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SUPER MoRRI – Scientific understanding and provision of an enhanced and robust monitoring system for RRI

D5.2 Patterns Studies Report

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List of Acronyms and Abbreviations

Table 1: Acronyms and abbreviations

Acronyms/Abbreviations	Definition
CCN	Country Correspondent Network
EU	European Union
EC	European Commission
GDP	Gross Domestic Product
GDPR	General Data Protection Regulation
GE	Gender Equality
GERD	Gross domestic expenditure on Research and Development
GTDB	Green Tech Database
ISP	International Satellite Partner network
OS	Open Science
PATSTAT	European Patent Office – Worldwide Patent Statistical Database
PE	Public Engagement
R&D	Research & Development
R&I	Research & Innovation
REI	Research Ethics and Integrity
RFO	Research Funding Organisations
RPO	Research Performing Organisations
RRI	Responsible Research and Innovation
SwafS	Science with and for Society
TM	Third Mission

Executive Summary

This report summarises selected results from empirical studies conducted to provide data and information for a monitoring framework to support open and responsible research and innovation. The final output of this process and the SUPER MoRRI project is an online portal named 'Platform for the Support of Responsibility and Openness and their Monitoring in Innovation and Science Ecosystems' (PROMISE, www.promise4era.eu).

The aim of the Report is to connect four markers of open and responsible research and innovation – *gender equality, open science, public engagement, research ethics and integrity* – with societal, economic, democratic, and scientific benefits.

The Report focuses on quantitative patterns of open and responsible research and innovation and uses a model of institutional change to make connections between these patterns and different types of benefits. A description of the model is contained at Section 2, summarising a project discussion paper.

The majority of pattern studies were based on three primary datasets generated by the SUPER MoRRI project. The first of these in chronological order was the research funding organisation (RFO) study (CCN-RFO) conducted in collaboration with the SUPER MoRRI network of country correspondents (CCs). This study was built on the voluntary participation of 55 funding organisations of different types. The study collected data and information about RFOs' priority setting, funding instruments, and research assessment processes.

The second dataset is from the study of European university policies and practices in relation to open and responsible research and innovation. This study also utilised the network of CCs and covered a sample of 122 universities. The study gathered data on the publicly facing policies and strategies of these organisations with regard to the four markers of open and responsible research and innovation plus the 'third mission'.

The third dataset is a researcher survey that was targeted at researchers from the same sample of 122 universities. This survey collected data and information about researchers' practices and motivations in regard to integrating the four markers of open and responsible research and innovation in their research.

These datasets form the basis for all of the case studies report here, with one exception. An addition study of responsible innovation focused on women inventors' participation in green technology patenting activities. This study was based on a curated and upgraded set of secondary data from the PATSTAT database.

A set of results from analyses conducted to date are presented in Section 4 of the Report. These results cover patterns produced using all three primary dataset plus the secondary patent data.

Section 5 addresses the main aim of the Report, the connection of empirical patterns with different types of benefits. The section links between the datasets, empirical patterns, and the benefits modelled using our conceptual approach, organised by the four markers of open and responsible research and innovation. The conceptualisation of benefits used in the model and the analyses is intrinsically normative and distinct from the concept of 'impact'. Ultimately, the analysis finds a number of benefits of different types that can be plausibly associated with practices and processes that enhance openness and responsibility in research and innovation.

An important theme of the Report is the potential for further exploitation of the datasets produced by SUPER MoRRI. The relevant variables and dimensions of the studies are specified (Section 3). The use cases presented in Section 4 illustrate some of the approaches to using the data that will populate the PROMISE portal and be available for extension in the future. Further description of how these data can contribute to the monitoring framework to support open and responsible research and innovation beyond the life of the SUPER MoRRI project will be contained in the Sustainability Plan (D7.5).

This Pattern Studies Report (D5.2) connects empirical 'snapshots' of open and responsible research and innovation with different types of benefits. The report can be read in conjunction with the Pathways Studies Report (D5.3) that provides descriptions, narratives, and analyses of processes contributing to these different types of benefits. A forthcoming report (D5.4) will synthesize these results in a forward-looking discussion of institutional transformation toward more open and responsible research and innovation systems.

1. Introduction

1.1. Background to Deliverable 5.2

The "Scientific understanding and provision of an enhanced and robust monitoring system for RRI" (SUPER MoRRI) project contributes to monitoring open and responsible research and innovation. This current deliverable, the Patterns Studies Report (D5.2), summarises our work with large-scale datasets to connect markers of responsible research and innovation with impacts or benefits.

Three strategic documents provided the background for the SUPER MoRRI project. The principles underpinning the SUPER MoRRI monitoring framework are outlined in the Strategic Development Plan (D1.2). The approach to large-scale data collection activities is provided in the Implementation Plan (D2.2). The Case Study Co-creation Methodology Report (D5.1) presents targeted empirical research efforts supporting the development of understanding and information regarding pathways to RRI benefits.[1] These primary data collections form an important part of one of the three pillars of the project design (Figure 1).

Figure 1: SUPER MoRRI project structure

1.2. Relation of D5.2 to Other Tasks and Deliverables

The Pattern Studies Report (D5.2) emerges from Task 5.2 of SUPER MoRRI. D5.2 is closely related to Tasks 5.3 and 5.4 leading to Deliverable 5.3 (Pathways Studies Report) and Deliverable 5.4 (Analytical synthesis report of experimental cases) respectively. The Pattern Studies Report (D5.2) and the Pathways Studies Report (D5.3) provide the input for the Analytical Synthesis Report (D5.4). D5.2 and D5.3 also relate to the revised Strategic Development Plan (D1.3) in that the data and information highlighted in these two deliverables summarises the major content to be delivered publicly through

[1] SUPER MoRRI strategic documents are available at the project Open Science Framework home https://osf.io/z95gw/

the PROMISE portal (http://www.promise4era.eu). D5.2 and D5.3 also relate to the Sustainability Plan (D7.5) which summarises options for the updating and development of the datasets provided by SUPER MoRRI and the monitoring elements hosted and made available at PROMISE. Finally, data and visualisations developed from the pattern studies are summarised in three Monitoring Reports (D2.2, D2.3 and D2.5). These Monitoring Reports also include details of the patterns of open and responsible research and innovation, including national level indicators, constructed using secondary data sources, including Eurostat, Eurobarometer, PATSTAT, She Figures, and Unpaywall. Secondary data from PATSTAT, which was upgraded in SUPER MoRRI to include the gender of inventors of 'green' technologies, is included in this Report in the section on Gender Equality.

1.3. Deliverable Structure and Navigation

This Pattern Studies Report is structured as follows. The Executive Summary briefly presents the purpose and contents of the report. Chapter 1 introduces the background of the deliverable, its relation to other tasks and deliverables within SUPER MoRRI, and its structure. Chapter 2 presents the conceptual approach to the connection of markers of open and responsible research and innovation with different types of benefits – scientific, democratic, economic, and societal – developed by the SUPER MoRRI project.

Chapter 3 presents concise summaries of the new data generated by SUPER MoRRI to construct pattern analyses of openness and responsibility in research and innovation. Chapter 4 then sets out the markers of openness and responsibility in research and innovation that are explored in the various pattern studies. The level or unit of analysis of these patterns is specified. Analyses that have already conducted are summarised, as are those that are upcoming. Together these analyses constitute the patterns data that will be provided using different forms of presentation at PROMISE. Chapter 5 then summarises how the patterns presented connect markers of openness and responsibility with impacts or benefits.

1.4. SUPER MoRRI research programme design

The design of SUPER MoRRI involved the development of parallel 'patterns' and 'pathways' studies. Large scale data collections were mainly organised in Work Package 2 and included the CCN-RPO, CCN-RFO, Researcher Survey (RESU), and Eurobarometer studies. Figure 2 presents the main quantitative studies according to the SUPER MoRRI Implementation Plan, including both secondary and primary data collections. Due to the COVID-19 pandemic the timing of these data collections were adjusted from the project proposal.

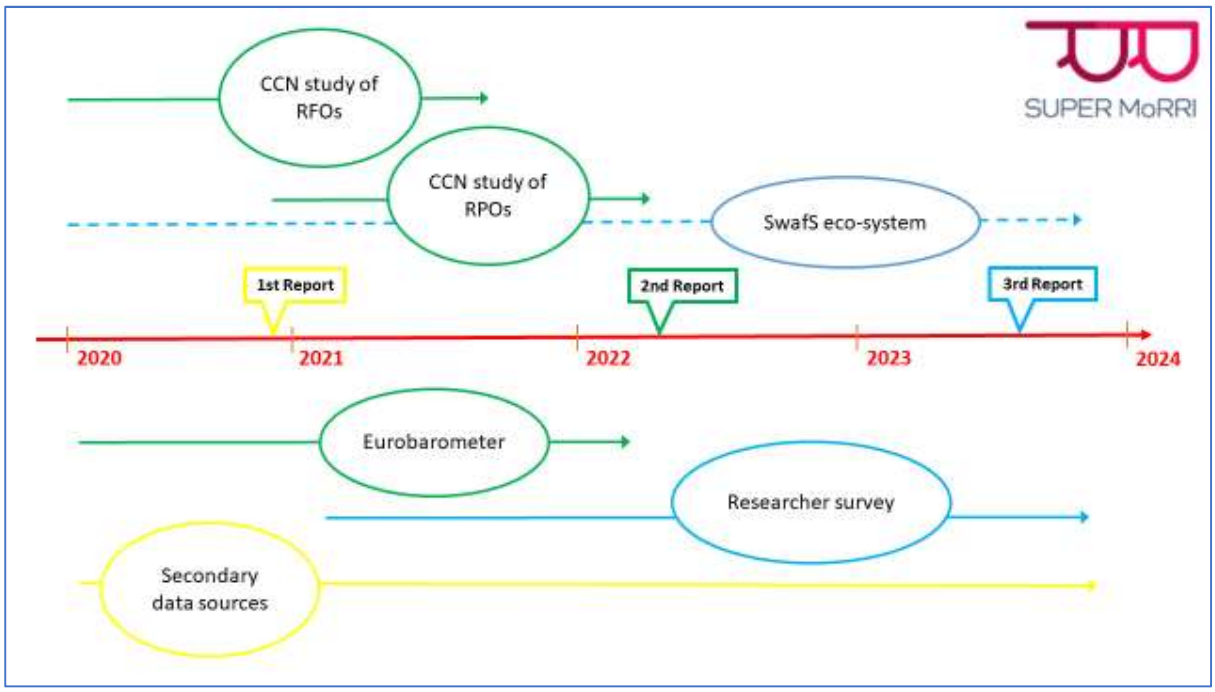


Figure 2: Revised timing of main data collection vehicles

1.4.1. Interaction between Work Package 2 and Work Package 5

The large data collections in SUPER MoRRI were organised in Work Package 2 (WP2). These data collections power patterns studies based on RPOs, RFOs and researchers. However, these studies were also used as data sources for two case studies organised through Work Package 5 (WP5) (Public Engagement with Science; Public Value Research Careers). Both these studies have produced outputs related to patterns of open and responsible research and innovation. In addition, a third WP5 case study, Gendered Eco-innovation, was also designed with a quantitative phase that has generated patterns outputs. This study is based on secondary data from the PATSTAT database that was subsequently upgraded with the gender of inventors.

Table 2: Work Package 5 case studies; methods and data sources

Case Study	Methods used	Data sources
CSOs at Science-Society interface	Ethnographic observation, document analysis, interviews	Policy and other documents; SUPER MoRRI primary data (observation, interviews)
Coding of ethics and values into autonomous systems	1) mapping of actors and networks (RFOs, RPOs, Swafs), 2) data collection through Eurobarometer and secondary sources, 3) interviews with select researchers identified in (1)	Eurobarometer, policy and other documents; SUPER MoRRI primary data (interviews)
Public value research careers (PVRC)	Qualitative content analysis, interviews, survey	Policy documents; SUPER MoRRI primary data (RESU dataset, interviews)
Transdisciplinary Research (funding)	Qualitative content analysis, interviews, focus group	Policy documents; SUPER MoRRI primary data (interviews, focus group)
Gendered eco-innovation	Patent data analysis; qualitative content analysis, interviews	PATSTAT / Greentech Database, policy documents; SUPER MoRRI primary data (interviews)
Alignment of preferences, practices, and repertoires in public engagement with research (PER)	Statistical analyses	Eurobarometer; SUPER MoRRI primary data (CCN-RPO and RESU datasets)

This deliverable reports on SUPER MoRRI pattern studies. Three studies organised through WP2, CCN-RPO, CCN-RFO, and Researcher Survey (RESU), generated primary datasets for use in monitoring patterns of open and responsible research and innovation. Details on these datasets are provided in Section 3 of this Report. In addition, three further pattern studies were organised through WP5. The public engagement with research (PER) study uses a combination of the CCN-RPO and RESU primary datasets, with future development intending to also use secondary (Eurobarometer) data. The public value research careers (PVRC) study uses the RESU dataset. The gendered eco-innovations study uses secondary data sources, PATSTAT and the Greentech Database. These three studies also include pathways dimensions that are reported in the Pathways Studies Report (D5.3).

The two deliverables (D5.2, D5.3) report on patterns and pathways connecting open and responsible research and innovation with different types of benefits. The two deliverables adopt a common and overlapping structure addressed to the following markers of open and responsible research and

innovation that can contribute to these benefits: citizen science (CS), gender equality (GE), open science (OS), public engagement (PE), research ethics and integrity (REI), sustainability (SUS), and the third mission (TM). Over the lifespan of SUPER MoRRI, extensive and continuous interactions occurred between tasks based in WP2 and WP5. This allowed the development of complex case studies that could address both patterns and pathways toward benefits of open and responsible research and innovation.

2. Connecting markers of openness and responsibility in R&I to scientific and societal benefits

As part of Tasks 5.3 and 5.4, a Discussion Paper (hereon Benefits Paper) was prepared on pathways to impact and benefits of open and responsible research and innovation (Wicher et al. 2022). It addresses how markers of open and responsible research and innovation can be linked to pathways to impacts in science and society. The Benefits Paper focuses on the development of 'impact narratives' in which researchers, R&I stakeholders, and citizens reflect on what they understand by beneficial impacts of R&I. This section introduces the conceptual framework developed in the Benefits Paper and explains how this framework shapes the analysis contained in this Pattern Studies Report (D5.2). This analytical procedure is consistent also with that used in the Pathways Studies Report (D5.3) and the Case Synthesis Report (D5.4).

2.1. Constructing impact pathways

At the level of actors and agents involved in institutional change processes, benefits are an inherently normative construct. Impacts need to be perceived and understood as 'beneficial' by situated stakeholders and other actors. The perceptions and understandings of relevant actors need to be investigated and interpreted in relation to an 'impact pathway' model. That is, the perceptions and understandings of situated stakeholders should be interpretable in terms of a coherent logic, or model, regarding how openness and responsibility in research and innovation contributes to beneficial impacts. An impact pathway thus should be interpretable in terms of an explicit or implicit theory of change, a series of steps connecting a practice or set of practices and an expected outcome that can be connected empirically or theoretically to benefits for science and/or society.

The Benefits Paper develops and model that does not seek to pin down all the (often overdetermined) factors that may contribute to the series of steps that can be interpreted as constructing an impact pathway. The focus is on the activities undertaken and the embedded logic, explicit or implicit, strongly defined or vague, that shapes the construction of an impact pathway from the perspective of stakeholders and participants. These perspectives need not be consistent, in fact they are more likely to be in relations of tension or even contest as stakeholders' interests and objectives are not homogenous. The Benefits Paper thus introduces a 'transducer' effect, which includes a recognition of the endogenous processes contributing to change that occur in the work of constructing impact pathways (Figure 3). The extent to which actor 'intentionality' shapes impact pathways remains an empirical question. What matters for the transducer model is to recognise that stakeholders' perceptions, actions, and understandings of desirable transformations can contribute to the construction of theoretical impact pathways. However, establishing linear and direct linkages between inputs and outputs, interests and outcomes, is unlikely to be feasible from a monitoring perspective and is theoretically likely to invite reductionist interpretations.

Figure 3: Signal transduction between input and output

The transduction process is thus neither monolithic nor consistent. Institutional and socio-cultural conditions that are configured in specific ways in different 'intervention contexts' shape the outcomes that actors strive to achieve. Transduction occurs in at multiple levels and in interlinked contexts in constructing an identifiable impact pathway. Transduction can be iterative and recursive, it can lead to consolidation as routines or to innovation through emergent events or structures. In the SUPER MoRRI model then, the transducer is the moment where endogenous and exogenous elements combine and catalyse possible future scenarios. In the Benefits Paper, this thinking underlies a model of impact pathways from the perspective of monitoring benefits for science and society.

