



Openness Profile

Modelling research evaluation for open scholarship

Published March 2021

Acknowledgments

This report is the effort of many. Thanks to the Knowledge Exchange Task and Finish group, with experts from all six Knowledge Exchange countries: Verena Weigert, Rachel Bruce, Daniel Beucke, Lorna Wildgaard, Clifford Tatum, Frederic Helein, Heidi Laine, Serge Bauin; Knowledge Exchange leads Josefine Nordling and Jean-François Nominé who coordinated the Task and Finish group and to the KE Office Bas Cordewener and Sarah James.

© Knowledge Exchange 2021

Title: Openness Profile: Modelling research evaluation for open scholarship

Authored by:
Dr Phill Jones
Dr Fiona Murphy
MoreBrains Cooperative

Foreword by James Wilsdon, Research on Research Institute and The University of Sheffield, UK

DOI: 10.5281/zenodo.4581490

All content published can be shared (CC BY 4.0)
creativecommons.org/licenses/by/4.0



Knowledge Exchange (KE) is a collaboration between six national research supporting organisations - DFG (Germany), Jisc (UK), DeiC (Denmark), SURF (The Netherlands), CSC (Finland), and CNRS (France) - working together to support the use and development of ICT infrastructures for higher education and research. Central to KE's mission is the development and support of digital infrastructures, communities of practice, and national and international policies to promote open scholarship. Towards that goal, KE conducts research to understand developments in evaluation, incentives, and dissemination within scholarly communications and research.

Foreword

In a provocative new year essay in *The Atlantic*, the science writer Ed Yong celebrates the success of the international research community in mobilising with unprecedented agility to develop and deploy vaccines, diagnostics, therapeutics and other responses to COVID-19¹. As it has ravaged and transformed economies and societies worldwide, so the pandemic has shifted the priorities of science. According to the Dimensions database, the total number of academic papers about COVID-19 surpassed 200,000 just before the end of 2020.

But as Ed Yong reminds us, alongside all of this creativity, dynamism and productivity:

...the COVID-19 pivot has also revealed the all-too-human frailties of the scientific enterprise ([nature.com/articles/s41591-020-1015-0](https://www.nature.com/articles/s41591-020-1015-0)). Flawed research made the pandemic more confusing, influencing misguided policies. Clinicians wasted millions of dollars on trials that were so sloppy as to be pointless. Overconfident poseurs published misleading work on topics in which they had no expertise. Racial and gender inequalities in the scientific field widened².

So as we start to glimpse light over the pandemic horizon, a tantalising dilemma for the research community-as for other sectors and institutions-is whether to swing back to business as usual, or to use this once-in-a-generation disruption, with all of its pain and possibility, as a moment to reset and renew.

The open scholarship revolution is a vital part of this. During the pandemic, we have seen many real-time innovations in processes of data-sharing, peer review and publication. Regular constraints, paywalls and protocols have been lifted or relaxed to accelerate the production and dissemination of relevant findings. These efforts have been reinforced by joint initiatives, such as the Covid-19 Publishers Open Letter of Intent, which aims to speed up review and publication processes, while maintaining rigour, quality and integrity³.

As this report notes, it has long been recognised that we need to speed up the transition to open. But realising the opportunities of the post-pandemic moment for radically-accelerated transition will require more than enthusiasm and good will. We need multiple actors to align, we need better infrastructure, and we need working systems of recognition and reward for open scholarship.

We all know by now the flaws with conventional approaches to research assessment, recognition and reward. In a recent paper, Stephen Curry, colleagues and I distil these into four problems⁴:

First, there is the misapplication of narrow criteria and indicators of research quality or impact, in ways that distort incentives, create unsustainable pressures on researchers, and exacerbate problems with research integrity and reproducibility.

Second, this narrowing of criteria and indicators has reduced the diversity of research missions and purposes, leading institutions and researchers to adopt similar strategic priorities, or to focus on lower-risk, incremental work.

Third, the systemic biases against those who do not meet - or choose not to prioritise - narrow criteria and indicators of quality or impact, or to conform to particular career pathways have reduced the diversity, vitality and representative legitimacy of the research community.

Finally, there has been a diversion of policy and managerial attention towards things that can be measured, at the expense of less tangible or quantifiable qualities, impacts, assets and values – a trend exacerbated by the rise of flawed university league tables.

As attention shifts from describing these problems, towards designing and implementing solutions, efforts are coalescing around the idea of responsible research assessment (RRA); an umbrella term for approaches which incentivise, reflect and reward the diverse and plural characteristics of high-quality, open and impactful research.

As a contribution to these systemic shifts now underway across global research, the Openness Profile (OP) is a brilliant, practical and timely proposal, with the potential to accelerate and embed the changes that so many people want to see, and know are possible. So it's a pleasure to commend this insightful report to funders, research organisations, infrastructure providers and all

the other institutions and individuals committed to accelerating change. To move forward, the OP will require ongoing leadership and support. This report sets out a compelling, evidence-informed case for why this should be a priority for 2021 and beyond.

James Wilsdon

James Wilsdon is founding director of the Research on Research Institute (RoRI) and Digital Science professor of research policy at the University of Sheffield, UK.

-
- 1 Curry, S., de Rijcke, S., Hatch, A., Pillay, D., van der Weijden, I. and Wilsdon, J. (2020) The changing role of funders in responsible research assessment: progress, obstacles & the way ahead. RoRI Working Paper No. 3., November 2020. DOI: [10.6084/m9.figshare.13227914](https://doi.org/10.6084/m9.figshare.13227914)
 - 2 theatlantic.com/magazine/archive/2021/01/science-covid-19-manhattan-project/617262/
 - 3 <https://oaspa.org/covid-19-publishers-open-letter-of-intent-rapid-review>
 - 4 Curry, S., de Rijcke, S., Hatch, A., Pillay, D., van der Weijden, I. and Wilsdon, J. (2020) The changing role of funders in responsible research assessment: progress, obstacles & the way ahead. RoRI Working Paper No. 3., November 2020. DOI: [10.6084/m9.figshare.13227914](https://doi.org/10.6084/m9.figshare.13227914)
-

Acknowledgements

Knowledge Exchange wishes to thank the below experts for their involvement and valuable input that helped the consultants and the Task and Finish group shaping this report. With great pride we present, in alphabetical order of their first names, colleagues who shared their expertise and views in various stages of the work.

- ▶ **Dr Adam Vials Moore**, Open Research Group, Jisc
- ▶ **Dr Adrian Burton**, Director, Data, Policy, and Services. Australian Research Data Commons
- ▶ **Arend Kuester**, Director Funder Relations, Springer Nature
- ▶ **Dr Bianca Kramer**, Utrecht University Library
- ▶ **Dr Birgit Schmidt**, Head of Knowledge Commons, University of Göttingen, State and University Library
- ▶ **Dr Bregt Saenen**, Policy and Project Officer, European University Association
- ▶ **Dr Catrion, J MacCallum**, Director of Open Science, Hindawi Ltd
- ▶ **Daniel Beucke**, Göttingen State and University Library
- ▶ **David Carr**, Programme Manager – Open Research, Wellcome Trust
- ▶ **Didier Torny**, Senior Researcher, CNRS, CSI-I3 (UMR 9217)
- ▶ **Dirk Pieper**, Deputy Director, Bielefeld University Library
- ▶ **Emmanuelle Morlock**, Research officer in Digital Humanities, CNRS
- ▶ **Dr Emily Sena**, University of Edinburgh
- ▶ **Eva Méndez**, Universidad Carlos III de Madrid / EU Open Science Policy Platform
- ▶ **Felix Weijdemans**, Utrecht University Library, Utrecht University
- ▶ **Dr ir Ingrid Vos**, project manager recognition and rewards, TU Delft
- ▶ **Dr Jeff Love**, Delft University of Technology
- ▶ **Hans de Jonge**, policy lead for Open Science, NWO (Dutch Research Council)
- ▶ **Hilda Muchando**, Jisc
- ▶ **Dr Jane Haley MBE**, University of Edinburgh
- ▶ **Dr Joona Lehtomäki**, University of Helsinki
- ▶ **John Doove (MSc)**, Innovation Program Manager, SURF
- ▶ **Joris van Rossum**, Research Data Director, STM
- ▶ **Josh Brown**, co-founder, research and strategy, MoreBrains Cooperative
- ▶ **Dr. Juliane Kant**, Programme Manager for Digital Publishing and Open Access, Deutsche Forschungsgemeinschaft
- ▶ **Karen Sofie Hytteballe Ibanez**, Technical University of Denmark
- ▶ **Kasper Gossink-Melenhorst**, Senior Policy Officer, NWO (Dutch Research Council)
- ▶ **Kristina Hettne**, Centre for Digital Scholarship, Leiden University Libraries
- ▶ **Lambert Heller**, Head of Open Science Lab, TIB - Leibniz Information Centre for Science and Technology
- ▶ **Liz Allen** - Annual Reviews

- ▶ **Dr Lorna Wildgaard**, Copenhagen University Library, The Royal Danish Library
- ▶ **Maria Cruz**, NWO (Dutch Research Council)
- ▶ **Marianne Gauffriau**, Copenhagen University Library / The Royal Danish Library
- ▶ **Prof Maryann Martone**, University of California, San Diego
- ▶ **Matt Buys**, Executive Director, DataCite
- ▶ **Dr. Michael Hill**, Deputy Head of Strategy, Swiss National Science Foundation (SNSF)
- ▶ **Michelle Barker**, Director, Research Software Alliance
- ▶ **Mikael Laakso**, Hanken School of Economics, Finland
- ▶ **Mike Taylor**, Digital Science
- ▶ **Mogens Sandfaer**, Head of Research Analytics, Technical University of Denmark
- ▶ **Natasha Simons**, ARDC (Australian Research Data Commons)
- ▶ **Neil Jefferies**, Bodleian Libraries, University of Oxford
- ▶ **Nick Juty**, Senior Research Technical Manager, University of Manchester
- ▶ **Odile Hologne**, INRAE (French National Research Institute for Agriculture, Food and Environment) – Department for Open Science
- ▶ **Paul Mollahan**, Services Director, Digirati
- ▶ **Pauli Assinen**, University of Helsinki, Helsinki University Library
- ▶ **Rachel Bruce**, UK Research and Innovation
- ▶ **Prof Richard G M Morris**, CBE, FRS. Professor of Neuroscience, University of Edinburgh
- ▶ **Richard Wynne**, Founder, Rescognito Inc
- ▶ **Sara Ball**, UK Research and Innovation
- ▶ **Dr Sarah Callaghan**, Editor-in-Chief, Patterns, Cell Press
- ▶ **Saskia Woutersen-Windhouwer**, Centre for Digital Scholarship, Leiden University Libraries
- ▶ **Serge Bauin**, CNRS
- ▶ **Siobhann McCafferty**, ARDC (Australian Research Data Commons)
- ▶ **Tiina Käkälä**, Senior adviser, Research services, University of Helsinki
- ▶ **Tom Demeranville**, Product Director, ORCID
- ▶ **Tung Tung Chan**, Centre of Science and Technology Studies, Leiden University
- ▶ **Vanessa Fairhurst**, Community Outreach Manager, Crossref
- ▶ **Vanessa Proudman**, Director, SPARC Europe
- ▶ **Ville Tenhunen**, Project manager, Center for InformationTechnology, University of Helsinki"

Executive summary

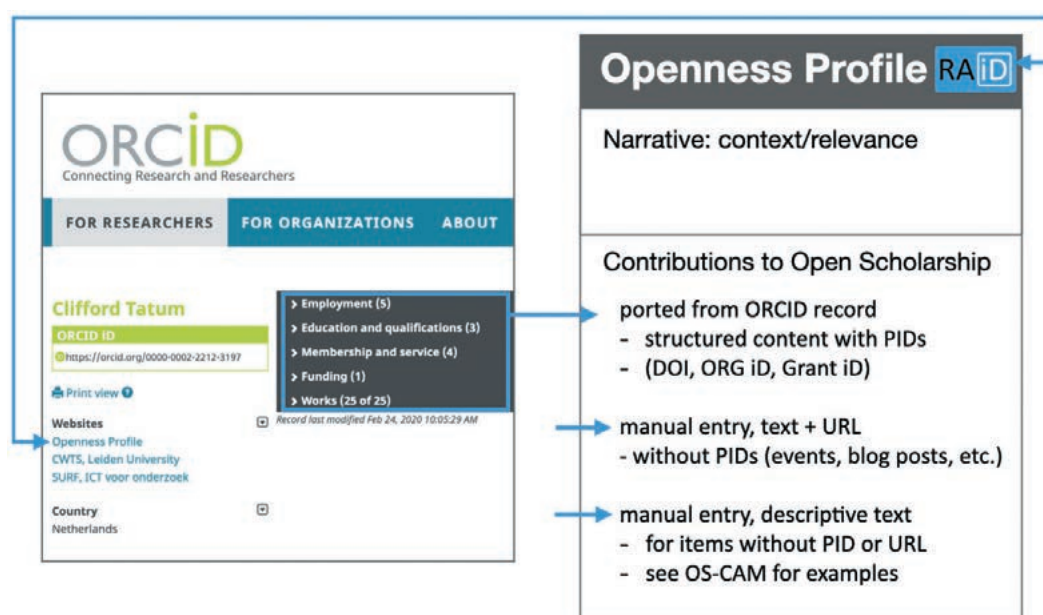
The Openness Profile (OP) will be a digital resource in which a research contributor's outputs and activities that support openness would be accessible in a single place.

The activities of scholarship go far beyond those typically used in the evaluation events that feed into hiring, promotion, and funding activities. In addition to peer-reviewed journal articles, they may include, but are not limited to: writing or refactoring computer software; developing data management plans; curating data for interoperability; developing infrastructures; and mapping research workflows. Teaching activities, including lectures, course design, curricula and syllabi design, as well as open scholarship training, are also vital contributions to training the next generation of researchers. In this report, we outline the concept of the Openness Profile (OP), which would create a mechanism to improve recognition of, and reward for practising, open scholarship.

The OP is conceived as a portfolio of contributions to open scholarship curated by the contributors themselves, as described in a presentation by Clifford Tatum at the Openness Profile workshop in July of 2020 [1]. In its initial implementation, the OP would integrate into ORCID as a means to source entries as well as being a part of the ORCID record (see diagram below).

The OP would be embedded in evaluation events conducted by institutions and funders to enable recognition and reward of open scholarship activities, many of which are aligned with the missions of those organisations but are currently invisible or not recognised.

A representation of the OP as a user-curated portfolio of contributions to open scholarship. The OP would include a narrative component to enable the research contributor to contextualise their work as well as contributions drawn from their ORCID record and from the web. Other contributions would be allowed that have no URL as descriptive text.



By extension, open scholarship contributions could be aggregated across groups. Those might be research groups, departments, institutions, private companies or funders. We note that an aggregated profile would require a suitable identifier for groups. These do exist, notably, the RAiD identifier, developed by ARDC, is primarily a project identifier but could also be used for this purpose. However, for reasons of scope and resources, in this report, we focus primarily on the individual openness profile.

The state of open scholarship

A key goal for Knowledge Exchange (KE) is to enable open scholarship by supporting information infrastructure on an international level. KE seeks to support the European research community's efforts to realise the significant advantages of interconnected, collaborative, and digitally-enabled scholarship.

It is widely recognised that there is a pressing need to accelerate the transition to open, and there have been a number of policy and infrastructure initiatives in recent years aimed at doing so. In addition to KE, and its own Open Scholarship Expert Group, such initiatives include DORA, ACUMEN, LERU, CRediT, THOR, and FREYA, among many others. At the same time, communities of practice have begun developing in both digital and open scholarship, involving researchers, open data experts, technologists, librarians, and others. However, despite this progress, operationalising and normalising open scholarship practices has proven challenging, and progress has been slower than ideal.

The need for collective action

The global academic system is complex, involving many different stakeholders. These include, but are not limited to, national funders, independent funders, national research organisations, academic institutions, commercial research organisations, technology and infrastructure providers, learned societies, commercial publishers, and information companies. Each has their own motives

and needs, which can seem to be in immediate conflict with each other. The situation is further complicated by the fact that research is increasingly conducted globally, but is typically funded and assessed based on national and regional strategic objectives.

Conflicting ambitions, combined with strong network effects that punish those who deviate from sector norms around research assessment and practice, make it challenging for individuals and organisations alike to become more open without risking real or perceived negative consequences.

Many of the challenges associated with the transition to open scholarship are economic [2], in that they are either financial or relate to incentives. The difficulty in changing any complex system that is economic in nature is that each actor will tend to behave in a way that most aligns with their own incentives. Systemic change towards openness therefore requires collective action to enable cultural change that shifts these incentives.

Credit where it is due

Significant cultural change is required to create a working system of recognition and reward for contributions to open scholarship. An over-reliance on traditional metrics such as citation counts, and outdated proxies like journal prestige and the Journal Impact Factor, distorts the behaviours of researchers and limits the types of activities that individual contributors can get credit for. In particular, the reliance on published articles to assert provenance creates risk for research contributors that share earlier stage outputs, like datasets and analysis programs.

Career progress is impeded for individuals whose contributions do not conform to that narrow set of characteristics, leading to a loss of talent and lack of diversity of skillsets in academia. As well as being fundamentally unfair, this monoculturalism in turn leads to poor research practices and outcomes due to shortages of critical skills. This works in two directions.

Firstly those research practitioners who are expert in data science, project management, and computer programming tend to leave academia and pursue roles in industry. Secondly, research support personnel within academia are not rewarded for their contributions to research and research outputs. Because their contributions are hidden - they cannot be fully quantified, understood or built upon. If key contributors to the academic knowledge ecosystem continue to be under-recognised, over time there will be a talent-drain towards the commercial knowledge sector.

The first step towards improving the diversity of contributions and contributors that are recognised is to create a shared taxonomy of research contributions and contributors, (such as the CRediT initiative). By making hidden work visible, it is possible to characterise, measure, and reward activities as part of an expanded research evaluation approach.

Investment is needed in the research e-infrastructure

Current research evaluation practices are hindered by overly cumbersome reporting practices that put too much burden on researchers, support staff, and administrators. The result is poor compliance with data entry, poor quality metadata, wasted and duplicated effort, and a degraded evidence base for policy-makers.

