**Public Value Research Careers (PVRC) WP5 Summary, February 2023**

**How do public value research careers make a difference to the science-society gap?**

Research careers can be understood as a specific social structure that mediates between science and society. As Jochen Gläser (2001: 699) described

> Research careers link individuals and institutions and they link social structures with knowledge production...careers provide a channel for societal influences on knowledge production...one of the phenomena that mediate between the scientific and non-scientific social structures, on the one hand, and knowledge production, on the other hand.

As a mediating structure, research careers should reflect both the professional demands of the scientific community in which it lived as a working life, and the values and expectations of the broader society in which it is embedded. In the case of public funded science, responsibility exists not just to perform professional tasks to the best standard possible, but to uphold and reflect the values of that society and polity which has designated science as a priority area for investment, in the interests of collective well-being and quality of life. While the differentiation of society into social fields, such as science, inevitably leads to the institutionalisation of norms of behaviour that are specific to that field, in liberal and social democratic societies an expectation endures that such context specific characteristics remain congruent with those of the society as a whole. Yet, in the everyday working life of a research scientist how are such anchoring 'public values' (Bozeman and Sarewitz 2011) that tie science and society together maintained and enriched? How easy is it for the challenges, trials, and the structure of ubiquitous evaluation that characterises scientific work life to become all-consuming and self-referential, challenging researchers' perseverance and ethical propriety? Public value research careers is a reflection on how the working life of research scientists can be shaped by institutional conditions and disciplinary practice norms that do not only face inward on the goal of scientific discovery and knowledge production, but are also open to a broader societal panorama in which the purpose and value of scientific work is ultimately located.

From a theoretical perspective, research careers enter into the structure and agency problem in sociology. To what extent are research careers the product of accumulated patterns of individual behaviour or the products of a set of institutional conditions that shape how research careers are performed? From the perspective of a 'public value' approach to research careers we can consider that careers are produced through the interaction between scientists' epistemic activities on the one side and societal forces on the other, particularly the institutional conditions which govern scientific knowledge production, but also, crucially, those broader non-scientific institutions, structures, and public expectations that characterise the social world as a whole.

The vast majority of studies of research careers investigate the interrelationships between the specific social and intellectual organisation of scientific fields and disciplines (Bourdieu 1975; Whitley 2000) and the varying institutional conditions that characterise the national research systems in which these activities take place. The governance of research is dominated by national investments in universities, research performing organisations, infrastructure and funding support (Whitley et al. 2010). Epistemic cultures (Knorr-Cetina 1999) are distributed networks that are increasingly global in scope, connecting scientists using similar methods and working on common or connected problems in contexts with highly varied levels of available resources and rewards.

The public value approach to research careers also understands them to be produced in the interplay between science and society, but with an emphasis on how non-scientific societal institutions and structures shape scientific careers. Only a relatively small discussion has occurred in the scholarly literature regarding the interconnections between non-scientific social institutions and structures and knowledge production. This discussion has three main threads: science as reproducing social stratification; science as situated in socio-political contexts; and science as a professional field in need of reform or realignment.

First, Bourdieu studied the academic field as an example of social reproduction. He highlighted how the academic field was reproduced through its domination by a particular class of French society. The homogeneity of the French scientific profession as a field occupied by individuals endowed with the range of social and educational capitals that made them a 'natural' fit for the academic world (Bourdieu 1988) is a situation that is replicated around the world. The consequences of this historic domination of the scientific field by a sub-population that does not reflect the broader socio-economic and cultural composition of society is thought to have consequences for knowledge production. These include a reduction in the scope of research topics and questions that are considered important in scientific communities. For example, the historical focus of health research in developed countries on topics that concern men reflects the persistent underrepresentation of women in science and in positions of leadership in scientific communities (EC 2021). Recent initiatives to improve the 'equity, diversity and inclusion' (EDI) of the scientific workforce and academia reflect an acknowledgement of this phenomenon of the lack of correspondence between the population structure of society and the make-up of the scientific workforce (UKRI 2022; Wellcome Trust 2021).

The second way in which non-scientific social structures are considered in relation to knowledge production is in relation to the importance of broad socio-political factors in the attractiveness of national science systems. Availability of and access to free public health care, including for family members, free public education for children, and labour market access for a spouse or partner are important in decisions to move to a national scientific system to work (Gläser 2004). Religious freedom and relatively low levels of institutional and personal racism and discrimination, and the right to retain dual or multiple citizenships, can also be considered important non-scientific factors that affect immigration decisions. Finally, societies with relatively low levels of corruption and crime, and relatively open and transparent systems of public administration also have an advantage in recruiting researchers. In short, societies that embody a range of positive 'public values' (Bozeman and Sarewitz 2011) in their social, economic and political institutions, are more attractive destinations for migrants, including relatively high-value and high-earning professionals such as scientists.

Third and most important for the idea of public value research careers, non-scientific societal institutions and knowledge production are increasingly connected through discussions of the need to reform or re-orient science. On the one hand, the framing of science and technology as the engine of economic growth and development placed increased demands on public funded researchers and research organisations to (co-)produce knowledge with social utility (Gibbons et al. 1994). The emergence and institutionalisation of whole of society responses to what are variously known as global or societal grand challenges has also had significant effects on the institutional conditions governing science and by extension the epistemic decisions of scientists. Scientists' research agendas in virtually all fields are being shaped by the increasing emphasis on mission-oriented funding that is designed to 'direct' a greater proportion of public funded research toward topics and problems prioritised by socio-political actors and citizens.

The institutionalisation of the Sustainable Development Goals monitoring framework provides a governance mechanism by which science generally, and research performing organisations in particular, can be assessed in terms of responsiveness and contribution to these societal demands.

