



MORE4 study

Support data collection and analysis concerning
mobility patterns and career paths of researchers

Annexes to the final report

PPMI, IDEA Consult and WIFO
February 2021

*Research and
Innovation*

MORE4 study: Support data collection and analysis concerning mobility patterns and career paths of researchers. Annexes to the final report

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MORE4

Support data collection and analysis concerning mobility patterns and career paths of researchers

PPMI, IDEA Consult and WIFO



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1. ANNEX TO THE CONCEPTUAL FRAMEWORK: DEFINITIONS AND POLICY-DRIVEN DEVELOPMENTS COMPARED TO MORE3

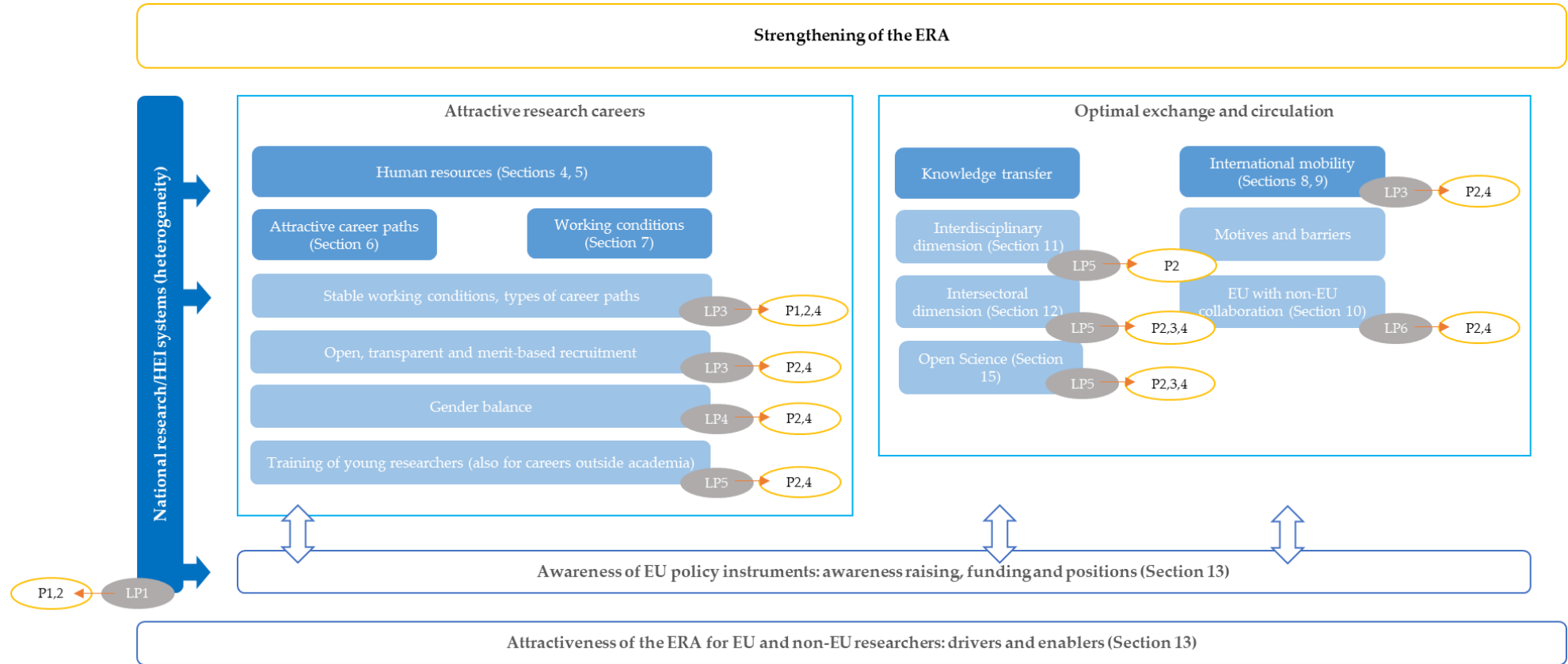
The conceptual framework (cf. Figure 1 below and Part 1, Section 3 in the MORE4 Final report) defines and structures a set of overarching concepts that are then applied consistently in the four different tasks of the MORE4 study. It is as such a tool for guidance in structuring and interpreting the findings in each of the tasks and integrating them in the final report. The conceptual framework is also strongly based on the framework in the MORE2 and MORE3 studies (2012 and 2016) for reasons of consistency and comparability^{1;2}.

The definitions of the concepts of mobility further take into account the existing standards or secondary sources so that comparability with other studies and contexts is maximised. In the following Sections 1.1.1 to 1.1.5, we repeat the definitions of a number of key concepts: researchers, different fields of science, research career stages and the type of mobility of researchers. Finally, Section 1.2 treats the refinements made to a number of concepts of career paths and working conditions, based on the identified evolution in the policy context.

¹ IDEA Consult et al. (2013). MORE2 - Support for continued data collection and analysis concerning mobility patterns and career paths of researchers, Final report. European Commission, DG Research and Innovation.

² IDEA Consult et al. (2017). MORE3 - Support for continued data collection and analysis concerning mobility patterns and career paths of researchers, Final Report. European Commission, DG Research and Innovation.

Figure 1: Conceptual framework in the policy context.



Source: MORE4

Note: LP – Legacy Priorities from ERA Communication 2012, P – Priorities from new ERA Communication 2020.

1.1. Definitions

1.1.1. Researchers

The main definitions on researchers in use derive from the Canberra Manual, covering Human Resources devoted to Science and Technology (HRST), and from the Frascati Manual, covering Research and experimental development and R&D personnel. These definitions have also been used in the previous MORE studies^{3;4;5}.

Definition from the Canberra Manual⁶:

- HRST: people who fulfil one or other of the following conditions:
 - Successfully completed education at the third level in an S&T field of study (HRSTE).
 - Not formally qualified as above but employed in an S&T occupation where the above qualifications are normally required (HRSTO).

Definitions from the Frascati Manual⁷:

- Research and experimental development (R&D):
 - "Research and experimental development (R&D) comprise creative and systematic work undertaken in order to increase the stock of knowledge – including knowledge of humankind, culture and society – and to devise new applications of available knowledge."
- R&D personnel:
 - "In broad terms, R&D personnel include highly trained researchers, specialists with high levels of technical experience and training, and other supporting staff who contribute directly to carrying out R&D projects and activities. [...], the scope of this concept encompasses all knowledge domains."
 - "R&D personnel in a statistical unit include all persons engaged directly in R&D, whether they are employed by the statistical unit or are external contributors fully integrated into the statistical unit's R&D activities, as well

³ IDEA Consult et al. (2010) MORE - Study on mobility patterns and career paths of EU researchers, Final report. European Commission, DG Research and Innovation.

⁴ IDEA Consult et al. (2013). MORE2 - Support for continued data collection and analysis concerning mobility patterns and career paths of researchers, Final report. European Commission, DG Research and Innovation.

⁵ IDEA Consult et al. (2017). MORE3 - Support for continued data collection and analysis concerning mobility patterns and career paths of researchers, Final Report. European Commission, DG Research and Innovation.

⁶ OECD (1995), The Measurement of Scientific and Technological Activities. Manual on the Measurement of Human Resources Devoted to S&T. "Canberra Manual", OECD, Paris. (Section 3.1.1.).

⁷ OECD (2015), Frascati Manual 2015: Guidelines for Collecting and Reporting Data on Research and Experimental Development, The Measurement of Scientific, Technological and Innovation Activities, OECD Publishing, Paris. DOI: <http://dx.doi.org/10.1787/9789264239012-en>.

as those providing direct services for the R&D activities (such as R&D managers, administrators, technicians and clerical staff). All persons employed directly on R&D should be counted, as well as those providing direct services such as R&D managers, administrators, and clerical staff.”

- Researchers:
 - “Professionals engaged in the conception or creation of new knowledge. They conduct research and improve or develop concepts, theories, models, techniques instrumentation, software or operational methods.”
 - “For practical reasons, doctoral students engaged in R&D should be counted as researchers.”

For this study, a researcher is defined in accordance with the Frascati manual⁸ as **“professionals engaged in the conception or creation of new knowledge, conducting research and improving or developing concepts, theories, models, techniques instrumentation, software or operational methods”**.

The European Charter for Researchers and Code of Conduct for the Recruitment of Researchers⁹, which are key elements in the European Union’s policy to make research an attractive career, as well as the European Commission’s communication on “Towards a European framework for research careers”¹⁰, also refer to the 2002 version of this definition of researchers¹¹. The definition is furthermore applied in R&D surveys which are the source for Eurostat and OECD R&D statistics.

To guarantee that respondents meet the criteria to be considered a researcher according to this definition, the questionnaire of the EU HE surveys in the MORE studies contain the following self-selection paragraph:

We specifically target “researchers” within this survey, including people:

- carrying out research OR
- supervising research OR
- improving or developing new products/processes/services OR
- supervising the improvement or development of new products/processes/services.

If you consider yourself to fall into one or more of the above categories, we kindly ask you to complete the questionnaire.