Persistent identifiers (PIDs), their associated metadata, and modern IT integrations through APIs are necessary to improve the flow of information between funders, national research organisations, assessors, institutions, publishers, and individual research contributors.

Currently, funder grant information systems are underfunded and underdeveloped. There is poor adoption of PIDs and little to no interoperability with downstream stakeholders. Institutional current research information systems (CRISs)- which are sometimes called research information or research information management systems (RIS/RIMs)- and institutional repositories (IRs) are evolving, with ever-improving interoperability, but

there is still much work to be done around standards for information interchange and best practices.

Skills and knowledge gaps

Levels of understanding the need for open scholarship, and what is potentially required to implement it, vary across policy- and decision-makers in funders, institutions and research organisations. More outreach and better education is required to help senior leaders understand the need for change, and the mechanisms that can and should be employed to achieve it.

Within research institutions, there are significant skills gaps at the practitioner level. Greater training is required in reproducibility, data management, computer programming, and open research workflows.

Study to explore the Openness Profile concept

The findings in this report are based on an 18 month study involving interviews, workshops, and focus groups that collectively engaged 80 individuals from 48 different organisations, representing a diverse range of stakeholders from across the research and scholarly communications ecosystem. The project began with a series of 20 semi-structured interviews with key representatives from all stakeholders, the results of which were presented in the report: **Openness Profile: Defining the Concepts [3]**. Consultation continued in the form of a virtual stakeholder workshop to identify challenges and opportunities involving the OP, and five targeted focus groups where preliminary use cases were identified.

Conclusions

At the end of the report, we present a series of recommendations, firstly for collective action on the next steps required to realise the OP, then specifically for key stakeholders, such as funders, national research organisations, infrastructure providers, and research institutions. These recommendations point towards improvements in education, technical infrastructure and assessment practices.

Definitions

Collective action - An action taken together by a group of people or organisations where the goal is to enhance a shared condition and achieve a common objective. A Collective action problem is one posed by disincentives that discourage individuals from acting towards a recognised collective good.

Current research information systems (CRISs) - Sometimes known as research information or research information management systems (RIS/RIMs). Databases and management systems that store, manage and exchange contextual metadata relating to research activities conducted at a research performing organisation or sometimes funded by an organisation.

Infrastructure/scholarly infrastructure - The systems, software, and standards for information interchange that enable content, data, and metadata to be available for reuse, as well as to support research claims.

National research organisations - A variety of organisations that support the development and administration of research policy and infrastructure. Examples include Jisc (UK), SURF (Netherlands), CSIRO (Australia), and FCT (Portugal).

Network effects - Phenomena in which the value of participating in an activity increases with the number of participants. The consequence is that members of a group are disadvantaged when deviating from existing norms. For example, a researcher choosing to publish in an open access journal rather than a more 'prestigious' subscription journal, could result in reviewers of the author's future funding applications taking a less favourable view of their work.

Open scholarship - Used in this report in a deliberately broad sense, to denote open research/open science and research communications regardless of discipline.

Research contributors - Anyone who contributes to the administration, design, conduct, or dissemination of research. This definition is broader than the traditional de facto definition of researcher, which excludes other types of work by individuals whose contributions are equally vital to the research process.

Reference model - A model based on a small number of unifying concepts, which may be used as a basis for education and for explaining standards to nonspecialists. Characteristics include: a representation of best practices; universal applicability; and reusability.

Use case - A written description of how users of a particular process will accomplish a goal. Each use case is represented as a sequence of simple steps, beginning with a user's goal and ending when that goal is fulfilled.

Contents

1. Motivation	15
1.1 The journey to open scholarship	17
1.2 The reference model as a holistic approach to open scholarship	17
1.3 Key areas of needed reform	18
1.4 Study scope	18
2. Project structure	19
3. Community momentum	20
4. The Openness Profile reference model	21
4.1 Shared taxonomies	22
4.1.1 Recognising all research contributions	22
4.1.2 Credit for a diverse range of contributor roles	23
4.1.3 Progress towards better taxonomies	23
4.2 Evolving research management workflows through cross-system integration	23
4.3 Stakeholder feedback	24
4.3.1 Policy-makers	24
4.3.2 Communities of practice	24
5. Use cases	25
5.1 Institutions	25
5.2 Funders	27
5.3 National research organisations	28
5.4 Ongoing application of the use cases	28
6. Challenges to increasing openness	29
6.1 A collective action problem	29
6.2 Organisational knowledge of openness at the macro level	29
6.3 The definition of high-quality research	30
6.4 Recognition and reward for all research contributors	30
6.4.1 Engineers and support staff	31
6.4.2 Diversity and inclusion	32
6.5 Skills and knowledge deficits	32
6.6 Information technology	33
6.7 Disciplinary variance	33
7. Requirements for an Openness Profile	35
7.1 Reducing administrative burden	35
7.2 Metrics and narratives	35
7.3 Credit for more types of outputs	37
7.4 Assertion provenance	37
7.5 Community governance	38

7.6 PID-enabled automated workflow	39
7.6.1 Funding systems	40
7.6.2 Current research information systems (CRISs)	40
7.6.3 Institutional repositories	40
8. Recommendations	42
8.1 Collective action to achieve the Openness Profile	42
8.2 Facilitate a stakeholder summit	42
8.3 Establish an ongoing working group	43
8.3.1 Develop a community-based governance strategy	43
8.3.2 Validation of the OP reference model	43
8.3.3 Taxonomies for contributors and contributions	43
8.3.4 Technical facilitation of research management workflows	43
8.3.5 Infrastructure survey and gap analysis	43
8.4 The Openness Profile requires one or more sponsors	44
8.4.1 Finding appropriate sponsors	44
8.5 Stakeholder-specific recommendations	45
8.5.1 Funder recommendations	45
8.5.2 National research organisations recommendations	46
8.5.3 Infrastructure providers recommendations	46
8.5.4 Institutions	46
9. Bibliography	48
Appendix A: Methodology	52
A.1 Interviews and the 'Openness Profile: Defining the Concepts' report	52
A.2 Virtual Stakeholder and Focus Groups	52
A.2.1 Stakeholder Group	52
A.2.2 Focus Groups	52
A.3 Use cases	53
A.3.1 Final institutional use case	55
A.3.2 Final funder use case	55
A.3.3 Final NRO Use Case	56
Appendix B: List of stakeholders	57
Knowledge Exchange members plus Task and Finish Group	57
PID providers	57
Publishers	57
National Research Organisations	57
Funders	57
Universities	57
Appendix C: A synthesis of various open scholarship taxonomies	58
Appendix D: Relevant initiatives	65

How to read this report

This report is broken down into sections (or chapters) that broadly correspond to various aspects of an 18 month study exploring the concept, feasibility and steps needed to achieve the Openness Profile (OP).

Section 1 outlines the motivation for the project, which covers both background and the high-level objectives.

Section 2 briefly describes the project structure.

Section 3 is a short discussion of the strength and pace of community momentum built over the course of the project.

The main findings of the project are presented in **sections 4 to 7**, starting with a description of the OP reference model in **section 4**, which was synthesised from input given by study participants over the course of the project. **Section 5** describes a series of use cases that were derived from focus groups covering the likely primary users of the OP (funders, institutions, and national research organisations). Over the course of the project, we uncovered many challenges to advancing open scholarship, which are catalogued and described in **section 6**. These challenges naturally inform the

requirements for the OP, which are laid out in **section 7**. The final section in the main body of the report, **section 8**, contains a series of recommendations for various stakeholder groups, including funders, institutions, infrastructure providers, and national research organisations.

At the end of the report, a series of Appendices provides a more in-depth description of the methodology, a list of represented organisations within the project, and a list of related initiatives in open scholarship for reference.

1. Motivation

This section covers the background to the project, a description of why the Openness Profile is necessary, and the high-level goals.

There is a need to accelerate the transition to open scholarship. Previous work by KE introduced the Open Scholarship Framework, which is described in Figure 1.

Motivations for the transition to open vary across stakeholder groups. Scholarship is increasingly complex, interconnected, and costly, which means that actors at the macro level are motivated to realise more value from their investments. On the other hand, information technology is expanding communication possibilities, changing behavioural norms and expectations among individual practitioners at the micro level as they need to

communicate a broader range of outputs and collaborate more efficiently. As a 2018 report [5] by the League of European Research Universities (LERU) states:

"Open Science is not about dogma per se; it is about greater efficiency and productivity, more transparency and a better response to interdisciplinary research needs."

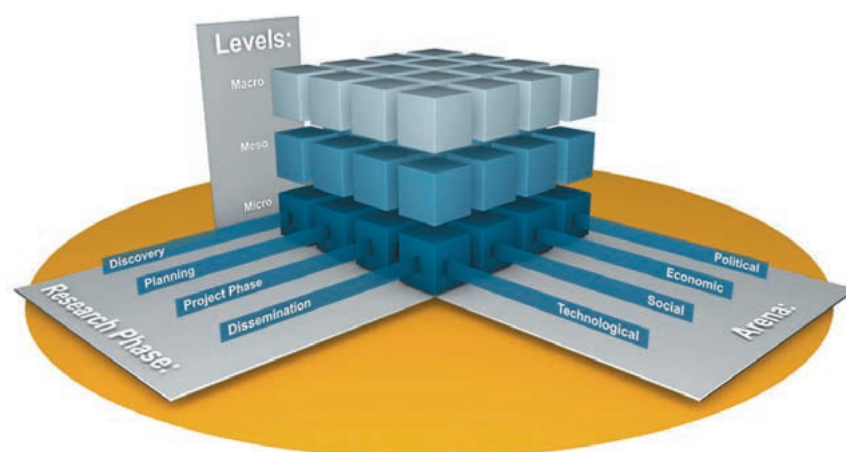
Open Scholarship Framework

In the 2017 report **Knowledge Exchange approach towards Open Scholarship** [4], Neylon et al. describe motivations and challenges in the transition to open scholarship and present the Open Scholarship Framework (OSF), which includes definitions of research phase, arena, and, most pertinent here, levels of action:

- ▶ Micro - Individual researcher contributors and open scholarship contributors
- ▶ Meso - Organisations and institutions including universities, research groups, companies, and so on
- ▶ Macro - Political and economic entities including governments, funders, and other policy-makers

Figure 1

A representation of the Open Scholarship Framework as developed for the 2017 Knowledge Exchange approach towards Open Scholarship by Neylon et al. [4].



The activities of scholarship go far beyond those typically used in the evaluation events that feed into hiring, promotion, and funding activities. In addition to peer-reviewed journal articles, some examples might be: writing or refactoring computer software; developing data management plans; curating data for interoperability; developing infrastructures; and mapping research workflows. Teaching activities, including lectures, course design, curricula and syllabi design, as well as open scholarship training, are also vital contributions to training the next generation of researchers. In this report, we introduce the concept of the Openness Profile (OP), which would create a mechanism to improve recognition of, and reward for practising, open scholarship [6] (Figure 2).

The OP is envisioned as a research contributor-curated portfolio of contributions to open scholarship. Research

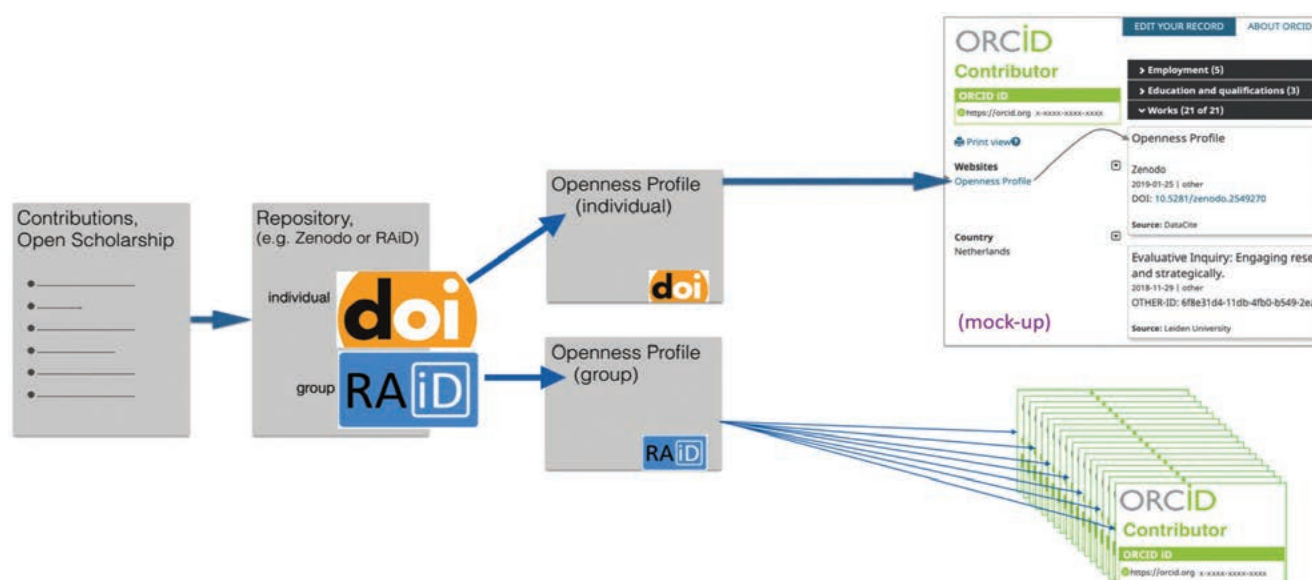
contributors create outputs that can be recorded or distributed in open scholarship platforms such as repositories. Those outputs should have persistent identifiers associated with them, which can be used to automate and authenticate their inclusion in the profile.

Figure 2 illustrates how those outputs could form the basis of a portfolio or profile that could be shown within, or linked from, the research contributor's ORCID profile. Inputs to the profile could be fed in from the ORCID profile itself to minimise the work required to populate the OP. Other sources might include URLs and URLs of resources on the web and free text narrative entries entered via a web form or portal.

In addition, it would be possible to aggregate those outputs over a group of individuals. That could refer to a research group, institution, company, funder or country.

Figure 2

A schematic representation of the Openness Profile concept that shows how individual open scholarship contributions might be curated and aggregated based on persistent identifiers at the individual and organisational level.



To do so, some kind of group persistent identifier (PID) would be necessary. One such possibility would be the Research Activity iDentifier, from ARDC [7]. Originally designed as a research project identifier, RAiD is an umbrella PID that enables other PIDs, including ORCID, DOI, and RoR, to be grouped together with timestamps that signal the beginning and end of the association. This flexible schema can lend itself to many applications including use as a group identifier or to group practice-based research outputs, for example in a museum collection or exhibit. There are a number of container identifiers, which have similarities to RAiD, and are also potentially suitable for this purpose currently being developed. This is an area that is still maturing and actively changing, so close collaboration with potential PID providers and continuing community consultation is required.

In any case, The OP would be embedded in assessment events conducted by institutions and funders alike. The exact nature of this integration is one of the subjects of the research study presented in this report, but would likely entail the use of dashboards, APIs or web portals to assess information about the open scholarship contributions of individuals or groups.

1.1 The journey to open scholarship

Academia is a vast, interlocking system, so effecting change in rewards and incentives requires wide, international backing across several stakeholder groups. To prevent damaging interruptions of these changes at the personal and institutional levels alike, individuals, universities, and countries must all be convinced to embark on similar trajectories, which can then be achieved through alliances and coalitions between academic sectors and international partners.

Over the past two decades, there has been a slew of top-down open research policy initiatives and mandates from governments, funders, and national research organisations, which have had varying levels of impact on research practice (macro) [8]. At the same time, bottom-

up communities of open research practice have emerged that include research managers, librarians, trainers, and research contributors themselves (micro) [9].

The meso level — which crucially sits in the middle and so acts as either conduit or blocker — has, to date, been the most challenging to influence. Changes at the organisational and inter-organisational level are vital, however, if improvements in open research infrastructure and workflows are to be achieved. Systems of evaluation and incentives are operationalised at the meso level in the form of hiring, promotion, and tenure decisions. Peer-review of both research outputs and funding applications, which feed into those evaluation events, also occurs at this level.

The meso level covers a broad spectrum of actors including research groups, universities, learned societies, commercial publishers, CRIS vendors, and infrastructure providers. As a result, there is a significant coordination challenge around standards, best practices, and workflow integrations. Each class of stakeholder also has its specific incentives and motivations, which are not always aligned. These difficulties go some way towards explaining why change has been so challenging at the meso level.

A number of initiatives have attempted to address coordination and standards challenges at the meso level. These include the CRediT taxonomy [10], research analytics practices and systems from Open Research Analytics (OPERA) [11], the CERIF research information format [12], and several others. Each of these initiatives addresses a component of the multi-faceted collective action problem impacting the transition to open scholarship.

1.2 The reference model as a holistic approach to open scholarship

To identify the cultural, social, workflow, and technical changes needed to build a system of recognition and reward for open scholarship contributions, it is necessary to take a holistic systems view of open scholarship. We

accomplish this by presenting the OP as a reference model [13] (Section 4), drawn from the findings of an 18-month consultation and engagement exercise involving stakeholders from 48 different organisations across all levels of the open scholarship framework. By doing so, the OP creates a series of opportunities to understand and address gaps in policy, e-infrastructures, information, and practice.

1.3 Key areas of needed reform

Many of the challenges associated with the transition to open scholarship are economic [2], in that they are either financial or relate to incentives. The difficulty in changing any complex system that is economic in nature is that each actor will tend to behave in a way that most aligns with their own incentives. Systemic change towards openness therefore requires collective action to enable cultural change that shifts these incentives.