On the other hand, there has been a rising level of public concern about the conduct and outcomes of research and innovation. Historically citizens have tended to regard science as a vocation that has integrity and legitimacy and scientists as worthy of public trust. However, the failure of research culture to evolve in ways that are aligned with broader social values and expectations can undermine this historical status. Scientific research and academia have been beset by a wide range of cultural failures, including research fraud, ethical misconduct, the institutionalisation of questionable research practices (QRPs) in many disciplines (Vitae 2020), along with socially unacceptable behaviour in relation to bullying, the exploitation of junior colleagues, and sexual harassment (UKRI 2020). The emergence of values-based initiatives within science governance, such as responsible research and innovation (RRI) (Owen et al 2012) and EDI movements, reflect evolution in non-scientific societal institutions that can be expected to shape the scientific field over time.

In summary, PVRC thus represents a starting point for a systematic consideration of how research careers can be concerned with not just knowledge production and the hierarchical intricacies of scientific communities, but also be alive and open to evolution in societal demands and public expectations, broadly understood. PVRC is thus concerned with how research careers can contribute not just to the production of new knowledge, but to the institutionalisation and the reinforcement of those public values on which social structures as a whole are based.

**What opportunities and shortcomings do you see in relation to reforming systems of recognition and rewards for researchers?**

To answer this succinctly, the opportunity presented by reform of systems of reward and recognition for researchers is to provide incentives and rewards for a more expansive range of contributions to knowledge production, to science, and to society more generally. The potential shortcoming in this endeavour is that reforms lack a framework or rationale for anchoring recognition also in non-scientific societal institutions and expectations. The risk then is that reform simply reflects specific 'internal' concerns that are most pressing to scientific communities in the short-term, stopping short of a reform that opens research careers to the influence of non-scientific societal institutions in the medium and longer term.

Critics of this line of thinking would argue that one of the current major problems with science is that it is already too open to societal influence, particularly the 'neo-liberal' co-opting of research and innovation to the objectives of multinational corporations and 'platform capitalism' (Mirowski 2018). This is undoubtedly a legitimate concern, however one of the advantages of taking a public values approach to the governance of science and the scripting of research careers is that different activities can be weighed and assessed in context and translated into recognition and rewards based on contributions to public values. Rather than a relatively universalist approach such as that constructed by Merton (1973), which treats science as ultimately governed by a narrow set of intrinsic values, a public values approach can be anchored in both scientific practice and social institutions and be more versatile and sensitive to heterogeneity in contexts of knowledge production and in research careers.

Linking research practices to public values can help move beyond assessments that focus predominantly on narrow definitions of productivity (publications) and impact (citations) that overly value rewarding the products of research over the processes. A reformed research assessment would not just recognise and reward what science was done, but *how* it was done. Such an assessment framework should strengthen incentives for doing science in a way that is aligned with and reinforces public values. Such an assessment would provide incentives and rewards for the kinds of example practices included in Table 1. These incentives and rewards would need to be built around expectations about research practices that are adjusted for career stage and avoid one-size-fits-all approach. Public value contributions could thus be assessed at a scale and intensity relevant to the career stage and acheivements relative to opportunities of individual researchers, and to the collective actions and institutional initiatives of research groups, for example.

I suggest to put Table 1 here and also to explain Table 1 more. Please explain, what you mean by attribute, model, public value mechanism and public values and please explain each of the rows.

Table 1 summarizes how attributes of research careers can be linked to a framework of public values.

Table 1. Research career attributes and public values

| **Attribute: Invent, adopt, train,** | **Public value practice examples** | **Public value mechanism** | **Public values** |
|---|---|---|---|
| Open Science practices | FAIR data, open-source tools, shared in scientific community and beyond<br>Rapid data sharing & dissemination<br>Documentation of methods | Efficient knowledge production, enhanced inclusion of stakeholders<br>Accelerated responsiveness to societal challenges<br>Reproducibility of results | Efficiency<br>Transparency |
| Research Integrity practices | External ethics approval acquired<br>Research data management plan<br>Pre-registration of research approach | Assessment of potential harm<br>Process for protection of personal information<br>Reduction in questionable research practices (QRPs) | Integrity<br>Privacy<br>Fairness |
| Public Engage-ment practices | Societal relevance of research results<br>Societal relevance of research outcomes | Co-creation of research agendas<br>Co-production of knowledge | Legitimacy<br>Efficacy |
| EDI practices | Elimination of discrimination or bias in training, hiring and promotion | Diversity and gender balance in the workplace | Equality<br>Fairness |
| Gender content analysis | Consideration and integration of gender issues in the design of research | Research outcomes that address both women and men | Equality<br>Fairness<br>Legitimacy |

In Table 1, an attribute refers to an aspect of research practice that can be considered to contribute to enhancing the public value of a researchers' work and career. The mechanism that features in each row relates to how the specific practices included can be considered to generate public value, with the specific public values that might be expected to be enhanced through the operation of this mechanism appears in the column to the right.

Recent approaches to research assessment reform, most prominently the Coalition for Advancing Research Assessment (CoARA), whilst not directly anchoring reform in the rewarding of contribution to public values, attempt to balance traditional assessment criteria of quality and impact with criteria of diversity, inclusiveness and collaboration. The Agreement on Reforming Research Assessment (2022) on which CoARA's activities are based, defines its purpose as to 'broaden recognition of the diverse practices, activities and careers in research, considering the specific nature of research disciplines and other research endeavours' (p.4). An impressive wishlist of activities that could foreseeably be deserving of recognition and reward within science is compiled. As the attributes in Table 1 highlight, many of the types of tasks and activities that reformed research assessment seeks to incorporate do line up with fundamental public values.

Systematizing and categorising the public value contributions of research activities to anchor research reform more thoroughly in both scientific and societal institutions does not seem a particularly complicated challenge. However, there are two main reasons why such an approach could benefit research assessment reform in the longer term. The first of these is to reassure researchers and scientific communities that research assessment reform need not be regarded as an attack on research freedom or as a distraction or burden on scientific discovery processes. Second, such an approach can help make explicit that public values may be in tension or conflict in specific contexts of knowledge production, necessitating a process of evaluation and prioritisation of actions that can be grounded in a coherent rationale.