2.2. From impact pathways to benefits

The Benefits Paper proposes a model designed to align the assessment of impact, impact pathways, and benefits from the perspective of monitoring to support open and responsible research and innovation (Figure 4). While to a certain extent broadly transformational impact pathways do have a certain 'direction' they involve plural and uncertain dynamics that may be far from linear in their trajectory.

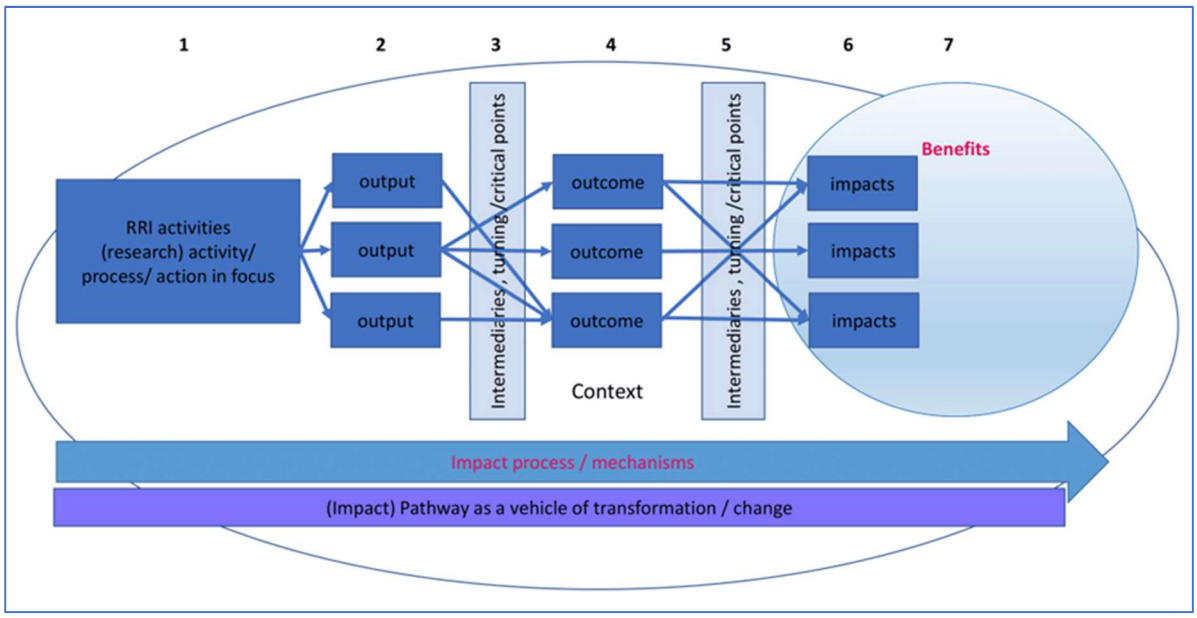


Figure 4: Model of impact pathways

While the model includes 'classical' research impact assessment concepts including outputs, outcomes, and impacts, it does not indicate a linear and/or univocal pathway at the level of actors and activities. Rather, from an empirical monitoring perspective, actors' interests, actions, and perspectives and evolving processes of 'transduction' in which they are involved, construct context dependent understandings of desired impacts and expected benefits. Multiple such context dependent interventions or active scenarios construct broader impact pathways (Figure 4), not necessarily in an additive or cumulative way but also through struggle, contestation, and messy co-existence.

From an analytical monitoring perspective these interventions and scenarios can be viewed as contributing in diverse ways to the macro-level depiction of broad transformational impact pathways illustrated in Figure 3. Activities associated with knowledge production and translation, or innovation, for example, can be expected to generate relatively shared or contested conceptualisations of impacts and benefits with different degrees of clarity and specificity. Monitoring should then support activities and processes of openness and responsibility that can actively contribute to and help shape contextualised configurations of impact and benefits, which over time define transformational impact pathway leading toward benefits for science and society.

From the practical perspective of experimenting with empirical monitoring tools and processes, three fundamental principles thus seemed appropriate and relevant with regard to the question of benefits.

- All effects of interventions are difficult to monitor and, due to time lags and problems of causality, difficult to attribute reliably.

- Accepting that benefits are (a) normative and (b) depend on interests and values, monitoring needs to question who or what is mobilized as a 'beneficiary.

- Monitoring activities reflexively impact the R&I system. We need to use responsible approaches to monitoring the contributions of open and responsible research and innovation to

benefits for science and society that make their own assumptions and potential effects as transparent as possible.

2.3. Types of benefits

As mentioned above, the notion of benefit adds normativity to outcomes and to impacts from research and innovation. The basic rationale for monitoring the contribution of open and responsible research and innovation to benefits for science and for society is the argument that public investment in science, research, and innovation should improve societal well-being and the environment. The category of 'benefits' is thus obviously broad and nebulous, seeking as it does to isolate 'positive' or 'enriching' effects and impacts from the complex and overdetermined maze of contributions that lead toward societal transformations. Benefits can thus only be thought of at a general or abstract analytical level.

In 2013, the European Commission issued a call for tender for the assessment of "economic, social and democratic" benefits of RRI. In its final report, the ensuing MoRRI project discussed the conceptualisation of benefits and how to connect markers of open and responsible research and innovation with markers of benefits.

> the concept of RRI benefits cannot be simply read off this intervention logic as an inevitable extension of the impacts of RRI. Although RRI benefits may indeed be partly or, in some contexts, largely based on an accumulation of positive impacts of RRI, this conceptualisation is not sufficient to capture what is meant by RRI benefits … RRI benefits cannot be sensibly interpreted, or systematically monitored, in the absence of a framework that guides expectations about the (expected) qualities and (desirable) directions of change", (Peter et al. 2018: 30).

The ensuing MoRRI project identified a fourth category, "scientific" benefits knowledge production and the research system itself (Peter et al., 2018).

In the empirical monitoring efforts of the SUPER MoRRI these four high-level categories – scientific, societal, economic, democratic - continued to be used to distinguish different types of benefits that monitoring would endeavour to associate, as plausibly as possibly, with open and responsible research and innovation. A dual strategy was adopted, to use patterns and pathways data as distinctive methodological approaches to describing apparent connections between markers of open and responsible research and innovation and markers of benefits of different types. This Pattern Studies Report (D5.2) thus uses patterns produced by quantitative data collections as markers of open and responsible research and innovation contributions to benefits. The separate Pathways Studies Report (D5.3) uses qualitative information and narratives as markers of open and responsible research innovation contributions to benefits. Together these two reports highlight the distinctive challenges of monitoring that seeks to inform about both the scope and the dynamics of generating impacts and benefits through open and responsible research approaches.

3. Primary datasets for pattern studies

This section introduces the primary data sources produced as part of the SUPER MoRRI project research programme. These data sources form the basis for analyses of markers of open and responsible research and innovation of various types. Not all pattern analyses produced in SUPER MoRRI use these primary datasets. Other patterns analyses are based on secondary datasets, including data from Eurostat, She Figures, Unpaywall and various Eurobarometers. Details and outputs of analyses based on secondary data sources can be found in the three Monitoring Reports (D2.2, D2.3, 2.5).

3.1. Research Performing Organisations dataset

The Country Correspondent Network (CCN) study of research performing organisations (CCN-RPO) examined a range of mechanisms through which HEIs work to enhance openness and responsibility in research. The study focused on the strategic priorities of European HEIs and their organisational policies, supporting structures, and actions related to *gender equality, open science, public engagement, research ethics and integrity, and the third mission (GE, OS, PE, REI, TM*).

The study design was based on selecting a representative sample of European HEIs. The study developed an overview and understanding of RRI policies and practices in different types of European universities. The data collection process compiled a comprehensive overview of each HEI's strategic focus, organisational policies, and support structures for RRI. Country correspondents (CCs) focused on externally communicated strategies and policies as these were presented on HEIs' institutional websites. CCs then produced a descriptive report of HEI strategic aims and actions corresponding to the six markers of open and responsible research and innovation.

The dataset was compiled for a total 122 European HEIs. Data was also collected for seven HEIs from USA, Australia, and Brazil to enable international benchmarking. HEIs were selected for each of the EU27 plus Norway and the UK. The selection methodology used the European Tertiary Education Register (ETER) database. Depending on the size of the country, either two, four or six HEIs were selected. Variation among these selections were based on three diversity measures (Ryan et al. 2021), size, disciplinary focus, and teaching/research balance. For each country, HEIs were clustered in groups based on these variables and one RPO in each cluster was selected. The method ensured variety of HEIs within each country and representativeness at the European level. Further details of the study design are available in the CCN-RPO study protocol.

The dataset developed in the CCN-RPO study is derived from organisational "strategy documents" or "policy, support structures and actions", as made available publicly on organisational websites. Measures reporting patterns of markers of open and responsible research and innovation include:

1. the proportion of HEIs who work with and include one or more of the five markers (*GE, OS, PE, REI, TM*) in their public organisational strategy;

2. the proportion of HEIs who have implemented specific policies, structures, and actions supporting one or more of these five markers;

3. the distribution of HEIs in terms of the strategic priority they place on each marker;

4. whether HEIs have a mainly aspirational or mainly practical approach to each marker; and

5. a composite metric that combines these four metrics.

These patterns are summarised in Table 3. Results can be analysed at geographic and organisational levels.

Table 3: Indicators derived from the CCN-RPO study

Name	Contents	Section
Strategy/policy Does the HEI include the RRI area in its strategic documents?	1-0 (yes-no)	GE, OS, PE, REI TM, RRI
Priority Degree of strategic prioritisation of an RRI area compared to all RRI areas for each HEI	High, Medium, Low	GE, OS, PE, REI TM, RRI
Aspirational – Practical Does the description of the strategy in this area appear to be mainly aspirational or practical?	1-5	GE, OS, PE, REI TM, RRI

GE = Gender Equality, OS = Open Science, PE = Public Engagement, REI = Research Ethics and Integrity, TM = Third Mission, RRI = Responsible Research and Innovation.

3.2. Research Funding Organisations dataset

The CCN study of research funding organisations (CCN-RFO study) examined the mechanisms through which research funding organisations (RFOs) enhance responsibility in research and innovation. Mechanisms that were the focus of the study were:

1. setting priorities for distributing research funding;

2. designing funding instruments; and

3. conducting assessments of grant proposals (research projects and researchers).

To generate the primary data for the CCN-RFO study CCs carried out three main tasks:

1. studied publicly available strategic documents relating to the policies and priorities of the RFO;

2. performed a key stakeholder interview with a suitably place official in the RFO regarding the mechanisms of priority setting, design of funding instruments, and assessment procedures; and

3. produced written summaries of their desk and field research activities.

The CCN-RFO study was not designed to assess or evaluate RFOs either individually or comparatively. The study sought to understand how RFOs work to improve responsibility in research practices and cultures.

The focus of data collection was qualitative, designed to build an understanding of the repertoires of policies and practices RFOs use, or are planning to introduce, in order to both shape their own actions and shape research culture to enhance responsibility.

Information and data collected in the CCN-RFO study included:

1. each organisation's formal policies to support open and responsible research and innovation;

2. the characteristics of each organisation's governance as it relates to engagement with scientific and societal stakeholders, and

3. the repertoires of procedures and processes followed by the organisation to a) ensure responsible conduct of its own activities, mainly in relation to assessment activities, and b) promote responsibility in the research communities supported by its grants.

These data were used as proxy markers of open and responsible research used to visualise patterns of institutional action. Patterns data from the CCN-RFO study are provided at the PROMISE portal at different levels of aggregation and along various dimensions. Patterns are not presented at individual country level as design of the study and the data and information collected were not intended to describe, and are not valid for, national level comparisons. Details of the methodological approach of the CCN-RFO study can be found in the Annotated Methodological Procedures Report (D2.4) and the CCN-RFO study Protocol appended to D2.4. Examples of data visualisations of categorical indicators produced from the CCN-RFO study can be found in the 2nd and 3rd Monitoring Reports (D2.3, D2.5).[2] Tables 4-7 summarise the patterns data available in the CCN-RFO dataset.

Table 4: Information about RFOs' policies

ID	Description	Dimensions (codes)	Comment/sub-dimension
POL1	Does the RFO have a publicly available policy or strategy about open and responsible research and/or related areas	RRI or responsibility Open Science (comprehensive) Open Access Research Integrity Gender Ethics Science Education / Communication Public Engagement Societal Impact Innovation Pathways Output Dissemination Other: specify	Standalone General/mixed Planned/aspirational None

[2] Definitions of open and responsible research and innovation practices and cultures used in the CCN-RFO study can be found at Table 6 in D2.4.

Table 5: Information about RFOs' research funding priority setting

ID	Description	Dimensions (codes)	Comment/sub-dimension
PRI1	Responsibility for the setting of research funding priorities	Strong Political Political Scientific Scientific-Societal Societal None of these	See Coder Analytics v1.0 for descriptors
PRI2	Linkage with other national policies	Education Economic Growth Health Smart Specialisation Sustainability/SDGs Welfare	
PRI3	Scientific stakeholders involved in priority setting	Learned Academies Peer RFOs RPOs Scientific Communities Scientific expert panel or advisory group	
PRI4	Societal stakeholders involved in priority setting	Citizens CSOs Industry Assoc./Companies International organisations Patient organisations Policymakers	

Table 6: Information about RFOs' funding instruments

ID	Description	Dimensions (codes)	Comment/sub-dimension
PRI3	Scientific stakeholders involved in designing funding instruments	Learned Academies Peer RFOs RPOs Scientific Communities Scientific expert panel or advisory group	
PRI4	Societal stakeholders involved in designing funding instruments	Citizens CSOs Industry Assoc./Companies International organisations Patient organisations Policymakers	
PRI5	Procedures for involving stakeholders in designing funding instruments	Committee or Workshop Formal Consultation Informal Consultation Invited or public submissions	
PRI6	Inclusion of open and responsible research and innovation or related aspects in funding instruments	AIRR Citizen Science Public engagement or participatory methods Gender Innovation Pathways Open Science Research Integrity/Ethics Societal Impact	Required Expected/Preferred

Table 7: Information about RFOs' research assessment practices

ID	Description	Dimensions (codes)	Comment/sub-dimension
RAS1	Composition of research assessment panels	Gender Geography Societal stakeholders Fields	Balance/inclusion National/international Industry; CSOs; POs; other Interdisciplinarity
RAS2	Criteria for selection of reviewers	Scientific Gender Geography Societal stakeholders	Pubs; H-Index Balance/inclusion National/international Industry; CSOs; POs; other
RAS3	Training or guidance provided for assessors	Unconscious bias Gender Interdisciplinarity Ethics RRI Other	
RAS4	Scientific assessment of researchers	Publications Data sets Policy reports Science communication Medical guidelines Other	
RAS4	Assessment of societal contribution/ impact of researchers	Statements or narratives of career societal contribution Impact cases / statements Stakeholder testimonials Letters of support Other	
RAS5	Assessment of societal contribution/ impact of research proposals	Problem orientation Engaged / participatory research design Stakeholder involvement Consideration of innovation / impact pathways Citizen science Outputs/ Communication strategy	
RAS6	Consideration of open and responsible research and innovation and related elements in research proposals	RRI Gender analysis Gender-balanced research team Open science AIRR Ethics Research integrity Other	

A selection of patterns data and information has been curated by SUPER MoRRI and presented as user interactive content at PROMISE. Potential extensions of the CCN-RFO patterns outputs presented at PROMISE are summarised in the Sustainability Plan (D7.5).

3.3 Researcher Survey dataset

The Researcher Survey (RESU study) examined European researchers' open and responsible research and innovation practices. It also investigated their perceptions of, and motivations toward, openness and responsibility in research and innovation.

The SUPER MoRRI project design foresaw linked studies utilising the RESU study dataset and the CCN-RPO study dataset (see Section 3.1). The CCN-RPO and RESU studies were based on the same stratified sample of 122 HEIs in 29 European countries.[3] The linked research design between the meso-level institutional policy context (CCN-RPO study) and the micro-level of individual research practices and perceptions (RESU study) allows combined multi-level analysis of patterns for six markers of open and responsible research and innovation.

The RESU dataset supports pattern studies for *gender equality, open science, public engagement, and research ethics and research integrity (GE, OS, PE, REI*). A basic set of RESU-based patterns have been identified, however changes and additions remained possible at the time of writing. More complete details on these data and information will be contained in the upcoming 3rd Monitoring Report (D2.5). Finalising the data and information from RESU that will be presented at PROMISE was continuing at the time of writing this deliverable.

A total of 5,420 researchers participated in RESU. Of these 5,420, 3,382 completed the survey. Overall, RESU had a completion rate of 3.2% (with regard to the gross sample) and a dropout rate of 38% (with regard to the net participation). Details of the RESU study methodology and discussion of the implementation process are available in the Annotated Methodological Procedures Report (D2.4).