⁸ OECD (2015), Frascati Manual 2015: Guidelines for Collecting and Reporting Data on Research and Experimental Development, The Measurement of Scientific, Technological and Innovation Activities, OECD Publishing, Paris.

DOI: <http://dx.doi.org/10.1787/9789264239012-en>.

⁹ http://ec.europa.eu/euraxess/pdf/brochure_rights/am509774CEE_EN_E4.pdf

¹⁰ “Towards a European Framework for Research Careers” (European Commission 2011, p. 2 http://ec.europa.eu/euraxess/pdf/research_policies/Towards_a_European_Framework_for_Research_Careers_final.pdf

¹¹ In Proposed Standard Practice for Surveys on Research and Experimental Development, Frascati Manual, OECD, 2002: “Professionals engaged in the conception or creation of new knowledge, products, processes, methods and systems, and in the management of the projects concerned.”

1.1.2. Fields of Science

Fields of science (FOS) are defined according to the Fields of Research and Development (FORD) classifications proposed by the OECD in the 2015 Frascati Manual¹²:

- Field 1: Natural Sciences
- Field 2: Engineering and Technology
- Field 3: Medical and health sciences
- Field 4: Agricultural and veterinary sciences
- Field 5: Social Sciences¹³
- Field 6: Humanities and the Arts

Consistent with the previous MORE studies, three categories are derived from this for the purpose of the Task 1 survey sample stratification. The three categories are an aggregation of the six FOS as follows:

- NATURAL: Field 1 (Natural Sciences) and Field 2 (Engineering and Technology)
- HEALTH: Field 3 (Medical and health sciences) and Field 4 (Agricultural and veterinary sciences)
- SOCIAL: Field 5 (Social Sciences) and Field 6 (Humanities and the Arts)

1.1.3. Research careers

There is a wide but diverse range of literature on the definition and typology of research careers. An overview is given in the RISIS Research Paper on the 'Conceptual framework for the study of research careers'¹⁴. According to this overview, three theoretical approaches can be identified to research careers: that of the individual agency¹⁵, of institutional and collectively produced processes¹⁶ or in between¹⁷. Based on these, careers are structured in stages. Four explicit models of career stages are identified, each focusing on different defining factors such as role sets/interdependence and authority (Laudel & Gläser, 2007); competences/independence and leadership (EC); positions/independence (ESF) and positions/ranks (LERU).

The MORE4 study, as its predecessors, takes the perspective of the individual researcher, and applies the EC model for career stages¹⁸. As such, it is situated in this context in the

¹² OECD (2015), Frascati Manual 2015: Guidelines for Collecting and Reporting Data on Research and Experimental Development, The Measurement of Scientific, Technological and Innovation Activities, OECD Publishing, Paris.

DOI: <http://dx.doi.org/10.1787/9789264239012-en>.

¹³ Including Economic Sciences.

¹⁴ RISIS – WP24 – Task 1. Conceptual framework for the study of research careers. Research paper synthesizing the theoretical model for research careers. January 2016.

¹⁵ The sociological model of the institutional processes that structure research careers (Gläser 2001; Laudel and Gläser 2008).

¹⁶ Economics of sciences (Black and Stephan 2010; Fox and Stephan 2001; Sauermann and Stephan 2012; Stephan 2008).

¹⁷ The scientific and technical human capital approach (Bozeman, Dietz, and Gaughan 2001; Bozeman and Rogers 2002).

¹⁸ The classification describes four broad profiles that apply to all researchers, independent of where they work in the private or public sector: in companies, NGOs, research institutes, research universities or universities of applied sciences. Source:

individual agency perspective, defined by competences/independence and leadership. This model was defined in the European Commission's Communication "Towards a European Framework for Research Careers" (European Commission 2011, p. 2)¹⁹ and is published on the EURAXESS website along with profile characteristics (desirable or necessary competences)²⁰. This career stage model, with its focus on competences and leadership, best fits the purpose of the study and at the same time allows for a high degree of standardisation across different related studies.

These four career stages are:

- 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);
- R4: Leading Researcher (researchers leading their research area or field).

According to the definitions given in the European Commission's Communication, the different stages are sector-neutral (applicable to companies, NGO's, research institutes, research universities or universities of applied sciences). As this classification is not known in formal data sources on researchers, the classification has been used by means of the self-selection of researchers in the surveys.

1.1.4. Mobility of researchers

Researcher 'mobility' refers to the movements researchers make during their career, which can be of varying lengths, with different goals, with different types of destinations and coming from different types of originating countries.

In the subsequent MORE studies, the definitions of mobility were improved and updated as new concepts of researcher mobility developed, and policies towards mobility and the evaluation of researchers' achievements had to be revisited²¹. However, the MORE4 definitions are consistent with the MORE3 definitions. In the following sections, we resume the main definitions of (different types of) mobility, including the in MORE3 updated approach for PhD mobility, and the introduction of a classification of mobility to distinguish cases of forced mobility (escape, expected and exchange mobility).

Overview of different types of mobility

According to the expert group on the research profession²² at least four types of mobility can be recognised:

<https://euraxess.ec.europa.eu/europe/career-development/training-researchers/research-profiles-descriptors>.

¹⁹ http://ec.europa.eu/euraxess/pdf/research_policies/Towards_a_European_Framework_for_Research_Careers_final.pdf

²⁰ <https://euraxess.ec.europa.eu/europe/career-development/training-researchers/research-profiles-descriptors>

²¹ New concepts of researcher mobility – a comprehensive approach including combined/part-time positions. Science Policy Briefing, ESF, April 2013.

²² "Excellence, Equality and Entrepreneurialism building sustainable research careers in the European Research Area" (2012), by the Expert Group on the Research Profession.

- Geographical or international mobility;
- Intersectoral mobility;
- Virtual mobility (based on tangible cross-border research collaboration);
- Mobility related to change of topics or disciplines.

In MORE1, the analysis mainly focused on “geographical” and “sectoral mobility”. By 2012, mobility could no longer be seen only in physical and geographical/international terms and “virtual mobility” was included for the first time in the MORE2 study. Mobility related to change of topics or disciplines was not explicitly included in the MORE2 study but was elaborated in MORE3 and continued in MORE4, so that this current study covers all four types of mobility. An overview of this evolution is shown in Table 1.

Table 1: Types of mobility covered in each MORE study.

	MORE1	MORE2	MORE3	MORE4
International mobility				
Virtual mobility				
Intersectoral mobility				
Interdisciplinary mobility				

In Table 2, the definitions of these different types of mobility are structured along the dimensions of type of mobility, phase in which mobility takes place, duration and purpose of mobility. Each of the definitions in this table will be analysed in this report in the indicated sections.

Table 2: Definitions of mobility.

		PhD mobility	Post-PhD mobility	
		Mobility of researchers enrolled in a PhD programme during their R1 career stage.	Mobility in any of the following research career stages and, even though the terminology selected for simplicity suggests otherwise, regardless of whether or not the researcher has obtained a PhD.	
Geographical or international mobility	Moving to another country	PhD degree mobility: Mobility with the purpose of obtaining the PhD in another country	>3 month mobility: Mobility with duration of 3 months or more	Employer mobility: Mobility including a change of employer
		>3 month mobility during PhD: Mobility of three months or more during the PhD while still obtaining the PhD in the home country		Mobility without employer change

	PhD mobility	Post-PhD mobility
	Mobility of researchers enrolled in a PhD programme during their R1 career stage.	Mobility in any of the following research career stages and, even though the terminology selected for simplicity suggests otherwise, regardless of whether or not the researcher has obtained a PhD.
	PhD non-mobility: Having never been PhD degree or during PhD mobile to another country	Non-mobility: Having never been mobile to another country for >3 months at a time
		<3 month mobility: Mobility with duration of less than 3 months
Intersectoral mobility	Moving to another sector (working in non-academic sectors).	
Interdisciplinary mobility	Having switched to another (sub)field during the academic research career ²³	
Virtual mobility	The use of web-based or virtual technology to collaborate internationally or interdisciplinary - based on tangible cross-border or cross-domain research collaboration	

Definition of PhD mobility

In MORE3, the presentation of PhD mobility was simplified to improve understanding and the user-friendliness and ease of interpretation of the results²⁴. MORE4 continues to use this improved definition. In practice, we make the following distinction (see Table 2 for an example):

- **PhD mobility:** Mobility with the purpose of obtaining the PhD in another country than the country of citizenship AND the country of Master's degree. The case where the destination country of the PhD degree is different from the country of citizenship, but equal to the destination of the Master's degree, is classified as Master's mobility.
- **During-PhD mobility:** mobility of three months or more during the PhD while still obtaining the PhD in the home country.

Based on the graduation country for each degree, the distinction between PhD mobility, PhD return mobility and Master mobility is made. To grasp Master mobility more directly,

²³ Which is to be distinguished from interdisciplinary research as such.