The first point refers to the fact that researchers tend to react in a defensive or antagonistic way to any policy or other initiatives that they perceive could infringe on academic freedom. Policies that can be seen as demands that scientists 'do more' or 'do things differently' can be viewed as creating additional burdens that distract from the essential work of scientific discovery. Scientists' research agendas are built around those disciplinary specific tasks that are 'epistemically necessary', all those elements of their work and role set that are associated with moving the frontier of knowledge and their own 'cognitive career' (Laudel and Gläser 2015) forward. New demands are likely to elicit a response in the organisation of disciplines to 'buffer' the scientific division of labour to protect epistemically necessary tasks and researchers' availability of time and resources to focus on those tasks.

The response to increased demands that can currently be observed in many fields is the construction of roles sets that protect epistemic necessary tasks, activities and functions from unnecessary interference or dilution. The emergence of such role sets, stretches the scientific division of labour, creating new positions that have a partial or non-existent dedication to epistemically necessary tasks, but rather are engaged primarily in activities such as project, stakeholder, or research data management. Researchers engaged in these role sets may find themselves excluded from the main currency of academic evaluations, authorship of scientific articles, with negative consequences for the progress of their research career. Indeed, such role sets are not recognised or effectively supported by institutional conditions in science systems.

Roles that are not dedicated to epistemically necessary tasks thus struggle for recognition. In the context of research assessment reform, adding additional activities and tasks to assessment protocols seems of somewhat limited value. Peer review processes in science will continue to privilege epistemic necessity in evaluating the worth of a scientist's contributions. Roles that are more directly involved in responding to non-scientific societal structures, such as managing liaisons with patient organisations, will struggle to compete for recognition in such contexts. An approach to research assessment reform that simply adds more tasks and activities as eligible for consideration in evaluation processes risks maintaining a hierarchy between those tasks perceived as epistemically necessary and the everything else. If only epistemically necessary tasks are reward with authorships of papers and patents then this essential divide can remain fundamentally unchanged.

A public value perspective re-frames the question of what is worthy of recognition and reward beyond lists of tasks to the relevant public values to which any specific research should contribute and reinforce. To use an example, advances in genetic diagnosis in rare diseases rely on collaboration with patient organisations for bio-samples. The work of discovery reported in a scientific journal may reflect a public value of 'progress'. However, this work of discovery should not be considered independently of the value of 'privacy' embedded in work of patient and patient organisation liaison and collaboration that ensured the safety and integrity of

processes of using personal information and bio-samples that made the epistemically necessary work ethically and scientifically possible. Rather, a public values approach requires that positive evaluation of such research is dependent on contributions to a range of public values, to ensure that not just research results but all processes integral to their production are also integral to research assessment.

The second point refers to the idea that a public values approach can help make explicit the tensions that can emerge between public values in different contexts of knowledge production. This can support reflection on research objectives and designs that reach beyond a singular focus on the successful execution of epistemically necessary tasks. An example can be described using the adoption of Open Science (OS) research practices. Resistance to adopting OS practices can come from scientists that argue that if OS is epistemically necessary, then a scientific discipline or specialization will already be doing it. Researchers may understand any expectations that they view as not epistemically necessary as undermining or interfering with their capacity to further their cognitive contributions to knowledge in their field, making their research agenda needlessly uncompetitive ('it will be done anyway'). In such circumstances a researcher many change their research agenda, change their organisational context to a more laissez-faire environment, or they may expand the division of labour to buffer their time focusing on epistemically necessary tasks by hiring someone to deal with what are perceived as additional OS tasks (data management plans and procedures, metadata preparation, ontologies, etc.). It is this expansion of the division of labour that leads to the emergence of positions and role sets in research that are not supported by traditional academic evaluation systems.

Nevertheless, as we can observe, Open Science Communities (OSCs) (Armeni et al. 2021) are emerging within scientific disciplines precisely with the intention to transform disciplinary norms in the interests of promoting public values such as transparency and efficiency of resource use at a collective or systemic level, over 'traditional' values of competition and primacy. These OSCs are found to be thriving particularly in contexts where there is organisational policy and strategic support for advancing OS, again for normative reasons associated with the integrity and accountability of public organisations that equate to a promulgation of broader public values in scholarship (Armeni et al. 2021).

A continuum can be expected along which aspects of OS are integrated into research agendas and designs. Partial adoption of OS philosophies and practices can be expected. Workflows, role sets and the division of labour can configure and institutionalise OS in different ways in specific contexts of knowledge production. There may be reasons that are separate from epistemic necessity that motivate researchers to adopt OS in some ways: to satisfy funders; to satisfy organisational policy 'pressure'; to unify and simplify training processes; or to improve accountability for resource use, for example. There may also be reasons that are integral to epistemic necessity that limit the integration of OS in disciplinary knowledge production practices. For example, in much qualitative social sciences work ensuring the anonymity of participants in data collection methods such as interviews is paramount. Here the public value 'privacy' should be prioritised over 'transparency'. In some biochemistry or virology research fields the public value 'safety' should be the highest priority. Anchoring research assessment in public values can thus provide a framework for recognising and rewarding researchers also for the reflexivity and judgement they exercise in balancing tensions between public values, between privacy and transparency for example, of for decisions they make to shift their research agendas due to ethical or safety issues that concern the greater public good. This

contextual sensitivity of a public values approach to research careers and to the reform of research assessment shares some characteristics with the perspective of post normal science which has already described how values, politics, and epistemic practices are differently configured in diverse contexts of knowledge production and utilisation (ravetz and functowicz). PVRC thus argues assessment practices should not be governed by de-contextualised assessments of productivity that reward only a limited set of outputs recording the performance of epistemically necessary tasks and activities. Rather, how tasks were done, how vital tasks that are not epistemically necessary were integrated, and how all these can be assessed to have contributed to, and reinforced, a range of public values, should all be fundamental to research evaluation.