The RESU dataset is structured around four markers of open and responsible research and innovation, public engagement (PE), open science (OS), gender equality (GE), and research esthics and integrity (REI)

An overview of participation (and cumulative dropouts) by RESU question block shows:

- Questions on Public Engagement completed: 4,107 (1,313 dropouts => 24.7%);
- Questions on Open Science completed: 3,672 (1,748 cumulative dropouts => 32.2%);
- Questions on Gender Equality completed: 3,504 (1,916 cumulative dropouts => 35.3%); and
- Questions on Ethics completed: 3,397 (2,023 cumulative dropouts => 37.3%).

The effect of this progressive dropout rate is that the RESU dataset has different numbers of complete responses for each marker of open and responsible research and innovation included in RESU. It is apparent that this is simply a function of the order in which the question blocks were presented to participants rather than to the topic of the block itself.

[3] Details of the HEI selection process are contained in the Protocol for the CCN-RPO study (Appendix A.1 of D2.4).

Table 8: Question blocks in the RESU study

Marker	RESU questions
Public Engagement	Which non-academic actors engaged with
	How engage with non-academic actors
	Motivations for engagement with non-academic actors
	Barriers to engagement with non-academic actors
	Institutional support for engagement with non-academic actors
	Observed or expected benefits from engagement with non-academic actors
Open Science	Which open science activities practiced
	Motivations for open science practices
	Barriers to open science activities
	Institutional support for open science
	Observed or expected benefits from open science
Gender Equality	Aspects of gender equality integrated in research
	Motivations for integrating gender equality aspects
	Barriers to gender equality aspects
	Institutional support for gender equality
	Observed or expected benefits of integrating gender equality aspects
Research Ethics and Integrity	Which ethics practices integrated in research
	Encounter with questions research practices (QRPs)
	Motivations for integrating ethics practices
	Barriers to ethics and integrity aspects
	Institutional support for ethics and integrity
	Observed or expected benefits of ethics and integrity

A consistent set of five questions was asked for each of the four thematic markers of open and responsible research and innovation included in the RESU study (Table 8). This set included questions on practices, motivations, barriers, institutional support, and benefits. An additional question on how researchers engage with non-academic actors was asked in the public engagement block. An additional question on the encounter with questionable research practices (QRPs) was asked in the research ethics and integrity block.

Patterns of open and responsible research and innovation can be developed for each of the four markers included in the RESU dataset. A number of variables included in the survey instrument can be used to construct these patterns and generate comparisons between them (Table 9).

Table 9: RESU study respondent variables and dimensions

Variable	Dimensions	Operation
Role in research	Reflexive scientist Fact finder Agenda setter Participation facilitator Knowledge broker	Rank
Country	29 European countries	Select one
HEI	122 universities in Europe	Select one
Perceptions of open and responsible research and innovation	Citizen Science Corporate Social Responsibility Ethics Excellence Gender Equality Inclusive innovation Open Science/Open Access Open Innovation Public Engagement Science Communication Science Education Social Equality Sustainability Transparency Other (specify)	Select multiple
Funding sources	National	Binary
	European Union	Binary
	European Union programmes: European Research Council Horizon 2020/Horizon Europe Eureka COST European Innovation Council European Institute of Innovation and Technology Other (specify)	Select multiple
	Contract research	Binary
Gender	Woman Man Non-binary A gender not listed here Prefer not to state	Select one

Scientific field	Medical and Health Agricultural and Veterinary Engineering and Technology Structural (Mathematics, Informatics, Logic) Natural (Physics, Chemistry, Geoscience, Astronomy, Biology) Social Sciences and Economics Arts and Humanities Other (specify)	Select one
Career duration (years post-Masters degree)	0-5 6-10 11-20 >20	Select one
Career stage	R1: First Stage Researcher (up to PhD) R2: Recognised Researcher R3: Established Researcher R4: Leading Researcher	Select one

Numerous pattern analyses can be produced from the combination of respondent variables and question blocks included in the RESU study. Additional options are available where data from the CCN-RPO and RESU datasets are linked. The patterns show in this Report illustrate some but not all of the possibilities for using the RESU dataset. Further patterns outputs using RESU will be presented in the 3rd Monitoring Report and at the PROMISE portal.

4. Pattern studies for monitoring contributions of open and responsible research and innovation to societal impacts and benefits

This section introduces data summaries from pattern studies used for monitoring contributions of open and responsible research and innovation to societal impacts and benefits. In particular, it focuses on those pattern studies for which data has not yet been reported: the researcher survey (RESU), public engagement in research (PER) and public value research careers (PVRC). Data for other pattern studies, the CCN-RPO study, the CCN-RFO study, and gendered eco-innovations were reported in the 2nd Monitoring Report (D2.3) and will be updated in the 3rd Monitoring Report (D2.5). Short summaries of the results presented for these three studies in D2.3 are included here.

4.1 Public engagement with research (PER)

The PER study assesses whether researchers are more likely to engage in public engagement practices when employed in organisations that emphasize, incentivise and/or support public engagement in their organizational policies, strategies, and support structures. The study identifies the set of policies an organisation employs to promote, support, and incentivise public engagement in their organisation. The study analyses whether the policy environment of RPO's affects the public engagement activity among its employees.

The PER study uses two coordinated primary data collections conducted by SUPER MoRRI: the CCN-RPO study of 120 European HEIs; and 2) the researcher survey study (RESU) with 4,108 respondents from the same 120 HEIs. The CCN-RPO study produced measures of the public engagement repertoire of the RPO, while the RESU study provides self-reported measures of the researchers' public engagement behaviour in their most recent research projects. The empirical analysis reported here is based on a reduced set of 42 HEIs (European universities) for each of which there are a minimum of 28 responses to the researcher survey.

The combination of the two datasets provides a great possibility to assess the degree to which policy emphasis on public engagement in research organisations relates to researchers' own practices. While there are some potential biases due to self-reporting in the survey and data availability in the HEI policy document study, these data provide and empirical foundation for discussing the central question: *how, and to what extent, do institutional repertoires for public engagement make a difference to individual researchers' public engagement practices?*

The remainder of this section is structured as follows. First, we describe the measures developed in two datasets. Second, we present the results of the analysis. Finally, we summarise the patterns of public engagement identified.

4.1.1. Measuring public engagement in European HEIs and researchers

The SUPER MoRRI project performed two coordinated data collection exercises, the CCN-RPO and RESU studies, in 2021 and 2022 respectively, as described in Section 3 of this Report.

The aim of the CCN-RPO study was to examine a set of policy mechanisms through which European universities (HEIs) endeavour to enhance openness and responsibility in research. Mechanisms in central focus in the study included: 1) the overall strategic priorities of the RPO; and 2) the concrete organisational policies, supporting structures and actions related to gender equality (GE), open science (OS), public engagement (PE), research ethics and integrity (REI), the third mission (TM) and responsible research and innovation.

For each of the countries included in the CCN-RPO study, a selection of RPOs were selected for inclusion. Depending on the size of the country, either 2, 4 or 6 RPOs were selected. In each country, the local country correspondent (CC) carried out desk research on each of the assigned RPOs. The CC performed three major tasks:

1. study publicly available documents and websites relating to the strategic priorities, policies, and supporting documents and actions of the organization;
2. perform a limited number of e-mail inquiries to validate and complement the information collected through publicly available documents and websites; and
3. produce a written case report for each RPO in a template provided to the CC.

The core questions CCs were asked to answer in relation to PE are shown in Table 10.

Table 10: Parameters of policy analysis of Public Engagement in HEIs

Please note if Public Engagement is addressed in the overall strategy: Yes_____ or No_____ If yes, please describe in a few sentences, what the RPO aspires to achieve in this area:
Please describe in bullet points any concrete goals, targets, or performance indicators outlined in relation to this area (if any):
Please describe in bullet points any practical / operational implementation elements outlined to meet the goals (if any):
Please note, if the RPO has specific policies about Public Engagement: Yes_____ or No_____ If yes, please describe in a few sentences, what the RPO aspires to achieve in this area:
please describe in bullet points any concrete goals, targets, or performance indicators outlined in relation to this area (if any):
please describe in bullet points supporting structures outlined in relation to policies about Public Engagement (if any): please describe in bullet points supporting actions outlined in relation to policies about Public Engagement (if any):

A total of 120 case reports were coded by members of the SUPER MoRRI team. Four team members were continually part of the coding process. The coding process was conducted in three rounds. All case reports were coded inductively by one of the team members. Hereafter the coding was reviewed by the team and divided along s between the team members. Each team member then did a small literature review and used this and the inductive coding to develop a closed coding scheme. This coding scheme was test-coded using eight case reports, and cross-coded by two team members. Based on this coding, a third and final coding scheme was developed (as presented below). One team member coded the reports based on the closed coding scheme. To ensure coding reliability, team members swapped coded material and an ex-ante coding check was conducted.

Codes were developed by SUPER MoRRI team members in an iterative process including an inductive pre-coding and were informed by the studies and reports within the field (Ravn, Mejlgaard & Rask 2014, Arnstein 1969, Glass 1979, Rowe & Frewer 2005). The coding scheme reflects the concept of the public engagement ladder (Figure 1). There are four sub-categories in which policies, support structures and various policy statements where coded. First, all content related to Public engagement was coded as such. Text is then coded in terms of the subject matter. General engagement represents text that describes the organisations aims and activities with regard to public engagement at a low level of resolution and detail. Content focused on the communication of research to the public is coded as public communication. Content focused on including the public in two way communication is coded as public consultation and advice while content aimed at public participation in science is coded as public participation.

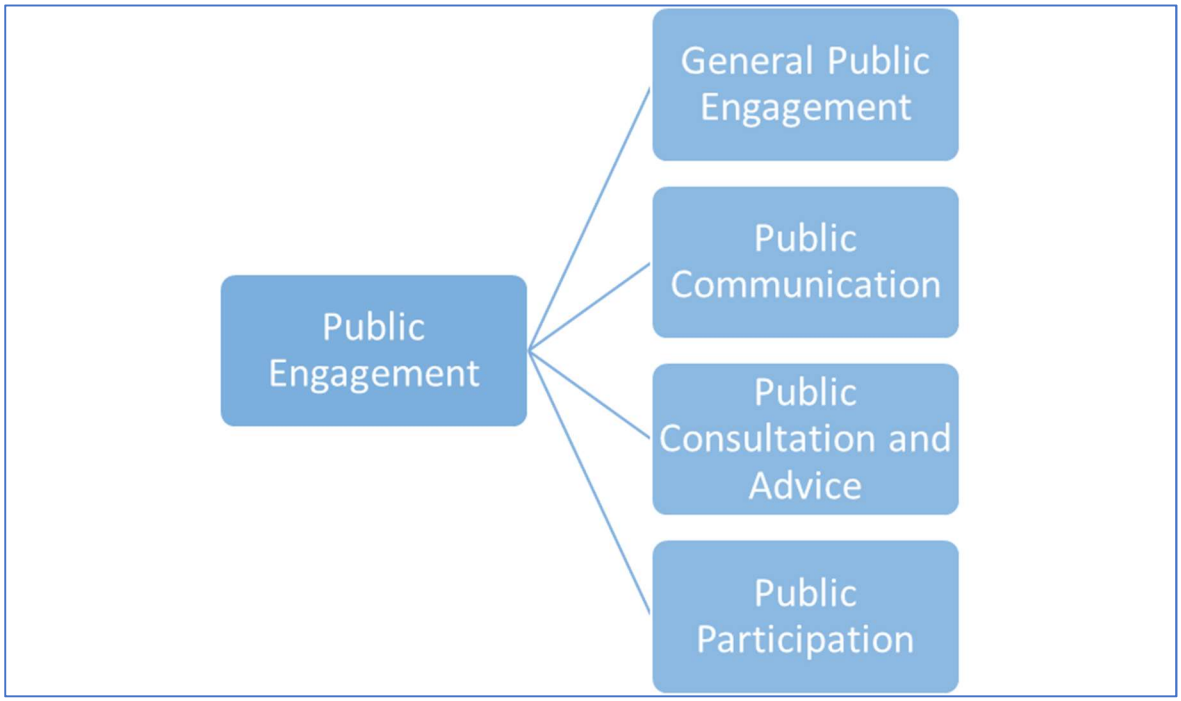


Figure 5: Strategic focus codes, public engagement with research (PER) study

A second layer of coding describes the type of policy mechanisms or practical implementation of policy. Practical Implementation Codes (PICs) (Table 11) were developed jointly and utilised for all four strategic focus sub-codes. Thus, a coded piece of text has both a strategic focus code (Figure 5) and a practical implementation code (Table 11). By discussing these extensively beforehand, coding reliability proved to be high in the *ex-ante* coding check. Each code reflects a different type of support structure, action, or communication of intention, related to public engagement.

Table 11: Practical implementation codes, public engagement with research (PER) study

Practical Implementation Codes (PICs)
Awareness campaigns
Dedicated unit
Events
Expressed aims (eg. Mission statement or broad declaration of intent)
Funds/funding
Infrastructure
Networks
Policy targets
Recommendations and suggestions
Reference to networks, alliances, etc.
Reporting of progress
Rewards and recognition
Rules and requirements
Training

4.1.1.1. Measuring the public engagement repertoires of HEIs

Table 12 provides an overview of the public engagement repertoires of the 120 European HEIs. PICs are divided into aims, policy instruments for supporting PE, and policy instruments for supporting and incentivising PE. The first category reflects expressions of intent without any specific or tangible goals and policies. The second includes "soft" policies such as providing recommendations and guidelines for PE, setting policy targets, arranging events and similar. The third includes rewarding and recognising PE activities through promotion, prizes etc. as well as providing training, and targeted funding for PE projects.

Table 12: Public engagement repertoires in HEIs

Category	Policy Mechanisms	PE general	PE communication	PE consultation	PE participation	No PE
No policy	-	48	38	90	94	26
Aims	Expressed aims Awareness campaigns References to (international) networks, alliances, etc.	23	21	24	12	-
Support	Networks Policy targets Events Recommendations and suggestions Reporting of progress	18	26	3	7	-
Support & incentives	Rewards and recognition Rules and requirements Training Infrastructure Dedicated unit Funds/funding	31	35	3	7	-
Total		120	120	120	120	-

These data show that the majority of HEIs refer to public engagement in their publicly available strategic material. Only 26 of the 120 RPOs did not mention PE, or concepts related to PE, on their institution website and available strategic documents. While many HEIs mention PE as an aim of their organisation, a much smaller fraction go beyond promoting the communication of science to the general public. Similarly, policy that provides tangible support and incentives to the researchers are also rare. In particular, this is the case when it comes to PE on the top of the ladder (participation and consultation.

It is difficult to provide a measure that captures the scope and variability of PE policy. The repertoires of HEIs are not easily translated into a single number or group. Yet, to investigate PE repertoires further, we create a simple variable that counts the number of different types of practical implementations within each of the four sub-areas of PE (variety in the figure below). This reflects the variety and scope of the PE repertoire of the RPO. Figure 6 shows the distribution of the measure of number of distinct policy instruments used in the RPO.

The distribution illustrates the story above, a handful of RPOs do not have any policy mechanism to support public engagement, the majority have between 1-6 different policy mechanisms and a small group have a diverse set of policy mechanism to support and promote public engagement. This diversity is interesting as it could relate to the action space researchers have for engaging with the

public when doing research, both in terms of sense of pressure, but also in how supportive they experience their organisation to be.

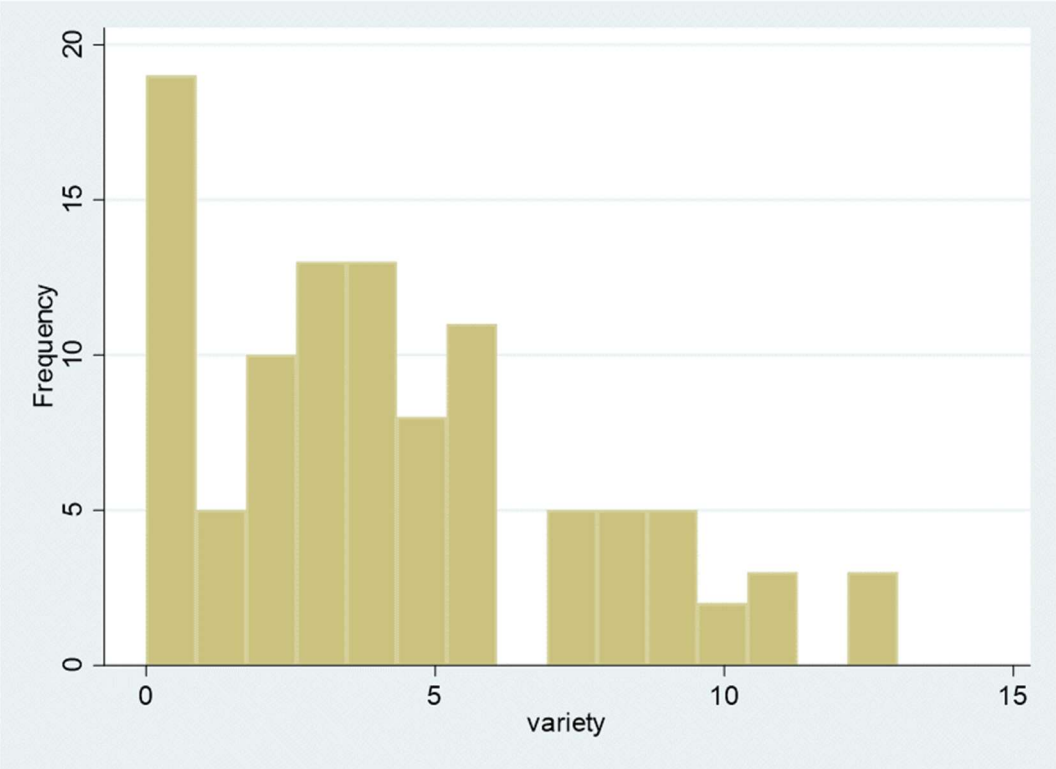


Figure 6: Distribution of PE policy instruments in 120 European HEIs

4.1.1.2 Measuring public engagement among European researchers

To shed light on European researcher's public engagement behaviour we draw on the SUPER MoRRI researcher survey (RESU) dataset. The sample of survey participants was based on the identification of (active) researchers from the HEIs included in the CCN-RPO study. The researcher survey asked respondents how often they have included non-researchers in their research (e.g. citizens, consumers and patients). Those that report doing were then also asked in which parts of their research they involved these actors (e.g. problem identification, data collection, deliberation of results and communication of research). Finally, they were asked how often they engaged with non-researchers in their past and current research projects.