²⁴ An important point of discussion in PhD mobility concerned the reference country. Different reference countries were tested: country of citizenship and country of Master degree. The results were presented both in terms of destination (% of researchers that moved TO the country to obtain a PhD) and in terms of origin (% of researchers that moved AWAY FROM this country to obtain a PhD; either from country of citizenship or from country of Master degree). These different presentation forms complicated the interpretation of the results. Therefore in MORE3 introduced an improved definition of PhD mobility, controlling for Master mobility, as well as a simplification of the presentation of the results.

we have also asked whether a Master’s student who has not obtained/will obtain their PhD in a country other than the country where they obtained their previous degree (the degree that gave access to the PhD), already moved during/for his/her Master’s degree anticipating on entering a PhD in this country. The mobility of Master’s students will not be analysed as such in the MORE4 study (as it is not a form of researcher mobility, but rather of educational mobility), but it is necessary to control for it in the interpretation of PhD mobility.

Table 3: Definition of PhD mobility – example.

Country of citizenship	Country of Master degree	Country of PhD degree	Mobility
Country A	Country A	Country A	Non-mobility for PhD
Country A	Country A	Country B	PhD mobility to country B
Country A	Country B	Country A	PhD return mobility to country A (after Master mobility to country B)
Country A	Country B	Country B	Non-mobility for PhD (after Master mobility to country B)
Country A	Country B	Country C	PhD mobility to country C (after Master mobility to country B)

For ease of interpretation, the analysis of PhD mobility focuses on the destination country (=country of PhD):

- **PhD mobility** (including an indication of PhD mobility after Master mobility) per country (country moved to for the PhD): *% of researchers who obtained a PhD in country X and who were mobile for this reason – of whom % after Master mobility;*
- **Non-mobility for PhD** (including an indication of non-mobility for PhD after Master mobility) per country (country stayed in for the PhD): *% of researchers who obtained a PhD in country X and who were not mobile for this – of whom % after Master’s degree.*

The latter case, non-mobility for PhD after Master’s degree, allows a better understanding of the reasons behind low PhD mobility to a particular country. It also enables us to test, for example, the assumption that mobility to this country takes place predominantly before the PhD stage.

Definition of escape, expected and exchange mobility

In MORE2, a number of results indicated that international mobility can be driven by push factors more than by pull factors. In some cases, the effects of mobility were even negative. To explore the explanations for these dynamics and outcomes in more detail, we introduced in MORE3 the concepts of escape mobility, expected mobility and exchange mobility. These concepts and definitions are also applied in MORE4.

- **Escape mobility** is the case where a researcher is ‘pushed’ away from his or her environment because of lack of funding, absence of sufficient academic positions relative to the number of researchers seeking posts, etc. This may mean that if they want to pursue a career as a researcher, they have to change

countries. The hypothesis is that this kind of forced mobility may show a different pattern of effects, also including negative effects such as the loss of network at home or a deterioration of working conditions.

- As a second perspective, we will also ask about situations where mobility may be viewed as being a 'natural' step in a research career, though not required. This is referred to as '**expected mobility**' and fits in between the two concepts of escape and exchange mobility.
- Finally, **exchange mobility** refers to a situation where a researcher chooses to move (personal motivation, self-selecting) with the aim of exchanging knowledge and work in an international network, or with the aim of using international experience as a way of boosting their career. The latter is expected to have more positive effects in terms of expanding a researcher's network and improving career progression opportunities. The latter also closely relates to the concept of Open Science, where global cooperation becomes increasingly important.

1.1.5. Country groups used for the analysis

Sometimes we use country groupings for the analysis to provide additional context to the interpretation of the survey results. One country grouping is geographical (Western, Northern, Eastern and Southern European countries) and contains all EU28 Member States. It mainly reflects differences in overall economic conditions. A second country grouping of 16 EU countries is based on a classification of higher education systems, based on Janger - Campbell - Strauss, 2019²⁵, who themselves draw on the comparative higher education literature cited therein, such as Enders-Musselin, 2008²⁶.

- The **Anglo-Saxon and Nordic systems** (e.g. United Kingdom, Sweden, The Netherlands) are higher education systems mostly based on collegiate department-style models, an intermediate share of tenured researchers and a high share of structured PhD training;
- The **continental higher education system** refers to countries such as Germany, the Czech Republic or Poland with a more hierarchical chair-based system and high shares of fixed-term researchers (the "survivor" model, see Enders-Musselin, 2008²⁷);
- The **Southern European system** refers to systems with high shares of tenured researchers also called "protective pyramid", with an early access to a permanent position following a strict competition. Further progression is then organised in hierarchical steps, depending on job availability. As Lissoni et al., 2011²⁸ and Pezzoni - Sterzi - Lissoni, 2012²⁹, document for the highly centralised academic systems of Italy and France, criteria for academic promotion in such protective pyramids are not limited to scientific productivity but include also issues such as social and political capital, seniority, gender.

²⁵ Janger, J., Campbell, D., F.J., Strauss, A., (2019), "Attractiveness of jobs in academia: a cross-country perspective", Higher Education, pp. 1-20.

²⁶ Enders, J., Musselin, C., (2008)"Back to the future? The academic professions in the 21st century", High. Educ. To, 2030, pp. 125-150.

²⁷ Ebd.

²⁸ Lissoni, F., Mairesse, J., Montobbio, F., Pezzoni, M., (2011), "Scientific productivity and academic promotion: a study on French and Italian physicists", Ind. Corp. Change, 20(1), pp. 253-294.

²⁹ Pezzoni, M., Sterzi, V., Lissoni, F., (2012) "Career progress in centralised academic systems: Social capital and institutions in France and Italy", Res. Policy, 41(4), pp. 704-719.

This is a stylised summary and there are significant intra-group differences, but there are also consistent between-group differences which make the analysis by country group worthwhile, not the least due to the high number of EU Member States.

1.2. Policy-driven developments in concepts of career paths and working conditions

In common with previous updates, this update in MORE4 aims to meet the need for indicators to be reviewed and amended over time to reflect the evolution in the phenomenon of researcher mobility, changes in the policy context and external factors. This will enable the impact on researchers of policy measures introduced during implementation of the EPR to be better assessed, in particular by providing new indicators to meet emerging policy needs and priorities. Building a strong evidence base over time to gather longitudinal information and data is necessary across all the areas identified as requiring action to promote mobility, better working conditions, and improved careers for researchers, with special attention to those issues which are related to age and gender aspects. As in MORE3, the MORE4 study addresses these issues as shown in Table 4.

Table 4: Continued relevant research areas in MORE4.

Relevant research areas with respect to the promotion of mobility, better working conditions, and improved careers of researchers	How these areas are addressed in the MORE4 study
Cross-sectoral mobility	<ul style="list-style-type: none"> • Mapping of intersectoral mobility (including sector, contract type, career stage), dual positions and collaboration; • Motives for intersectoral mobility; • Comparison of working conditions in and outside the HE sector; • Importance of intersectoral mobility as positive or negative factor for recruitment and career progression; • Mapping and importance of intersectoral collaboration in PhD training.
Attraction of foreign researchers and international mobility	<ul style="list-style-type: none"> • Mapping of international mobility (including countries, timing, duration, frequency, contract type and employer change, career stage), and collaboration; • Motives and barriers for international mobility and non-mobility; • Effects of international mobility; • Comparison of working conditions in and outside the EU; • Importance of international mobility as positive or negative factor for recruitment and career progression; • Mapping and importance of international network/collaboration in PhD training; • Impact of virtual technology on international collaboration.
Promotion of Marie Curie Actions (H2020)	<ul style="list-style-type: none"> • Mapping of researchers who obtained an MSCA grant

Relevant research areas with respect to the promotion of mobility, better working conditions, and improved careers of researchers	How these areas are addressed in the MORE4 study
	<ul style="list-style-type: none"> • New in MORE4: Effects experienced from their MSCA grant (if it was the most recent grant the researcher received)
Promotion of HR Excellence in Research and implementation of HRS4R	<ul style="list-style-type: none"> • Awareness among researchers of the European Charter for Researchers and Code of Conduct for the Recruitment of Researchers; • Not new, but further elaborated in MORE4: Researchers' opinion on several aspects of the recruitment process in their home institution.
Open, transparent and merit-based recruitment procedures (OTM-R)	<ul style="list-style-type: none"> • Researchers' opinion on several aspects of the recruitment process in their home institution, and more specifically on open, transparent and merit-based recruitment procedures.
Program Innovative Doctorate Training and career development	<ul style="list-style-type: none"> • Mapping of supervision structure in PhD training; • Awareness among researchers of the 7 Innovative Doctoral Training Principles and attributed importance; • Application of the 7 Innovative Doctoral Training Principles; • Application of and barriers for training in transferable skills.
Gender/ Equal opportunity initiatives	<ul style="list-style-type: none"> • Gender is one of the main dimensions in the analysis, i.e. all key indicators are calculated per gender and compared; • New in MORE4: Researchers' opinion on several aspects of the recruitment process in their home institution, among which whether measures are taken to foster representation of underrepresented groups.
Support/promotion of EURAXESS	<ul style="list-style-type: none"> • Awareness among researchers of the services offered by EURAXESS; • Use of any of the EURAXESS services.