The following areas are identified as key to achieving behavioural change:

- ▶ **Recognition and reward** - current mechanisms encourage competitive, rather than cooperative, behaviours. For example, reliance on publishing articles to assert provenance discourages sharing of outputs such as data and computer programs that are created earlier in the research cycle
- ▶ **Research evaluation** traditionally relies on a relatively narrow range of proxy indicators (e.g. Journal Impact Factor) for a narrow range of research outputs: articles, awarded grants, and sometimes inventions and technology transfer
- ▶ **Staff employed primarily as researchers** are typically hired, evaluated, and incentivised using a narrow set of metrics. This excludes those who contribute in other ways to the research outputs and impacts of the institution and domain

- ▶ **Research management and reporting workflows** are often admin-heavy and used sub-optimally. Emerging research requirements - such as data management plans or Open Access publication - vary across funders and institutions. Staff within institutions are unsure about procedures, policies, precedence, licensing rules, and best practices

While these issues were known to us at the start of the project, we collected further, more detailed insights, which are presented in detail in [section 6](#).

1.4 Study scope

While we are proposing a potentially global solution to a global problem, this project was not fully international in scope. Knowledge Exchange encompasses six Western European countries, so this region is heavily represented among the participating stakeholders, and the project's findings may be skewed accordingly. In addition, although we noted the interplay of diversity and inclusivity issues, we did not embark on a full enquiry in that direction. We have, however, provided references and some indications of how further research may feed into the OP scope in the future.

Similarly, we have provided partly, rather than wholly, developed use cases, and have indicated the need for 'taxonomies' for the OP, rather than depicting a fully worked-through reference model. We hope there will be an opportunity for these tasks to be accomplished in the near future, as part of the OP's next phase.

In the future, the OP could be used in partnership with a group PID to aggregate open scholarship contributions across research groups, departments, institutions, private companies and funders. In this report, however, we focus on the individual application of the OP and recommend that the requirements and use cases for group profiles be the subject of future work.

2. Project structure

A brief overview of the methodology used over the course of the investigation. A more in-depth description can be found in [Appendix A](#).

This project was conducted between April 2019 and September 2020. We carried out a series of 20 semi-structured interviews with a variety of stakeholders ranging from senior policy leaders to research students, as well as administrators and research support staff. Findings from 19 of the interviews were presented in a report - Openness Profile: Defining the Concepts (a late-running twentieth interview was folded into the project's overall findings at a later date) [3].

After the report's publication, a group of stakeholders assembled for an online workshop. In addition, five online

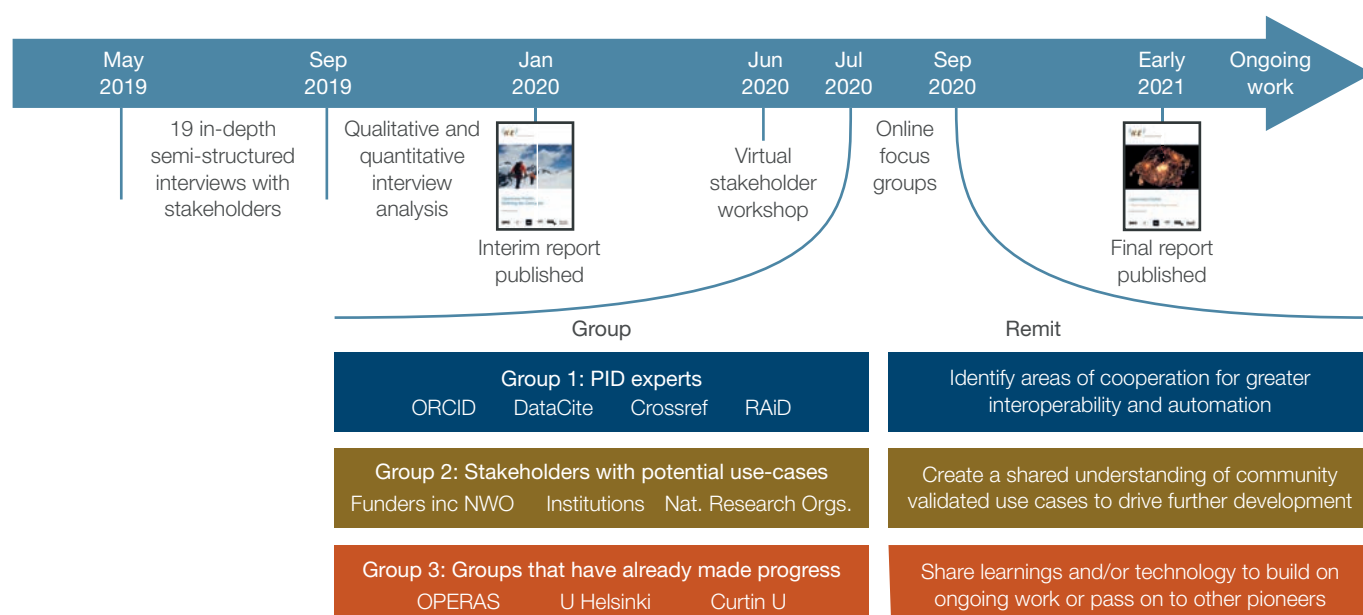
focus groups were convened during Q3 2020, with representatives from the following stakeholder groups:

- ▶ Organisations that have implemented openness assessment mechanisms
- ▶ Persistent identifier (PID) and infrastructure providers
- ▶ Funders
- ▶ Research institutions
- ▶ National research organisations

Outputs from the above consultation exercises were analysed using computer aided qualitative and mixed methods analyses. Full details of methodologies are given in [Appendix A](#).

Figure 3

A schematic diagram of the project structure showing the various phases of the project including the initial semi-structured interviews, the virtual stakeholder workshop and online focus groups. Follow-up work from this report will take place in the near future.



3. Community momentum

The Openness Profile concept was extremely well received by all the stakeholders we interacted with. In this section, we discuss the wider sense of momentum around open scholarship.

Given the extent of the required changes, a key tenet of this project has been to prioritise community consultation - through interviews, a virtual stakeholder meeting, and focus group sessions, as noted above. In addition to legitimising the project's overall direction and findings, this enabled us to build a significant level of common understanding and momentum among key figures within the open scholarship ecosystem - leaders from e-infrastructure providers, publishers, funders, national research organisations, and other organisations across the KE countries and beyond (see the full list of participating organisations in [Appendix B](#)).

In parallel with the timeframe of the project, we have witnessed an increased awareness of open scholarship, as well as an enthusiasm for supporting its growth. For example, the League of European Research Universities (LERU) is actively seeking to implement open research capacity and practices through coordinating efforts on an implementation plan [5], while Research England has funded work at Jisc to develop a coordinated PID strategy [14]. Meanwhile the impact of COVID-19 has accelerated progress on open peer review [15], the integration and validation of preprints [16], and increased open access to relevant research articles [17].

The OP project has thus been party to, and benefited from, a general increase in support for the adoption of open scholarship, with an emerging community seeking opportunities to work together to address the needs of open scholarship - its practice, dissemination, and evaluation. Consequently, the OP project has emerged as a focal point to discuss possibilities, bring evidence of progress already made, and, potentially, plan further activities.

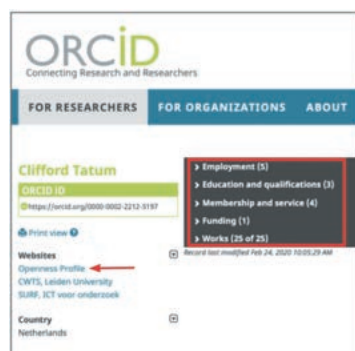
4. The Openness Profile reference model

A description of the Openness Profile as a reference model for an idealised reward and recognition system. It is employed at the meso level according to the open scholarship framework.

In [section 1](#), we introduced the concept of the Openness Profile and how research contributors might use it to add visibility and context to their open scholarship contributions. Figure 4 contains a summary of where information would come from to populate the OP.

Figure 4

The OP would be integrated into ORCID, it would take evidence of research outputs from and present those which conform to open scholarship values, for example, open access articles and open datasets. In addition, other research outputs and activities would be evidenced with web addresses. Finally, some outputs and activities would simply be supported with narrative text from the research contributor.



Category	Content	Source
Narrative	Free text composed by the contributor to provide a textured account of their contributions to open scholarship.	User
Entries from ORCID record	DOI - OA publications	ORCID: works
	DOI - OA presentations	
	DOI - OA Dataset	
	Org ID - Service contribution	ORCID record: service
	Org ID - OS affiliation ⁵	ORCID record: affiliation
User-entered items with associated URIs	Grant ID - OS award ⁶	ORCID record: Grant awards
	Open peer review	ORCID record: peer review
	URL - software	e.g. Github
	URL - OS tools	e.g. website, repository
	URL - even	e.g. website, blog post
	URL - course curriculum	Institutional webpage
User-entered items that cannot be evidenced by public documentation	URL - art exhibit	Institutional profile / webpage
	URL - (social) media mentions	e.g. altmetrics providers
	Descriptive text and references	Activities that do not create a web presence. Example might include those in the OS-CAM matrix[18] (Page 15)

Source: <https://zenodo.org/record/3929036#.YD8Tty1h3gg>

⁵ Affiliation with an open scholarship initiative, e.g. FORCE11, Research Data Alliance, Invest in Open Infrastructures, Global Sustainability Coalition for Open Science Services

⁶ An awarded funding grant for research into or development of open scholarship

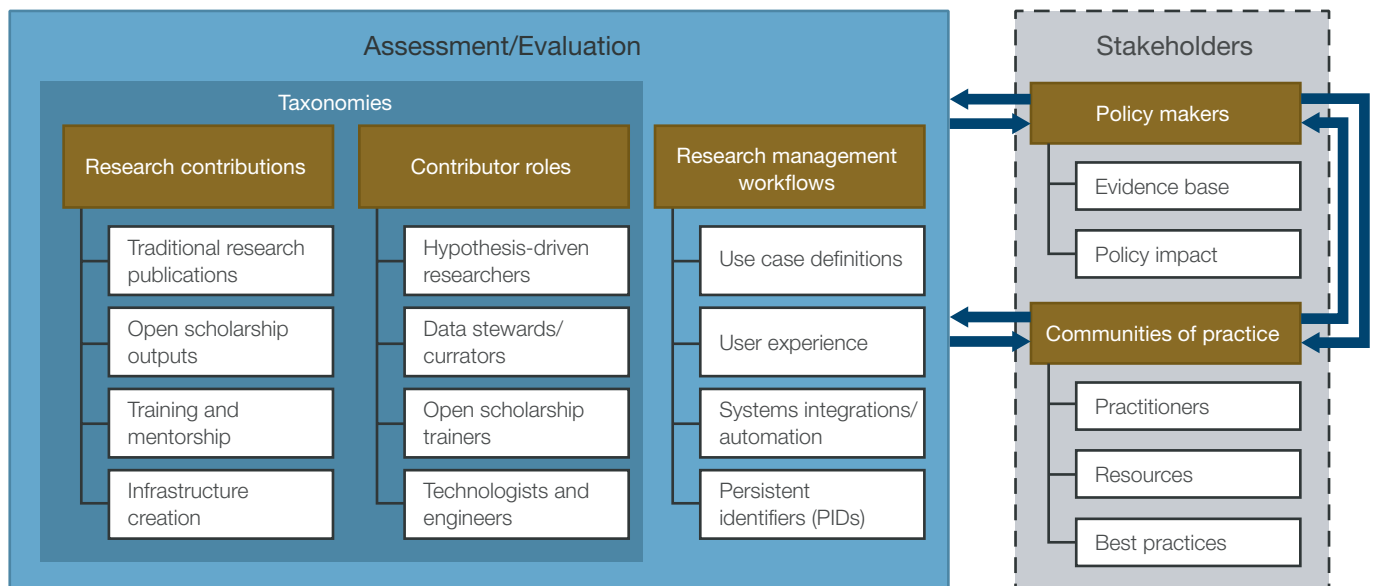
In order for the OP to be used both by researchers to document their open scholarship activities and outputs and by institutions and funders in evaluation events and workflows, various components of social and technical infrastructure need to be in place.

To that end, we present the OP reference model [13]. Derived from the conversations and input that we had with

contributors over the course of this research project, the reference model describes the requirements for open scholarship recognition and reward systems. We recommend that it is used as a basis for gap analysis and prioritisation when designing interventions to make the OP a reality. A graphical representation is shown in Figure 5, and the various aspects are described in the following sections.

Figure 5

The Openness Profile reference model showing the various requirements uncovered during this research study and the feedback loops needed to maintain their development.



4.1 Shared taxonomies

Accreditation for research contributions is currently based primarily on authorship of articles and books, and the attainment of grants. There are some conventions around ordering of author names to confer seniority or research lead, but they are inconsistent across research disciplines, leading to bias in perceptions of contribution and provenance [19].

To increase the types of activities that are credited and incentivised, it is necessary to attribute qualitative credit to the types of activities that are valued, as well as to the people and groups that engage in them.

4.1.1 Recognising all research contributions

Academic researchers are typically pressed for time and, therefore, in a competitive environment must focus

on activities that are rewarded, prioritising ‘high impact journal articles’ above all other outputs. As a result, the absence of recognition for open scholarship activities can create powerful disincentives to working in a transparent and accountable way. For example, during our interviews, we spoke to a senior professor who recounted a story of being ‘scooped’ by a competitor after sharing early data at a conference.

The interviewee cited this experience as a cautionary tale about being too open with ideas and data. On the other hand, enabling researchers to assert precedence over an idea earlier in the research process, by recognising scholarly outputs other than final publication, would alleviate the need to work in a closed way, thus improving research outcomes.

4.1.2 Credit for a diverse range of contributor roles

Many research activities are carried out by individuals who are not considered traditional academic researchers (who could also be called ‘hypothesis-driven researchers’). Data curation and stewardship tasks, research workflow development, the creation of teaching resources, and provision of training in scholarly techniques and processes, as well as infrastructure development, are often conducted by administrative and support-defined staff. A significant amount of the work needed to create new knowledge is, therefore, being carried out by people who receive no recognition for doing so.

This lack of recognition is fundamentally unfair, and also creates a sustainability risk as described in [section 6.4](#). If key contributors to the academic knowledge ecosystem continue to be under-recognised, over time there will be a talent-drain towards the commercial knowledge sector.

4.1.3 Progress towards better taxonomies

There have been a number of attempts made to create taxonomies for research contributions. One of these, Academic Careers Understood through Measurements and Norms (ACUMEN), a European FP7 project, proposed

a conceptual framework for research evaluation that highlighted what it called invisible work, which researchers engage in but are not currently evaluated on [\[20\]](#). ACUMEN proposed a portfolio for assessment that includes six areas of expertise - from scientific/scholarly through to organisational and communication skills. There are also output and influence measures that extend across teaching, outreach, and other online activities, which the authors say should be used alongside traditional bibliometric measures to give a complete picture of research contribution. We discuss more aspects of the ACUMEN project in [section 7.2](#).

During the OP project, we came across a number of institutions and national research organisations that are attempting to implement broader research evaluation frameworks. This points towards the pressing need to create a unified taxonomy of research contributions, particularly in the transition to open scholarship. In preparation for this study, a list of open scholarship activities and tools was synthesized based on a series of five primary sources [\[9\]](#), [\[21\]](#)–[\[24\]](#). The list is shown in full in [Appendix C](#).

Representatives from some of these, such as OpenAIRE, the German ORCID Consortium, the Danish-funded OPERA, and EMBL-EBI, participated in OP events. Others have, at this time, a more tangential relationship with the OP project, although this may change (see also [Appendix D](#)).

4.2 Evolving research management workflows through cross-system integration

Recent work by UKRI and Jisc [\[14\]](#) has highlighted the need for PID-enabled, metadata-rich workflows that cut across stakeholders including funders, institutions, research contributors, and scholarly publishers. Many of the types of workflows that are needed for assessment of both research quality and openness are dependent on information moving between information systems.

Currently, stakeholders' information systems are not interconnected, which places a significant burden on both administrators and contributors. Crossref, ORCID, and DataCite, among others, have made strides in creating PIDs with rich metadata, but the lack of interoperability between stakeholder IT systems remains a major frustration, with funders, for instance, often unable to collect detailed information about the outputs their own funding has produced, and so not able to adapt their strategies or understand what impact they have had.

The solution to this challenge requires a holistic approach based on cooperation between stakeholders. A clear understanding of each stakeholder's use case is needed to understand how they would interact with the OP and the user experience requirements. In turn, this would dictate the types of information that would need to move between systems. As described later in this report, the use of PIDs and associated metadata, combined with agreed standards for information interchange, would be central to the design.

4.3 Stakeholder feedback

This report seeks to uncover the motivations and requirements at the meso level of the open scholarship framework. By doing so, we hope to determine the mechanisms by which the policies of governments, funders, national research organisations, and other macro-level organisations can be operationalised in a way that meets the needs of communities of practice operating at the micro level. To develop and continually improve an operational layer that is fit for purpose, it is necessary to establish feedback loops to both sets of communities.

4.3.1 Policy-makers

Organisations that have an influence on research policy include national governments and international bodies such as the European Commission, intergovernmental agencies, non-governmental organisations, funders, national research organisations, national academic associations, and think tanks.

Policy organisations themselves have individual incentives, in many cases associated with research strategy for national competitiveness, (for example [25], [26]). There is a growing trend, however, towards support of open scholarship and, for many policy-makers, this is a key driver in itself [27]. Among the challenges faced by macro-level actors is the lack of good data about the state of openness in their particular domain. According to many of the stakeholders we spoke to during the project, this can lead to increasingly onerous reporting requirements, with little guidance as to how to achieve goals or gather evidence.

Greater availability of information about openness that can be aggregated over the organisational or meso level and compiled in the Openness Profile would enable policymakers to set better goals and make evidence-based decisions about the effectiveness of various open scholarship policy initiatives.

4.3.2 Communities of practice

Within many universities, national research organisations, and infrastructure providers, there are individuals and groups that support and develop open scholarship systems, infrastructure, and practices [28]. Communities of practice are emerging among subject librarians, particularly in the life, environmental, and physical sciences; and research management and support functions are exemplified by the increasingly common job functions of research data steward [29] and data curator.

The OP provides a common focus, taxonomy, and framework for these diverse efforts, around which to develop best practices and mechanisms for assessment.

5. Use cases

A series of use cases was identified for funders, institutions, and national research organisations during the focus group phase of the project. In this section we present our findings. A more in-depth description of the focus group methods and outputs can be found in section A.3.