Table 13 illustrates the number of researchers in the sample that report engaging with the public and at what level they do so. A categorical variable with four categories is defined by responses to a series of survey questions. If respondents answer that they have engaged with Citizens, CSOs or consumer or patient groups in the last three years, they are categorized as either 'public communication', 'public consultation' or 'public participation'. If they have not engaged, they are categorized as 'no public engagement'. The distinction between communication, consultation and participation depends on the type of interaction they report to have had with one or more of the groups. Respondents are coded as 'participation' if they answer that they have involved citizens in the development of research agenda; as 'consultation' if they have discussed the consequences of research / its application (including technology assessment) with citizens; and as 'public communication' if they have engaged in dissemination and presentation of research results to citizens.

The categorisation attempts to follow the logic of the public engagement ladder, where one-way communication to the public is on the lowest level and involving the public in decision making is on the highest level. Thus, the more intensive and collaborative the interaction, the higher on the ladder. The majority engage in public communication, while only a minority engage with the public on "higher steps of the ladder".

In terms of frequency of PE activities there is a skewed distribution. A total of 11% of respondents have engaged in some form of public engagement in all of their recent projects, 30% in some, 40% in a few and 27 % in none at all. In total, 74 % of the sample report to engaging in some form of PE.

Table 6 illustrates that there are some clear divides between the fields of science: Social scientists and medical and health scientists are the most prolific in terms of public engagement. They are both more likely to engage with the public and to engage beyond communication of research. That likely relates to the epistemological and historical properties of the fields and sub-fields.

Table 13: Public engagement ladder, researchers in European HEIs

Public engagement category	**Number of researchers**	**Percentage of researchers**
No Public engagement	1,108	26.5
Public Communication	1,596	38.2
Public Consultation	684	16.4
Public Participation	792	19.0
Total	4,180	100.1*

*Does not add up to exactly 100 because of rounding.

Table 14: Public engagement frequency, researchers in European HEIs

Public engagement frequency	**Number of researchers**	**Percentage of researchers**
No public engagement	1,108	26.5
In few projects	1,654	39.6
In most projects	960	23.0
In all projects	458	11.0
Total	4,180	100.1*

*Does not add up to exactly 100 because of rounding.

Table 15: Public engagement frequency, researchers in European HEIs, by field of science

Field of science	No Public engagement	Public Engagement
Structural Sciences (Mathematics, Informatics, Logic)	0.56	0.44
Natural Sciences (Physics, Chemistry, Geosciences, Astronomy, Biology)	0.38	0.62
Engineering and Technology	0.28	0.72
Agricultural and Veterinary Science	0.23	0.77
Arts and Humanities	0.23	0.77
Others	0.21	0.79
Social Sciences and Economics	0.18	0.82
Medical and Health Sciences	0.14	0.86

4.1.1.3 The empirical relationship between public engagement repertoires of HEIs and the public engagement activities of researchers

In this section, we provide an analysis of the empirical relationship between organisational repertoires and researchers' public engagement practices. We examine a subset of 42 HEIs from which a sufficiently large number of researchers responded to the researcher survey. The average percentage of researchers engaged with the public in each HEI is illustrated in the Figure 7 (av_pe).

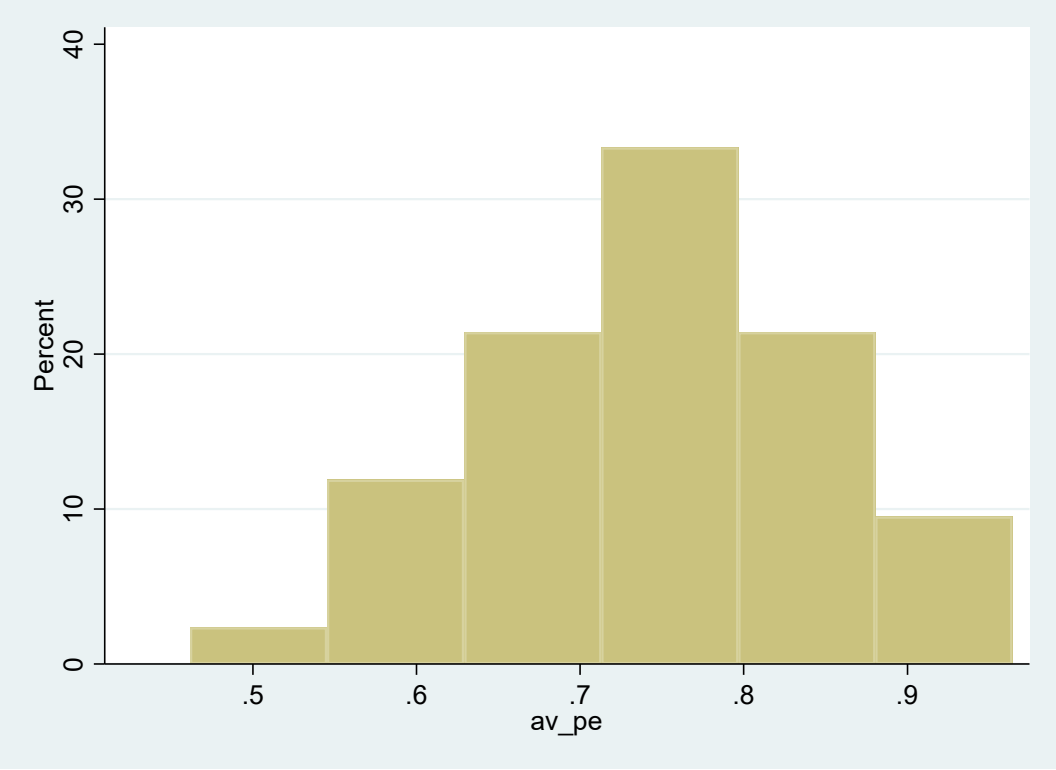


Figure 7: Proportion of staff engaged with the public in 42 European HEIs

Figures 8-10 show the relationship between variety of RPO public engagement repertoires and three measures of public engagement. Figure 8 shows average public engagement plotted with the number of policy mechanisms employed in the HEI. The plot indicates a positive correlation between the variety of policy mechanisms in HEIs repertoires and the proportion of its staff who engage with the public. However, it is also obvious from the plot, that public engagement can be high in RPOs with a less varied public engagement repertoire.

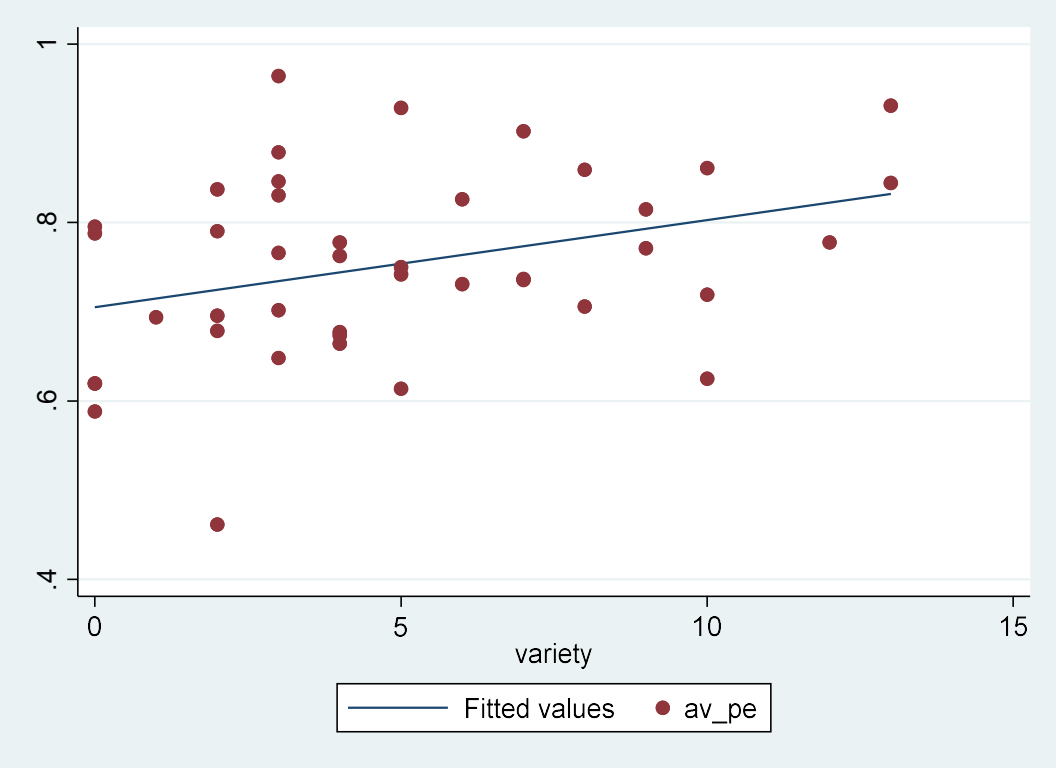


Figure 8: Average public engagement among staff by variety of public engagement policy mechanisms in 42 European HEIs

Figure 9 plots variety with average public engagement frequency. A similar picture emerges of a positive relationship between how often researchers in a HEI engage with the public and how varied the PE repertoire is. Figure 10 plots the average step on the public engagement ladder for each HEIs researchers [where no PE=0, public communication=1, public consultation=2 and public participation==3). Again a similar picture shows that RPOs with a varied repertoire have a higher number of researchers engaged at the higher steps on the public engagement ladder.

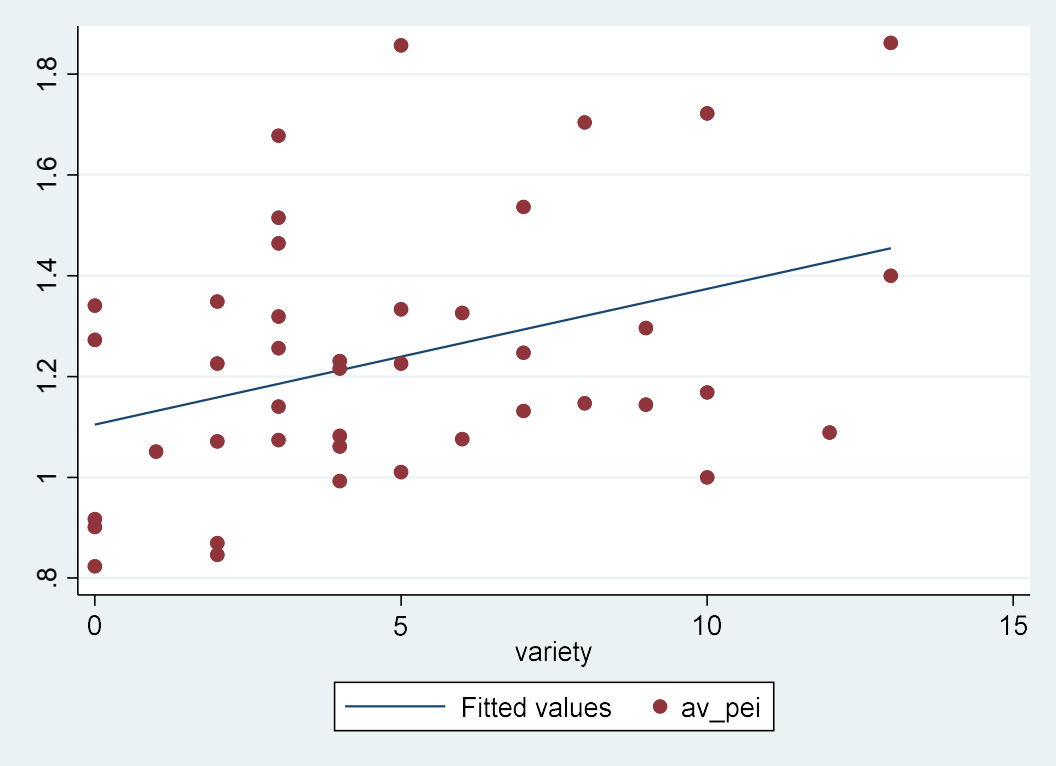


Figure 9: Average public engagement frequency among staff by variety of public engagement policy mechanisms in 42 European HEIs

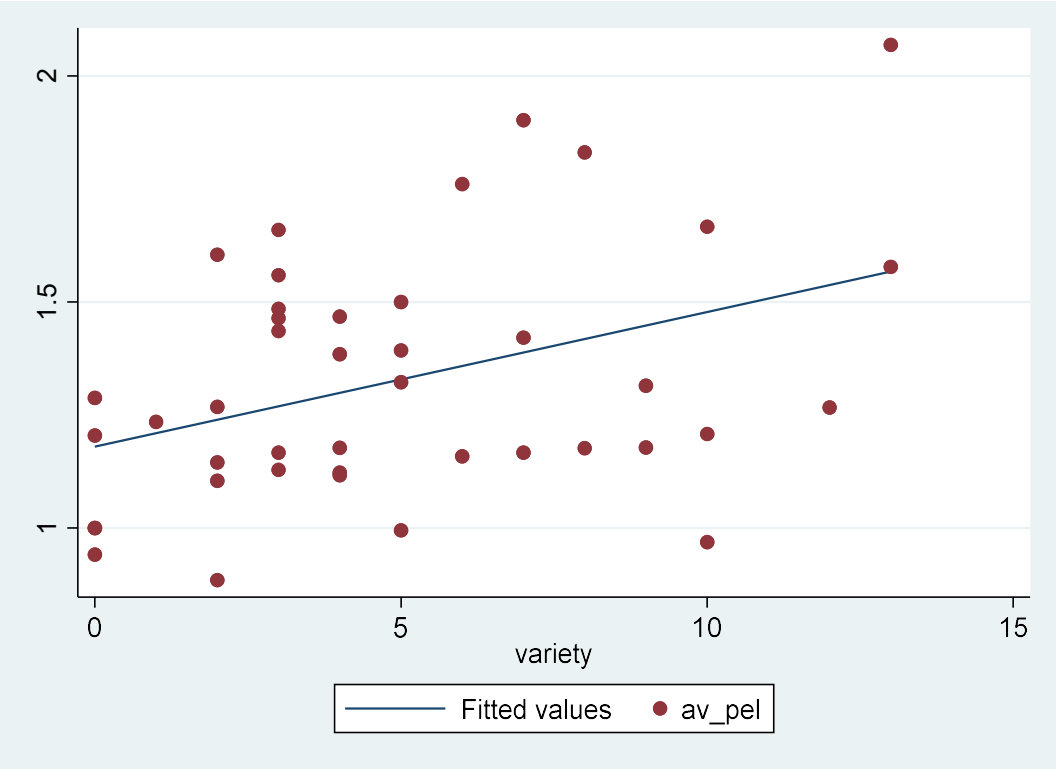


Figure 10: Average public engagement ladder among research staff by variety of public engagement policy mechanisms in 42 European HEIs

Figures 8-10 together provide a robust indication that there is a positive relationship between the variety of public engagement repertoires and researchers' public engagement practices.

4.1.2. Patterns of public engagement in HEIs in Europe

Public engagement is an important dimension of openness and responsibility in research and innovation that enhances the integration of societal stakeholders and citizens in R&I and deepens the alignment between the diverse interests and objectives of all actors in the R&I system. Monitoring patterns public engagement activities and motivation can thus support all stakeholders who are working to promote such institutional transformation. It can also provide opportunities to communicate and interest additional actors to expand the community of practice around public engagement. The SUPER MoRRI PER case study generates a novel approach to monitoring public engagement by combining organisational and individual researcher datasets to create pattern outputs.