Recent elements that have required the development of new indicators in MORE4 are the concept of Open Science³⁰ and other developments identified in the impact assessment of the forthcoming framework programme Horizon Europe:

- The impact of the EU-level R&I investments in terms of supporting public goods with a high European added value: through EU-wide competition for excellence, EU investments support the training and mobility of scientists, create transnational and multidisciplinary collaboration, leverage additional investment from the public

³⁰ <https://ec.europa.eu/research/openscience/index.cfm?pg=open-science-policy-platform>

and private sectors, build the scientific evidence necessary for effective EU policies, and structure national R&I systems.³¹

- The amplifying effect of support for mobility on the added value of EU programmes and funds, particularly in the form of skills and career development, as well as improvements in social cohesion and cooperation between European researchers, thus increasing the productivity of this community³².

Table 5: New relevant research areas in MORE4.

New research areas with respect to the promotion of mobility, better working conditions, and improved careers of researchers	How these areas are addressed in the MORE4 study
<p>Open Science and its impact on the activities of the HEI and therefore on researchers</p>	<ul style="list-style-type: none"> • Introduction of a new question on engagement in activities of Open Science: <ul style="list-style-type: none"> • publishing in (or sending articles for review to) open access journals, • sharing research data, software or research protocols publicly, • participating in public awareness activities (to increase the awareness of scientific issues among the general public). • Skills training and importance of skills for a research career: introduction of the categories 'innovative digital skills' and 'collaboration with citizens, government and broader society' (also in MORE3) • PhD training: introduction of category 'training in Open Science approaches' • Recruitment and career progress: introduction of a question on how 'alternative' skills and outputs are taken into account, namely³³: <ul style="list-style-type: none"> • having published in open access journals, having shared research data in open platforms • engagement in public awareness activities • project-related work experience • engagement in knowledge transfer, management of research or innovation,

³¹

https://ec.europa.eu/info/sites/info/files/swd_2018_307_f1_impact_assesment_en_v7_p1_977548.pdf

³²

https://ec.europa.eu/info/sites/info/files/swd_2018_307_f1_impact_assesment_en_v6_p2_977548.pdf

³³ In MORE3, there was one aggregate category 'alternative forms of research output', instead of the first four categories in MORE4 (having published in open access journals, having shared research data in open platforms; engagement in public awareness activities; project-related work experience; engagement in knowledge transfer, management of research or innovation, contribution to patents or development of inventions).

New research areas with respect to the promotion of mobility, better working conditions, and improved careers of researchers	How these areas are addressed in the MORE4 study
	<p>contribution to patents or development of inventions</p> <ul style="list-style-type: none"> • intersectoral mobility • interdisciplinary mobility • international mobility • transferable skills <ul style="list-style-type: none"> • Collaboration: introduction of 'non-researchers (users or social stakeholders' in the list of potential collaboration partners) (also in MORE3) • Comparison of working conditions in and outside the EU and comparison of working conditions in and outside the HE sector: introduction of the category 'Acceptance of/commitment to Open Science approaches (e.g. publishing in open access journals, sharing research data, participating in citizen science events, etc.)' • Effects of entire mobility experience; effects current stay in Europe by non-EU researchers; effects of grants: introduction of the category 'Understanding and application of Open Science approaches (e.g. publishing in open access journals, sharing research data, participating in citizen science events, etc.)'
<p>European value added in terms of:</p> <ul style="list-style-type: none"> • training and mobility of scientists, • transnational and multidisciplinary collaboration, • additional investment from the public and private sectors, • scientific evidence necessary for effective EU policies, and • structuring the national R&I systems 	<ul style="list-style-type: none"> • Detailed monitoring of several aspects and effects of training, international, intersectoral and interdisciplinary mobility, grants, etc. • Heterogeneity in the EU, and potential convergence or divergence: all analyses on country differences and evolutions therein
<p>Amplifying effect on skills and career development, improvements in social cohesion and cooperation between European researchers</p>	

2. SURVEY METHODOLOGY OF THE EU HE SURVEY

2.1. Ex-ante: Survey and sampling design

The sampling strategy is at the core of the methodological approach of the MORE4 EU HE survey. It is based on stratified random sampling, the best option for a survey of individuals that have to be classified according to a number of common characteristics (e.g. country, gender, age, field of science, career stage, etc.). It was as such designed at the start of the process with the aim of producing estimates with a minimum degree of accuracy (5% max error -p value of 5%) at both EU28 and individual country level for the EU28+3 countries, and in consistency with the MORE3 EU HE survey (2016) and the MORE2 EU HE survey (2012).

In what follows, we briefly summarise the sampling strategy of the MORE4 EU HE survey in view of interpreting the indicators in this report correctly and to their full value. For more detailed information, we refer to the Methodological Report complementing the MORE4 EU HE report.

Objective: The objective in the MORE studies is to define a sampling methodology under the requirements of random selection of the units in order to define the necessary sample size in accordance with a predefined level of accuracy of the estimates. Estimates are to be produced at country level after stratification of researchers by field of science (FOS). The sampling strategy is therefore built from the start on information on researchers in Europe per country and field and the necessary sampling size is calculated for each combination of country and field.

The rationale behind a FOS-based stratification, arises from the assumption that the field of science affects closely some variables of analysis (for example mobility), even if it is not the only relevant feature affecting the variables of the survey. Career stages (e.g. distinguishing PhD phase³⁴), age, university size, level of funding and many other factors are relevant for the study, yet the lack of available information on these variables make that they cannot be adopted for stratification. Thus, estimates in some cases can be affected by not including these variables in the sampling frame³⁵.

Sampling frame: The 'optimal' sampling frame consists of an up-to-date nominal list of researchers including both contact details and the auxiliary information necessary for the definition of stratification variables (e.g. country, gender, age, field of science, career stage, etc.). If this kind of information is available, it is possible to define a random stratified sample of units that, after the survey, can be weighted for representing the total population with respect to the selected variable(s).

This sampling frame for researchers currently working in HEIs in Europe is not given, but the study team developed a proxy frame in the early stages of the project based on

³⁴ Even if many HEI usually include PhD candidates in the research workforce the lack of official totals by country and by FOS is an obstacle for adopting this variable as a stratification one.

³⁵As we will describe further, and like in MORE3, we have made an attempt for post-stratification based on career stage, a characteristic that turned out to have large explanatory power in the MORE2 study. However, as no information was available ex-ante this could not be considered in the sampling design ex-ante and only serves for the purposes of post-stratification of the results.

available information on the HEIs in Europe (HEI websites, national Ministry of Education directories, etc.). In this proxy frame, publicly available information for individual researchers has been registered: country and field of science are generally available. Information on age, gender or career stage are not generally available and are as such not included in the proxy frame.

Further, we have developed a two-stage stratified sampling strategy.

Two-stage stratified sampling strategy:

- A proxy frame for HEIs is available, so in the first stage HEI clusters were sampled from this (first stage or primary unit);
- In the second stage researchers (second stage or secondary unit) were then selected in these HEIs and stratified by FOS.

The clustering of HEIs has the property to ensure that the sample of researchers is allocated proportionally to the FOS in each country so that estimates are consistent with the country number of researchers in each FOS. This also avoids that a too limited number of clusters cover all the sampled researchers which would in turn result in a bias of the estimates.

The practical implementation of this sampling strategy consists of the following steps:

- Calculation of the sample size for each country necessary for making country estimates according to the random sampling formula for estimating proportions with a maximum (sampling) error of 5% with a probability of 95%.
- Allocation of the initial sample into the 3 broad FOS according the known totals (stratification procedure) under the assumption that FOS affects the variables of study.
- Since the sampling frame for researchers is not a priori available, a list of HEI clusters is developed as sampling frame for the primary units (HEI) and we know by our sampling frame the contact references of each cluster/HEI and its FOS.
- Under the assumption that each secondary unit is specialised in the FOS of the primary unit we can calculate the population of researchers within each cluster and select a subsample.
- The implementation of the sampling strategy is based on an oversampling methodology ensuring a selection at random to ensure sample significance at country and FOS level. The sampling matrix will thus consist of 93 final cluster strata (each cluster strata is composed of the HEIs found for the same country and the same FOS, where the target countries are 31 in number and the FOS are 3), and will indicate for each cluster (HEI) the minimum number of researchers to be surveyed.

Each of these steps is further detailed in the Methodological report complementing the MORE4 EU HE report.

Once the sample of researchers to address for the survey is finalised, the survey is implemented. As in the previous MORE studies, the raw data collection in MORE4 was organised through computer-assisted telephone interviews (CATI) and computer-assisted web interviews (CAWI).

To further refine the information and in particular its statistical significance, a calibration and editing strategy is applied:

- First, a non-response survey is organised to collect data on why researchers did not participate in the main survey and on whether they would deviate from the general answering pattern in three key questions (>3 month mobility, <3 month mobility and intersectoral mobility).
- A second action in the refinement of the main data is the editing of partial responses by means of donor techniques so as to recycle information of researchers that have filled in a substantial part of the survey but did not reach the end.

The sampling strategy to collect sufficient information per country and field of science, combined with the calibration and editing strategy to refine the information and correct for non-response effects, results in the calibrated final sample on which all indicator development and measurement is based.