A major goal of the OP project was to define a series of community-validated use cases [30]. Given that the scholarly and research management ecosystem is so complex, and various institutions and funders have diverse requirements and interests with regards to research assessment and incentivisation of openness, building a picture of the users, trigger events, and requirements for each of the three potential adopter categories has provided both a grounding for this report's findings, and a platform from which to launch possible future activities.

5.1 Institutions

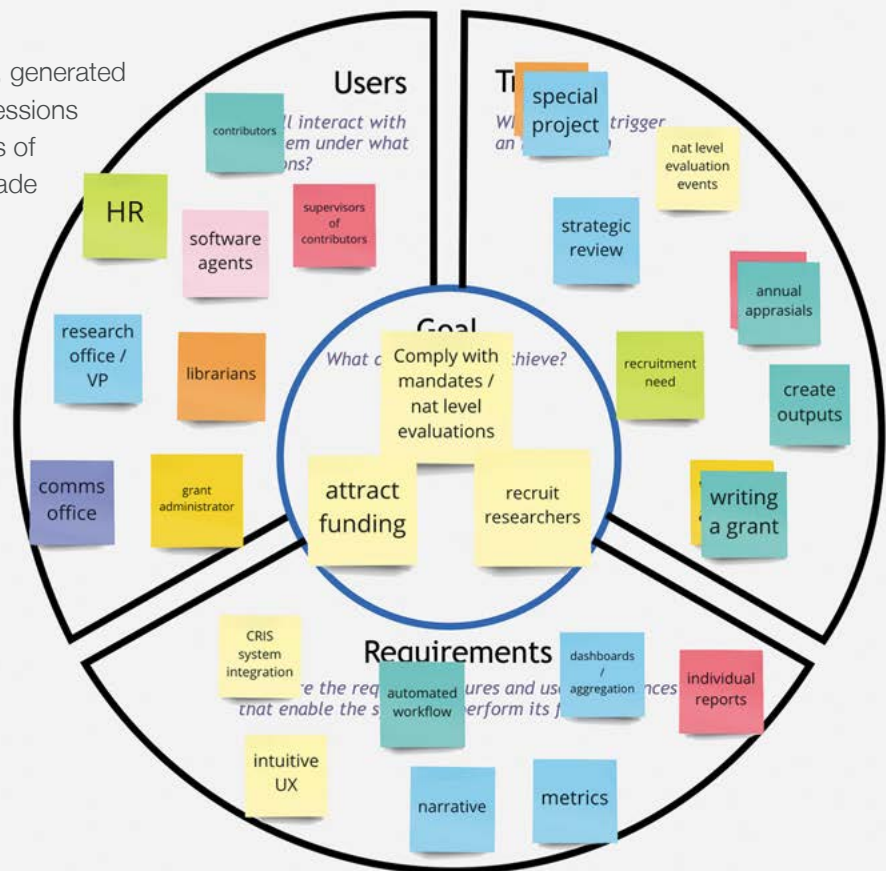
The institutional use case is a refined version of the one originally presented at the virtual stakeholder meeting. Two of the focus groups, 'groups that have made progress' and 'institutions', walked through the central goal/user/trigger event/requirements processes with us to check their accuracy and determine where the gaps were. We collected and recorded their insights during the meetings and then separately worked through the findings. Our aim was to rationalise the final result so that

it was as clear, generally applicable, and as potentially actionable as possible. We also coordinated the colour coding across the three final use cases, to make it clear which users correspond to which triggers and requirements across the total OP. For each of the use cases in this report, the yellow notes indicate general, overarching requirements. Other colours correspond to those in the 'users' segment of Figure 6. [Appendix A.3](#) contains a full set of colour/segment uses.

Institutions potentially have a broad range of OP users - from the HR department (for recruitment) to research offices (strategic reviews) and the researchers themselves (annual appraisal, to create outputs, when writing grant applications). It was also envisaged that the OP could have some applicability for additional users outside of academia (such as journalists and citizen scientists), although we decided that these instances lay outside the scope of the current project.

Figure 6

Preliminary use-case for institutions, generated from a synthesis of brainstorming sessions in two focus groups: representatives of institutions and groups that have made progress towards processes with similar goals to the OP.⁷



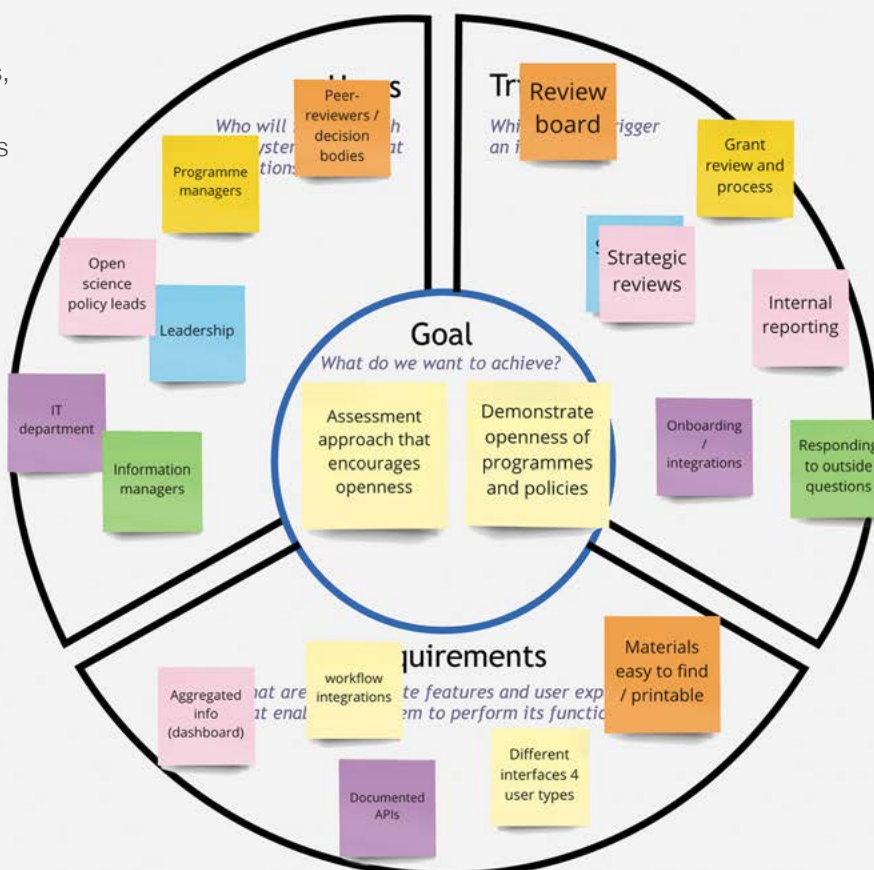
⁷ Figure A.1 in the Appendix shows a clean version of this canvas.

5.2 Funders

Funders, on the other hand, contain a smaller, tighter range of actors. As with the institutional use case, we worked with two focus groups (the 'funders' and 'PIDs') to sense-check the first prototype funder use case from the stakeholder plenary. We found that there are two main sub-groups within funders that would potentially benefit from the OP: the systems/operational functions (IT, grant management, and monitoring) and the strategic/scientific areas (strategic/policy development, proposal evaluations). Given that a key sub-set of the latter group - the peer reviewers - are external to the organisation itself, there is particular emphasis on the OP being easily downloaded and assimilated into the grant workflow.

Figure 7

Preliminary use-case for institutions, generated from a synthesis of brainstorming sessions in two focus groups: representatives of funders and PID experts.



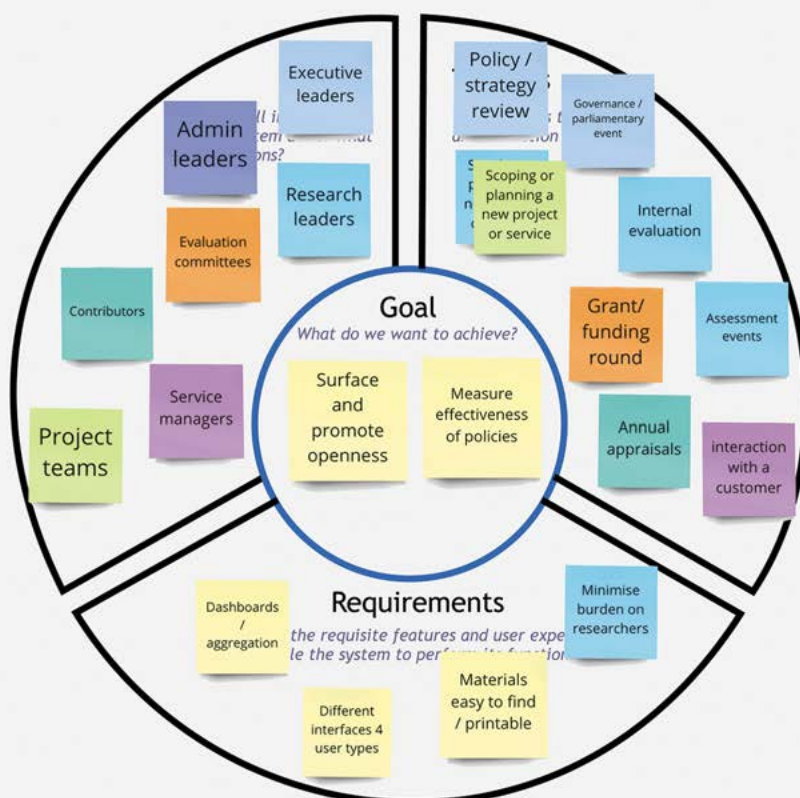
5.3 National research organisations

The entire session with the fifth focus group - national research organisations (NROs) - was devoted to the development of its own, separate use case in addition to the previous two. There was initially some vagueness about NROs' range of responsibilities, as they vary between countries. However, the group was able to agree on a few central goals, including evaluation of the effectiveness of policies, supporting researchers/institutions in putting policy into practice, and ensuring good governance throughout the process.

The OP potentially provides NROs with the means to be more effective in these roles, as it would optimise how information would flow between users, as well as standardising what the information would consist of, look like, and be used for.

Figure 8

Preliminary use case for national research organisations, generated from a synthesis of a brainstorming session in the national research organisation focus group.



5.4 Ongoing application of the use cases

The delineation of these use-case canvases has provided a solid grounding for the reference model development phase of the OP project (Section 4). At the same time, we need to stress that further work on the OP is needed beyond this project, in order to fully realise the draft workflows. We describe the nature of this work as part of the recommendations in section 8.

6. Challenges to increasing openness

There are significant challenges in the transition to open scholarship. In this section, we discuss barriers to progress towards greater openness, which were a major theme in our findings.

6.1 A collective action problem

In 2019, the European University Association (EUA) found that the vast majority of institutions were either highly or mostly autonomous in developing and implementing research assessment approaches [31]. The same report states that, despite a desire to incentivise openness, traditional metrics, such as the number of publications and journal impact factor, remain the dominant forces in research assessment.

There is an increasing number of high-profile initiatives designed to support the responsible use of more progressive metrics that are more favourable to open scholarship, such as the Leiden Manifesto [32], DORA [33], and the LERU statement on new metrics. This leads to the question, 'Why has progress towards openness not proceeded more quickly?'

In a previous work by Knowledge Exchange [2], the need for collective action to achieve open scholarship is shown to relate to conflicts in values, motives, and incentives, and to the creation of network effects around 'gravitational hubs,' such as Google or Facebook.

Network effects were central to discussions at every stage of this study. Stakeholders at the macro, meso and micro levels, from national funders to individual researchers, said that it would be impossible to change their own behaviour and practices unless others in the ecosystem do so first. During a virtual focus group, a participant anonymously wrote on the whiteboard:

"Research is still organised with 'well defined' rules that do not include 'open'-related criteria - if the old-fashioned rules are not obeyed, no career ..."

This stark observation reflects complaints that we heard from many stakeholders. Researchers are compelled to follow the requirements of their funders, institutions, and publishers. Institutions are subject to external pressures to compete for funding and prestige. Publishers respond to what researchers and libraries tell them is required. Funders are often concerned about disadvantaging researchers that they fund and low compliance levels. They also need to be viewed as funding high-impact, high quality research based on the value structures that are currently in place. With the research environment becoming increasingly competitive, there is a strong incentive for all stakeholders to conform to existing performance expectations or risk loss of prestige, perceived relevance, or funding.

6.2 Organisational knowledge of openness at the macro level

Although impeded by systemic inertia, funders, governments, and national research organisations do have the power to exert significant pressure on the system and force change. Funder mandates around open access, for example, have already caused significant changes in researcher behaviour, although questions remain about funders' ability to enforce these mandates [33]. Funders

also exist within a competitive environment, and are under pressure to demonstrate impact from their investments. Their drive towards openness is often balanced against conservative views of what constitutes high-quality research, as measured by traditional metrics.

The funding organisation representatives we spoke to stated that levels of understanding of openness vary within their own organisations, indicating the need for greater outreach and education, particularly towards senior colleagues within macro organisations. A further difficulty lies in changing the values by which scholarship and research contributors are measured. Decisions around funding are made by groups of senior scholars, who were trained in a specific way of thinking about scholarship and research quality that does not necessarily extend to openness. This situation can create a disconnect between a funder's stated policy goals and the operationalisation of the associated values through funding decisions.

Your full research contributions are as important as your high impact publication list but the very practical thing we're facing, with implementing DORA, It's tough to tell our evaluators "Don't think about H-indices or Nature publications"

6.3 The definition of high-quality research

Research quality is a nebulous concept. Many of the stakeholders we spoke to from the macro organisations conveyed the idea that reviewers and research administrators may not be able to define high-quality research but they know it when they see it. In other words, an underlying de facto definition of quality that is somewhat circular underpins decision-making. This results in perceived 'high-quality research' receiving

many citations in part because of the reputations of the researchers, institutions, and publishing venues concerned, which are then further enhanced.

In recent years, a number of European nations have adopted performance-based research funding systems that effectively broaden the working definition of high-quality research. They typically seek to incentivise real-world impact, which includes technology transfer, economic impact, improvements in quality of life and public engagement, and which use a mixture of quantitative research metrics and peer review [32], [35].

To effect movement towards openness, the definition of high-quality research must put greater emphasis on the quality of research practice, including both fundamental and applied research. Participants in our stakeholder workshop quickly reached a consensus that openness, transparency, and accountability should be considered the hallmarks of good research practice and be incentivised accordingly.

6.4 Recognition and reward for all research contributors

Throughout the OP project, we have envisaged 'research contributors' as including a broader range of practitioners than those traditionally thought of as researchers. A recent position paper from four academic associations in the Netherlands (VNSU, NFU, KNAW, and ZonMW) [36], called for a system of recognition that enables diversification of career paths in academia, as well as encouraging openness in scholarship and prioritising quality of work over quantitative results. The paper states that *"putting these shared ambitions into practice requires modernisation of the system of recognition and rewards"*.

During interviews, we spoke to a project manager/data scientist for a national research organisation, who said:

"A project manager's job in science involves a fair amount of looking after the other people in the project and making sure they know what's going on and know what they're doing. A similar sort of thing is ... public outreach [activities]... you're not spending as much time sitting at the lab bench and doing the 'proper research'."

In another interview, a tenured researcher who works in metascience and reproducibility stated:

"In terms of pushback⁸, institutions are probably the most difficult. They haven't shown they value this sort of work and so the incentives aren't there. If you needed to be more open in terms of promotions and reviews, that would have a bigger impact more broadly"

This lack of incentives for excelling at the more technical aspects of research, such as data wrangling, software engineering, and management may be leading to a loss of talent, as those with such skills and interests leave for the commercial sector where they feel more highly valued.

6.4.1 Engineers and support staff

Some national research systems tackle this incentive problem by having a class of less prestigious research contributors referred to as 'engineers'. This approach has its own risks - while these engineers may in some cases be building the infrastructure to enable traditional researchers to be more open, they may not consider their own work as scholarship or as important enough to be part of the open scholarly record. During the research phase of this project, we spoke to an engineer who expressed how this arbitrary distinction between 'researchers' and 'support staff' affects the way they think about their own work:

"...as I told you, I'm not a researcher. My job is to support researchers, so openness is not my job."

The lack of incentives or proper recognition for many segments of the research process creates the risk of an unsustainable situation, in which both demographic and skill homogeneity degrade the impact and effectiveness of academic research. Moreover, keeping activities crucial to open scholarship hidden may hinder the valuable development of appropriate highly-skilled research contributors.

⁸ In this instance, 'pushback' is a colloquial term for reluctance to change or adapt.

6.4.2 Diversity and inclusion

While not the primary focus of our research, we encountered some evidence of how institutionalised gender bias interacts with bias against certain research contributor roles. The project manager/data scientist previously quoted spoke of a cyclical problem in which young, female colleagues are steered into less prestigious positions, which are in turn less highly valued.

"You often find it's the younger female researchers who are pushed into doing this sort of thing... It's a function of the overarching gender norms of women having to be looking out for their coworkers and doing the mothering."

Replicated in many institutions over the years, this monocultural trajectory will have resulted in the loss - through disillusion, failure to progress - of hundreds, if not thousands of women from the research pool. This is part of a huge issue within academia and research assessment that is discussed more fully elsewhere [37]–[39]. More generally, the interaction of biases - around gender, ethnicity, LGBTQ status [40], neurodiversity, socio-economic background, and more - and the lack of recognition and reward for the full breadth of research contributions, is worth further study with the OP in mind.

6.5 Skills and knowledge deficits

A recurrent theme throughout our research was the need for researcher training in the skills necessary for open scholarship. During our semi-structured interviews, we asked practising open scholars and open scholarship trainers to tell us about the skills they require to be open, the tools they use, and what they teach to others.

Invariably, practitioners noted the need to be able to manage, transform, and curate data. Knowledge of what good data management is and how to use standard data structures are key to interoperability and reusability. Open scholars need to be aware of standard data schemas, as well as the principles of tidy data [41] and how to achieve them using open source scientific data science software like R and Python.

The importance of these skills is currently worryingly underrated in academia. During the virtual workshop a professor from a major North American university remarked that:

"Often the people who talk about openness and the importance of openness, they're very vocal, and we're very passionate about it, but it hasn't penetrated the majority of faculty yet."