Incentives for researchers and scientific communities should then be a consequence of a consistent orientation toward and imbuing of the public values that are thought to matter in publicly funded science organisations and institutions. There should be a recognition of the plurality of ways in which contributions can be made to those values throughout a research career. Some contributions may be relatively context dependent and situated in and for society, while others may be relatively abstract and generalised epistemic contributions that mainly serve the academic community. What characterises a public value research career approach or framework would be the consistency of the public values that orient diverse scientific occupational role sets and flexibility and versatility to recognise and reward contributions in those terms. Public value research careers would integrate these values in the entirety of the research career, from undergraduate and graduate education and doctoral training onward.

**What does your case teach us about responsibility in research and innovation as it relates to career assessment, Open Science, career stages and PVRC more broadly?**

Empirical data from the RESU isbeing analysed for the PVRC project (see Appendix 1 for initial results). These data have to date been used to compare perceptions of RRI, and motivations and practices of researchers in relation to Public Engagement and Open Science. Entering into these preliminary analyses it was anticipated that there would be a higher level of take-up or responsible practices among early career researchers (R1 and R2) than amongst senior researchers (R4). However, preliminary results suggest that this is far from a unform outcome and that close attention will need to be paid to identifying exactly where career stage differences can be clearly discerned. The dimensions of Gender Equality and Ethics have not yet been analysed by career stage.

Secondary data relevant to PVRC has been gathered from the MORE surveys. Results from the most recent MORE4 survey showed that on average 19% of PhD students in EU27 countries ‘received training in Open Science approaches (publishing in open access journals, sharing research data, participating in citizen science events, etc.)’ (PPMI et al. 2019: 139-140). Countries with the highest proportion of PhDs receiving open science training included Romania (72%), Croatia (42%) and Sweden (37%). Countries reporting the lowest proportion of OS training included Germany (11%), the Netherlands and Spain (14%). No data are available for this question for other career stages in MORE 4.

Results from MORE4 also show that 83% of EU27 researchers published in, or sent articles for review to, open access journals. Countries reporting the highest rate of open access publishing included Romania (96%), Latvia (94%) and Poland (91%). However, no significant differences were found between countries in terms of the share of researchers engaging in open access

publishing activities. These results are being analysed by career stage as part of the PVRC project.

Overall, the case argues that more attention should be paid to the pathways through which researchers contribute to the institutionalisation and reinforcement of public values over the course of their careers. These contributions will vary by scientific disciplines and by career stages, but can form a thread of continuity across the career trajectory. It seems evident that there is significant variation between the extent to which individual researchers may be motivated to contribute in ways that reinforce public value. The key point is that the 'script' of the average research career could shift, through changes in training processes and disciplinary norms, and in the levels and dimensions of institutional support for responsible research cultures and practices. This is the medium term goal that imagines the typical research career of the future to be more open and connected to non-scientific societal institutions and expectations that is currently the case.

What the PVRC case teaches us about responsibility in research and innovation is that transformation of research careers requires multiple transformations in institutional settings, professional expectations and disciplinary norms and practices. As the initial data analysis (Appendix 1) suggest, the extent to which different aspects of responsibility are recognised by researchers at different stages of the career may vary considerably in relation to some aspects of ORRI, but less so in others. It will be necessary to build further knowledge about how career stage impacts on perceptions and practices related to responsibility in the future.

From a theoretical point of view we should not think of this as simply a matter of 'directed' or 'planned' change, although this can be part of the story. Disciplinary norms and practices also transform due to the requirements of epistemic necessity and the cultural environment advanced by leaders in fields and organisations. The integration of responsible practices in research training is one essential element of shifting the script of research careers. Shaping early career researchers to adopt norms and practices that advance and reinforce public values is an achievable objective. However, it cannot be achieved without the support of senior researchers, mentors and doctoral supervisors. Very senior scientists who have worked in a closed competitive model of science throughout long successful careers cannot be expected to switch to open science at the end of their careers – and resistance to both policy advocates and OSCs from senior researchers is well known and understood. However, senior researchers supporting (or at least not obstructing) the acquisition of OS skills and practices by junior researchers in their lab or department is an achievable objective, which could also be incentivised and supported institutionally.

A framework such as public values can thus orient the 'scripting' of research careers in subtle and incremental ways. If researchers who understand their careers as a journey that can contribute to a range of values held in esteem by society, beyond a twin focus on discovery and economic exploitation, become the norm, then the public value of research careers will be enriched, to the benefit of society and science.

**Is there any impact in terms of the six keys? Please answer for each key and qualify and provide arguments for your answer.**

PVRC is particularly relevant to aspects of open science, research integrity, public engagement and gender equality. Public value research career attributes relevant to these dimensions are summarised in Table 1 above. The mechanisms by which these attributes contribute to deepening a range of public values are also set out. Reform of research evaluation to

recognised and reward these dimensions as contributing to the public value of research and innovation would shift research career scripts in the direction of more responsible cultures and practices along the lines of these RRI key areas.

**Is there any benefit in terms of social, democratic, scientific and economic impact? Please answer for each benefit and qualify and provide arguments for your answer.**

The whole premise and rationale for PVRC is that the research career, as a social structure that mediates between science and society, could provide greater returns to public values than is currently the case. It follows that if research careers can, over the several decades of their trajectory, be more open to co-creation of research questions and co-production then there should be benefits to society. Similarly, if research careers more strongly integrate research integrity then the results and outcomes of research are more likely to withstand public scrutiny and appear legitimate to citizens. Research careers that integrate open science practices which enhance the transparency and accountability of often resource intensive activities that rely on public funding seem to logically provide a benefit to democratic values.