2.2. Ex-post: Stratification strategy

The MORE4 EU HE survey strategy (as that of the predecessors) is thus based on stratified random sampling, for which a proxy frame is developed and a sample selected in two stages. As mentioned before, the standard stratification that was already defined and integrated in the sampling strategy ex-ante, is based on the variable 'field of science'. However, we also looked into post-stratification based on gender and career stage. In the analysis phase, it is the available information in both the sampling frame and population that together determine the extent to which ex-ante or post stratification is possible in the analysis. This is explained below in order to understand the applied stratifications in our analysis, reflected in the indicators of this report.

Sampling frame: If sufficient information is available for specific variable(s) in the sampling frame, it is possible to define a random stratified sample of units that, after the survey, can be weighted for representing the total population with respect to the selected variable(s). Given the set-up of our sampling strategy, this is the case for country and the fields of science. Information on age, gender or career stage are not generally available and are as such not included in the proxy frame (see supra).

Population: Eurostat provides statistics on the overall research population in Europe, distributed per country, gender, age and field of science. In other words, for these variables also information on the distribution in the total population is available. This is a benchmark for the representativeness of the responses and allows weighting sample information in order to reflect this population with a specific level of accuracy. There is however no information on the distribution for career stage in Eurostat.

Ex-ante versus ex-post stratification: For the MORE4 EU HE survey (as for its predecessors), accuracy is aimed for at country level, and the sampling strategy EX-ANTE takes into account the distribution across countries and fields of science. This is indeed possible because these two types of information are known up front for the sampling frame (proxy frame) as well as their distribution for the entire population (Eurostat data).

For those variables where the information is not publicly available upfront, like for gender (only population, not proxy frame) and career stage (not in population nor proxy frame), the EX-POST weighting is the only option. An EX-ANTE strategy is not possible as the response cannot be steered towards this if there is no information in the proxy frame to steer on. We also point out that ex-post weighting will result in less accurate estimates than the ex-ante defined country level estimates (the aim for accuracy of the country level

estimates is 5% at a probability of 95%) because the response is not 'steered' for these variables and weighting is only done ex-post.

An EX-POST weighting is possible under the conditions that:

- If the variable is not available ex-ante, it is surveyed so that it becomes available ex-post for all respondents;
- There is information on the distribution of the population to allow for ex-post weighting (to better reflect the constitution of the population with respect to this variable).

For gender, the information is surveyed and the information on the distribution of the population is available in Eurostat. The first condition for career stages is also fulfilled by asking about the career stage in the MORE4 survey. But for career stage there is no information on the population available in Eurostat. However, to make post-stratification possible, the second condition needs to be fulfilled: information on the distribution over the total population needs therefore be collected. Therefore, we have collected data from other, national, sources in order to come to an indicative distribution for the research population in Europe (per country).

An important limitation when population information is built on many different national sources, is a lack of consistency and coverage. That is why we combine the information from national sources with the MORE3 career stages estimates and methods. Second, based on data availability, we formulate a proposal for the post-stratification for career stages. For the detailed outline of this approach, we refer to the Methodological Report complementing the MORE4 EU HE report. Important for the interpretation of the results in this report is that:

- Only a **rough approximation** of the distribution of the researcher population per country over career stages could be obtained due to the strong heterogeneity of national sources across countries and within countries³⁶. On the one hand, estimates have improved compared to MORE3 thanks to the availability of more and higher-quality national data for most countries and additional consistency checks made possible by this. On the other hand, the limited comparability of national data across countries, combined with difficulties with the measurement of R1 compared to the total number of researchers³⁷, remain important issues

³⁶ Heterogeneity of data across countries is due to the following factors. Each country adopts its own methods to classify researchers according to national legislations – which are not necessarily harmonised at international level. In addition, data is not available for all countries in the sample: in two cases a career breakdown is missing in the national data; in three other cases national sources publish figures about career stages only in aggregations like R1&R2 or R3&R4, and in one case, the only available source there is only data from one HEI available on career stage distribution. The reference years in national sources often differ from that of the Eurostat totals and also across countries. Information is in some cases outdated. Within countries as well, different national sources are found with different approaches depending on their purposes (statistical or administrative purpose, for instance).

³⁷ Eurostat data were used for the total number of researchers in HEI per country as well as the total number of PhD students (R1 researchers) per country. However, these two indicators stem from two different statistical domains: R&D and education respectively. For the total number of researchers per country we use the official Eurostat data for the year 2016, which is also the

for the accuracy of the estimates. This reflects on the framework built for the post-stratification for career stages and **leads to the resulting indicators being an equally rough estimation of the reality.**

- The survey stratification is designed to achieve 5% error estimates of researchers at country level – but not at career stage level. In the interpretation of the results, it must thus be taken into account that **errors for estimates based on career stage post-stratification will be (substantially) higher than this 5%**, in particular for those strata where only a small number of responses was obtained (career stage*country).

These are important limitations that cannot be addressed without better quality of the basic data on career stages at national level and that lead us to predominantly report on the key indicators weighted for the ex-ante defined strata based on country and field of science (also consistent with the MORE2 and MORE3 indicators). The post-stratification for career stages will be used mainly as a validation of how well this indicator is balanced for the career stages and/or how it might be affected by a potential unbalance. It is only reported at EU level and for the key indicators in the report.

2.3. Description of the sample

The survey has been administered in 31 European countries: the 28 Member States of the European Union and Iceland, Switzerland and Norway. It has been implemented through both CAWI (Computer-assisted web interviewing) and CATI (Computer-assisted telephone interviewing) techniques. One third (28.7%) was collected through CAWI and the remaining two thirds of the responses (71.3%) through CATI. The total number of respondents that answered the survey is 9,321.

In the following sections we describe the MORE4 EU HE sample and how its characteristics compare to:

- 1) The information collected ex-ante in the sampling frame (country, field of science) – this helps to assess the quality of the sampling frame;
- 2) Each other, i.e. are response patterns logical (age and career stage) – this helps to assess the quality of the collected survey data;
- 3) The characteristics of the population according to Eurostat; this helps to assess the effect of the weighting on the final results at population level.

2.3.1. Country level

The number of respondents per country and field of science are given in the table below. For more information on the relation with the sample size requirements and the error rates based on the comparison of both, we refer to the Methodological Report complementing the MORE4 EU HE report.

reference data for the MORE4 HEI survey sampling design. However, comparing the Eurostat estimates for R1 researchers with this figure brings about a number of issues: in two cases, the number of R1 researchers is higher than the total population of researchers according to Eurostat and in one case, this is close to the total number of researchers. Also, in other countries, the share of R1 researchers seems to be relatively high compared to the total.

Table 6: Sample per country and field of science.

	NATURAL	HEALTH	SOCIAL	TOTAL
Austria	243	48	89	380
Belgium	116	96	130	342
Bulgaria	170	63	89	322
Croatia	158	72	138	368
Cyprus	87	18	78	183
Czech Republic	207	66	85	358
Denmark	169	66	153	388
Estonia	90	39	61	190
Finland	120	38	102	260
France	190	50	153	393
Germany	186	83	71	340
Greece	191	107	91	389
Hungary	134	29	85	248
Iceland	63	20	68	151
Ireland	145	59	112	316
Italy	188	59	137	384
Latvia	41	58	103	202
Lithuania	136	48	96	280
Luxembourg	65	12	60	137
Malta	77	38	75	190
Netherlands	143	59	111	313
Norway	121	46	175	342
Poland	155	54	43	252
Portugal	144	92	75	311
Romania	136	85	154	375
Slovakia	120	75	82	277
Slovenia	117	43	53	213
Spain	131	97	159	387
Sweden	125	98	145	368
Switzerland	122	45	121	288
United Kingdom	167	63	144	374
Total EU28	3,951	1,715	2,874	8,540
Total EU28+3	4,257	1,826	3,238	9,321

Source: MORE4 EU HE survey (2019)

Note:

- (n=9,321)

The questionnaire included a set of sociodemographic questions that allow to validate and refine the relationship of each of the researchers with the countries in which they have worked and studied. These questions allow to validate the stratification procedure at country level: 94% of the respondents declare to currently work in the same country that was used for the sampling process. There is also a very high correlation between country of residence and country of current employment. This correlation pattern is logical and comparable to the one found in previous MORE studies.

Around 84% of the respondents have the citizenship of the country where they currently work. 76% of the respondents indicate to have obtained their PhD in the same country where they are currently working. 79% has obtained their PhD in the country of their citizenship.

Table 7: Overlap across countries of reference.