As discussed in [section 1](#), open scholarship skills are not only about openness of outputs but extend to the quality of research practice. The ability to design a data management plan with a clear and clean data pipeline is critical to performing high-quality, reproducible research.

Anecdotally, outside of the existing communities of open scholarship practice, few scholars seem to have a good understanding of the components of open scholarship that are already in place. Within specific communities, there is good awareness of structured data repositories and community-specific infrastructure, such as GenBank for genetics data, the NERC data centres for climate science, or CLARIN for linguistics. More general open scholarship initiatives, for example, Zenodo, Dryad Data Repository, and EOSC, are less well known, particularly among the wider community of

practitioners, with some commercial solutions having greater name recognition. As a result, the data stewards and research administrators involved in our consultations often face questions from faculty members about where data and other outputs can be placed.

Equally, research support staff report that knowledge of institutional repositories and other aspects of institutional-level research infrastructure is variable across faculties. Reasons for difficulties may include a lack of time for research contributors to investigate options, the complexity of institutional workflows, and frustrations with poor user experience.

The findings presented here are anecdotal, but they support the findings of the European Commission's high-level policy group on the European Open Science Cloud, which recommended that 500,000 data experts are needed across the European Union, and that 5% of all research funds should be directed to making data reusable [42]. There are also a number of initiatives that focus a degree of effort on open scholarship and data management skills education. Two notable ones are FORCE11 [43] which runs an annual scholarly communications institute (FSCI) and OBERRED [44] which is creating badges for recognition of research data management skills. Further work would be needed to fully map the gaps in levels of understanding of open scholarship infrastructure over a larger and more diverse range of research contributors.

6.6 Information technology

Tracking and curating open scholarship contributions for evaluation and assessment requires systems to be in place and information to move between them interoperably. A mixture of systems is currently used to track research information among funders, governments, institutions, researchers, and publishers, many of which do not exchange information with each other.

Institutions, in particular, are faced with the challenge of managing complex and overlapping systems to serve a variety of requirements and use cases - from HR, payroll, and purchasing, to internal performance reviews, funder, and national level reporting. Many institutions suffer from legacy IT infrastructure, which can be further hampered by confusion about the safety and security of modern approaches such as cloud computing [45].

Beyond restrictions due to policies, we found variations in experiences of information systems within institutions, even among users of the same systems, implying that levels of IT capability and investment are variable across the sector. Moreover, some institutions spend money on information management systems that have not been fully implemented or integrated into internal or external systems.

Funder representatives also expressed concerns about IT capabilities within their organisations, with one recounting:

"So in principle I found the whole concept of this Openness Profile very interesting but I'm still very unsure ... what it would take in terms of technology... and frankly I'm worried about that as we have a completely obsolete grant management system at the moment, which is already a big problem."

6.7 Disciplinary variance

Research contributors in the humanities and social sciences are traditionally underserved by research assessment practices, particularly with regards to metrics [46]. In part, this is due to the differences in communication channels - research journals tend to receive greater numbers of views and citations than the full-length monographs often preferred by humanities scholars - as well as the disparity in pace of change and size of domains. On the other hand, there are also cultural differences between disciplines. A striking example of this was given by an individual who is both a humanities scholar and a data steward at a prestigious university in Europe, when asked about their own ORCID profile:

"No, I do not [have an ORCID] and neither does anybody else in the Humanities! There are very few and I can tell you why. There's a tradition in the Humanities of humility. There's a lack of interest in being too well publicised. People seen as self-promoting are viewed negatively. So having a PID... attaching your stuff to it. From my own perspective, it's about privacy. I don't want another number associated with me, I find that demeaning and a lot of my colleagues feel the same."

We also observed an attitude among humanities scholars which mirrors the research engineers, as described in [section 6.4.1](#), whereby some scholars did not see their own outputs as involving 'data' and, therefore, believed that open scholarship was not directly applicable to them. We experienced this during another interview with an early career researcher in linguistics who worked with corpora, and who only realised that their own work involved data after we explained our own methodology:

"Yes, the corpora. I didn't think of corpora as datasets, but you're right, they are datasets. For example, they're POS tagged, so they're actually enriched datasets."

We encountered these sorts of opinions and attitudes many times during our research, however, they may not be entirely representative of the humanities as a whole. Recent analysis of ORCID adoption across disciplines by the THOR project [47], suggests that researchers in the humanities are overrepresented among ORCID iD holders, but underrepresented in terms of the data they are connecting to their records. Further study is required to understand this discrepancy.

7. Requirements for an Openness Profile

In the previous section, we discussed barriers to progress as reported by participants. In this section, we present a series of requirements for an ideal system of recognition and reward for openness that would overcome those barriers.

7.1 Reducing administrative burden

There is a tension between requiring researchers to provide evidence of a broader range of contributions and types of impact, and the over-burdening of both researchers and administrators alike. During the interview phase of this project, a number of administrators working on policy in both national research organisations and funders identified this tension as a barrier to implementing openness policies. Institutional research management professionals also spoke of the difficulty of getting time-pressed researchers to comply with existing reporting requirements:

"I'm constantly asking academics to put information into platforms at the behest of various organisations. It can get really tedious, very embarrassing, and it really upsets the academics."

An underlying cause of excessive administrative burden is a lack of workflow integration through the scholarly research value chain. This deficit manifested itself strongly throughout our research as a barrier to progress, an unmet need, and a requirement of the OP itself.

7.2 Metrics and narratives

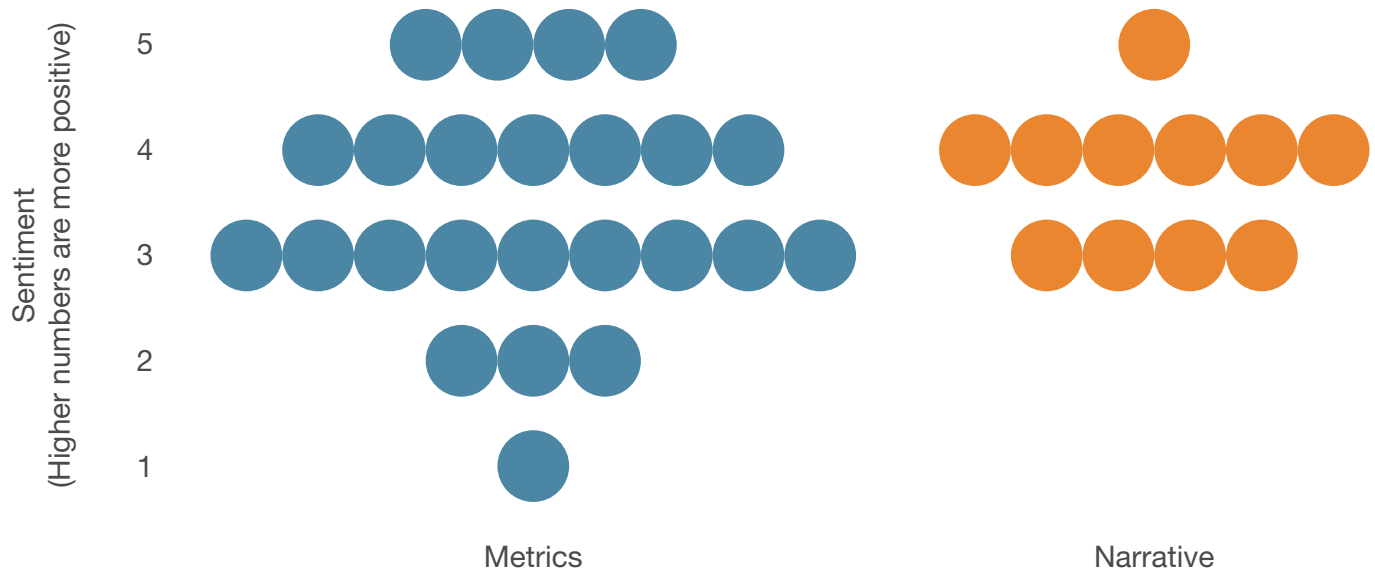
The responsible use of metrics to assess research quality and impact has been a matter of some debate [35], [48]. The San Francisco Declaration on Research Assessment [33] recommends that journal-based metrics be eliminated from research assessment, as

part of a broader agenda to assess work based on merit rather than the container used to communicate it, as well as to support greater transparency in assessment criteria. The Leiden Manifesto [32] advocates for increased use of qualitative expert assessment, supported by quantitative metrics, greater context in assessment with respect to institutional, subject area, and local relevance, and, again, greater transparency. Responsible metrics should be used to enable research managers and funders to make evidence-based decisions about funding, promotions, and investments. On the other hand, many research practitioners, particularly in the humanities and practice-based research disciplines, are concerned that they have already been disadvantaged by traditional metrics, which privilege established over emerging institutions and individuals, and the sciences over the arts. To counterbalance the quantitative metrics effects, various recent research assessment exercises have sought to make processes fairer by enabling researchers to put their work into a narrative context.

The ACUMEN project, for instance, [20] has made several valuable advances in our understanding of how to structure and present a more portfolio-based evaluation mechanism. These included realising that; applicants need greater insight into what was required of them for specific evaluation events (such as grant funding vs promotion), through clearer guidelines that are more consistently applied; there is a need to reduce administrative work/redundancy/overload; and that providing opportunities for the applicant to explain the value of their outputs in narrative form is an important part of normalising the process for all concerned.

Figure 9

The results of sentiment analysis for metrics and narrative in research assessment. Every time a study participant mentioned either the use of metrics in evaluation or narrative based evaluation during the workshop or focus groups, their sentiment was qualitatively gauged. A higher number reflects a more positive sentiment.



As part of our analysis, we tagged mentions of both metrics and narrative in the transcripts for the workshop and focus groups. Metrics were spoken about more than twice as frequently as narrative but slightly less favourably, as shown in figure 9. Those from a research or research management perspective expressed concern that the overuse of metrics can lead to perverse incentives, and can fail to capture the full breadth of researchers' contributions, particularly with respect to openness. Those from a policy and management background tended to point out how metrics reduce the administrative burden in decision-making, while some researcher contributors felt that the use of metrics can be an effective way to drive the usage and adoption of models like the OP. One researcher that we interviewed said:

"The sad fact is that if you want to encourage people to do something, the easiest thing is to put a number on it and a metric because then people start to compete and say my number is better than your number and there will be competition involved in that"

Given the proposed use cases for the OP, there is a practical need to enable responsible metrics for research assessment and strategic decision-making at both the macro and meso levels. Care must be taken to ensure that metrics incentivise both openness and the quality of the research process to the greatest extent possible. An OP must also support narrative-based research assessment approaches that already exist and facilitate the development of similar frameworks. This will, of necessity, require an iterative approach, with regular reviews and the scope to adapt as emerging metrics, and their uses, begin to mature.

7.3 Credit for more types of outputs

Central to the reference model of the OP is a steep increase in recognition for a wider range of both research contributions and contributors. The reasons for this are described in detail in [section 6.4](#).

There is a need for consistency in the types of activities that are recognised and rewarded across institutions and roles, so that research contributors can be mobile in their careers. The OP must reference taxonomies of roles, outputs, and activities that are developed in collaboration with stakeholders throughout the scholarly ecosystem, as defined in the open scholarship framework ([Section 1](#)) - that is to say funders, national research organisations, institutions, researcher contributors, and administrators.

7.4 Assertion provenance

An important requirement for the OP is that it should be auto-populated ([Section 7.1](#)) to the greatest extent possible, while preserving the ability for *contributors to tell their own story* ([Section 7.2](#)) about their contribution to research and openness. There is also a balance to be struck between the ability for contributors, institutions, and funders to control their own narrative and the need to ensure the accuracy of claims made, whether they be about research quality, impact, or openness. As one member of the PIDs focus group put it:

"Provenance is really important ... what something like Crossref creates is a collection of assertions from publishers and organisations about who published what. The links between objects are not [guaranteed to be correct], they are claims made by the various participants"

There is a concern that a profile which is dependent on an individual's account of their own activities could degrade from an evaluation tool into a platform for uncertified self-promotion. It is therefore important that as many assertions as possible are verified through existing infrastructure, for example, through licensing metadata, PIDs that resolve to free resources, or authoritative stakeholder data, such as funder records, to establish the validity of a claim by a contributor that they received funding.

When assertions cannot be verified, data provenance allows users to make decisions about the trustworthiness of the assertion.

7.5 Community governance

The OP reference model ([Section 4](#)) is proposed as a solution to the collective action challenge posed by the meso level of the open scholarship framework ([Section 1](#)).

There is a need for community consensus over taxonomies, workflows, standards, and points of integration between systems and for the prevention of information lock-in within proprietary systems.

There are strong network effects within research assessment that can only be overcome by mutual agreement between stakeholders across multiple levels. A practical example of this effect was described by a funding organisation representative at a focus group, talking about gaining internal support for components of research evaluation:

"I think in our experience [you need an] accepted standard... When discussing it with internal stakeholders [or] evaluation panel chairs, it can help massively if you can say [something] was developed by an international group of experts, it is widely used, these top funders are using it, it is state of the art and we are lagging behind. [You] can speed up many discussions and if you don't have that, people come up with all sorts of reasons for why we should not do this and we should wait for others."

Community governance involves the creation of independent, cross-stakeholder groups that work together on components of the OP reference model. This approach would be an effective counter to network effects by enabling a diverse range of organisations to progressively adopt shared taxonomies, workflows, and research assessment components.

7.6 PID-enabled automated workflow

The importance of PIDs goes beyond simple identification of entities. Crucially, metadata associated with PIDs enables them to be used to create links between entities (people, organisations, outputs, etc), for example, to identify and count open access research articles or data sets associated with a particular institution. Through the use of modern software integration technologies like APIs, platforms can create knowledge graphs that meet the reporting needs of funders, institutions, and publishers [49].

An ongoing research project, commissioned by Jisc [14], details an ‘open access workflow’ from funder to repository and publisher. By conducting an in-depth workflow analysis, the authors were able to identify a series of integration points and five priority PIDs that require further development to enable an automated workflow.

Consistent with the findings of the Research England-supported Jisc study, we found three key systems that should be prioritised in order to more efficiently gather and curate open scholarship contributions: funding systems, CRISs, and institutional repositories. Each of these will be addressed in the next paragraphs.

Table 1

The five priority PIDs identified in the Jisc persistent identifier roadmap project.

People	People are authors, readers, researchers, and research contributors. The actors that engage in research need to be identified so that it's possible to know who did what work without any confusion over people who have the same/similar names, whose name changes, or who use different versions of their name.
Institutions	Institutions are universities, hospitals, national research centers and commercial organisations. There is currently no widely accepted standard identifier for institutions making it difficult to reliably collate, analyse, or assess the outputs of institutions.
Funded Grants	Research grants are often the starting point for research projects. A widely adopted persistent identifier would enable easier analysis of which institutions or people were awarded which grant and what the associated outputs were.
Projects	Some projects are small and performed by a single researcher, others are massive multi-institutional collaborations. A PID for projects would enable easier research management and make both the funding and outputs for a project easier to track.
Outputs	Research outputs are more than just articles. Data and other outputs need to be tracked so they can be associated with people, institutions, grants, and projects. Outputs appear in many venues including repositories, websites, with a wide variety of identifiers in use.

7.6.1 Funding systems

Much of the progress towards openness has been driven by funder goals and mandates, however, funders themselves have not been at the forefront of developing open practices. Although many funders make awarded grant information public, the systems that provide that information do not always use APIs, and data are not always made machine-readable with appropriate controlled vocabularies.

There has been progress in recent years, most notably through work done at Crossref, but the use of PIDs for grants remains rare, and some of the funder representatives who took part in this research confidentially reported patchy understanding of open scholarship within their own organisations.

The use of PIDs by funders, improved information management, and appropriate technology to enable interoperability should be a major priority not just for the OP but for the scholarly information ecosystem in general. A good starting point for PID integrations by funders is Crossref's grant DOIs system [50], extending to DOIs for articles, books, and other outputs associated with grants, ORCID for research contributors [50], RoR for institutions [50], and RAiD for projects and collections [7].

7.6.2 Current research information systems (CRISs)

In recent years, a lot of attention has been paid to research information management within institutions. INORMS [52] was formed in 2001 to bring together research management societies from around the world and currently has 20 organisational members. The rise in importance of this discipline reflects the increasing focus by institutions on strategic research management, largely in response to mandates and an increasingly competitive funding environment.

Current Research Information Systems (CRISs), have a four-decade history. Typically, they catalogue projects, people, organisational units, funding programmes, research outputs, facilities, equipment, and events [53].

With the entrance of new vendors into the market, the development of national and regional CRISs, and the development of the CERIF standard [12], these systems have been evolving from internal operational databases to cloud-based, interoperable platforms that enable the cataloguing of a broad range of research outputs, as well as tracking suites of metrics and indicators that can be used for a variety of reporting exercises and other purposes.

There is still much progress to be made in this area. Many institutions have not yet invested in CRISs and, when asked about the systems they use, some institutional representatives we spoke with complained of a lack of openness and interoperability, particularly with respect to proprietary systems, (a substantial segment of the market) [54].

Experiences of CRISs vary across academia, with different research managers and librarians reporting varying levels of satisfaction with the same systems. Some of this variability may be due to the continued use of legacy versions of certain products, as well as poor support from institutional IT departments. Nevertheless, as institutions increasingly rely on CRISs to manage internal operational knowledge, improved interoperability enabled by PIDs, and expanded scope of the types of information that can be tracked, should be priorities.

7.6.3 Institutional repositories

There has been a widespread increase in the use of institutional repositories (IRs) over recent years. The directory of Open Access Repositories (openDOAR) currently lists nearly 6,000 globally, an increase from less than 1,500 a decade ago [55]. While in the past, institutional repositories (IR's) were seen as competing with research information systems, they are now increasingly viewed as complementary [56]. With a focus on community-driven, institutionally-supported content curation and dissemination of a wide range of research outputs, institutional repositories (IR's) are well placed to support the movement towards open scholarship.

The challenges associated with the creation and upkeep of institutional repositories (IR's) are well documented; storage and staffing costs, low usage, and limited uptake by faculty are endemic [57]. In many ways, these challenges are symptomatic of the challenges around systemic inertia, misaligned incentives, and the lack of technical workflow integrations that we have been encountering throughout this project.