Influencing the `scripting' of research careers to integrate different types of responsible practices depends heavily on training and mentoring processes. While it may not be pragmatic for a late career research Professor to switch his own research practices to Open Science, for example, supporting financially and intellectually the taking up of appropriate OS practices by ECRs in their labs or institutes can be viewed as an also important contribution. The reform of evaluation systems to incentivise and reward such contributions is key to the shifting of disciplinary career scripts toward an enhanced contribution to and reinforcement of public values. While the most obvious areas of benefit from PVRC would seem to be social and democratic benefits, changes which improve (among other values) the transparency, legitimacy, and integrity of research seems likely to bring with it a profound benefit to scientific knowledge production. If research careers are also made more accessible and fairer for incoming cohorts of young scientists who more closely reflect the composition of the general population, then benefits to science in terms of more diverse research agendas, and to the economy in terms of research outcomes that are relevant to a broader cross-section of society, might also be assumed to emerge in the medium- to longer-term horizon.

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**Appendix 1: Initial data analysis for PVRC**

**1. Introduction**

Engagement with open and responsible research and innovation (ORRI) practices and cultures continues across the research careers. However, research careers are very different in their early, middle, and later stages. Key responsibilities and the configuration of occupational roles sets (research, teaching, administration, third mission) vary as the succeeding stages of the research career unfold. Researchers' contributions to the institutionalisation of ORRI in their lab or group, scientific community and organisation need to be viewed through the lens of this career stage perspective. Public value research careers thus refers to this intersection between the take-up and diffusion of ORRI and researchers' career trajectories.

The public value research careers (PVRC) project within Work Package 5 of the SUPER MoRRI project examines the relationships between ORRI and research career stages. Conceptually, PVRC argues that contributions to ORRI practices and cultures contributes to the furthering of those 'public values', such as transparency, fairness, and integrity, that are considered important markers of a society's values by its citizens (Bozeman and Sarewitz 2011). From a career perspective, it is assumed that an individual researcher's capacities and opportunities to contribute to different public values will vary across the course of their career. Early career researchers (ECRs), mid-career academics, and leading professors shape and influence practices and cultures in their field in different ways, depending on factors such as their access to and control over funding and other resources, their team leadership responsibilities, and their organisational decision-making power. Monitoring to support ORRI thus needs to take these differences into account, understanding that as research careers evolve so do opportunities to introduce and develop aspects of openness and responsibility in a variety of professional contexts.

This section provides an overview of ORRI practices in European universities from the perspective of research career stages. It uses data from researcher survey (RESU) conducted by the SUPER MoRRI project. The section presents an overview of the survey respondents by career stage and descriptive data on their engagement in ORRI, followed by comments on these data and on prospects for monitoring public value research careers.

**2 Open and responsible research and innovation and research careers**

This section first summarises respondents to the SUPER MoRRI survey (RESU) by career stage, gender, scientific field, and job roles. Data on respondents' participation in ORRI is then presented.

**2.1 Researcher survey (RESU study), respondents and career stage**

The RESU study used the European Commission framework for research career stages (EC 2011). This framework includes four stages (R1-R4) that are based on the progressive acquisition of research competences. These stages are as follows:

- R1 First Stage Researcher (up to the point of PhD);
- R2 Recognised Researcher (PhD holders or equivalent who are not yet fully independent);

- R3 Established Researcher (researchers who have developed a level of independence); and
- R4 Leading Researcher (researchers leading their research area or field).

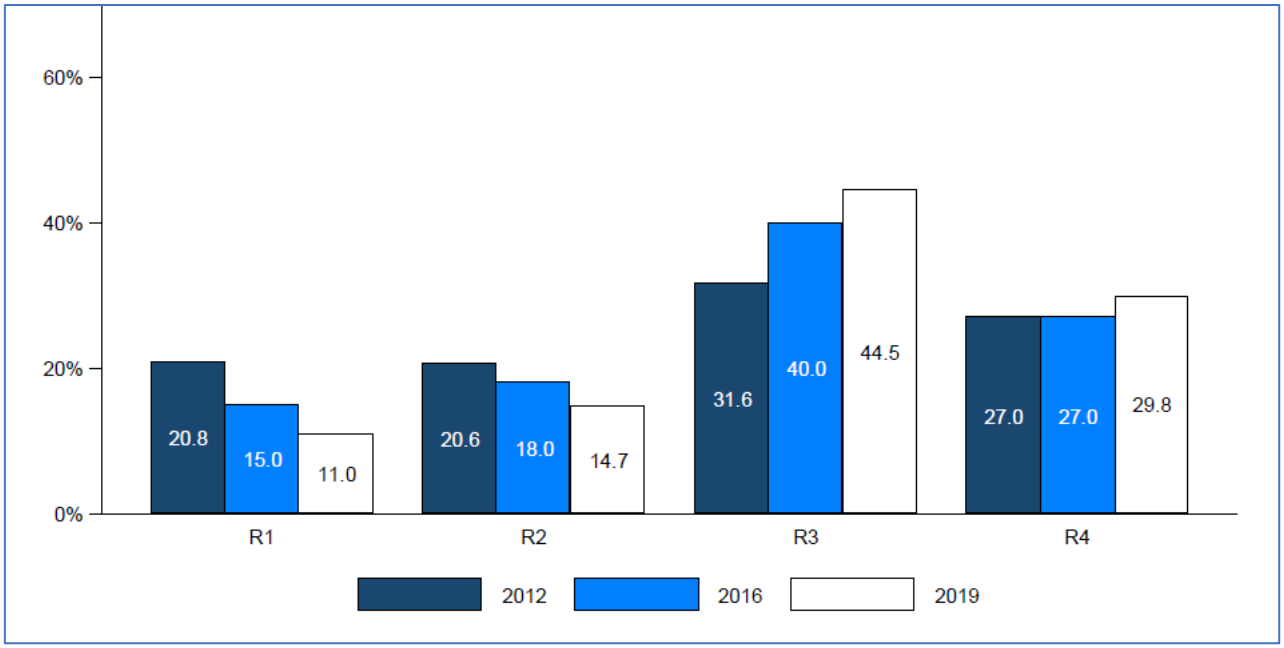
The full description of each of the four career stages includes a set of 'necessary' and 'desirable' competences or 'characteristics'. In the RESU study, each respondent was asked to select their current career stage. Table 1 shows the distribution of respondents by career stage.