	Equal to panel country	Equal to country of current employment	Equal to country of residence	Equal to country of citizenship (first)
Country of current employment	93.6%			
Country of residence	93.4%	95.8%		
Country of citizenship (first)	82.3%	84.4%	85.4%	
Country of PhD degree	73.2%	76.1%	76.0%	79.4%

Source: MORE4EU HE survey (2019)

Notes:

- Panel country is equal to country of current employment for 98% of the respondents in the sample.
- Country of employment is based on question 27: "Country of employer"
- Country of residence is based on question 4: "Country of residence"
- Country of citizenship is based on question 5: "Country of citizenship"
- Country of PhD degree is based on question 9: "Please indicate below all higher education (=post-secondary) diplomas/degrees you have obtained so far and their details."
- (n=9,321)

2.3.2. Fields of science

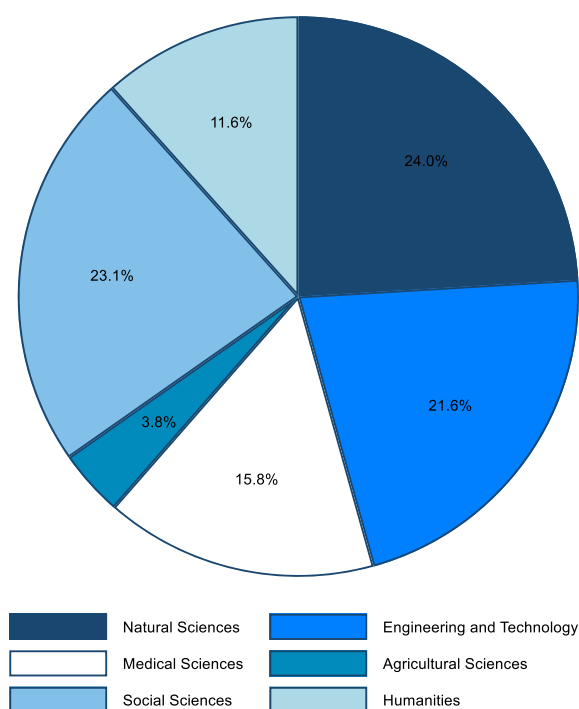
The MORE4 EU HE survey asked the respondents to self-select their field of science from a list of six fields, based on the Fields of Research and Development (FORD) classifications proposed by the OECD in the 2015 Frascati Manual³⁸ :

- Field 1 (Natural Sciences);
- Field 2 (Engineering and Technology);
- Field 3 (Medical and health sciences);
- Field 4 (Agricultural and veterinary sciences);
- Field 5 (Social Sciences);
- Field 6 (Humanities and the Arts).

Figure 2 shows the overall distribution of respondents across the six fields of science. The largest share of respondents corresponds to the Natural Sciences and the smallest to Agricultural Sciences.

³⁸ OECD (2015), Frascati Manual 2015: Guidelines for Collecting and Reporting Data on Research and Experimental Development, The Measurement of Scientific, Technological and Innovation Activities, OECD Publishing, Paris.
DOI: <http://dx.doi.org/10.1787/9789264239012-en>.

Figure 2: Distribution of fields of science in the sample.



Source: MORE4 EU HE survey (2019)

Notes:

- Based on question 11: "What is your main field of research in your current position?"
- (n=9,321)

As described in detail in the previous section, the MORE4 EU HE survey applied a stratification strategy in order to achieve representative results in the combined strata of country of employment and fields of science. Consistent with the stratification applied in the previous MORE studies, this was based on an aggregated level of three fields of science:

- NATURAL: Field 1 (Natural Sciences) and Field 2 (Engineering and Technology)
- MEDICAL: Field 3 (Medical and health sciences) and Field 4 (Agricultural and veterinary sciences)
- SOCIAL: Field 5 (Social Sciences) and Field 6 (Humanities and the Arts)

The table below provides an overview of the sample distribution in terms of the fields of sciences declared by the respondents and the population distribution according to Eurostat. From this we find that in most countries, the sample distribution is similar to the population distribution.

Overall, the Natural Sciences and Engineering and Technology have a 6pp higher share in the sample than in the population, mainly to the expense of Medical and Agricultural Sciences. Important differences between the composition of the sample and that of the population are found in only a few countries. The share of researchers working in the Natural Sciences and Engineering and Technology is lower in the sample than in the population in Latvia (29pp) and in Romania (26pp). This field has higher shares in the sample than in the population in Hungary (20pp) and in Poland (24pp). The Medical and Agricultural Sciences are underrepresented in Denmark (25pp), Iceland (30pp), Norway (20pp). The Social Sciences and Humanities are overrepresented in Romania (29pp) and Latvia (22pp) and underrepresented in Poland (22pp) and in Portugal (18pp).

When FOS-based weights are applied in the analysis, we see that in countries with a lower share of one of the FOS than in the population, the responses of researchers in this FOS will receive higher weight than those of researchers in the overrepresented fields. In general, the responses of the researchers in Natural Sciences and Engineering and Technology will be given less weight in the calculation of aggregated indicators than those of Medical and Agricultural Sciences.

Table 8: Field of science distribution in the sample and in the population.

COUNTRY	Population			Sample		
	HEALTH	NATURAL	SOCIAL	HEALTH	NATURAL	SOCIAL
Austria	22.1%	45.8%	32.1%	12.6%	63.9%	23.4%
Belgium	31.1%	39.0%	29.9%	28.1%	33.9%	38.0%
Bulgaria	27.0%	33.3%	39.7%	19.6%	52.8%	27.6%
Croatia	30.2%	36.1%	33.8%	19.6%	42.9%	37.5%
Cyprus	7.9%	44.6%	47.5%	9.8%	47.5%	42.6%
Czechia	26.2%	46.1%	27.7%	18.4%	57.8%	23.7%
Denmark	41.6%	29.4%	29.0%	17.0%	43.6%	39.4%
Estonia	15.6%	48.8%	35.7%	20.5%	47.4%	32.1%
Finland	20.8%	39.1%	40.1%	14.6%	46.2%	39.2%
France	24.3%	39.2%	36.6%	12.7%	48.3%	38.9%
Germany	25.9%	41.0%	33.1%	24.4%	54.7%	20.9%
Greece	19.0%	43.0%	38.0%	27.5%	49.1%	23.4%
Hungary	23.2%	33.6%	43.2%	11.7%	54.0%	34.3%
Iceland	42.8%	22.2%	35.0%	13.2%	41.7%	45.0%
Ireland	20.4%	45.2%	34.4%	18.7%	45.9%	35.4%
Italy	22.4%	40.5%	37.1%	15.4%	49.0%	35.7%
Latvia	22.2%	48.9%	28.9%	28.7%	20.3%	51.0%
Lithuania	18.1%	35.9%	45.9%	17.1%	48.6%	34.3%
Luxembourg	12.3%	43.8%	43.9%	8.8%	47.4%	43.8%
Malta	22.6%	28.4%	49.0%	20.0%	40.5%	39.5%
Netherlands	35.4%	34.1%	30.5%	18.8%	45.7%	35.5%
Norway	33.9%	24.2%	42.0%	13.5%	35.4%	51.2%
Poland	23.3%	37.4%	39.3%	21.4%	61.5%	17.1%
Portugal	18.7%	39.4%	41.9%	29.6%	46.3%	24.1%
Romania	24.3%	62.4%	13.3%	22.7%	36.3%	41.1%
Slovakia	19.0%	41.2%	39.8%	27.1%	43.3%	29.6%
Slovenia	29.3%	41.5%	29.2%	20.2%	54.9%	24.9%
Spain	20.2%	39.0%	40.8%	25.1%	33.9%	41.1%
Sweden	27.2%	37.2%	35.7%	26.6%	34.0%	39.4%
Switzerland	17.1%	48.1%	34.8%	15.6%	42.4%	42.0%
United Kingdom	24.3%	37.6%	38.1%	16.8%	44.7%	38.5%
EU28+3	24.2%	39.4%	36.4%	19.6%	45.7%	34.7%

Source: MORE4 EU HE survey (2019)

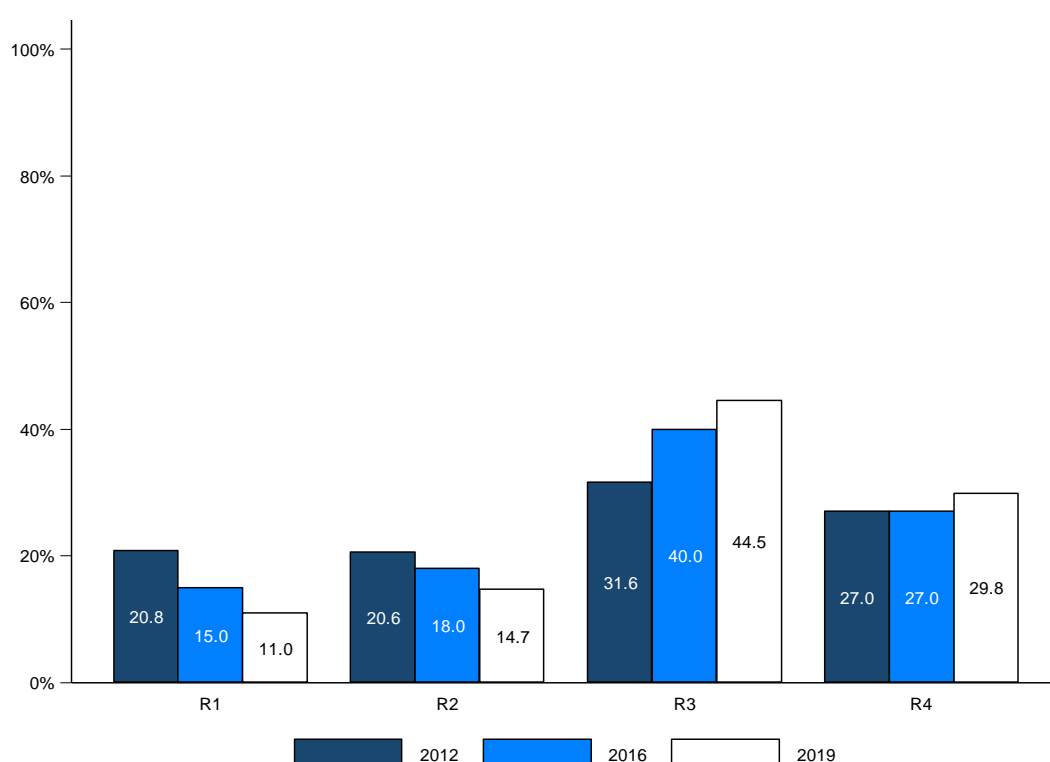
Note: (n=9,321)

2.3.3. Career stage

Figure 3 shows the distribution per career stage of researchers as declared by them in the three last MORE studies. There is a strong emphasis on the later career stages in the sample (R3 in particular) and this trend is stronger over time.