An area of focus for institutional repositories (IR's) should be interoperability. Many institutional repositories (IR's) do not integrate or register DOIs, instead using non-persistent instances of Handles for unique identifiers. Together with a lack of ORCID integration and poor connectivity into other types of PIDs, such as data DOIs and grant IDs, content in institutional repositories (IR's) is somewhat disconnected from the broad information infrastructure.

The participants of our 'progress' focus group observed that the use of PIDs, and in particular ORCID, was key to enabling research contributions to be automatically counted and the scale of contributions to open scholarship assessed. Creation of agreed standards and certification can be a useful tool in mitigating these challenges, for example, DINI certification has proven effective in encouraging best practice in Germany [58].

8. Recommendations

In the final section, we discuss recommendations for a variety of stakeholders by identifying actions to enable better recognition and reward of open scholarship in general, which in turn will provide the rationale and basis for further operationalising the OP.

8.1 Collective action to achieve the Openness Profile

The scholarly communications ecosystem is a complex, multi-stakeholder environment with strong network effects that disadvantage individuals and organisations that stray too far from accepted norms. The situation is complicated by conflicting ambitions of, and competitions between, stakeholders across all levels of the open scholarship framework.

We face, however, a tremendous sense of urgency. The activities of scholarship go far beyond those typically used in the evaluation events that feed into hiring, promotion, and funding activities. Lack of recognition and reward for the full range of scholarship is leading to significant sustainability problems within academia. Fragile and fragmented infrastructure leads to overly burdensome reporting procedures that rob research contributors and administrators of precious time. Activities that lead to greater transparency, reproducibility and better research quality are actively disincentivised, and key contributors to the academic knowledge ecosystem continue to be under-recognised, risking a talent-drain towards the commercial knowledge sector.

As [section 6](#) of this report illustrates, even where a range of stakeholders agrees in general terms that, for instance, open scholarship should be encouraged and supported, outside that high-level consensus, there can be problems with aligning the priorities and paths towards this ultimate goal. Consequently, for any meaningful progress to be made towards realising the OP - which itself facilitates and encourages the promotion of open

scholarship practices and outputs - there is a continued need to build on the consensus and community that has already begun to emerge in the course of this project. Accordingly, we provide two sets of recommendations. The first group are high level, multi-stakeholder, collective actions, while the second set supplies next-step recommendations for individual organisations by category (e.g. funders).

Three high level recommendations will be described in the following sections. These are:

- ▶ Stakeholder summit
- ▶ Working group
- ▶ Sponsor for the OP

8.2 Facilitate a stakeholder summit

The primary recommendation of this report is a call for action to the main players in the research community, to ensure continued consensus-building by investing in productive exchange and collaboration.

To execute that recommendation, the next stage of the OP project will be a cross-stakeholder summit meeting to which key actors in the research community are invited to participate.

Such actors include:

- ▶ Policy-makers
- ▶ Funders
- ▶ Institutional leadership
- ▶ Institutional research managers
- ▶ Data stewards and curators
- ▶ Subject-specific and data librarians
- ▶ Open scholarship trainers
- ▶ Mainstream researchers at each career stage
- ▶ Infrastructure experts
- ▶ Technologists
- ▶ Standards organisations
- ▶ CRIS vendors

8.3 Establish an ongoing working group

A key output of the summit - and our second recommendation - is for KE, with support from those key actors, to facilitate the creation of a cross-stakeholder working group. Based on the findings of the current project, we recommend the working group to initially focus on five areas:

- ▶ Community governance model
- ▶ Validation of the OP reference model
- ▶ Taxonomies for contributors and contributions
- ▶ Technical facilitation of research management workflows
- ▶ Infrastructure survey and gap analysis

8.3.1 Develop a community-based governance strategy

There is a strong desire across the stakeholder community to establish buy-in and sustainability through robust community-based governance. A multi-organisational approach, that can continue to maintain and govern the OP as needed, will ensure resilience. The use of community-based governance also encourages a broader range of needs to be considered when making decisions. We therefore recommend that the working group develop a sustainable community-based governance strategy with representatives from a broad range of stakeholders.

8.3.2 Validation of the OP reference model

The reference model presented in [section 4](#) represents a synthesis of contributions from all stakeholders over the 18-month project period. We recommend that the working group socialise and validate the model, with feedback from stakeholders. Once validated, it can be used as the basis for gap analysis and prioritisation of interventions that will enable reward and recognition of open scholarship contributions and the OP.

8.3.3 Taxonomies for contributors and contributions

Key to the reference model are the taxonomies for both contributors and contributions. There have been a number of initiatives, including CRediT [\[10\]](#), Acumen [\[20\]](#), and OPERA [\[11\]](#), that have aimed to create taxonomies. Rather than creating another list in this report, we recommend that the working group facilitate agreement upon and adoption of standards by coordinating with relevant stakeholders and taking relevant initiatives into account.

8.3.4 Technical facilitation of research management workflows

The use of PIDs and technical integrations are vitally important to creating automated workflows that enable compliance with reporting requirements, with reduced opportunity for error and without undue burden ([Section 7.6](#)). We recommend that the working group dedicate significant time and effort to developing standards for information interchange and interoperability as well as identifying key points for integration.

We recommend that funder information systems, CRISs and institutional repositories (IR's) be considered as a priority for technical integrations and workflows.

8.3.5 Infrastructure survey and gap analysis

Coordination with related initiatives is important to avoid duplication of effort and to further build consensus. The section on related initiatives ([Appendix D](#)) describes a

number of efforts that tackle questions closely aligned with the OP. Significant parts of the ecosystem necessary to support the OP already exist. Examples include:

- ▶ Taxonomy of contributions created by CRediT that is administered by NISO
- ▶ Research analytics practices and systems from Open Research Analytics (OPERA)
- ▶ Portfolio of new invisible contributions identified by the ACUMEN project
- ▶ Workflow and PID metadata recommendations from the Jisc PID roadmap
- ▶ Implementation guidelines on open scholarship assessment from LERU

We recommend therefore that as part of the working group's remit, a thorough infrastructure survey and gap analysis should be conducted with regard to a validated OP reference model. This analysis will create a shared understanding of what is already in place to support the openness profile and what should be prioritised to better enable reward and recognition of open scholarship contributions.

8.4 The Openness Profile requires one or more sponsors

We recommend that a sponsor is identified and recruited by the working group. To be successful, the OP will require ongoing leadership and financial support. This should come from either a single sponsor or a small coalition of co-sponsoring organisations that have an interest in the successful implementation of a minimum viable implementation of an OP.

The sponsor(s) would be responsible for a number of programme management tasks needed to bring the OP to the point of being a minimum viable implementation:

- ▶ Development of detailed use cases that build on the preliminary ones presented in [section 5](#)
- ▶ Compilation of user stories to feed into development requirements
- ▶ Acting as development partner to third-party vendors of funder systems, institutional research management systems, and institutional repositories (IR's) to identify and prioritise unmet user experience requirements ([Section 7](#))
- ▶ Engineering of middleware to connect information systems using PID metadata ([Sections 6.6](#) and [7.6](#))
- ▶ Working with stakeholders' IT departments to create implementation guidelines and best practices ([Section 6.6](#))
- ▶ Coordinating open scholarship training programmes, working closely with organisations that already support communities of practice ([Appendix D](#))

8.4.1 Finding appropriate sponsors

We strongly recommend that one or more funders or national research organisations act as a sponsor for the OP. The OP forms a critical part of the modernisation of research assessment and making contributions to open scholarship visible. Funders and national research organisations with a mandate to advance openness or sponsor infrastructure development are well placed to convene stakeholders and would benefit from taking a strong leadership position both in terms of global reputation and meeting their own strategic goals for open scholarship.

KE has already convened a community that could morph into the working group. We recommend KE should continue to play a central role both in convening of the working group, recruitment and identification of a sponsor. KE itself is well placed to act as a primary or co-sponsor

with support from one or more key actors from the funder or national research organisation communities. Given the breadth of the reference model, we strongly recommend a continued collaborative approach. A broad range of organisational capabilities will be required from the sponsors making it unlikely that one organisation will have experience in all areas. Co-sponsors should therefore be drawn from a combination of funders, infrastructure providers, and one or more institutions that are already working towards increased credit for open scholarship.

8.5 Stakeholder-specific recommendations

By defining the various components of the OP reference model (Section 4), and through consultation with a broad range of stakeholders, we have uncovered a series of barriers to open assessment and requirements for the OP that include, but are not limited to, systems integrations, shared taxonomies, and training requirements. Accordingly, we have developed a set of recommendations, designed to address both the challenges and the opportunities that potentially lie ahead directed towards four specific stakeholder groups: funders, national research organisations, infrastructure providers, and institutions.

8.5.1 Funder recommendations

Recommendations for funders fall into two broad categories. The first three are related to much needed technical improvements to funder information systems, the remaining three are related to improving alignment between stated funder policy and actions in practice.

1. Invest in scholarly infrastructure to enable automated workflows that minimise research contributor and institutional administrator burden. (Sections 7.1 and 7.6)
2. Increase investment in internal information systems that support grants and funding workflows. Funders should work to improve their technical capabilities and interoperability with downstream stakeholders' systems, such as institutional CRISs, institutional repositories (IR's), publishers' content management and production systems. (Sections 6.6, and 7.6.1)
3. Implement persistent identifiers in grant information systems. Begin with Crossref's DOIs for grants and extend to ORCID, RoR, and RAiD. (Section 7.6.1)
4. Develop decision monitoring and reviewer education programmes that improve alignment between funder open scholarship policies, for example, as exemplified by DORA [32], and funding decisions based on peer review (Sections 6.2 and 7.3)
5. Modernise funding application processes to shift the emphasis of information submitted by applicants away from traditional metrics and towards a mix of responsible metrics and narrative. Applicants must be able to describe the quality of their research and scholarship process. (Section 7.2-3)
6. Enable funding applicants to assert provenance over ideas using evidence produced earlier in the research cycle. Allowing greater use of pre-prints, data sets and pre-registered experiments will reduce risk associated with working openly. (Section 4.1.1)
7. Expand the types of outputs that can be presented as evidence of research activity, quality, and impact. In particular, the inclusion of earlier stage outputs, such as preprints, pre-registered experiments, and datasets would reduce the perception of risks to researcher contributors practicing open scholarship. (Section 7.4)

8.5.2 National research organisations recommendations

National research organisations (NROs) are in a strong position to drive the open scholarship agenda forward, particularly if they increase the breadth and depth of their collaborations with infrastructure providers.

1. Coordinate on standards around information interchange and interoperability. Create a common understanding of the components of high-quality research to help overcome collective action problems caused by poorly aligned incentives. (Section 6.1)
2. Promote community governance within the scholarly infrastructure. NROs should collaborate to set up consortia to support PID subscriptions/membership and development, and provide local registration agency services where necessary. (Section 7.5)
3. Develop a research community-led certification programme for CRISs and institutional repositories (IR's) to encourage adoption of best practices. (Section 7.6.3)

8.5.3 Infrastructure providers recommendations

Five priority PIDs were identified in the recent Jisc PID roadmap report (ORCID, Crossref, Datacite, ARDC (RAiD), and RoR) [14]. These actors would benefit from, and are well placed to support, greater interoperability between research systems that would in turn enable further development of the OP.

4. Take an active role in developing research infrastructure and associated workflows. Work in partnership with national research organisations, funders, institutions, and publishers. (Section 7.6)
5. Where necessary, increase capacity to ensure that systems are adequately scalable. In particular, greater adoption of ORCID in institutional CRIS and funder systems may significantly increase the use of ORCID records and APIs. (Section 7.6)

6. Review governance structures to ensure that they are primarily responsive to community needs, and that individual interests, whether governmental, institutional, or commercial are not over-represented. (Section 7.5)

8.5.4 Institutions

Data stewardship and curation are necessary in order to improve data sharing and interoperability. The recommendations below fit into two categories. The first four relate to technical investments that are needed to modernise information and technical architecture with institutions, thus enabling the gathering of evidence of open scholarly outputs for evaluation, reward, and recognition. The fifth recommendation relates to operationalisation frequently stated institutional goals of encouraging high-quality, reproducible research practice and open scholarship. The final two relate to supporting research contributors to work more openly, thereby improving scholarship and research practices overall.

1. Increase investment in local research infrastructure and IT capability (Section 6.6)
2. Adopt modern product management approaches to develop systems that minimise the time and repeated work burden on both researchers and administrative staff (Section 7.1)
3. Make use of PID- and metadata-enabled workflows, beginning with mandating ORCID for all research contributors, including technicians, engineers and support staff. Expand to DOI for outputs and awarded grants, RoR, and RAiD (Section 7.6)
4. Fully integrate CRISs into institutional repositories (IR's). Institutions and national research organisations that are involved in the development of open source or custom information systems should treat this requirement as a priority (Section 7.6.2-3)

5. Modernise internal evaluation, recognition, and reward mechanisms to focus more on the quality and openness of research and the scholarly and research process, as well as the responsible use of an expanded suite of metrics and narrative. ([Section 6.3](#))
6. Provide mechanisms to allow researchers to assert provenance over ideas with earlier stage outputs and recognise that provenance in evaluation processes to reduce the risks of working openly. ([Section 4.1.1](#))
7. Hire and train research data stewards. Researchers must have access to data stewardship support. Where necessary, institutions should create departments, support services, and career trajectories to enable this. ([Section 6.5](#))
8. Provide research management training and support for researchers. Such training should cover open scholarship, data management, good research practice, reproducibility, the use of PIDs, and open workflows. It should also be tailored to specific domains and career stages. ([Section 6.5](#))

9. Bibliography

1. Tatum, Clifford, 'Research Evaluation and Open Scholarship: Cultural resources, agents of change, and partnerships', Jul. 2020,
doi: [10.5281/ZENODO.3929036](https://doi.org/10.5281/ZENODO.3929036)
2. C. Neylon et al., Open Scholarship and the need for collective action. Knowledge Exchange, 2019
doi: [10.5281/zenodo.3454688](https://doi.org/10.5281/zenodo.3454688)
3. F. Murphy and P. Jones, 'Openness Profile: Defining the Concepts', Zenodo, Jan. 2020.
doi: [10.5281/ZENODO.3607579](https://doi.org/10.5281/ZENODO.3607579)
4. C. Neylon, 'Knowledge Exchange Approach Towards Open Scholarship', Jul. 2017,
doi: [10.5281/ZENODO.826643](https://doi.org/10.5281/ZENODO.826643)
5. P. Ayris, K. Maes, and I. Labastida, 'Open Science and its role in universities: a roadmap for cultural change', LERU, Advice Paper 24, May 2018. Accessed: Nov. 04, 2020. [Online]. Available: leru.org/publications/open-science-and-its-role-in-universities-a-roadmap-for-cultural-change
6. C. Tatum and J. Nordling, 'Resources for recognizing and rewarding contributions to open scholarship', Oct. 2019,
doi: [10.5281/ZENODO.3501793](https://doi.org/10.5281/ZENODO.3501793)
7. 'RAiD for integrators', raid.
raid.org.au/for-service-providers
(accessed Dec. 01, 2020)
8. SPARC Europe and Digital Curation Centre, 'An Analysis of Open Science Policies in Europe v4', Zenodo, Aug. 2019.
doi: [10.5281/ZENODO.3379704](https://doi.org/10.5281/ZENODO.3379704)
9. E. C. McKiernan, 'Imagining the "open" university: Sharing scholarship to improve research and education', PLOS Biol., vol. 15, no. 10, p. e1002614, Oct. 2017,
doi: [10.1371/journal.pbio.1002614](https://doi.org/10.1371/journal.pbio.1002614)
10. L. Allen, A. O'Connell, and V. Kiermer, 'How can we ensure visibility and diversity in research contributions? How the Contributor Role Taxonomy (CRediT) is helping the shift from authorship to contributorship', Learn. Publ., vol. 32, no. 1, pp. 71–74, 2019,
doi: [10.1002/leap.1210](https://doi.org/10.1002/leap.1210)
11. F. Falcoz, B. Lowe, N. D. Lauridsen, C. Steensboe, M. Sandfær, and K. S. H. Ibanez, 'The University Research Analytics Platform: Collaboration-, Publication-, Researcher- and Unit Modules', Technical University of Denmark, Office for Research, Advice and Innovation, 2800 Kgs. Lyngby, Denmark, 2020.
doi: [10.11581/DTU:00000087](https://doi.org/10.11581/DTU:00000087)
12. C. S. Pinto, C. Simões, and L. Amaral, 'CERIF – Is the Standard Helping to Improve CRIS?', Procedia Comput. Sci., vol. 33, pp. 80–85, Jan. 2014,
doi: [10.1016/j.procs.2014.06.013](https://doi.org/10.1016/j.procs.2014.06.013)
13. D. Pajk, M. Indihar-Štemberger, and A. Kovačič, 'Reference model design: An approach and its application', in Proceedings of the ITI 2012 34th International Conference on Information Technology Interfaces, Jun. 2012, pp. 455–460,
<https://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=6308050>
14. J. Brown, 'Developing a persistent identifier roadmap for open access to UK research', Jul. 2019. Accessed: Oct. 15, 2020. [Online]. Available: <http://repository.jisc.ac.uk/id/eprint/7840>