- There is considerable variety in the extent and variety of European universities' policy commitments to public engagement.
- A majority of researchers in European universities report engaging with the public.

- A majority of researchers engage in public communication activities, while only a minority engage with the public on what we term “higher steps of the public engagement ladder”.
- At organisational level, institutional conditions for public engagement effect researcher performance. The public engagement repertoires of HEIs have a positive relationship with their employees’ propensity to practice public engagement and the type of public engagement that they practice.
- There is considerable heterogeneity evident in the relationship between organisational support for PE and researchers’ participation in PE activities. Researchers’ participation in PE can also be strong in institutional contexts characterised by relatively lower levels of support for PE.
- There are some clear differences in patterns of PE between fields of science. Social scientists and medical and health scientists are the most involved in PE. Researchers in both these fields are more likely to engage with the public and to engage further up the ‘ladder’, beyond communication of research. These results likely reflect the epistemic and social organisation of science fields and sub-fields.
- This section reported the combined use of two datasets from two different SUPER MoRRI studies (CCN-RPO, RESU). The study combines data on HEI support for PE and researchers’ performance of PE. This study can be replicated for the other markers of open and responsible research and innovation investigated in the researcher survey namely open science, gender equality, and research ethics and integrity. Additional analyses will be included in the 3rd Monitoring Report and presented at PROMISE focusing these additional areas.

4.2 Public value research careers (PVRC)

The public value research careers study (PVRC) investigated how patterns of practices and motivations associated with open and responsible research and innovation are affected by the career stage of researchers. 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 open and responsible research and innovation 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 refer to this intersection between the take-up of open and responsible research and innovation and researchers’ career trajectories.

Conceptually, the PVRC study 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) (See D5.3 for a full description). 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 engagement with open and responsible research and innovation thus needs to take these differences into account. As research careers evolve so do opportunities to introduce and develop aspects of openness and responsibility in a variety of professional contexts.

Table 16: Research career attributes and public values

Attribute: Invent, adopt, train	Public value practice examples	Public value mechanism	Public values
Gender content analysis	Consideration and integration of gender issues in the design of research	Research outcomes that address both women and men	Equality Fairness Legitimacy
Open Science practices	FAIR data, open-source tools, shared in scientific community and beyond Rapid data sharing & dissemination Documentation of methods	Efficient knowledge production, enhanced inclusion of stakeholders Accelerated responsiveness to societal challenges Reproducibility of results	Efficiency Transparency
Public Engagement practices	Science communication Collaboration with non-academic actors	Diffusion of research results Co-creation of research agendas Co-production of knowledge	Legitimacy Efficacy
Research ethics & integrity practices	External ethics approval acquired Research data management plan Pre-registration of research approach	Assessment of potential harm Process for protection of personal information Reduction in questionable research practices (QRPs)	Integrity Privacy Fairness

Table 16 illustrates the connection between four different markers of open and responsible research, research practices, value creation mechanisms, and public value contributions. An attribute refers to open and responsible research practices that can be considered to contribute to enhancing the 'public value' of a researcher's 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.

This remainder of this section provides an overview of patterns of researchers' engagement with open and responsible research and innovation by research career stage. It uses data from the SUPER MoRRI researcher survey (RESU) study. The section first presents an overview of the survey respondents by career stage and provides descriptive data on their perceptions of what is included in open and responsible research and innovation. This is followed by examples of using data on public engagement and open science to monitor the public value contributions of researchers at different career stages.

4.2.1 Researcher survey (RESU) study respondents and career stage

The researcher survey used the European Commission framework for research career stages (EC 2011) to differentiate among respondents. 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 17 shows the distribution of respondents by career stage.

Table 17: Researcher survey (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	1,168	34.8	70.9
R4: Leading Researcher	977	29.1	100.0
Total	**3,360**	**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 was leading researchers (R4). The smallest group of respondents was 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 11).

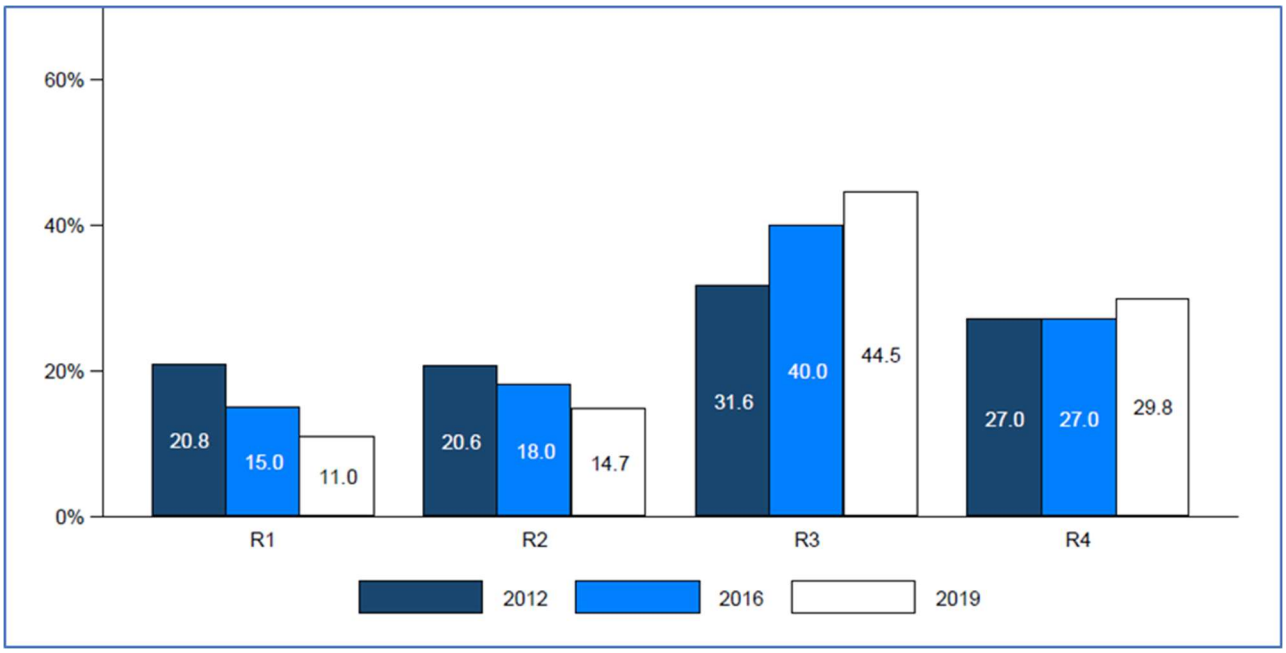


Figure 11: Career stage of respondents, MORE surveys*

* 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 women and men respondents, the largest sub-group is the R3 Established Researchers and the smallest sub-group is 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 18).

Table 18: Gender of researcher survey (RESU) respondents, by career stage

		R1: First Stage Researcher	R2: Recognised Researcher	R3: Established Researcher	R4: Leading Researcher	TOTAL
Women	Count	253	334	456	333	1,376
	% 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	1,827
	% 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	3,352
	% 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%) (Table 19). 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 19: Scientific field of researcher survey (RESU) respondents, by career stage

Field		**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 & Veterinary Science	Count	17	26	42	36	121
	%	3.20%	3.80%	3.60%	3.70%	3.60%
Engineering & 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 & Economics	Count	120	162	288	197	767
	%	22.60%	23.70%	24.70%	20.20%	22.80%
Arts & 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	1,167	976	3,357
	%	100.00%	100.00%	100.00%	100.00%	100.00%

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

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).

Overall, there was a clear ranking of 'fact finding' as the number one role. . Fact finding was the first ranked role of a majority of respondents (64.6%), followed by reflexive scientist and knowledge broker. 'Agenda setting' and 'participation facilitation' were ranked interchangeably as the fourth and fifth most important job roles.

The role composition of academic occupations did not vary by career stage Established (R3) and Leading (R4) researchers were more likely to rate reflexive scientist as their primary role compared to First Stage (R1) and Recognised, 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 the concept of 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 the concept of RRI were relatively consistent when comparing career stage groups. However, 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).

Some differentiation in patterns of what is considered part of the concept of RRI could thus be seen when comparing career stages. While these differences were often not large, enough variation by career stage exists in these descriptive data to suggest that it is important to take this variable into account in trying to understand the 'public value' of research careers.

4.2.2 Researcher participation in public engagement and career stage

Respondents were most 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 20 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 20: Researchers' cooperation with societal stakeholder, by career stage

Stakeholder type	R1	R2	R3	R4	TOTAL
Citizens	45,8%	54,1%	58,7%	64,5%	57,3%
Government	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 all stakeholders	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 21), we can see that slightly more than one-fifth of researchers (22.6%) reported cooperating with citizens in all or most of their projects.

Table 21: Researchers' cooperation with citizens, by career stage

Cooperation level		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%

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.

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 organisations) (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

4.2.3 Researcher participation in open science and career stage

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 22 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 22: Researchers' participation in Open Science practices, by career stage

Open science practice	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 all open science practices	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 23), 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 23: Researchers' participation in Open Access publication practices, by career stage

Participation level		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

4.2.4 Patterns of participation in public engagement and open science by career stage

This section has provided a brief overview of how career stage affects researchers' perceptions of open and responsible innovation and their participation in PE and OS practices. The data used were from the SUPER MoRRI researcher survey (RESU) dataset. Further career stage analyses for both PE and OS will be included in the Third Monitoring Report (D2.5, M56). In addition, career stage analyses for gender equality and research ethics and integrity will also be included in D2.5. A narrative presentation of the impact that career stage has on researchers' perceptions and practices of open and responsible research and innovation will be presented at the PROMISE portal. An overview of the public value research careers narrative is also included in the Pathways Study Report (D5.3).

- Initial exploration of data from the researcher survey shows mixed results regarding the effect of career stage on researchers' contributions to 'public value' through the practices they adopt.
- Motivations for undertaking PE activities are driven by the belief that it is part of good research practice and to maximise the impact of their research.
- First stage researchers are more likely to be strongly motivated by the desire to maximise the impact of their research than were respondents as a whole
- First stage researchers are also more likely to strongly motivated by a personal interest in better involving the public in research than respondents overall.
- Leading researchers are more likely to be collaborating with citizens than first stage researchers.

- More experienced researchers a more likely to have collaborated with societal stakeholders.
- Early career researchers are more likely to perceive open science as part of responsible research and innovation.
- 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 OS, however the differences are not large.
- It is difficult to disentangle the effect of having already had a longer career from motivations to participate in open and responsible research and innovation. Further exploration will seek to identify where a career stage effect appears to be most significant in shaping attitudes and practices.
- This section reported the use of the RESU dataset to develop monitoring data based on a 'public value' contribution model of research careers. Only part of the data available for PE and OS were described here. This study can be replicated for the other markers of open and responsible research and innovation investigated in the researcher survey namely gender equality, and research ethics and integrity. Additional analyses will be included in the 3rd Monitoring Report and presented at PROMISE focusing on these areas.

4.3 Gendered eco-innovations

The green economy and the promotion of gender equality are at the top of the EU R&I policy agenda and the deepening and widening of the new European Research Area (ERA) (EC 2020: EUCO 2021). In this SUPER MoRRI case study, these objectives are combined to investigate two broad innovation themes: 1) trends in patenting related to green technology; and 2) women inventors' participation in green-tech innovation.

The first stage of the Gendered Eco-Innovations study uses PATATAT patent data curated and upgraded in the GreenTech Database (GTDB)[4]. This database identifies patterns of eco-innovations via patent analysis based on respective EU patents geo-coded at national, NUT2 and NUTS3 levels. As part of Work Package 5 of SUPER MoRRI, the GTDB data on green technology groups (Table 24) was upgraded to include inventor gender. This new functionality allows the development of new information and indicators about women inventors in green innovation. The pattern analysis of the Gendered Eco-Innovations study addressed a knowledge gap as it refers to (largely) private sector innovation from the perspective of responsible innovation. Results from this study can be viewed in the 2nd Monitoring Report (D2.3). The outcomes of ongoing analyses will be included in the 3rd Monitoring Report (D2.5). The Gendered Eco-Innovations study also included qualitative case studies of individual women inventors. Details on this part of the study can be found in the Pathways Studies Report (D5.3).

[4] https://www.greentechdatabase.com/

Table 24: Green patents, by technology group

CPC Code	Description	Patent families (N)
Y02A	Technologies for adaptation to climate change	226011.103
Y02B	Climate change mitigation technologies (CCMTs) related to buildings, e.g. housing, house appliances or related end-user applications	162510.279
Y02C	Capture, storage, sequestration or disposal of greenhouse gases [GhG]	7762.178
Y02D	CCMTs in information and communication technologies [ICT], i.e. information and communication technologies aiming at the reduction of their own energy use	73831.546
Y02E	Reduction of greenhouse gas [ghg] emissions, related to energy generation, transmission or distribution	492671.436
Y02P	CCMTs in the production or processing of goods	423804.190
Y02T	CCMTs related to transportation	320036.985
Y02W	CCMTs related to wastewater treatment or waste management	200345.732

4.3.1 Patterns of gendered eco-innovations

The Gendered Eco-Innovation study provides data and information on responsible innovation based on patent data on green technologies. It also provides data and information on women inventors' participation in patenting green technologies. These data will be made available at the national level in the PROMISE portal.

- There are 1,906,973.41 patent families in PATSTAT 2020a that are identified as related to climate change mitigation and adaptation (tagged with the Y02 CPC class, called "green"), from 1971 to 2020.
- The number of new green technology patents has been increasing rapidly, particularly since 2005.
- Green patenting activities are concentrated in North America, Europe, India, China and Australia.
- In Europe, pattern analysis at the NUTS3 level for the period 1971-2020 shows Germany is the leading country in green patent families, followed by France. North-west Europe and Scandinavia were also relatively highly productive areas for green patenting in this period.
- The number of women inventors in green technology patenting has been rising strongly since around 1995, but has accelerated markedly since 2005.
- The ratio of women inventors has been rising in all technology groups of patents, particularly since 2000. This growth rate of this ratio can be described as moderate and steady.
- At country level, the ratio of women inventors is highest in Brazil, Columbia, Russia, Mali, Nigeria and Iran.

- In Europe, pattern At the NUTS3 level in Europe, the ratio of women inventors in green technology patents is relatively high in the Baltic and Eastern Europe regions.
- This section summarised work on responsible innovation and gender using a secondary patent dataset. These data will be used to provide indicators for the PROMISE portal on patterns of responsible innovation, including gender participation. Planned indicators are described in the 2nd Monitoring Report (D2.3, section 8.4). Full descriptions of the final selection of indicators and the mode of their presentation will be presented in the 3rd Monitoring Report (D2.5, M56).

4.4 Researchers and gender equality in research

This section provides an insight into patterns of open and responsible research and innovation that can be derived from the Research Survey (RESU) study. Details of the variables contained in the RESU dataset are contained at section 3.3 of this Report. The data used in this section are related to the Gender Equality (GE) marker of open and responsible innovation. The following section provide overviews of researchers' reported GE practices, motivations, barriers, and benefits. It also highlights country level comparisons for researchers' most popular reported GE practice and strongest reported motivation for GE activities.

4.4.1 Gender equality aspects in research

Researchers' were asked about five main aspects of integrating GE into research. A majority of respondents reported including these different aspects. Table 24 shows the number and percentage of respondents who reported integrating these aspects into their research. The figures in Table 25 include researchers' who reported including these aspects in 'all', 'some' or 'a few' of their research projects.

Table 25: Researchers who report including gender aspects in their research

Gender equality aspects of research	**N.**	**%**
Gender-balanced research team	2,322	67,0
Gender in research design	2,031	58,8
Gender in research implementation	1,952	56,8
Gender in data analysis	1,878	54,5
Gender in results dissemination	1,662	56,8
Average		58,8

A total of 26.7% of researchers reported achieving gender-balanced research teams in all their projects. A total of 21.9% of respondents reported including GE aspects in research design in all their projects. The GE aspect that was least likely to be reported as being included in all projects was results dissemination (17.6%).

4.4.2 Motivations for integrating gender equality aspects in research

The strength of researchers' reported motivations for including GE aspects in their research varied widely between a 'belief that GE is good research practice' (75.3%) and the availability of 'organisational rewards' (21.2%) (Table 26). The other motivation that was above the overall average was 'personal interest in GE in research' (60.7%). The most reported 'strong' motivations were good research practice (49%) and personal interest (37%).

