in the same office works well for the CEE. This close proximity facilitates collaboration and the team is small enough to manage without the need for additional hierarchical structures. Moreover, the small size is perceived to offer an additional advantage by automatically compelling researchers from different disciplines to work together, whereas larger groups may allow researchers to work in disciplinary isolation. While the size stimulates IDR within the centre, it also motivates the staff to seek external collaborations, including those with other researchers at the university. The smaller size of the University of Exeter is also seen as an advantage for IDR, as it makes it easier to establish contacts between researchers from different disciplines.

Across the university, academics are time poor with many competing responsibilities. This can lead to a low priority for IDR projects. The university has found that allocating IDR resources to individuals rather than projects can work better in some instances, as it may lead to more consistent and sustainable IDR activity. When IDR is just one project among many, it is more likely to stall or be slow to progress than if a researcher's core funding is provided specifically to conduct IDR. As a result, the university now generally funds fewer projects and more IDR posts, as well as additional IDR training. The CEE has profited from this approach through PhD students who have taken IDR courses offered by the university.

5.10.7 Future strategy for IDR

The CEE appears well placed to continue to deliver its mission of providing research on energy and environmental issues in the built environment. The University of Exeter plans to further embed IDR and is demonstrating its commitment through initiatives such as the Living Systems Institute, which will open in autumn 2016 and co-locate researchers from different disciplines[160]. This approach will also be reflected in the university's Global Vision 2050 strategy which will be published in August 2016. The strategy will emphasise fixed-term research on specific topics in place of the thematic approach adopted previously. The specific influence of this strategy on the CEE and its involvement in the new initiatives remain to be seen.

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[160] https://www.exeter.ac.uk/livingsystems/

Appendix A   Interview questions

1. What is the institution's approach to IDR and is it reflected in institutional policies/strategies? If so, how?

2. Why is the institution involved in IDR and how is IDR managed and supported? What is the reason for using this particular model?

3. Which disciplines does your institution's IDR span?

4. What particular approaches have you used to (1) stimulate and grow IDR, (2) support and sustain IDR, and (3) embed IDR in your institution?

   a. Did you encounter any challenges and how did you manage them?

   b. What were/are your criteria for success? Do you use any indicators/targets? Why and how did you decide to use these criteria? Were the criteria agreed at the outset and were they considered contentious?

   c. How successful were your approaches? Was the approach evaluated? When and how was this done?

   d. Which initiatives do you currently use? Have you made any changes since they were first implemented? Why?

   e. Did you have to revise your approach during implementation? Why?

   f. What did you learn? What is the current legacy of these approaches?

5. Has your institution taken steps with regard to the following in relation to IDR? For what purpose?

   a. Infrastructure

   b. Culture change

   c. Rewards and career structures

   d. Training

   e. Networking/collaborating

6. In your opinion, what consistently works in supporting IDR?

7. Similarly, what type of approaches should be avoided in your opinion?

8. What are the institution's future plans in relation to IDR?

9. Any other comments/issues?

Appendix B   List of interviewees

Table 2 List of interviewees

Institution	Interviewee, role
Royal College of Art	Dr Emma Wakelin, Director of Research, Knowledge Exchange & Innovation Ms. Christie Walker, Head of Research Development
London School of Hygiene and Tropical Medicine	Prof. Anne Mills, Deputy Director & Provost Prof. Jeff Waage, Director of the London International Development Centre
Nottingham Health Humanities	Prof. Paul Crawford, Co-Director Dr. Anna Greenwood, Co-Director
University of Southampton	Ms. Frances Clarke, Research & Innovation Services Prof. Timothy Leighton, Chair, Network for Anti-Microbial Resistance and Infection Prevention
CCISC, Aston University	Dr. Gary Fooks, Co-Director
Institute of Advanced Study, Durham University	Prof. Robert Barton, Director Prof. Martin Ward, Director Prof. Claire Warwick, Pro Vice-Chancellor Research Prof. Colin Bain, Dean and Deputy to PVC Research Ms. Linda Crowe, Administrator Dr. Giles Gasper, Senior Lecturer in History Prof. Corinne Saunders, Associate Director, Centre for Medical Humanities Prof. Chris Greenwell, Adjunct Professor in Chemistry
Northumbria University	Dr Katherine Baxter, Reader in English Literature and Programme Director Prof. Ian Davidson, Professor of Modern and Contemporary Literature Mr. Scott McGee, Research Funding and Policy Manager
White Rose University Collaboration	Dr. Craig Walker, Director, White Rose University Consortium Prof. Julian D Richards, Director, White Rose College of the Arts and Humanities, University of York

	Prof. Martin Jones, Director, White Rose Social Science Doctoral Training Centre, University of Sheffield
	Prof. Daniel Goodley, University of Sheffield
	Dr. Zoe Darwin, Research Fellow, University of Leeds
	Prof. Matthew Collins, University of York
Manchester Metropolitan University	Prof. Craig Banks, Associate Dean of Research, Faculty of Science and Engineering
	Dr. Toby Heys, Research Centre Leader
	Dr. Amir Keshmiri, Senior Lecturer
	Mr. Clive Parkinson, Director, Arts for Health
	Prof. David Raper, Director of Research and Enterprise[161]
Centre for Energy and the Environment, University of Exeter	Mr. Tony Norton, Director
	Dr. Andy Richards, Head of Research Development and Strategic Partnerships at University of Exeter

Source: The authors

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[161] This was Professor Raper's role when the study was initiated; he has since returned to his post as Professor of Environmental Science at MMU.

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