15. M. A. Johansson and D. Sadler, 'Open peer-review platform for COVID-19 preprints', *Nature*, vol. 579, no. 7797, p. 29, 2020, doi: [10.1038/d41586-020-00613-4](https://doi.org/10.1038/d41586-020-00613-4)
16. C. Vlasschaert, J. M. Topf, and S. Hiremath, 'Proliferation of Papers and Preprints During the Coronavirus Disease 2019 Pandemic: Progress or Problems With Peer Review?', *Adv. Chronic Kidney Dis.*, p. S1548559520301191, Aug. 2020, doi: [10.1053/j.ackd.2020.08.003](https://doi.org/10.1053/j.ackd.2020.08.003)
17. 'Publishers make coronavirus (COVID-19) content freely available and reusable | Wellcome'. <https://wellcome.org/press-release/publishers-make-coronavirus-covid-19-content-freely-available-and-reusable> (accessed Nov. 06, 2020)
18. European Commission. Directorate General for Research and Innovation., Evaluation of research careers fully acknowledging Open Science practices: rewards, incentives and/or recognition for researchers practicing Open Science. LU: Publications Office, 2017. <https://www.zotero.org/google-docs/?feDm3a>
19. D. Feenberg, I. Ganguli, P. Gaulé, and J. Gruber, 'It's Good to be First: Order Bias in Reading and Citing NBER Working Papers', National Bureau of Economic Research, Inc, NBER Working Paper 21141, May 2015. Accessed: Oct. 28, 2020. [Online]. Available: <https://econpapers.repec.org/paper/nbrnberwo/21141.htm>
20. European Commission, 'Academic Careers Understood through Measurement and Norms', European Commission, Final report, Apr. 2014. Accessed: Oct. 28, 2020. [Online]. Available: <https://cordis.europa.eu/project/id/266632/reporting>
21. European Commission. Directorate General for Research and Innovation., Mutual learning exercise: open science : altmetrics and rewards : Horizon 2020 policy support facility. LU: Publications Office, 2018 <https://op.europa.eu/en/publication-detail/-/publication/449cc187-693f-11e8-ab9c-01aa75ed71a1>
22. B. Kramer and J. Bosman, 'Rainbow of open science practices', Jan. 14, 2018, doi: [10.5281/zenodo.1147025](https://doi.org/10.5281/zenodo.1147025)
23. J. Tennant et al., 'Foundations for Open Scholarship Strategy Development', MetaArXiv, Jan. 2019. doi: [10.31222/osf.io/b4v8p](https://doi.org/10.31222/osf.io/b4v8p)
24. J. Bosman and B. Kramer, 'Innovations In Scholarly Communication - Data Of The Global 2015-2016 Survey'. Zenodo, Apr. 15, 2016, doi: [10.5281/ZENODO.49583](https://doi.org/10.5281/ZENODO.49583)
25. 'Forschung und Innovation für die Menschen', Die Bundesregierung, Strategy document HTS-2025. Accessed: Nov. 05, 2020. [Online]. Available: bmbf.de/en/high-tech-strategy-2025.html
26. 'UK Research and Development Roadmap', Department for Business, Energy & Industrial Strategy, Policy Paper, Jul. 2020. Accessed: Nov. 05, 2020. [Online]. Available: gov.uk/government/publications/uk-research-and-development-roadmap/uk-research-and-development-roadmap
27. E. Mendez, R. Lawrence, C. MacCallum, and E. Moar, 'Progress on open science: towards a shared research knowledge system', European Commission. Directorate General for Research and Innovation., LU, Final report KI-02-20-348-EN-N, 2020. Accessed: Nov. 05, 2020. [Online]. Available: <https://data.europa.eu/doi/10.2777/00139>

28. C. Clare et al., *Engaging Researchers with Data Management: The Cookbook*. Open Book Publishers, 2019. Available via openbookpublishers.com/download/book/1103
29. M. Teperek, M. J. Cruz, E. Verbakel, J. K. Böhmer, and A. Dunning, 'Data Stewardship – addressing disciplinary data management needs', Jan. 2018, doi: [10.17605/osf.io/mjk9t](https://doi.org/10.17605/osf.io/mjk9t)
30. Assistant Secretary for Public Affairs, 'Use Cases', Oct. 09, 2013. usability.gov/how-to-and-tools/methods/use-cases.html (accessed Dec. 01, 2020)
31. B. Saenen, R. Morais, V. Gaillard, and L. Borrell-Damián, 'Research Assessment in the Transition to Open Science: 2019 EUA Open Science and Access Survey Results', European Universities Association, 2019. [Online]. Available: <https://www.eua.eu/component/attachments/attachments.html?id=2444>
32. D. Hicks, P. Wouters, L. Waltman, S. de Rijcke, and I. Rafols, 'Bibliometrics: The Leiden Manifesto for research metrics', *Nat. News*, vol. 520, no. 7548, p. 429, Apr. 2015, doi: [10.1038/520429a](https://doi.org/10.1038/520429a)
33. R. Cagan, 'The San Francisco Declaration on Research Assessment', *Dis. Model. Mech.*, vol. 6, no. 4, pp. 869–870, Jul. 2013, doi: [10.1242/dmm.012955](https://doi.org/10.1242/dmm.012955)
34. V. Larivière and C. R. Sugimoto, 'Do authors comply when funders enforce open access to research?', *Nature*, vol. 562, no. 7728, Art. no. 7728, Oct. 2018, doi: [10.1038/d41586-018-07101-w](https://doi.org/10.1038/d41586-018-07101-w)
35. J. Wilsdon et al., 'The Metric Tide: Report of the Independent Review of the Role of Metrics in Research Assessment and Management', 2015, doi: [10.13140/RG.2.1.4929.1363](https://doi.org/10.13140/RG.2.1.4929.1363)
36. NSNU, NFU, KNAW, NWO, and ZonMw, 'Room for everyone's talent'. U, NFU, KNAW, NWO and ZonMw., Nov. 2019, Accessed: Oct. 28, 2020. [Online]. Available: nwo.nl/en/news-and-events/news/2019/11/knowledge-sector-sector-takes-major-step-forward-in-new-approach-to-recognising-and-rewarding-academics.html
37. M. S. Khan et al., 'More talk than action: gender and ethnic diversity in leading public health universities', *The Lancet*, vol. 393, no. 10171, pp. 594–600, Feb. 2019, doi: [10.1016/S0140-6736\(18\)32609-6](https://doi.org/10.1016/S0140-6736(18)32609-6)
38. J. Kaiser, 'NIH Uncovers Racial Disparity in Grant Awards', *Science*, vol. 333, no. 6045, pp. 925–926, Aug. 2011, doi: [10.1126/science.333.6045.925](https://doi.org/10.1126/science.333.6045.925)
39. J. Gvozdanović and K. Maes, 'Implicit bias in academia: A challenge to the meritocratic principle and to women's careers - And what to do about it', *League of European Research Universities*, 23, Jan. 2018. Accessed: Nov. 25, 2020. [Online]. Available: leru.org/publications/implicit-bias-in-academia-a-challenge-to-the-meritocratic-principle-and-to-womens-careers-and-what-to-do-about-it
40. 'GENDER-NET Plus ERA-NET Cofund', GENDER-NET Plus ERA-NET Cofund. <http://gender-net-plus.eu/> (accessed Dec. 11, 2020)
41. H. Wickham, 'Tidy Data', *J. Stat. Softw.*, vol. 59, no. 10, 2014, doi: [10.18637/jss.v059.i10](https://doi.org/10.18637/jss.v059.i10)
42. European Commission. Directorate General for Research and Innovation., 'Realising the European open science cloud: first report and recommendations of the Commission high level expert group on the European open science cloud.', Publications Office, LU, 2016. Accessed: Nov. 26, 2020. [Online]. Available: <https://data.europa.eu/doi/10.2777/940154>

43. 'FORCE11', FORCE11. force11.org (accessed Dec. 11, 2020)
44. 'Oberred – Oberred'. <http://oberred.eu> (accessed Dec. 11, 2020)
45. U. Gasser and D. O'Brien, 'Governments and Cloud Computing: Roles, Approaches, and Policy Considerations', SSRN Electron. J., 2014, doi: [10.2139/ssrn.2410270](https://doi.org/10.2139/ssrn.2410270)
46. E. Reale et al., 'A review of literature on evaluating the scientific, social and political impact of social sciences and humanities research', Res. Eval., vol. 27, no. 4, pp. 298–308, Oct. 2018, doi: [10.1093/reseval/rvx025](https://doi.org/10.1093/reseval/rvx025)
47. R. Dasler, A. Deane-Pratt, A. Lavasa, L. Rueda, and S. Dallmeier-Tiessen, 'Study Of Orcid Adoption Across Disciplines And Locations', Zenodo, Dec. 2017. doi: [10.5281/ZENODO.841777](https://doi.org/10.5281/ZENODO.841777)
48. D. Science, 'Digital Research Report: Evidence for excellence: has the signal overtaken the substance? An analysis of journal articles submitted to RAE2008', Digital Science, report, Mar. 2016. doi: [10.6084/m9.figshare.1291121.v2](https://doi.org/10.6084/m9.figshare.1291121.v2)
49. M. Y. Jaradeh, M. Stocker, and S. Auer, 'Question Answering on Scholarly Knowledge Graphs', ArXiv200601527 Cs, Jun. 2020, Accessed: Oct. 20, 2020. [Online]. Available: <http://arxiv.org/abs/2006.01527>
50. R. Lammey, 'Crossref Curriculum for Funders', Crossref. crossref.org/education/curriculum-funders (accessed Nov. 26, 2020)
51. 'ROR'. <https://ror.org> (accessed Dec. 01, 2020)
52. 'International Network of Research Management Societies | INORMS'. <https://inorms.net> (accessed Oct. 20, 2020)
53. K. Jeffery and A. Asserson, 'Institutional Repositories and Current Research Information Systems', New Rev. Inf. Netw., vol. 14, no. 2, pp. 71–83, Nov. 2009, doi: [10.1080/13614570903359357](https://doi.org/10.1080/13614570903359357)
54. R. Bryant et al., 'Practices and Patterns in Research Information Management: Findings from a Global Survey', 2018, doi: [10.25333/BGFG-D241](https://doi.org/10.25333/BGFG-D241)
55. 'OpenDOAR Statistics - v2.sherpa'. http://v2.sherpa.ac.uk/view/repository_visualisations/1.html (accessed Oct. 21, 2020)
56. P. de Castro, K. Shearer, and F. Summann, 'The Gradual Merging of Repository and CRIS Solutions to Meet Institutional Research Information Management Requirements', Procedia Comput. Sci., vol. 33, pp. 39–46, Jan. 2014, doi: [10.1016/j.procs.2014.06.007](https://doi.org/10.1016/j.procs.2014.06.007)
57. N. Foster and S. Gibbons, 'Understanding Faculty to Improve Content Recruitment for Institutional Repositories', 2005, Accessed: Oct. 21, 2020. [Online]. Available: <http://hdl.handle.net/1802/1292>
58. U. Müller et al., DINI Certificate for Open Access Repositories and Publication Services 2019. Humboldt-Universität zu Berlin, 2020
59. 'Preliminary report on the first draft of the Recommendation on Open Science', United Nations Educational, Scientific and Cultural Organization. Accessed: Nov. 06, 2020. [Online]. Available: <https://unesdoc.unesco.org/ark:/48223/pf0000374409.locale=en.page=10>

Appendix A: Methodology

Between May and September 2019, the consultants conducted a range of in-depth, semi-structured interviews with research contributors, publishing the report 'Openness Profile: Defining the Concepts' in January 2020. A stakeholder workshop was planned for April 2020, but postponed due to COVID-19 restrictions. This workshop was to be held across two days and was designed to gather key experts in open scholarship together to road-test the OP concept and seek some consensus on possible next steps. The face-to-face workshop was morphed into a virtual workshop (which was held in July for three hours) followed by a series of five focus group sessions conducted between August-September 2020.

A.1 Interviews and the 'Openness Profile: Defining the Concepts' report

The focus areas of the interviews were strategies, mandates, skills, community norms, appraisals/evaluations, non-individual profiles, barriers, incentives, and feedback on the OP concept itself.

The study showed that:

- ▶ The OP could serve the purposes of being part of their annual review, informing decision making or creating incentives/metrics at their organisation
- ▶ There is a frustration with current incentive structures and cultural inertia is very common, which translates into a desire for systemic change in how contributions to scholarship are valued and who is credited
- ▶ It was frequently found that openness is either not currently discussed in detail in interviewees' personal evaluations, or that interviewees had only informal evaluations or none at all.

Following the report's publication, the project team developed some preliminary use cases and presented them to the Virtual Stakeholder Meeting.

A.2 Virtual Stakeholder and Focus Groups

A.2.1 Stakeholder Group

There were 44 attendees from a range of organisations, such as KE's own members, funders, publishers, and infrastructure providers. The vast majority of attendees were from KE-representing countries, however, there were two each from the USA and Australia.

The workshop programme was constructed so as to allow participants opportunities to discuss and feed back on the OP. They tested whether it had the potential to support potential users, and whether its implementation would, on balance, benefit research producers, upon whose contributions the profiles would be built. Having achieved preliminary consensus that it was worthwhile taking the OP forward, the group was canvassed on the possible technical, cultural and other resources that would be required to take the next steps.

A.2.2 Focus Groups

As the next step, we convened five stakeholder-function based focus groups. Participants consisting mainly, but not entirely, of previous contributors to the project.

- ▶ **PIDs** (Attendees: Crossref, DataCite, ORCID, RAiD, Jisc and KE/T&F members)
- ▶ **Progress** (Attendees: Bielfeld, Helsinki and Oxford Universities, Rescognito and Digirati)
- ▶ **Institutions** (Attendees: STM Association, UCSD, KE, University of Finland, TU Delft, EUA, Utrecht University, Leiden)
- ▶ **NROs** (Attendees: Jisc, SURF, CSC, EMBL, CNRS Digital Science, ELIXIR)
- ▶ **Funders** (Attendees: Wellcome, NWO, SNF, UKRI, DFG, KE/T&F members)

We took each of the groups through a recap of progress to date and invited them to contribute to the use cases. We then took them through a short series of questions via a menti board.

A.3 Use cases

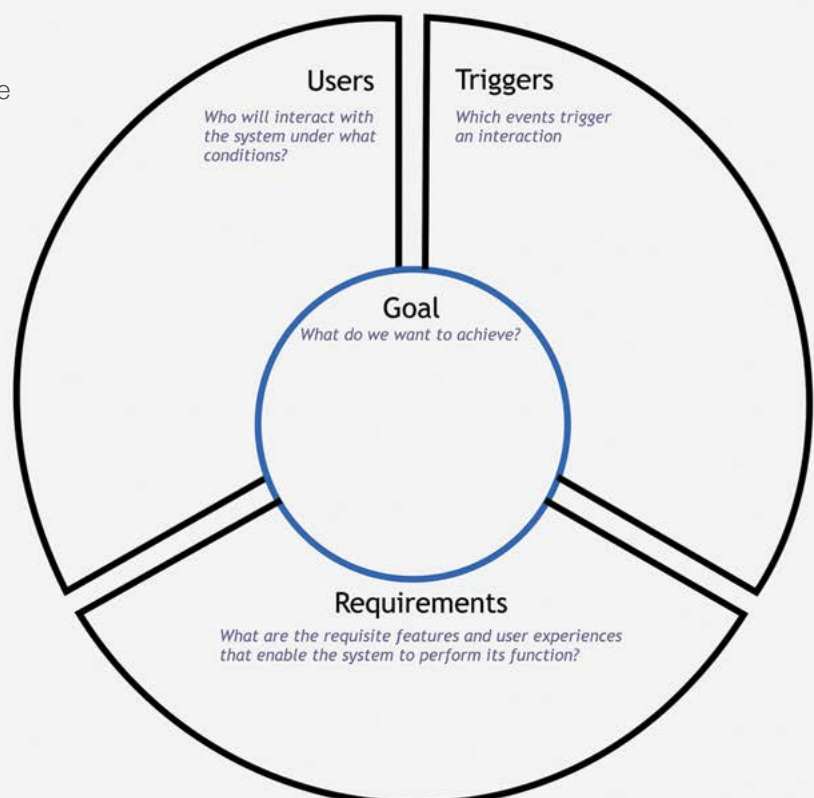
The OP is envisaged as a practical solution to a number of academic evaluation issues. As such, we needed to build up a picture of who might use it, when and why. Following on from the 'Openness Profile: Defining the Concepts' report had been published, the next step was to have been an in-person 1.5 day workshop. This would have convened a group of open scholarship experts and practitioners to check its key findings, and determine some next steps together.

When the COVID-19 pandemic necessitated a change of plan, we reworked the project's course, so converting the in-person workshop to the three-hour virtual plenary followed by the focus groups. As part of adapting the agenda for these events, the Project team used the report's findings to develop two use cases for the OP - Institutions and Funders.

These were initially produced in narrative form, as user 'stories'. However, it became apparent that a visual representation would be much easier to discuss and adapt in real time. Accordingly, using the collaboration platform, Miro, we developed a simple canvas that could be populated, discussed, updated and rationalised in real-time.

Figure A.1

A blank version of the preliminary use-case canvas that was used for the focus group use-case brainstorm.



Having circulated the narrative use cases ahead of the plenary, during the event itself, we explained the canvas configuration and then invited contributions from the stakeholders via a series of questions and a virtual (menti) whiteboard. We collected and processed the information and then presented the first visual versions of the use cases to the focus groups.

In order to maximise the potential utility of the use cases, in each instance we started with the centre of canvas - the main goal of the organisation with respect to research evaluation (e.g. for Funders: 'A grant application and assessment approach that encourages openness'). In relation to this, we identified potential trigger events, such as 'writing a grant' that would be performed by 'researchers submitting a grant', who would require 'Support PIDs for range of outputs', and colour-coded (in this case with green notes) accordingly.

We worked through all the instances, testing that they were unique and relevant. Where possible, we changed the colour coding to yellow to indicate a general requirement. When all the focus group sessions had been completed, we conducted an additional rationalisation and colour-coding phase, in order to achieve a final set of results that were as complete and consistent as possible.

The figures and tables overleaf indicate how the separate use cases were refined by the focus groups, as well as the links between the various users, triggers and requirements for each case. If the OP is to progress to operational viability, then the next steps should include full extrapolation of user workflows, together with any already-existent systems, as well as gap analyses to assess its feasibility.

A.3.1 Final institutional use case

Main Goals: Attract funding, recruit researchers, comply with mandates and national level evaluations

General requirements: CRIS system integration, intuitive UX

General trigger: national level evaluation events

Colour	Trigger Events*	Users	Requirements*
Green	Writing a grant Annual appraisals Create outputs	Contributors	Automated workflow
Red	Annual appraisals	Supervisors of contributors	Individual report
Blue	Strategic review Special project	Research office/VP	Dashboards/aggregation Metrics Narrative
Olive	Recruitment need	HR	
Gold	Grant Administrator	Writing a grant	
Pink		Software agents	
Orange	Special project	Librarians	
Purple		Communications office	

*Where requirements or trigger events fields are blank, only the General requirements apply.