Table 26: Researchers' reported motivations for including gender aspects in their research

Motivations for including gender aspects in research	**N.**	**%**
Legal requirement	1,405	42,7
Funder requirement	1,551	47,1
My organisation rewards this	693	21,2
Maximise reach and impact of my research	1,463	44,4
Believe it is good research practice	1,463	75,3
Personal interest in GE in research	1,999	60,7
Average		48,6

4.4.3 Perceived barriers to integrating gender equality aspects in research

There was also great variety in the barriers to integrating GE aspects in research that respondents were likely to report (Table 27). The most common barriers were 'not finding GE relevant for research' (45%), and 'no institutional incentives' (32.4%). All other barriers were reported as effecting less than one in five of the RESU respondents. In contrast, 21.7% of respondents 'strongly agreed' that the lack of relevance for their research was a barrier to integrating GE in research.

Table 27: Researchers' reported barriers to gender equality in research

Barrier	**N.**	**%**
My university does not support Gender Equality activities	438	13,1
No institutional incentives to promote Gender Equality activities	1,080	32,4
Considering Gender Equality negatively affects the quality of research	377	11,3
I did not find it relevant for my research	1,510	45,0
I am not sure how to do it	643	19,4
It is too time consuming	333	10,1
The benefits are too few for me	681	20,6
Average		21,7

4.4.4 Benefits of integrating gender equality aspects in research

The RESU dataset also contains information on benefits associated with GE in research that researchers reported having already observed (Table 28). The major benefit reported was the production of new findings that would not have emerged without the integration of gender aspects. This benefit was reported by one quarter of the respondents. A fifth of the respondents reported that they expected or had observed the emergence of new research topics and an enhanced social relevance of scientific outputs from integrating GE aspects in their research.

Table 28: Researchers' who report observing benefits from gender equality in research

Benefits	**N.**	**%**
Emergence of new research topics	655	20,0
Findings which would not have occurred without taking gender aspects into account	803	24,5
Enhanced visibility in the research community	487	14,9
Higher social relevance of scientific outputs	657	20,1
Higher quality of scientific outputs	613	18,7
Increased societal impact of my research	560	17,1
Mobilizing further research funding	341	10,4
Products & services with higher comparative advantage due to ensured gender suitability	206	6,3
More innovations, including social innovations	313	9,6
Inclusion of disadvantaged groups	605	18,6
Average		16,0

In addition to the benefits from GE observed by researchers, considerable additional benefits were *expected* in the future. A total of 35.5% of researchers expected benefits arising from the inclusion of disadvantaged groups due to the integration of GE aspects in their research. A total of 32.1% of researchers expected benefits arising from the increased societal impact of their research due to the integration of GE aspects. Relatively high levels of expected benefits due to integrating GE aspects were also reported for 'more innovations, including social innovations' (32.5%) and mobilizing further research funding (31.8%).

4.4.4 National level patterns of GE activities and motivations

This section illustrates two examples of national level patterns related to the integration of GE aspects in research.

Table 29 shows how researchers from different countries responded about the integration of gender-balanced teams in their research. High levels of 'always' using gender-balanced teams were reported by respondents in Cyprus, Ireland and Norway. Table 30 shows how researchers from different countries responded about the motivation that gender equality is part of good research practice. Highest levels of strong agreement that this is the case came from respondents in the UK, Ireland and Finland.

Table 29: Researchers' who report attempting to achieve a gender-balanced research team, by country (%, n=3,461)

Country	Attempted to obtain a gender-balanced composition of the research team?				
	Yes, in all project I have been part of	*Yes, in most of projects*	*Yes, in a few projects*	*No, in none of the projects*	*Total*
Austria	32,4%	29,7%	12,8%	25,0%	100,0%
Belgium	22,6%	19,2%	19,2%	38,9%	100,0%
Bulgaria	17,9%	28,6%	14,3%	39,3%	100,0%
Croatia	29,2%	12,5%	25,0%	33,3%	100,0%
Cyprus	44,4%	27,8%	16,7%	11,1%	100,0%
Czech Republic	13,8%	19,0%	20,7%	46,6%	100,0%
Denmark	30,0%	25,1%	15,2%	29,8%	100,0%
Estonia	23,7%	22,0%	23,7%	30,5%	100,0%
Finland	30,7%	23,8%	13,4%	32,2%	100,0%
France	26,2%	16,7%	28,6%	28,6%	100,0%
Germany	26,8%	26,0%	13,4%	33,8%	100,0%
Greece	25,7%	29,7%	13,5%	31,1%	100,0%
Hungary	18,5%	14,8%	18,5%	48,1%	100,0%
Ireland	40,0%	17,5%	16,9%	25,6%	100,0%
Italy	22,3%	22,9%	19,4%	35,4%	100,0%
Latvia	19,6%	25,5%	25,5%	29,4%	100,0%
Lithuania	16,1%	22,6%	25,8%	35,5%	100,0%
Luxembourg	21,4%	28,6%	28,6%	21,4%	100,0%
Malta	30,3%	15,2%	9,1%	45,5%	100,0%
Netherlands	21,9%	22,9%	17,2%	38,0%	100,0%
Norway	36,1%	21,3%	12,9%	29,7%	100,0%
Poland	19,0%	14,3%	17,5%	49,2%	100,0%
Portugal	18,9%	21,1%	24,2%	35,8%	100,0%
Romania	20,0%	30,0%	40,0%	10,0%	100,0%
Slovakia	17,6%	23,5%	41,2%	17,6%	100,0%
Slovenia	17,7%	23,4%	17,7%	41,1%	100,0%
Spain	26,7%	21,4%	20,6%	31,3%	100,0%
Sweden	26,8%	25,3%	17,4%	30,6%	100,0%
UK	29,7%	18,8%	18,8%	32,7%	100,0%
Other	25,0%	35,0%	10,0%	30,0%	100,0%
Total	26,7%	23,0%	17,3%	33,1%	100,0%

Table 30: Researchers' who report being motivated to implement gender equality because it is good research practice, by country (%, n=3,307)

Country	Gender equality is good research practice					
	strongly agree	*rather agree*	*rather disagree*	*strongly disagree*	*don't know*	*Total*
Austria	56,2%	19,2%	6,2%	9,6%	8,9%	100,0%
Belgium	38,4%	30,0%	8,9%	9,4%	13,3%	100,0%
Bulgaria	16,0%	40,0%	16,0%	16,0%	12,0%	100,0%
Croatia	38,1%	33,3%	9,5%		19,0%	100,0%
Cyprus	62,5%	25,0%		12,5%		100,0%
Czech Rep.	30,4%	12,5%	14,3%	21,4%	21,4%	100,0%
Denmark	48,7%	25,2%	6,6%	8,0%	11,5%	100,0%
Estonia	52,6%	22,8%	1,8%	8,8%	14,0%	100,0%
Finland	65,6%	18,5%	4,1%	4,6%	7,2%	100,0%
France	52,5%	27,5%	2,5%	15,0%	2,5%	100,0%
Germany	42,1%	28,5%	5,7%	10,1%	13,6%	100,0%
Greece	40,3%	30,6%	6,9%	6,9%	15,3%	100,0%
Hungary	41,7%	25,0%	12,5%	0,0%	20,8%	100,0%
Ireland	66,9%	19,7%	5,1%	1,3%	7,0%	100,0%
Italy	47,6%	26,9%	5,1%	10,9%	9,5%	100,0%
Latvia	35,4%	37,5%	10,4%	10,4%	6,3%	100,0%
Lithuania	44,4%	37,0%	7,4%	0,0%	11,1%	100,0%
Luxembourg	54,5%	36,4%	0,0%	0,0%	9,1%	100,0%
Malta	58,1%	22,6%	3,2%	3,2%	12,9%	100,0%
Netherlands	48,9%	27,2%	3,3%	8,2%	12,5%	100,0%
Norway	54,4%	26,6%	3,7%	4,1%	11,2%	100,0%
Poland	40,0%	23,3%	8,3%	11,7%	16,7%	100,0%
Portugal	47,7%	29,5%	8,0%	5,7%	9,1%	100,0%
Romania	40,0%	60,0%	0,0%	0,0%	0,0%	100,0%
Slovakia	21,4%	35,7%	14,3%	14,3%	14,3%	100,0%
Slovenia	32,9%	36,8%	6,6%	9,9%	13,8%	100,0%
Spain	48,8%	30,6%	5,8%	4,1%	10,7%	100,0%
Sweden	49,8%	25,1%	7,1%	6,8%	11,1%	100,0%
UK	68,1%	20,2%	1,1%	4,3%	6,4%	100,0%
Other	50,0%	25,0%	5,0%	10,0%	10,0%	100,0%
Total	49,0%	26,3%	6,0%	7,7%	11,1%	100,0%

4.4.5 Patterns of research engagement with gender equality in research

This section has provided a brief overview of how researchers report their involvement in gender equality aspects of open and responsible research and innovation. The data used were from the SUPER MoRRI researcher survey (RESU) dataset. Further analyses of GE aspects using the RESU dataset, plus analyses of PE, OS and REI aspects using these data will be included in the Third Monitoring Report (D2.5, M56). A selection of data and information using the RESU dataset will be presented at the

PROMISE portal. Details on the open availability of RESU data will also be specified in the Sustainability Plan (D7.5)

- A majority of researchers report including gender equality aspects in at least some part of their research.
- Inclusion of aspects of GE in research appears to occur quite evenly across the research cycle including design, implementation and dissemination.
- Resarchers are more strongly motivated to integrate GE in their research by personal beliefs and attitudes than due to institutional rules or incentives.
- Personal perspectives on the relevance of GE for research are also reported as a stronger barrier to integrating GE than institutional barriers.
- Researchers report having observed a number of benefits from integrating GE in their research. High levels of expectation of future benefits from integrating GE are also reported.
- This section reported the use of the RESU dataset to develop monitoring data based on a 'public value' contribution model of research careers. Only parts of the data available for PE and OS were described here. This study can be replicated for the other markers of open and responsible research and innovation investigated in the researcher survey namely gender equality, and research ethics and integrity. Additional analyses will be included in the 3rd Monitoring Report and presented at PROMISE focusing on these areas.

4.5 Research funding organisations shaping open and responsible research practices and cultures

This section provides an insight into patterns of open and responsible research and innovation that can be derived from the research funding organisation (CCN-RFO) study. Details of the CCN-RFO dataset are contained at section 3.2 of this Report. Initial results from the CCN-RFO study were reported in the 2nd Monitoring Report (D2.3). More results will be reported in the 3rd Monitoring Report (D2.5, M56). Work is ongoing to design presentations of data and information from the CCN-RFO study for the PROMISE portal.

Most public RFOs are the organisational expression of the multiple institutional processes required to allocate a percentage of a national or regional budget to scientific research. These processes are particularly interdependent with national fiscal and higher education policies and are often coordinated through a national science and research strategy. RFOs are thus embedded within a structure of authority relations (Whitley, Gläser and Engwell 2010) that influences the degree of autonomy they have to set strategy, design funding programmes and instruments, and implement assessment and grant award procedures. In addition to national funders, in the EU the European Commission (EC) is a major transnational public funder of research across Member States (and beyond), principally through its successive seven-year research and innovation framework funding programmes.

The CCN-RFO study examined the mechanisms through which research funding organisations (RFOs) enhance openness and responsibility in research and innovation. Mechanisms that were the focus of the study were:

1. setting priorities for research funding;
2. designing funding instruments; and

3. conducting assessments of grant proposals (research and researchers).

As research funding organisations (RFOs) are key actors in national system and have varying legal and administrative status, enjoy different degrees of institutional autonomy, and have diverse governance structures (Braun 1998), the scope and scale of their funding activities also uniquely configured according to national factors. Therefore the capacity of RFOs to set funding priorities, design funding instruments, and conduct responsible assessments is uniquely configured according to the institutional context in which they operate.

On the other hand, RFOs are also learning organisations interacting within a community of practice. In Europe, many of the major public RFOs are affiliated with Science Europe, a peak organisation that operates in their collective interest in terms of policy intelligence and development, knowledge sharing, and best practice exchange and support. Many other funders are members of, and work together through, the European Foundation Centre funder thematic groups. Whilst these horizontal learning processes could in theory lead toward a degree of institutional isomorphism, individual RFOs tend to retain their own characteristics aligned with existing political-economic organisation, cultural values, and societal expectations.

For these reasons direct comparisons between individual RFOs or RFOs operating in different national contexts do not have great value in monitoring to support open and responsible research and innovation. The focus of the CCN-RFO has therefore been to develop tools for monitoring RFOs contributions to open and responsible research and innovation as a systemic phenomenon. Nevertheless, selected patterns of RFO activity in relation to open and responsible research and innovation will be available by RFO type and European region (exact scale to be decided).

Participants in the CN-RFO study RFOs included a major public funding organisation from all EU-27 countries plus Norway and the UK. A second RFO also participated in the CCN-RFO study in 27 countries. Figure 12 summarises the participants by organisation type.

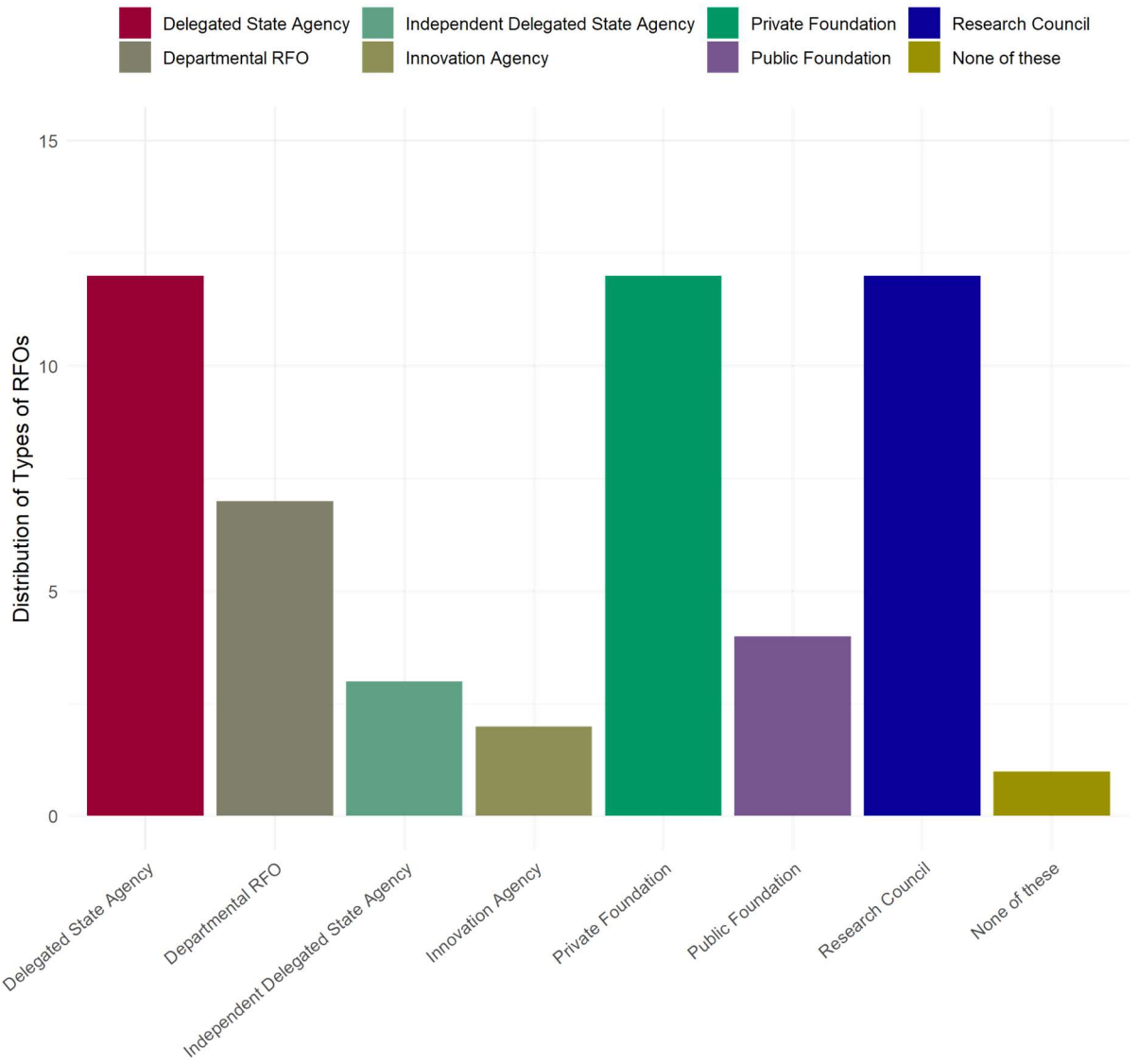


Figure 12: RFO participants in the CCN-RFO study, by organisation type

The CCN-RFO study was designed to develop our understanding of RFOs promotion of open and responsible research and innovation. The study sought to develop monitoring data and information about how RFOs work to shape open and responsible research practices and cultures. A very broad definition of what was meant by open and responsible research practices and culture was thus employed in the study (Table 31).