In Table 9, we observe that R3 is the category with a higher share of researchers across almost all countries. Only in Austria, Finland, and Greece, R4 researchers constitute relatively larger groups (38%, 39%, and 51% respectively). The largest shares of R1 researchers are found in Luxembourg (24%), Belgium (24%) and Switzerland (20%). R2 researchers constitute a larger group in Luxembourg (27%), Romania (23%), Germany (23%) and Slovakia (22%).

Figure 3: Self-declared career stages.



Source: MORE4 EU HE survey (2019), MORE3 EU HE survey (2016), and MORE2 EU HE survey (2012),

Notes:

- Based on question 13: "In which career stage would you currently situate yourself?"
- (2019: n=9,321; 2016: n=10,394; 2012: n=10,546)

Table 9: Number of respondents per career stage (self-declared in the survey).

	Total	R1	R2	R3	R4	R1 %	R2 %	R3 %	R4 %
Austria	380	48	61	127	144	12.6%	16.1%	33.4%	37.9%
Belgium	342	81	68	104	89	23.7%	19.9%	30.4%	26.0%
Bulgaria	322	28	43	185	66	8.7%	13.4%	57.5%	20.5%
Croatia	368	26	40	191	111	7.1%	10.9%	51.9%	30.2%
Cyprus	183	7	20	102	54	3.8%	10.9%	55.7%	29.5%

	Total	R1	R2	R3	R4	R1 %	R2 %	R3 %	R4 %
Czech Republic	358	32	57	166	103	8.9%	15.9%	46.4%	28.8%
Denmark	388	59	70	157	102	15.2%	18.0%	40.5%	26.3%
Estonia	190	24	27	92	47	12.6%	14.2%	48.4%	24.7%
Finland	260	24	45	90	101	9.2%	17.3%	34.6%	38.8%
France	393	48	52	160	133	12.2%	13.2%	40.7%	33.8%
Germany	340	56	78	109	97	16.5%	22.9%	32.1%	28.5%
Greece	389	8	17	165	199	2.1%	4.4%	42.4%	51.2%
Hungary	248	34	21	131	62	13.7%	8.5%	52.8%	25.0%
Iceland	151	20	11	66	54	13.2%	7.3%	43.7%	35.8%
Ireland	316	21	56	164	75	6.6%	17.7%	51.9%	23.7%
Italy	384	15	29	223	117	3.9%	7.6%	58.1%	30.5%
Latvia	202	31	28	81	62	15.3%	13.9%	40.1%	30.7%
Lithuania	280	34	47	111	88	12.1%	16.8%	39.6%	31.4%
Luxembourg	137	33	37	45	22	24.1%	27.0%	32.8%	16.1%
Malta	190	11	22	104	53	5.8%	11.6%	54.7%	27.9%
Netherlands	313	56	46	129	82	17.9%	14.7%	41.2%	26.2%
Norway	342	57	30	138	117	16.7%	8.8%	40.4%	34.2%
Poland	252	12	40	118	82	4.8%	15.9%	46.8%	32.5%
Portugal	311	29	62	161	59	9.3%	19.9%	51.8%	19.0%
Romania	375	12	88	152	123	3.2%	23.5%	40.5%	32.8%
Slovakia	277	30	61	132	54	10.8%	22.0%	47.7%	19.5%
Slovenia	213	31	44	70	68	14.6%	20.7%	32.9%	31.9%
Spain	387	32	32	205	118	8.3%	8.3%	53.0%	30.5%
Sweden	368	50	44	161	113	13.6%	12.0%	43.8%	30.7%
Switzerland	288	57	67	99	65	19.8%	23.3%	34.4%	22.6%
United Kingdom	374	15	28	209	122	4.0%	7.5%	55.9%	32.6%
EU28+3	9,321	1,021	1,371	4,147	2,782	11.0%	14.7%	44.5%	29.8%

Source: MORE4 EU HE survey (2019)

Notes:

- Based on question 13: "In which career stage would you currently situate yourself?"
- These figures reflect the distribution in the sample. No weights are applied.
- (n=9,321)

When we compare the age structure in the sample with the self-declared career stages, we expect a higher average age for higher career stages. Table 10, Table 11 and Table 12 confirm that this is indeed the case in the sample of the MORE4 EU HE survey, both with or without weighting of the sample.

Table 10: Distribution of groups of age per self-declared career stage (no weighting is applied).

Age group	R1	R2	R3	R4	Total
<35	63.9%	23.1%	4.2%	0.7%	12.5%
35-44	19.8%	44.1%	33.1%	9.1%	26.1%
45-54	10.6%	21.7%	35.7%	32.9%	30.1%

Age group	R1	R2	R3	R4	Total
55-64	5.0%	8.5%	21.4%	38.5%	22.8%
>65	0.8%	2.6%	5.6%	18.8%	8.6%
Total	1,021	1,371	4,147	2,782	9,321

Source: MORE4 EU HE survey (2019)

Notes:

- Based on question 13: "In which career stage would you currently situate yourself?" and question 3: "What is your year of birth?"
- (n=9,321)

Table 11: Distribution of groups of age per self-declared career stage (weighted by field of science).

Age group	R1	R2	R3	R4	Total
<35	69.4%	22.8%	3.8%	0.6%	12.3%
35-44	17.7%	45.9%	31.4%	8.0%	25.0%
45-54	8.4%	18.5%	37.2%	35.4%	31.0%
55-64	3.9%	9.9%	21.8%	37.7%	23.1%
>65	0.6%	2.8%	5.7%	18.3%	8.6%
Total	154,745	216,353	674,786	457,621	1,503,505

Source: MORE4 EU HE survey (2019)

Notes:

- These figures are the result of applying the weights designed on the basis of field of science.
- Based on question 13: "In which career stage would you currently situate yourself?" and question 3: "What is your year of birth?"
- (n=9,321)

Table 12: Distribution of groups of age per self-declared career stage (poststratification weights are applied).

Age group	R1	R2	R3	R4	Total
<35	67.5%	21.2%	4.5%	0.8%	37.4%
35-44	16.8%	43.9%	31.2%	9.0%	23.7%
45-54	9.5%	22.5%	37.1%	35.4%	20.9%
55-64	5.7%	9.2%	20.6%	37.8%	13.6%
>65	0.6%	3.3%	6.6%	16.9%	4.5%
Total	722,330	281,290	298,799	201,087	1,503,505

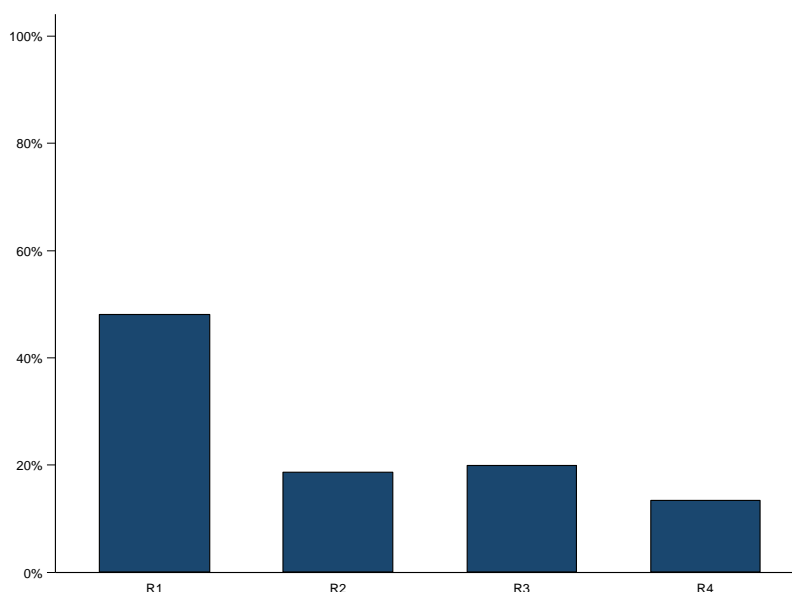
Source: MORE4 EU HE survey (2019)

Notes:

- These figures are the result of applying the weights designed on the basis of career stage post stratification weights.
- Based on question 13: "In which career stage would you currently situate yourself?" and question 3: "What is your year of birth?"
- (n=9,321)

To what extent the distribution of researchers per country over career stages in the sample reflects the reality is difficult to assess as no Eurostat data on this dimension is available. Based on the information that is available in literature and Eurostat totals and R1 data, we assume that there are relatively higher shares of R3 researchers and lower shares of R1 researchers in the sample than expected. When the career stage-based weights are applied, we see that indeed the distribution is shifted towards a majority of R1 and decreasing shares in the following career stages (Figure 4).