A.3.2 Final funder use case

Main goals: Assessment approach that encourages openness, demonstrate openness of programmes and policies

General requirements: workflow integrations, different interfaces for user types

Colour	Trigger Events*	Users	Requirements*
Pink	Strategic reviews Internal reporting	Open science policy leads	Aggregated information (dashboard)
Gold	Grant and review process	Programme managers	
Purple	Onboarding/integrations	IT department	Documented APIS
Green	Responding to outside questions	Information managers	
Orange	Review board	Peer reviewers/decision bodies	Materials easy to find/printable
Blue	Strategic Reviews	Leadership	

*Where requirements or trigger events fields are blank, only the General requirements apply

A.3.3 Final NRO Use Case

Main goals: Surface and promote openness, measure effectiveness of policies

General requirements: Dashboards/aggregation, different interfaces for user types, materials easy to find/printable

Colour	Trigger Events*	Users	Requirements*
Orange	Grant/funding round	Evaluation committees	Minimise burden on researchers
Blue	Internal evaluation Assessment events Scoping or planning a new project or service	Research leaders	
Light Green	Scoping or planning a new project or service	Project teams	
Purple	Interaction with a customer	Service managers	
Green	Annual appraisals	Contributors	
Dark blue		Admin leaders	
Light blue	Policy/strategy review Governance/parliamentary event	Executive leaders	

*Where requirements or trigger events fields are blank, only the General requirements apply.

Appendix B: List of stakeholders

Interviewees, Attendees at the Virtual Stakeholder & Focus Group members (each counted only once although several people and organisations contributed to more than one of these events).

Knowledge Exchange members plus Task and Finish Group

PID providers

ORCID, Australian Research Data Commons (RAiD), Crossref, DataCite

Publishers

STM Association, Annual Reviews, Hindawi, Springer Nature, Elsevier/Cell Press

National Research Organisations

Jisc, SURF, CSC, CNRS, Fundação para a Ciência e a Tecnologia (FCT)

Funders

NWO Dutch Research Council, Deutsche Forschungsgemeinschaft (German Research Foundation), UKRI, Wellcome Trust, Swiss National Science Foundation, Academy of Finland, Nessling Foundation

Universities

Utrecht University, Erasmus University Rotterdam, and Centre for Science and Technology Studies (CWTS), Leiden, Bodleian Libraries - University of Oxford, Copenhagen University Library/Royal Library Denmark, The University of Manchester (ELIXIR-UK), University of Helsinki, Technical University of Denmark, University of Edinburgh, Bielfeld, TU Delft, University Paris Diderot, University of California San Diego, University of Finland, TIB - Leibniz Information Center for Science and Technology, Max Planck Institute for Biophysical Chemistry, Hanken School of Economics

Other organisations: Research Software Alliance, SPARC Europe, Rescognito
Digirati Ltd, Digital Science, European University Association, EMBL, AcademicTransfer, INRA

Appendix C: A synthesis of various open scholarship taxonomies

'In preparation for the study presented in this report, a compilation of open scholarship activities as well as the tools used in those activities was synthesized. Here we list the sources used.

- ▶ E. C. McKiernan, 'Imagining the "open" university: Sharing scholarship to improve research and education', PLOS Biol., vol. 15, no. 10, p. e1002614, Oct. 2017, doi: [10.1371/journal.pbio.1002614](https://doi.org/10.1371/journal.pbio.1002614)
- ▶ European Commission. Directorate General for Research and Innovation., Mutual learning exercise: open science : altmetrics and rewards : Horizon 2020 policy support facility. LU: Publications Office, 2018
- ▶ B. Kramer and J. Bosman, 'Rainbow of open science practices', Jan. 14, 2018, doi: [10.5281/zenodo.1147025](https://doi.org/10.5281/zenodo.1147025)
- ▶ J. Tennant et al., 'Foundations for Open Scholarship Strategy Development', MetaArXiv, Jan. 2019. doi: [10.31222/osf.io/b4v8p](https://doi.org/10.31222/osf.io/b4v8p)
- ▶ J. Bosman and B. Kramer, 'Innovations In Scholarly Communication - Data Of The Global 2015-2016 Survey'. Zenodo, Apr. 15, 2016, doi: [10.5281/ZENODO.49583](https://doi.org/10.5281/ZENODO.49583)

Activity	Tools	
Assessment		
▶ Adding alternative evaluation, e.g. with altmetrics	SocialCite	Mendeley
▶ Collaboratively collect feedback through annotation or evaluation	ORCID	ResearcherID
▶ Involve stakeholders in peer review process	LimeSurvey	Research Gate
▶ Contributing to open peer review processes	PubPeer	Harzing.com
▶ Examining or assessing open research	Plum	PLOsone
▶ Sign my manuscript reviews	Altmetrics	EigenFactor.org
▶ Stop using journal-level metrics, like impact factor, to evaluate the quality and impact of research articles. Institutions can sign the San Francisco Declaration on Research Assessment (ascb.org/dora).	JISC Open	DOAJ
▶ Use article-level metrics, such as citation counts, as one quantitative measure of article use and impact.	Citations	Journal Citation reports
▶ Use alternative metrics, such as tweet activity and media coverage, as one way of evaluating the broader societal impact of research works.	Hypothes.is	Peerage of Science
▶ Consider shared code and data deposited in public repositories as research products that count in evaluations. Quantitative measures of impact could include citations, repository forks, and pull requests.	Google Scholar Metrics	PubPeer
	F1000 research	NatureIndex beta
	Microsoft Academic Search	

Activity	Tools	
Assessment continued		
<ul style="list-style-type: none">▶ Consider preprints as evidence of academic productivity. Preprints do not necessarily have to count as highly as peer-reviewed articles but should still count in evaluations.▶ Value scientific outreach, such as blogging and articles in popular media, as academic outputs that count in evaluations.▶ Make forms flexible by adding space for researchers to describe nontraditional research outputs and their open scholarship activities▶ Recognize code and data in promotion and tenure evaluations. Additional metrics, such as repository follows, forks, pull requests, and other measures of community engagement should also be considered▶ Recognize, celebrate, and support outreach activities Recognition could start with simple actions, like providing space on academic evaluation forms for faculty to describe how they are helping the university meet its commitments to the community through their outreach efforts▶ Consider altmetrics as one measure of broader impact▶ Allow faculty to include narrative summaries of their impact		
Outreach		
<ul style="list-style-type: none">▶ Communicating through social media, e.g. Twitter▶ Sharing posters & presentations, e.g. at FigShare▶ Collaboratively enrich the Commons (Wikipedia, wikimedia, wikidata)	DOI Wikipedia Microsoft Academic Search Sb Academia.edu PhilPapers Research Gate ResearcherID	Mendeley F1000 posters The Conversation FigShare Google Scholar ORCID Lanyrd.com Institutional repository Nature Blogs

Activity	Tools	
Publication		
▶ Using open licenses, e.g. CC0 or CC-BY	PubPeer	Zenodo
▶ Share videos	Zenodo	Quality
▶ Publishing open access, ‘green’ or ‘gold’	Vimeo	Peerage of Science
▶ Using open peer review, e.g. at journals or PubPeer	YouTube	SCIREV
▶ Sharing preprints, e.g. at OSF, arXiv or bioRxiv	ZUM	PeerJ
▶ Self-archiving	Kolibri	Libre
▶ Using FAIR data principles, quality standards in open data managements, making use of open data from other users	Serlo	Authorea
▶ Share posters and presentations through repositories	OER Content Buffet	BMJ Open
▶ Using open source software and other open tools. Developing new software and tools that are open to other users	Merlot	FigShare
▶ Securing funding for open science activities	Dryad	Dryad
▶ Participating in public engagement activities	Dataverse	Git
▶ Sharing research results through non-academic dissemination channels	Pixir	DataCite
▶ Translating research into a language suitable for public understanding	Wikimedia	Jane
▶ Being knowledgeable on the legal and ethical issues relating to IPR Transferring IP to the wider economy	Unsplash	PhilPapers
▶ Share and edit images, illustrations	Pixabay	SherpaRomeo
▶ Share OER in open development environments/platforms	H5p.org	PLoSOne
▶ Evidence of use of research by societal groups	Evernote	Dataverse networks
▶ Recognition from societal groups or for societal activities	Padlet	DOAJ
▶ Share notes	Tutory	Creative Commons
▶ Make content available	Slidewiki	ET Blast
▶ Share datasets	OpenStax	DOI
▶ Publish only in open access journals	GigaScience	BioMed Central
▶ Openly share my working manuscripts as preprints	Cedanz	PMC
	F1000 research	WebCite
	FigShare	ArXiv.org
	Hcommons	

Activity	Tools
Writing	
<ul style="list-style-type: none"> ▶ Using actionable formats, e.g. with Jupyter or CoCalc ▶ Open XML-drafting, e.g. at Overleaf or Authorea ▶ Collaboratively work on articles, essays, papers etc ▶ Organize collaborative bookprints ▶ Collaboratively create OER ▶ Collaborate on tasks & notes ▶ Project management and collaboration ▶ Collaboratively create presentations ▶ Read and annotate collectively ▶ Share & collaborate bibliographies and reading collections 	<ul style="list-style-type: none"> DocEar Zotero Hypothes.is Paperhive VideoAnt H5P Slidewiki GitPitch GitHub GitLab Mattermost Overleaf Authorea Gitbook HackMD ShareLaTeX PrettyPress Wikiversity Tutory OER content buffet H5P.org OERCommons Etherpad Penflip HackMD Write Latex OverLeaf Authorea F1000 RefMe Google Docs Mendeley Zotero RefWorks Citavi WebCite Reference Manager
Analysis	
<ul style="list-style-type: none"> ▶ Sharing protocols & workfl., e.g. at Protocols.io ▶ Sharing notebooks, e.g. at OpenNotebookScience ▶ Sharing code, e.g. at GitHub with GNU/MIT license ▶ Sharing data, e.g. at Dryad, Zenodo or Dataverse ▶ Pre-registering, e.g. at OSF or AsPredicted ▶ Engaging society and research users in research process ▶ Sharing research results through open platforms ▶ Collaborative projects ▶ Team science and cross disciplinary teams ▶ Awareness of ethical & legal issues related to data sharing, confidentiality, attribution and environmental impact of open science activities. ▶ Recognize the contribution of others in research projects, inc. collaborators, co-authors, citizens and open data providers ▶ Take into account risks involved in open science ▶ Openly share my code and data under version control ▶ Openly share my electronic laboratory notebooks 	<ul style="list-style-type: none"> Science Exchange R, R studio IP[y] Protocols Plotly Myexperiment GoogleDocs GalaxyZoo SPSS Zooniverse RopenSci LabGuru

Activity	Tools	
Discovery		
▶ Commenting openly, e.g. with Hypothes.is	Creative Commons	Dryad
▶ Using shared reference libraries, e.g. with Zotero	GNU	Git
▶ Sharing (grant) proposals, e.g. at RIO	OER world map	TOCi
▶ Communicate practice and results via text based social media	LRMI	PhilPapers
▶ Communicate practice and results via websites/blogs	schema.org	DataCite
▶ Communicate practice and results via image-based social media	Open Access	Academia.edu
▶ Collaboratively add content to meta search engines and aggregators	Twitter	Mendeley
▶ Collaboratively optimize semantic metadata	Facebook	Research Gate
▶ Use open licenses	Reddit	DOAJ
▶ Use platform independent formats/languages, eg HTML, xml, Markdown	Wordpress	Google Scholar
▶ Label content with machine readable license code	Grav	Base
	Instagram	OAlster
	Pinterest	CITEc
	Cross Mark	eTblast
	Web of Science/	F1000
	Scopus etc	Doi
	Sparrho	Hinari
	Google Books	RePEc
	JISC Open Citations	Sci
	FigShare	Citeseer
	F1000 Prime	ArXiv.org

Activity	Tools
Leadership	
<ul style="list-style-type: none"> ▶ Developing vision and strategy on how to integrate OS practices in the normal practice of doing research. Driving policy and practice in open science. Be a role model in practicing open science ▶ Ask my professional societies to support open scholarship ▶ Speak out in support of open scholarship ▶ Redirect site license funds into supporting open access publishing ▶ Develop a two-five-year plan to move to open source software ▶ Offer financial incentives to faculty to develop or improve open source alternatives to proprietary software ▶ Provide incentives for researchers to preregister their studies. Registering hypotheses, data collection, and analysis plans before conducting research can diminish bias and decrease selective reporting ▶ Encourage code and data sharing under version control ▶ Recognize preprints as valuable research products ▶ Remove financial and administrative support for patents ▶ Redirect funds to hire grant and scholarly communication personnel. (McKiernan) ▶ Organize academic “cross-pollination” events. Schedule events with broad interest and invite multiple departments ▶ Establish shared, interdisciplinary laboratory spaces ▶ Develop ways to recognize collaborative efforts 	
Networking	
<ul style="list-style-type: none"> ▶ Participating in national and international networks relating to open science 	
Academic standing	
<ul style="list-style-type: none"> ▶ Developing an international or national profile for open science activities ▶ Contributing as editor or advisor for open science journals or bodies ▶ Engaging in open innovation with partners beyond academia 	

Activity	Tools
Teaching and supervision	
▶ Training other researchers in open science principles and methods	MOOIN
▶ Share MOOCs	IMoox
▶ Developing curricula and programs in open science methods, including open science data management	Iiversity
▶ Raising awareness and understanding in open science in undergraduate and masters' programs	Coursera
▶ Mentoring and encouraging others in developing their open science capabilities	EdX
▶ Supporting early stage researchers to adopt an open science approach	Udacity
▶ Preferentially assign openly licensed materials in my classes,	
▶ Create openly licensed teaching materials	
Continuing professional development	
▶ Investing in own professional development to build open science capabilities	
▶ Successfully delivering open science projects involving diverse research teams	
▶ Demonstrating the personal qualities to engage society and research users with open science	
▶ Showing the flexibility and perseverance to respond to the challenges of conducting open	
▶ Science	
▶ Edit and review only for open access journals	

Appendix D: Relevant initiatives

As we have emphasised throughout this report, the timeframe of the OP project has coincided with a general surge of interest in open scholarship.

As well as lending additional momentum to its community-building aspect, it is important to be aware of the ongoing potential for learning from, aligning and collaborating with some of the emerging initiatives. In addition, as has been flagged up elsewhere in this report, for the OP to build traction and relevance with researchers, it has to make sense with respect to local, international and domain approaches.

Taking a high-level view, to begin with, UNESCO conducted an investigation on, and drafted and reported on, its own global Recommendation on Open Science earlier in 2020 [59], noting there are many regional variations in current practices and preoccupations:

"For example, in Western Europe and North America, the need for aligning incentives for Open Science, including by reviewing the current systems of scientific evaluation and rewards based on the principles of Open Science, has been identified among the key priorities..... In Asia and the Pacific, the actors pointed to the need for a clear common vision for Open Science, a coherent regional Open Science policy framework and practical guidelines on different Open Science elements, practices and policies."

As early as 2014, the **Academic Careers Understood through Measurement and Norms (ACUMEN)** project highlighted the problems with evaluation practices and developed a portfolio approach that would more accurately reflect the range of outputs being produced, the types of impacts they may have, and also contextualise the less than straightforward career paths that have often disadvantaged women, mature students, those returning from industry, etc.

The **League of European Research Universities (LERU)** is made up of 23 research universities across Europe⁹. It is currently developing a report on how to implement Open Science within research intensive universities and - in an echo of the UNESCO report's predictions - has identified evaluation and reward issues as "key issues in the ability and wish of universities to move to adopt Open Science practice" while recognising the scale of the difficulty in achieving this:

⁹ Member institutions are situated in the UK, The Netherlands, France, Germany, Switzerland, Denmark, Sweden, Italy, Finland, Belgium, Ireland, and Spain.

"Redefining criteria for academic assessment is not a simple top-down process. Involvement and support of the faculty and the research community is essential. It is also important to note the differences between scientific domains, who have very different traditions and cultures, e.g. in publishing. ... Broadening the assessment framework intends to acknowledge a diversity of contributions to research. Rewards and evaluation can be a national and a European issue."

KE member organisation, Jisc, has responded to calls within the UK for clearer pathways towards Open Access by instigating a national PID Consortium project. Based upon assessments of current research and evaluation systems, together with a survey of the potentialities for PID-enabled research, Jisc has been working hard to build community support by prioritising the meaningful inclusion of and contributions by a range of stakeholders. These include the PID providers themselves, library and university representatives, publishers and funders. Their aim is to raise PID usage levels, whilst simplifying the procurement, implementation and training requirements this would entail.

The **Consortia Advancing Standards in Research Administration Information (CASRAI)** seeks to improve the principles and best practices of open standards and data governance. Since 2012, CASRAI has been facilitating Contributor Roles Taxonomy (CRediT). This describes 14 contributor roles that those participating in research production and outputs might perform, and opens up opportunities for accruing a range of credit. Currently CRediT is an informal standard, but its proponents are working towards its formal standardisation through NISO, as well as integrations with both ORCID and Crossref.

Impactstory, one of the OurResearch suite of initiatives, is an open source tool that mines publishing, Twitter and other research-related data to provide researchers and institutions with data-supported information about their work's impact. Impactstory profiles can be linked with ORCIDs and focus on a range of 'openness' achievements, and its instigators can be described as 'fellow travellers' within the open scholarship evaluation space.

This brief overview of parallel initiatives is both intimidating and encouraging for the OP's own future. It demonstrates the complexity of the overarching system as well as the scale of cultural, technical, systemic and political challenges that need to be engaged with. At the same time, this is also strong evidence of the sheer level of interest in, and activities already undertaken to support open scholarship, its practice and evaluation. Much progress has been made and more is planned.

Knowledge Exchange
C/O Jisc
4 Portwall Lane,
Bristol,
BS1 6NB
United Kingdom

t: +44 203 697 5804
e: office@knowledge-exchange.info