Table 31: Definitions of open and responsible research practices and cultures, CCN-RFO study

	Refers to all aspects of doing research
Open and responsible research practices	Aspects of how research is designed: *gender analysis; pre-registration; reflection on potential negative consequences; citizen science; non-academic partners; consultation with stakeholders about research questions or methods; co-creation of research problems, questions, and approaches with diverse partners; etc.* How a research design is implemented: *openness; reproducibility; research integrity; ethical conduct; transparency regarding design modifications; etc.* How research is reported and disseminated: *FAIR open data deposited; no publication fraud; no p-hacking; dissemination to participants and stakeholders; communication to the public; etc.*
	Refers to all aspects of the research environment
Open and responsible research cultures	Training of researchers: *open science; FAIR open data; principles of anticipation, inclusiveness, reflection and responsiveness (AIRR); societal readiness thinking tool; research integrity and ethics; cultural sensitivity; engaged research designs; etc.* Assessment of research and researchers: *Declaration on Research Assessment* (DORA) *Recognition of and reward for both researchers' scientific contributions and their societal contributions: employment; promotion; evaluation; grant proposal assessment; alternative CV formats and criteria for assessments of various types; etc.* Recognition of and reward for researchers' interdisciplinary contributions: *evaluation; grant proposal assessment; etc.* Shared and systemic valuing of responsible research practices Support for developing responsible professional competences by leadership at all levels of formal and informal organisation of research: *groups; specialisations; epistemic communities; scientific fields.* Formal support (incentives and rewards) for research careers that make both scientific and societal contributions: *universities; public sector research organisations; research funding organisation; accreditation agencies; evaluation frameworks; etc.* Formal support (organisational procedures) for responsible research cultures: *gender equality in hiring panels, ethics committees, management committees; etc.*

4.5.1 Patterns and repertoires of RFOs' support for open and responsible research and innovation

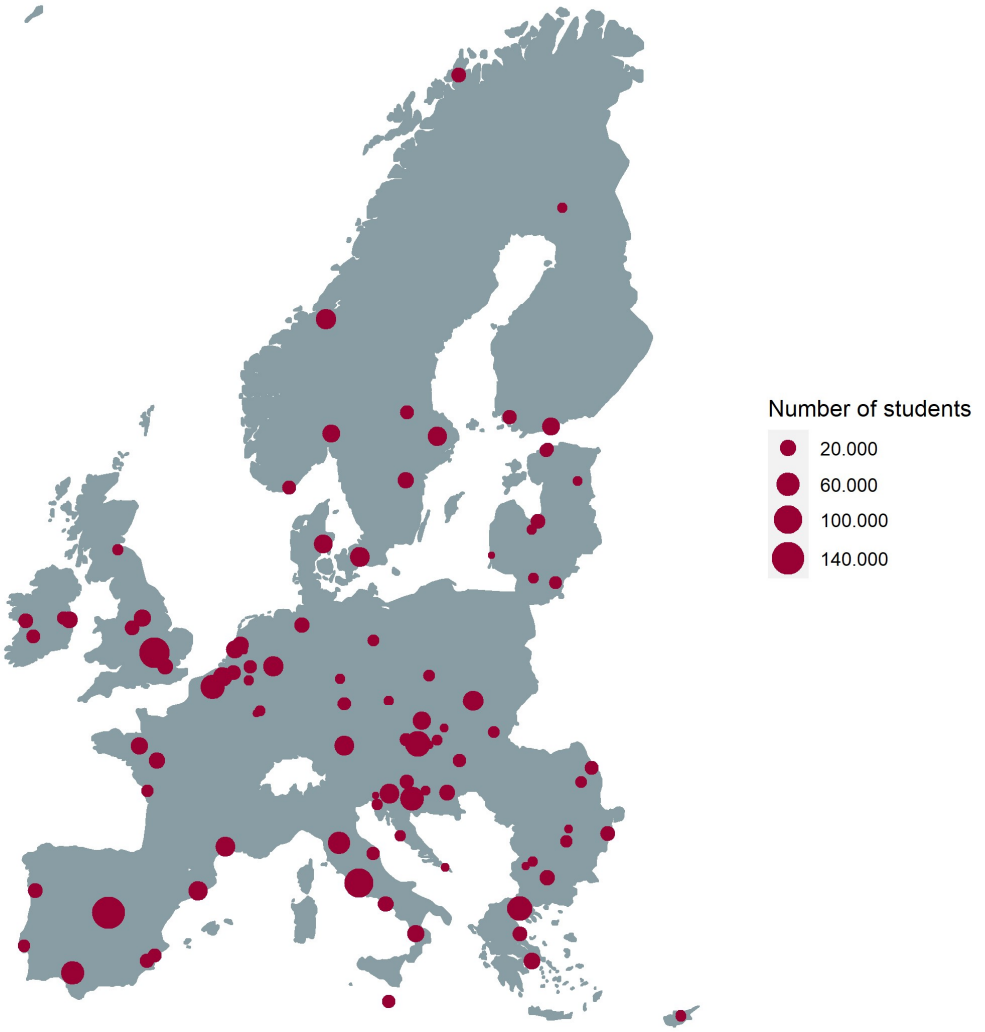
The CCN-RFO study provides data and information on open and responsible research and innovation based on the actions of research funding organisations (RFOs). This data and information is organised according to three main themes, research funding priority setting, design of research funding instruments, and the conduct of responsible research assessments. Details of the results of the CCN-RFO produced to date can be viewed in the 2nd Monitoring Report (D2.3, section 7).

- RFOs are most likely to have standalone policies for open science, gender equality and research ethics and integrity.
- Aspects of openness and responsibility that are most likely to be included in mixed policies of RFOs include societal impact, gender equality, communication and dissemination of results, and open science.
- A majority of RFOs include societal stakeholders in the governance structures that provide them with formal advice.
- Around one quarter of RFOs integrate a broad set of open and responsible research elements in their funding instruments and make them required criteria for funding.
- The largest group of RFOs (30%) include a core set of open and responsible research elements (3-4 elements) in their funding instruments, as a mix of required and preferred approaches.
- Another group of RFOs (27%) include a basic set of open and responsible research elements (1-2 elements) in their funding instruments, mainly as required approaches.
- A majority (60%) of RFOs have gender-balanced panels and include non-academic experts where appropriate in their organising of research assessments.
- A minority (30%) of RFOs provide training to reviewers regarding responsibility aspects such as gender bias and value interdisciplinarity and/or transdisciplinarity in assessments.
- Overall, half of RFOs consider responsible approaches in the formation of their assessment panels, while one third provide training and/or guidance on these aspects.
- This section summarised work on openness and responsibility in the work of research funding organisations. It only covered work to date on the results for RFOs use of strategic funding priorities, funding instruments, and research assessments to promote open and responsible research and innovation, as summarised in the 2nd Monitoring Report (D2.3).
- The CCN-RFO study dataset will be used provide further patterns of categorical variables, by RFO type and a level of regional granularity to be determined. These patterns will use the variables described in section 3.3 of this report and will be reported in the 3rd Monitoring Report (D2.5, M56). Visualisations of these results will be provided at the PROMISE portal.

4.6 Institutional support for open and responsible research and innovation in European universities

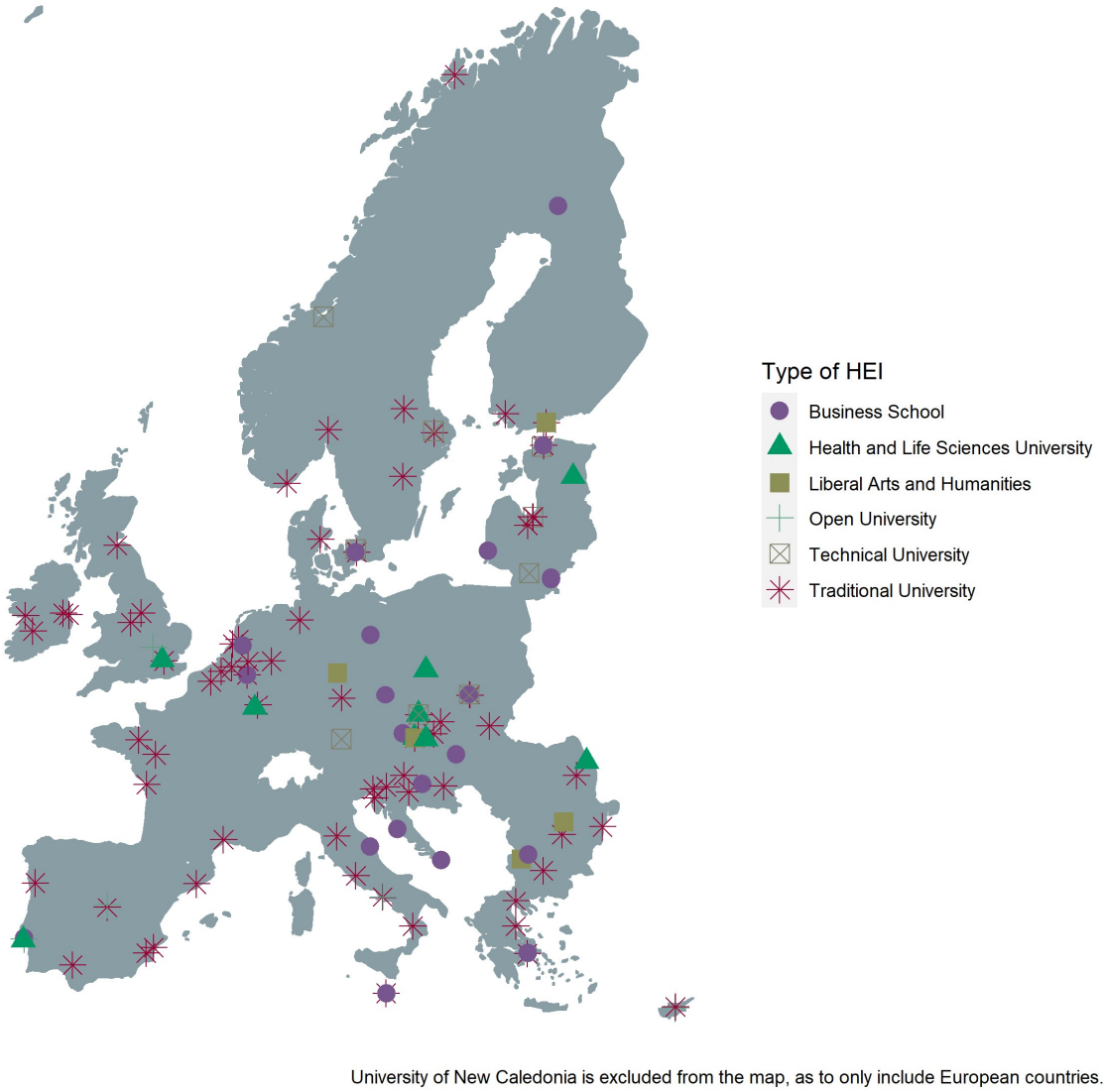
This section provides an insight into patterns of open and responsible research and innovation that can be derived from the research performing organisation (CCN-RPO) study. Details of the CCN-RPO dataset are contained at section 3.1 of this Report. Initial results from the CCN-RPO study were reported in the 2nd Monitoring Report (D2.3). More results will be reported in the 3rd Monitoring Report (D2.5, M56). Work is ongoing to design presentations of data and information from the CCN-RPO study for the PROMISE portal.

The CCN-RPO dataset was built from the public policy documents of a stratified sample of European universities (HEIs). Universities were included based on selection criteria including the size of countries' university sectors, number of students (Figure 13), orientation or type of the HEI (Figure 14), and the amount of Horizon 2020 funding the HEI had received (Figure 15). A full description of this selection process and of the CCN-RPO study methodology can be found in the Annotated Methodological Procedures Report (D2.4).



University of New Caledonia is excluded from the map, as to only include European countries.

Figure 13: Map of HEI sample for CCN-RPO study, by number of students



University of New Caledonia is excluded from the map, as to only include European countries.

Figure 14: Map of HEI sample for CCN-RPO study, by type of HEI

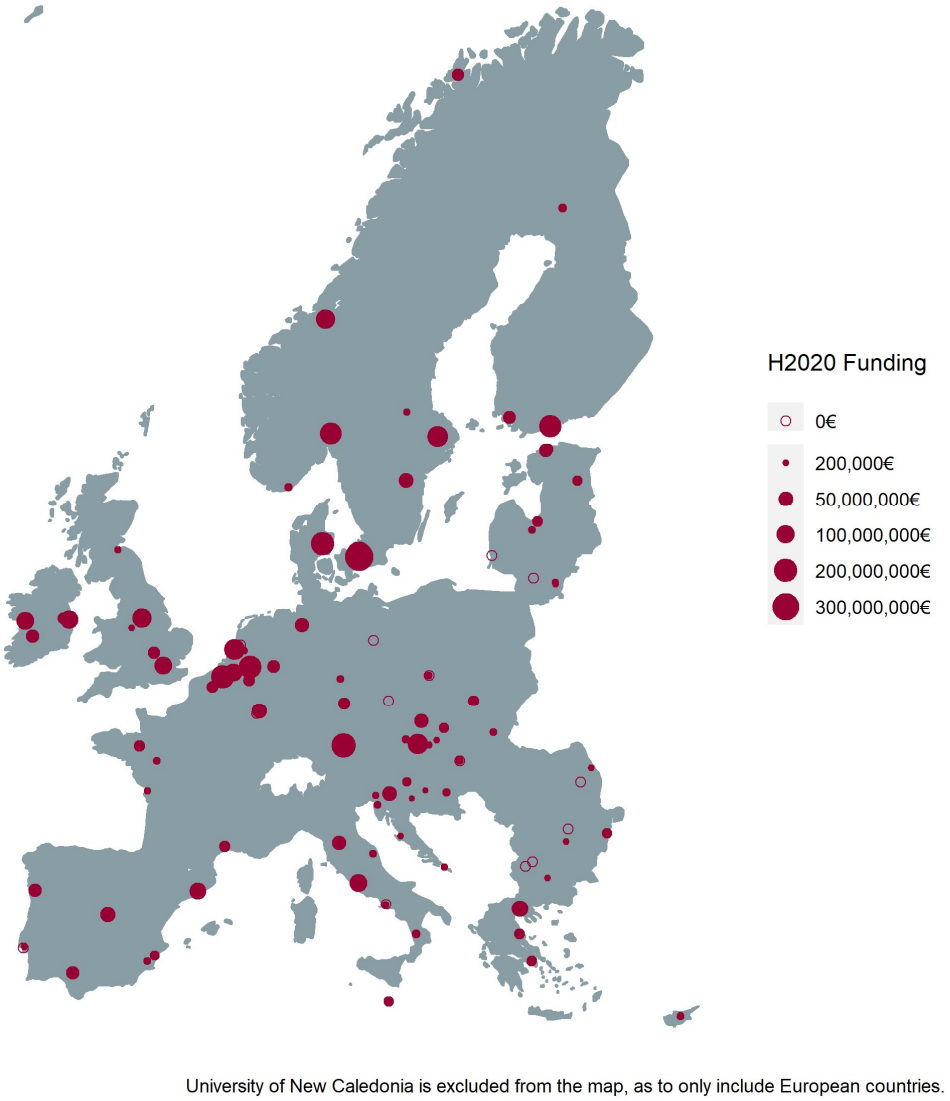


Figure 15: Map of HEI sample for CCN-RPO study, by amount of H2020 funding

4.6.1 Patterns and repertoires of RPOs' support for open and responsible research and innovation

The RPO study investigated policies for five markers of open and responsible research and innovation policy: gender equality (GE); open science (OS), public engagement (PE), research ethics and integrity (REI); and the third mission (TM).

- A majority of HEIs had dedicated policy for all five markers of open and responsible research and innovation. The strongest area of policy support was for REI, with 81% of HEIs having a specific policy available on their public website. This was followed by TM (73%), OS (69%), GE (64%) and PE (55%).
- A total of 77 HEIs include GE in their core policy and strategic documents. Of these, 40% were rated as giving GE a medium strategic priority.