Table 1. RESU respondents by career stage

| **Career Stage** | **Frequency** | **Valid Percent** | **Cumulative Percent** |
|---|---|---|---|
| R1: First Stage Researcher | 530 | 15.8 | 15.8 |
| R2: Recognised Researcher | 685 | 20.4 | 36.2 |
| R3: Established Researcher | 1168 | 34.8 | 70.9 |
| R4: Leading Researcher | 977 | 29.1 | 100.0 |
| Total | 3360 | 100.0 | |

Just over one-third of respondents said they were in the established research (R3) stage of their careers. The second largest career stage respondent sub-group were leading researchers (R4). The smallest number of respondents were first stage researchers (R1). This distribution of respondents is similar to those obtained in three waves of MORE mobility surveys conducted in Europe (PPMI et al. 2021) (Figure X.1)-

Figure 1. Career stage of respondents, MORE surveys*




* Source: MORE 4 Study, Annexes to the final report, page 26 (PPMI et al. 2021).

Comparing the distribution of respondents into career stage groupings, the profile of female and male respondents is relatively similar. For both the largest sub-group is the R3 Established Researchers and the smallest the R1 First Stage Researchers. However, the R4 Leading Researcher groups makes up a much larger proportion of the male respondents. Comparing men and women by career stage, there is parity at the R1 and R2 stages, but men make up 56 and 62 per cent of the more senior R3 and R4 groups respectively (Table 2).

Table 2. Gender of respondents, by career stage

| | | R1: First Stage Researcher | R2: Recognised Researcher | R3: Established Researcher | R4: Leading Researcher | TOTAL |
|---|---|---|---|---|---|---|
| Women | Count | 253 | 334 | 456 | 333 | 1376 |
| | % within gender | 18.4% | 24.3% | 33.1% | 24.2% | 100.0% |
| | % within career stage | 47.8% | 48.8% | 39.1% | 34.3% | 41.1% |
| Men | Count | 254 | 320 | 655 | 598 | 1827 |
| | % within gender | 13.9% | 17.5% | 35.9% | 32.7% | 100.0% |
| | % within career stage | 48.0% | 46.7% | 56.2% | 61.5% | 54.5% |
| Non-binary | Count | 6 | 6 | 5 | 1 | 18 |
| | % within gender | 33.3% | 33.3% | 27.8% | 5.6% | 100.0% |
| | % within career stage | 1.1% | 0.9% | 0.4% | 0.1% | 0.5% |
| Prefer not to state | Count | 15 | 22 | 45 | 36 | 118 |
| | % within gender | 12.7% | 18.6% | 38.1% | 30.5% | 100.0% |
| | % within career stage | 2.8% | 3.2% | 3.9% | 3.7% | 3.5% |
| Other | Count | 1 | 3 | 5 | 4 | 13 |
| | % within gender | 7.7% | 23.1% | 38.5% | 30.8% | 100.0% |
| | % within career stage | 0.2% | 0.4% | 0.4% | 0.4% | 0.4% |
| TOTAL | Count | 529 | 685 | 1166 | 972 | 3352 |
| | % within gender | 15.8% | 20.4% | 34.8% | 29.0% | 100.0% |
| | % within career stage | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% |

The main scientific fields of respondents are social sciences and economics (23%), natural sciences (21%), engineering and technology (17%) and medical and health sciences (16%). The largest sub-group of respondents in medical and health sciences is R4 Leading Researchers (19%). This contrasts with engineering and technology in which the largest sub-group (24%) is R1 First Stage Researchers. In the natural sciences, the R2 Recognised Researcher group (22%) is marginally larger than the R3 and R4 groups. The most even distribution of respondents across the four career stages is found in the social sciences and economics field. Arts and humanities, in contrast, is heavily skewed toward respondents from the more senior R3 and R4 stages.

Table 3. Scientific field of respondents, by career stage

| | | R1: First Stage Researcher | R2: Recognised Researcher | R3: Established Researcher | R4: Leading Researcher | TOTAL |
|---|---|---|---|---|---|---|
| Medical and Health Sciences | Count | 94 | 122 | 146 | 187 | 549 |
| | % | 17.70% | 17.80% | 12.50% | 19.20% | 16.40% |
| Agricultural and Veterinary Science | Count | 17 | 26 | 42 | 36 | 121 |
| | % | 3.20% | 3.80% | 3.60% | 3.70% | 3.60% |
| Engineering and Technology | Count | 125 | 114 | 191 | 143 | 573 |
| | % | 23.60% | 16.70% | 16.40% | 14.70% | 17.10% |
| Structural Sciences # | Count | 32 | 22 | 63 | 50 | 167 |
| | % | 6.00% | 3.20% | 5.40% | 5.10% | 5.00% |
| Natural Sciences ## | Count | 88 | 153 | 251 | 205 | 697 |
| | % | 16.60% | 22.40% | 21.50% | 21.00% | 20.80% |
| Social Sciences and Economics | Count | 120 | 162 | 288 | 197 | 767 |
| | % | 22.60% | 23.70% | 24.70% | 20.20% | 22.80% |
| Arts and Humanities | Count | 23 | 49 | 129 | 115 | 316 |
| | % | 4.30% | 7.20% | 11.10% | 11.80% | 9.40% |
| Others | Count | 31 | 36 | 57 | 43 | 167 |
| | % | 5.80% | 5.30% | 4.90% | 4.40% | 5.00% |
| TOTAL | Count | 530 | 684 | 1167 | 976 | 3357 |
| | % | 100.00% | 100.00% | 100.00% | 100.00% | 100.00% |

# Structural Sciences (Mathematics, Informatics, Logic); ## Natural Sciences (Physics, Chemistry, Geosciences, Astronomy, Biology).