- Among the HEIs that include GE in their core strategy documents, 44% were assessed as having a mainly practical approach in place compared to those that were rated as having a mainly aspirational approach (35%).
- A majority of HEIs have an OS policy (n=84) and a little more than half of these also highlight or mention aspects of open science in their core strategic documents.
- Of the HEIs with an OS policy, a small minority (11%) were assessed by the local CC as giving a high strategic priority to OS. The remaining HEIs who had an OS policy were even split in their rating between giving OS a low and medium strategic priority.
- Among the HEIs that include OS in their core strategy documents, 31% were assessed as having a mainly practical approach to OS in place, compared to 50% assessed as having a mainly aspirational approach.
- Of the HEIs with a PE policy, a minority (24%) were assessed by the local CC as giving a high strategic priority to OS. Of the remaining HEIs who had an PE policy, 41% were rated as giving PE medium strategic priority.
- Among the HEIs that include PE in their core strategy documents, 29% were assessed as having a mainly practical approach to PE, compared to 45% assessed as having a mainly aspirational approach.
- Of the HEIs with a REI policy, a minority (36%) were assessed by the local CC as giving a high strategic priority to REI. Of the remaining HEIs who had an REI policy, 43% were rated as giving REI a low strategic priority.
- Among the HEIs that include REI in their core strategy documents, 37% were assessed as having a mainly practical approach to REI, compared to 46% assessed as having a mainly aspirational approach.
- Of the HEIs with a TM policy, a majority (70%) were assessed by the local CC as giving a high strategic priority to the TM. Of the remaining HEIs who had a TM policy, 21% were rated as giving the TM a medium strategic priority.
- Among the HEIs that include TM in their core strategy documents, a majority (53%) were assessed as having a mainly practical approach to TM, compared to 27% assessed as having a mainly aspirational approach.
- Comparing the five aspects of open and responsible research and innovation policy development in HEIs, by far the highest strategic priority overall is the third mission. This reflects the long-standing expectation that universities actively seek to transfer knowledge and technology to society in order to generate economic and social impacts.
- Gender equality and research ethics and integrity are the areas that are most likely to be a high strategic priority in HEIs.
- When it comes to practical versus aspirational policies, the third mission is again the most highly developed as a practical policy domain, followed by gender equality.
- This section summarised work on openness and responsibility in the policies and strategies of European universities, summarising key findings reported in the 2nd Monitoring Report (D2.3). The CCN-RPO study dataset will be used provide further patterns of categorical variables, by RPO type and a level of regional granularity to be determined, which will be reported in the 3rd Monitoring Report (D2.5, M56). Data, information, and visualisations of CCN-RPO study results will be provided at the PROMISE portal.

This section has provided an overview of work in progress on pattern studies emerging from the primary data collections conducted by SUPER MoRRI. It also contained a summary of work in progress

on the curation and upgrading of a secondary dataset for a specific case study (gendered eco-innovations). The following section links the results summarised here to the model of expected impacts and benefits of different types presented in section 2 of this Report.

5 Markers of open and responsible research and innovation and societal, economic, democratic, and scientific benefits

This section connects the evidence of patterns of open and responsible research and innovation to expected impacts and benefits of different types. Section 4 summarised the results of six studies of the patterns of markers of open and responsible developed by the SUPER MoRRI project. In this section these findings are organised according to the six markers of open and responsible research operationalised in these studies: gender equality (GE), open science (OS) public engagement (PE), research ethics and integrity (REI), and the third mission (TM). For each of these five markers links are made to expected benefits of different types.

The connections to different democratic, economic, scientific, and societal benefits described in this section draw on the MoRRI project (D6), and the expected impacts of Horizon Europe WIDERA Work Programme. The connections to emerging benefits described should not be understood as limiting other interpretations as the data and information used in this Report do not shed light on the complex research, innovation, and social processes involved in moving from open and responsible research activities and interventions to impacts and benefits. Insights into the process dimension are reported in the Pathways Studies Report (D5.3).

5.1 Gender Equality

Monitoring gender equality provides data and information on progress in eliminating gender bias from science, research, and innovation. SUPER MoRRI pattern studies provide points of observation of this progress and can be linked to expected impacts of reducing and eliminating gender bias. Of course, reduction or elimination of gender bias can itself be understood as an intrinsic democratic and societal benefit. Such intrinsic benefits can take a multitude of different forms that are not limited in any way by the patterns observed here, or by our interpretations of relevant benefits.

Table 32 summarises the links between the SUPER MoRRI research programme, patterns of gender equality, and expected benefits. The steps between patterns observed and benefits described in this Report cannot be explained by these 'snapshot' data. However, our understanding is guided by the model of 'transducer' effects and the complex interactions between actors, results, outputs, and outcomes in open and responsible research and innovation described in Section 2.

It should be reiterated that the pattern studies results discussed in this Report represent work in progress completed to date. As has been emphasised at relevant points throughout the Report, a substantial set of further analyses and presentations of markers of gender equality can be produced from the various SUPER MoRRI datasets (Section 3). Further gender equality focused outputs will be forthcoming in the 3rd Monitoring Report, the Case Studies Synthesis Report (D5.4), and at the PROMISE portal.

Table 32: Patterns of gender equality contributing to benefits of open and responsible research and innovation

Study	Pattern identified	Benefit
Gendered eco-innovations	Increased number of women inventors in green technologies	Inclusion of women in research design & development improves quality of scientific outputs - Economic benefit Pluralisation of research topics and approaches, moving R&I toward society & market – Economic benefit Pluralisation of research topics and approaches, improving relevance of R&I outputs – Societal benefit
Researcher survey (RESU)	Aspects of gender equality included across the research cycle	Reduction in bias against women (in R&I, society) – Democratic benefit
	Researchers' personal commitment to gender equality more important motivator than rules	
	A majority of researchers include gender equality in their research	Diffusion of good practices promoting change in R&I projects and organisations – Democratic benefit
Research funding organisations (CCN-RFO)	Most research funding organisations have standalone gender equality policies or include gender equality in mixed policies	
	A majority of research funding organisations use gender-balanced panels in research assessment	
	A sizeable minority of research funding organisations provide training or guidance to reviewers on gender bias in assessments	
Research performing organisations (CCN-RPO)	Three quarters of European universities include gender equality in their core strategic documents	
	Almost half of European universities take a practical approach to implementing gender equality	

5.2 Open Science

Monitoring open science provides data and information on progress in opening up the products, tools, and underlying inputs of the R&I system, encouraging their re-use for the reproduction, exploration, and extension of research results. SUPER MoRRI pattern studies provide points of observation of this progress and can be linked to expected impacts of advancing open science. Open science takes a multitude of different forms and approaches that are not limited in any way by the particular patterns that are observed in this Report. Equally the benefits that we describe in this section should not be considered a comprehensive statement of the possible benefits, of different types, which can arise from the expansion of open science practices and cultures.

Table 33 summarises the links between the SUPER MoRRI research programme, patterns of open science, and expected benefits. The steps between patterns observed and the benefits described in this Report cannot be explained by these 'snapshot' data. However, our understanding is guided by the model of 'transducer' effects and the complex interactions between actors, results, outputs, and outcomes in open and responsible research and innovation described in Section 2.

The pattern studies results discussed in this Report represent work in progress completed to date. As has been emphasised at relevant points throughout the Report, a substantial set of further analyses and presentations of markers of open science can be produced from the various SUPER MoRRI datasets (Section 3). Further open science focused outputs will be forthcoming in the 3rd Monitoring Report, the Case Studies Synthesis Report (D5.4), and at the PROMISE portal.

Table 33: Patterns of open science contributing to benefits of open and responsible research and innovation

Study	Pattern identified	Benefit
Public value research careers (PVRC)	Two thirds of all researchers identify open science as contributing to open and responsible research and innovation; compared to three quarters of first stage researchers	Diffusion of good practices promoting change in R&I projects and organisations – Democratic benefit
	Nine out of ten researchers consider open science to be good research practice	Improved transparency, integrity, and reproducibility of research – Scientific benefit
	First stage researchers are the most likely to believe research must be open	
	One-third of researchers publish open access in all projects, a further third in most projects.	Diffusion of research results stimulates social innovation and situated problem-solving – Societal benefit Improved transparency, integrity, and reproducibility of research – Scientific benefit
	First stage and recognised researchers more likely to plan to make data open at the start of projects	Exploitation of shared research data stimulates creativity and innovation, facilitates more efficient use of resources – Economic benefit
Research funding organisations (CCN-RFO)	More than half of RFOs include some aspect of open science in their funding instruments, as a required or preferred approach	Diffusion of good practices promoting change in R&I projects and organisations – Democratic benefit
	Open science is the most common standalone policy at RFOs	Improved transparency, integrity, and reproducibility of research – Scientific benefit
Research performing organisations (CCN-RPO)	A majority of European universities make open science a high or medium strategic priority	Diffusion of good practices promoting change in R&I projects and organisations – Democratic benefit
	A third of European universities take a practical approach to implementing open science	Improved transparency, integrity, and reproducibility of research – Scientific benefit

5.3 Public engagement and the third mission

Monitoring public engagement and third mission provides data and information on progress in opening up of information flows between different parts of the research and innovation system and the public at large, and the involvement of societal stakeholders and citizens in research and innovation processes across the entire research cycle. SUPER MoRRI pattern studies provide points of observation of this progress and can be linked to expected impacts of advancing public engagement and the third mission. Public engagement and the third mission take a multitude of different forms and approaches that are not limited in any way by the particular patterns that are observed in this Report. Equally the benefits that we describe in this section should not be considered a comprehensive statement of the possible benefits, of different types, which can arise from the expansion of public engagement and third mission practices and cultures.

Table 34 summarises the links between the SUPER MoRRI research programme, patterns of open science, and expected benefits. The steps between patterns observed and the benefits described in this Report cannot be explained by these 'snapshot' data. However, our understanding is guided by the model of 'transducer' effects and the complex interactions between actors, results, outputs, and outcomes in open and responsible research and innovation described in Section 2.

The pattern studies results discussed in this Report represent work in progress completed to date. As has been emphasised at relevant points throughout the Report, a substantial set of further analyses and presentations of markers of public engagement can be produced from the various SUPER MoRRI datasets (Section 3). Further public engagement focused outputs will be forthcoming in the 3rd Monitoring Report, the Case Studies Synthesis Report (D5.4), and at the PROMISE portal.

Table 34: Patterns of public engagement and the third mission contributing to benefits of open and responsible research and innovation

Study	Pattern identified	Benefit
Public engagement with research (PER)	A majority of researchers in European universities engage with the public	Inclusion of citizens' perspective in R&I policymaking – Democratic benefit
	Institutional support positively effects the amount and types of researchers' public engagement activities	Diffusion of good practices promoting change in R&I projects and organisations – Democratic benefit
Public value research careers (PVRC)	A majority of researchers have cooperated with government, NGOs, and citizens, with cooperation becoming more frequent as the career advances	Pluralisation of connections between actors, fostering creativity – Economic benefit Increased understanding & grounds acceptance of stakeholder roles & contributions – Societal benefit Pluralisation of connections between stakeholders, improving awareness and shared understanding – Societal benefit
	First stage researchers are most likely to be motivated to involve the public in research	Inclusion of citizens' perspective aligns R&I better with societal expectations - Societal benefit
	Leading researchers are more likely to be collaborating with citizens than first stage researchers	
	Early career researchers are more likely to be motivated by the desire to maximise research impact	
Research funding organisations (CCN-RFO)	A majority of RFOs include societal stakeholders in their governance and advice structures	Pluralisation of actors involved in R&I decisions – Democratic benefit
	A majority of RFOs include non-academic experts where appropriate in research assessments	Pluralisation of actors involved in R&I decisions – Democratic benefit Diffusion of good practices promoting change in R&I projects and organisations – Democratic benefit

Research performing organisations (CCN-RPO)	More than half of European universities have standalone public engagement policy	Pluralisation of actors involved in R&I decisions – Democratic benefit Diffusion of good practices promoting change in R&I projects and organisations – Democratic benefit
	Three-quarters of European universities have a standalone third mission policy	Diffusion of good practices promoting change in R&I projects and organisations – Democratic benefit
	Nine out of ten European universities make the third mission and high or medium strategic priority	Diffusion of good practices promoting change in R&I projects and organisations – Democratic benefit
	Half of European universities take a practical approach to the third mission	
	Two-thirds of European universities give public engagement a high or medium strategic priority	
	Around one-third of European universities take a practical approach to public engagement	

5.4 Research ethics and integrity

Monitoring research ethics and integrity provides data and information regarding progress in creating a reflexive climate and procedural guidance around ethical issues, that can have democratic benefits in terms of developing an R&I system that is not prejudicial to the interests of society. It also provides data and information about immediate benefits for the conduct of science in terms of reduction in misconduct, in questionable research practices, and in undesirable research outputs. SUPER MoRRI pattern studies provide points of observation of this progress and can be linked to expected impacts of enhanced research ethics and integrity. Institutionalising research ethics and integrity includes informal practices and formal rules. Not all potential avenues for improving ethics and integrity in research are covered in Report. Equally the benefits that we describe in this section should not be considered a comprehensive inventory of the possible benefits, of different types, which can arise from a transformation in ethics and integrity in research and innovation.

Table 35 summarises the links between the SUPER MoRRI research programme, patterns of research ethics and integrity, and expected benefits. The steps between patterns observed and the benefits described in this Report cannot be explained by these 'snapshot' data. However, our understanding is guided by the model of 'transducer' effects and the complex interactions between actors, results, outputs, and outcomes in open and responsible research and innovation described in Section 2.

The pattern studies results related to research ethics and integrity discussed in this Report represent work in progress completed to date. As has been emphasised at relevant points throughout the Report, a substantial set of further analyses and presentations of markers of research ethics and integrity can be produced from the various SUPER MoRRI datasets (Section 3). Further REI focused outputs will be forthcoming in the 3rd Monitoring Report, the Case Studies Synthesis Report (D5.4), and at the PROMISE portal.

Table 35: Patterns of research ethics and integrity contributing to benefits of open and responsible research and innovation

Study	Pattern identified	Benefit
Public value research careers (PVRC)	Three quarters of researchers consider research ethics and integrity are part of open and responsible research and innovation	R&I system adopts and conforms to ethical standards – Societal benefit Diffusion of good practices promoting change in R&I projects and organisations – Democratic benefit Integration of ethics and integrity in research designs – Scientific benefit
Research funding organisations (CCN-RFO)	Exclusion of any conflict of interest is expected in the research assessment processes of all RFOs.	
	The vast majority of RFOs have a standalone research ethics and integrity policy; all RFOs include some aspects of REI in either standalone or mixed policies	
Research performing organisations (CCN-RPO)	Four-fifths of European universities have a specific publicly available research ethics and integrity policy.	
	One-third of HEIs with a REI policy make it a high strategic priority.	
	One third of HEIS with a REI policy take a practical approach.	

5.5 Summary

This section has compiled a selection of pattern markers that can be used for monitoring open and responsible research and innovation. It has then contextualised these markers in a model connecting open and responsible research and innovation practices and cultures to a normative conceptualisation of societal, economic, democratic, and scientific benefits. The accompanying Pathways Studies Report (D5.3) provides narratives and analyses of the 'hidden' processual dimensions underpinning the connective model that structures this Report. The exploitation of the SUPER MoRRI pattern studies datasets is far from complete. Section 3 of this Report provided details of the variables and dimensions available in these datasets that can be used to generate additional analyses of GE, OS, PE and REI in particular. Additional results will be presented in the 3rd Monitoring Report and at the PROMISE portal.

6. Conclusion

The purpose of this Pattern Study Report (D5.2) has been to highlight selections from the quantitative research conducted by the SUPER MoRRI project in order to generate data and information for a monitoring framework to support open and responsible research and innovation. The major objective of the Report has been to connect patterns of five markers of open and responsible research and innovation – gender equality, open science, public engagement, research ethics and integrity, the third mission – with societal, economic, democratic, and scientific benefits. These connections were made using an model of institutional transformation developed in the SUPER MoRRI project (Section 2) based on a review of theory-based models of research evaluation and impact assessment.

Benefits are normative and one of the advantages of this exercise is that it is not within its scope to consider all impact dimensions, whether these be positive, negative, or a mixture of the two. The expected impacts of research and innovation can be definition lead to unforeseen and potentially negative consequences. Modelling the benefits of open and responsible research and innovation takes a particular perspective by attempting to identify some dimensions of positive institutional change that are a consequence of adopting and experimenting with openness and responsibility in research and innovation.

After introducing the theoretical model (Section 2) and summarising the contours of the major SUPER MoRRI primary datasets (Section 3), the body of this Report built connections between empirical results along five dimensions of open and responsible research and innovation and a small number of benefits to both society and science. Attribution of these benefits is of course challenging, but for monitoring purposes this exercise is valuable in terms of potential learning and stakeholder engagement.

The vast quantity of monitoring data produced by SUPER MoRRI remains to be more fully exploited. The 3rd Monitoring Report will update some of the pattern studies results described here (D2.5, M56). A further analysis that integrates this Pattern Studies Report with the Pathways Studies Report (D5.3) is also forthcoming (D5.4, M58). A selection and curation process is also underway in terms of those elements of the datasets discussed here that will be use to power data, information and visualisation tools available at the PROMISE (www.promise4era.eu) portal.

Ultimately, a substantial proportion of the data and information that has been generated may remain unexploited until after the SUPER MoRRI project has been completed. The Annotated Methodological Procedures Report (D2.4) and the Sustainability Plan (D7.5) will provide the beneficiaries of the SUPER MoRRI datasets and methods with the necessary tools to take up the task of further exploiting these resources in the interests of expanding and updating the monitoring framework for open and responsible research and innovation.

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