In terms of respondents' main job roles, there was a clear ranking of 'fact finding' as the number one role. 'Reflexive scientist' and 'knowledge broker' roles were ranked second and third overall respectively. 'Agenda setting' and 'participation facilitation' were the ranked interchangeably fourth and fifth most important job roles. In terms of these main job roles there was no important difference detectable by career stage.

Respondents were asked to describe their current position in terms of the combination of their main work roles. Respondents were asked to rank the importance of five roles for their current work:

- Reflexive scientist (reflecting the rules norms and values of doing research; developing theories and methods of research);
- Fact finder (collecting, analysing and interpreting empirical data; formulating and discussing new theories and facts within the scientific community);
- Agenda setter (communicating science in media, policy-making and other societal contexts; intervening in public debate on the basis of the latest scientific results);
- Participation facilitator (selecting appropriate extra-scientific stakeholders; stakeholder analysis and setting up criteria for participation); and
- Knowledge broker (translating knowledge between scientific disciplines, professions, stakeholders; making implicit knowledge from different practice domains visible).

The role composition of academic occupations did not vary by career stage. Fact finding was the first ranked role of a majority of respondents (64.6%), followed by reflexive scientist and knowledge broker. Established (R3) and leading (R4) researchers were more likely to rate reflexive scientist as their primary role, whereas first stage (R1) and recognised (R2) researchers were a little more likely to rate fact finding as their primary role.

Respondents were also asked about their perceptions of what is included in the concept of responsible research and innovation (RRI). A majority of respondents reported that ethics (76.6%), open access/open science (64.4%), and transparency (68.8%) are what come to mind when thinking about RRI. Science communication (47.4%), sustainability (47.6%) and excellence (44.1%) were also considered part of RRI by a relatively large proportion of respondents.

Perceptions of RRI were relatively consistent when comparing career stage groups. First stage (R1) researchers (76.6%) were more likely to consider open access/science when thinking of RRI than leading (R4) researchers (55.3%). Majorities of first stage (R1) (54.2%) and recognised (R2) (50.2%) researchers considered sustainability part of RRI, compared to 43.6 percent of leading researchers (R4). First stage researchers (R1) (54.5%) were the only group above the overall respondent average (47.4%) in including science communication when thinking of RRI. A majority of leading researchers (R4) (53.9%) considered excellence as part of RRI, compared to 29.6 percent of first stage researchers (R.1) and 39.0 percent of recognised researchers (R2).

### 2.2 Participation in ORRI activities, by career stages

This section summarises respondents' self-reported participation in ORRI practices. It focuses on public engagement and open science.

#### 2.2.1 Public engagement

Respondents were most strongly motivated to undertake in Public Engagement activities by a belief that this forms part of good research practice (86.5% agree or strongly agree) and by the desire to maximise the impact of their research (86.3% agree or strongly agree). The good research practice motivation was of similar importance to researchers at all career stages. First stage researchers (R1) were more likely (50.3%) to be strongly motivated by the desire to maximise the impact of their research than were respondents as a whole (44.5%). First stage

researchers (R1) (33.6%) were also more likely to strongly motivated by a personal interest in better involving the public in research than respondents overall (26.2%).

Table 4 summarises researchers' engagement with a range of societal stakeholders. It shows the rate at which researchers' reported cooperating with these stakeholders on research projects, including cooperating on all, most or a few of their projects.

Table 4. Researchers' cooperation with societal stakeholder, by career stage

| | R1 | R2 | R3 | R4 | TOTAL |
|---|---|---|---|---|---|
| Citizens | 45,8% | 54,1% | 58,7% | 64,5% | 57,3% |
| Govt. | 52,6% | 63,1% | 69,6% | 79,5% | 68,5% |
| Firms | 36,6% | 45,1% | 52,2% | 59,9% | 50,4% |
| NGOs | 54,2% | 57,1% | 64,1% | 69,9% | 62,7% |
| CSOs | 34,6% | 37,4% | 37,4% | 43,8% | 38,8% |
| Average | 44,8% | 51,4% | 56,4% | 63,5% | |

A majority of respondents reported cooperating on projects with government (66.2%), NGOs (61.3%) and citizens (55.8%). For all types of stakeholders, a similar pattern can be observed by career stage, with cooperation rates rising as the research career advances.

Looking more closely at cooperation with citizens in research projects (Table 5), we can see that slightly more than one-fifth of researchers (22.6%) reported cooperating with citizens in all or most of their projects. There was little difference in this level according to career stage. However, more than half of first stage researchers (R1) reported that they do not cooperate with citizens in any of their projects (54.2%), compared to just over one-third of leading researchers (R4) (35.5%) and 42.7 per cent of respondents overall. The proportion of researchers that do not cooperate at all with citizens in their projects can be seen to decline as career stage advances. This can possibly be explained by the accumulation of experience and prestige, coupled with control over resources, among researchers in advanced career stages, which likely makes involving citizens more easily achievable.

Table 5. Researchers' cooperation with citizens, by career stage

| | | R1 | R2 | R3 | R4 | TOTAL |
|---|---|---|---|---|---|---|
| Yes, in all projects I have been a part of | Count | 45 | 46 | 62 | 72 | 225 |
| | % | 9,00% | 7,20% | 5,80% | 8,20% | 7,30% |
| Yes, in most of the projects | Count | 68 | 91 | 167 | 147 | 473 |
| | % | 13,50% | 14,20% | 15,60% | 16,80% | 15,30% |
| Yes, in few of them | Count | 117 | 210 | 400 | 344 | 1071 |
| | % | 23,30% | 32,80% | 37,30% | 39,40% | 34,70% |
| No, in none of them | Count | 272 | 294 | 443 | 310 | 1319 |
| | % | 54,20% | 45,90% | 41,30% | 35,50% | 42,70% |
| Total | Count | 502 | 641 | 1072 | 873 | 3088 |
| | % | 100,00% | 100,00% | 100,00% | 100,00% | 100,00% |

A similar pattern exists in relation to researchers' more frequent engagement with other types of stakeholders. The proportion of respondents who said they cooperated on their research all or most of their projects varied by stakeholder type: citizens (22.6%); government agencies (33.0%); NGOs (16.7%); firms (25.6%); and consumers or concerned groups (e.g. patient organsiations) (15.6%). In terms of career stages, there was a consistently higher levels of engagement when comparing more advanced stage researchers (R3 and R4) with early or early-mid career researchers (R1 and R2) for all stakeholder types.

2.2.2 Open Science

Respondents were most strongly motivated to undertake in Open Science activities by a belief that this forms part of good research practice (91.3% agree), the desire to maximise the impact of their research (88.3% agree), and believing that research must be open (85.2%). The good research practice motivation was of similar importance to researchers at all career stages. First stage researchers (R1) were more slightly more likely (90.2%) to be motivated by the belief that research must be open.

Table 6 summarises researchers' participation in a range of open science practices. It shows the rate at which researchers' reported participating in open science practices including in all. Most or a few of their research projects.

Table 6. Researchers' participation in Open Science practices, by career stage

| | R1 | R2 | R3 | R4 | TOTAL |
|---|---|---|---|---|---|
| Pre-registered studies or shared in other ways | 48,6% | 48,8% | 42,5% | 51,9% | 47,5% |
| Considered how to make data and analysis openly available in the planning phase of the project | 66,0% | 70,7% | 68,9% | 74,6% | 70,5% |
| Published working papers that are freely accessible | 73,0% | 76,2% | 80,2% | 83,5% | 79,2% |
| Shared data in open repositories | 58,3% | 68,0% | 69,9% | 75,3% | 69,3% |
| Published Open Access | 85,7% | 92,5% | 92,7% | 95,7% | 92,4% |
| Improved data infrastructures to ease the use of data | 43,2% | 47,5% | 45,8% | 52,3% | 47,6% |
| Made data available for free to other researchers after it was requested | 64,4% | 72,1% | 72,3% | 79,3% | 73,0% |
| AVERAGE | 62,7% | 68,0% | 67,5% | 73,2% | |

A majority of respondents reported publishing open access (92.4%), publishing freely available working papers (79.2%), making data available on request (73.0%), considering open science issues in project planning (70.5%), and sharing data in open repositories (69.3%). In terms of overall participation rates, career stage appeared to have only small effects. First stage researchers (R1) are less likely to have shared data in open repositories (58,3%) or made data available on request (64.4%) compared to the respondents overall (69.3% and 73.0% respectively). This likely simply reflects less opportunity or responsibility for such decisions in the early career phase.

Looking more closely at researchers' participation in Open Access (Table 7), we can see that slightly more than one-third of researchers (33.6%) reported publishing Open Access in all of their projects. A further one-third (33.7%) reported doing so in most projects. There was little difference in the levels of participation in Open Access publishing according to career stage.

Table 7. Researchers' participation in Open Access publication, by career stage

| | | R1 | R2 | R3 | R4 | Total |
|---|---|---|---|---|---|---|
| Yes, in all projects I have been a part of | Count | 209 | 222 | 338 | 352 | 1121 |
| | % | 39,7% | 32,6% | 29,2% | 36,3% | 33,6% |
| Yes, in most of the projects | Count | 143 | 256 | 489 | 359 | 1247 |
| | % | 27,2% | 37,6% | 42,3% | 37,0% | 37,4% |
| Yes, in few of them | Count | 99 | 151 | 245 | 216 | 711 |
| | % | 18,8% | 22,2% | 21,2% | 22,3% | 21,3% |
| No, in none of the projects | Count | 75 | 51 | 85 | 42 | 253 |
| | % | 14,3% | 7,5% | 7,3% | 4,3% | 7,6% |
| Total | Count | 526 | 680 | 1157 | 969 | 3332 |
| | % | 100,0% | 100,0% | 100,0% | 100,0% | 100,0% |

A similar pattern exists in relation to researchers' more frequent engagement with other types of stakeholders. The proportion of respondents who said they always used Open Science practices varied by practice: published freely accessible working papers (22.6%); made data available on request (22.6%), and planned how to make data and analysis open at the start of projects (16.5%). In terms of career stages, first stage researchers (R1) were consistently the most likely to always undertake these practices than respondents at later career stages, although these differences were not large.

**3. Summary**

This section has provided a brief overview of how career stage affects researchers' perceptions of ORRI and participation in Public Engagement and Open Science practices. These data are generated by the SUPER MoRRI Researcher Survey. Further data are available for both Public Engagement and Open Science, which will be included in the Third Monitoring Report (D2.5, M56). In addition, data for Gender Equality and Ethics will also be included in D2.5.

A broader narrative presentation of the impact that career stage has on ORRI perceptions and practices will be produced for the PROMISE portal.

Initial exploration of data from the researcher survey shows mixed results. Early career researchers are more likely to perceive open science as part of responsible research and innovation, yet motivations for participating in various Open Science practices do not vary markedly by career stage. Early career researchers may be more likely to always practice some aspects of Open Science for example, however the differences are not large. Indeed, the effect of having already had a longer career may be more important in explaining the differences that we see so far in these data. Further exploration will seek to identify where a career stage effect appears to be most significant in shaping attitudes and practices.