Figure 4: Distribution of self-declared career stages (poststratification weights are applied).



Source: MORE4 EU HE survey (2019)

Notes:

- Based on question 13: "In which career stage would you currently situate yourself?"
- (n=9,321)

2.3.4. Gender

In total, 41% of the respondents in the sample are female. A similar share was obtained in the MORE3 survey. This is also very close to the share found in Eurostat for the entire population of researchers (42%). Also, at country level the distributions of sample and population are similar (Table 13). The main differences are found in Latvia (+14pp), Croatia (+10pp) and United Kingdom (-13pp)³⁹. When gender-based weights are applied in the analysis, we will see that in countries with a lower share of female researchers than in the population, the responses of the female researchers receive higher weight than those of their male counterparts. As the overall balance between sample and population is good, this will have only limited effect on the values for the indicators.

Table 13: Gender distribution in the sample and in the population.

	Share of female researchers in the population	Share of female researchers in the sample
Austria	39.9%	36.6%
Belgium	41.6%	38.3%
Bulgaria	51.9%	49.7%
Croatia	49.0%	58.7%
Cyprus	37.6%	33.3%

³⁹ In the MORE3 survey these were also the countries where the largest variations were found: Croatia (13pp), Latvia (10pp) and United Kingdom (-15pp).

	Share of female researchers in the population	Share of female researchers in the sample
Czechia	34.4%	29.3%
Denmark	44.5%	38.1%
Estonia	47.8%	49.5%
Finland	48.4%	46.2%
France	35.4%	43.8%
Germany	38.9%	34.4%
Greece	37.7%	29.0%
Hungary	39.9%	30.2%
Iceland	54.4%	43.7%
Ireland	45.1%	39.2%
Italy	41.0%	43.5%
Latvia	54.1%	68.3%
Lithuania	55.8%	49.3%
Luxembourg	38.1%	34.3%
Malta	33.1%	30.5%
Netherlands	42.8%	37.1%
Norway	48.2%	37.7%
Poland	43.7%	49.2%
Portugal	48.8%	52.7%
Romania	48.4%	44.3%
Slovakia	45.9%	41.5%
Slovenia	41.7%	48.8%
Spain	42.1%	41.3%
Sweden	44.9%	38.3%
Switzerland	38.8%	41.7%
United Kingdom	45.5%	32.4%
Total	42.4%	41.3%

Source: MORE4 EU HE survey (2019)

Notes:

- Based on question 2: "What is your gender?"
- (n=9,321)

2.4. Ex-ante versus ex-post stratification: a comparison of estimates

This section presents the results for the main indicators when the post-stratification by career stage is applied, comparing it to the results obtained by ex-ante weighting procedures, and it addresses the reasons behind the few cases in which there are differences across both types of estimates.

Section 2.2 of this Annex has presented the main potential limitations of post-stratifying the data by career stage, being the most important ones the incomplete availability of secondary data (lack of data for specific countries), and substantially higher error rates. In spite of these potential pitfalls, the estimates obtained applying both stratification weights are very similar, with the differences being lower than the sampling error in most of the cases.

Table 14: Career paths and working conditions (EU28).

Indicator	Weights based on field of science	Weights based on career stages	Difference (in pp)
Early stage researchers in doctoral programme	74.8%	73.2%	1.6
Share of researchers with a PhD degree	83.6%	54.9%	28.7
Average duration current employment	13.0%	9.1%	4.0
Share of researchers with a fixed term contract	20.2%	41.2%	-21
Share of researchers with a dual position in current employment	10.9%	11.6%	-0.7
Share of researchers with a dual position in the private industry	1.1%	1.5%	-0.4
Share of researchers with a dual position in the public sector	3.3%	3.7%	-0.4
Satisfaction with current position: academic factors	92.6%	92.8%	-0.15
Satisfaction with current position: employment factors	85.0%	82.8%	2.2
Satisfaction with current position: career progression	74.9%	73.6%	1.3
Satisfaction with current position: personal factors	89.2%	89%	0.2
Share of researchers in full time positions	91.1%	81.7%	9.4
Average category of teaching load	48.8%	40.1%	8.7

Source: MORE4 EU HE survey (2019)

Table 14 shows the indicators related to career paths and working conditions. The cases in which the differences between indicators are larger are those referring to the share of researchers with a PhD degree: +29pp difference between the estimate weighted by field of science compared to the one weighted by career stage. This difference is also consistent with one that was obtained in 2016 when applying the poststratification weights in MORE3 data (+25 pp.). Other variables where the differences are substantial are the share of researchers with a fixed-term contract (-21 pp. difference), and the share of researchers in full time positions (+9 pp. difference). These are precisely the indicators which show a larger variation across career stages, especially between R1 researchers and higher career stages.

Table 15 shows the distribution of researchers with a PhD across career stages. The shares of researchers are very similar within the career stages when applying the weight based on field of science and the weight based on career stages. It can be observed that R1 researchers have a much lower share of researchers with a PhD than the other career stages since many of them are still enrolled in PhD training. Since the post-stratification weight increases the importance of this group to the expense of R2, R3 and R4 stages, this entails that that the overall estimate produces a significantly different result.

Similarly, Table 16 reflects the extent to which the ex-ante stratification and the career stage weight post-stratification produce consistent findings at career stage level on the shares of researchers with a fixed-term contract. It is the reweighting of the sample –

through giving a larger weight to R1 researchers – what produces the disparities at EU level. Similarly, the shares of researchers in full-time positions are displayed in Table 17 and show that the difference in the estimates produced by the ex-ante stratification and by the career weight post-stratification comes from attributing a larger importance to R1 researchers in post-stratification estimates.

Table 15: Share of researchers with a PhD across career stages (EU28).

Career stages	Weights based on field of science	Weights based on career stages
R1	16.8%	16.5%
R2	90.0%	90.0%
R3	90.1%	89.1%
R4	92.4%	92.3%

Source: MORE4 EU HE survey (2019).

Table 16: Share of researchers with a fixed-term contract across career stages (EU28).

Career stages	Weights based on field of science	Weights based on career stages
R1	68.5%	62.6%
R2	44.8%	40.5%
R3	11.8%	9.2%
R4	4.2%	4.4%

Source: MORE4 EU HE survey (2019)

Table 17: Distribution of researchers in full-time positions across career stages (EU28).

Career stages	Weights based on field of science	Weights based on career stages
R1	69.8%	71.2%
R2	85.1%	85.0%
R3	95.4%	95.4%
R4	94.5%	95.2%

Source: MORE4 EU HE survey (2019)

In Table 18 we observe that the indicators referring to PhD mobility and mobility during the PhD stage are very robust. The ex-ante stratification and the post-stratification produce very similar results.

Table 19 presents the indicators related to mobility and collaboration in the post-PhD stage. The only case in which the difference between both indicators is larger than the sampling error is the one referring to international collaboration. The differences between the two indicators rely on the fact that the distribution of responses is very much dependent on career stage, as it is shown in Table 20.

Table 18: PhD mobility and mobility during PhD stage (EU28).

Indicator	Weights based on field science	Weights based on career stages	Difference (in pp)
PhD Mobility	15.5%	16.8%	1.3
Mobility during PhD	22.7%	21.3%	-1.4

Source: MORE4 EU HE survey (2019)

Table 19: Collaboration and mobility in post-PhD stage (EU28).

Indicator	Weights based on field of science	Weights based on career stages	Difference (in pp)
Post PhD: Long-term mobility in the last ten years	26.5%	23.1%	3.4
Post PhD: Long-term mobile more than ten years ago	24%	21.7%	2.3
Post PhD: Never long-term mobile	49.4%	55.3%	-5.9
Post PhD: Short-term mobility in the last ten years	31.8%	29.9%	1.9
Post PhD: Short-term mobility more than ten years ago	18.6%	15.3%	3.3
Post PhD: Never short-term mobile	49.6%	54.7%	-5.1
International collaboration with colleagues from EU or non-EU countries	70.1%	58.9%	11.2
Interdisciplinary mobility	18.9%	18%	0.9
Interdisciplinary collaboration	79.5%	77.1%	2.4
Intersectoral mobility	23.8%	22.7%	1.1
Intersectoral collaboration	26.5%	23.1%	3.4

Source: MORE4 EU HE survey (2019).

Table 20: Distribution of international collaboration across career stages.

Career stages	Weights based on field science	Weights based on career stages
R1	47.1%	47.2%
R2	45.4%	55.1%
R3	74.8%	77.2%
R4	82.1%	79.5%

Source: MORE4 EU HE survey (2019).

2.5. Potential and limitations of the resulting sample

The final average sampling error rate across countries obtained in MORE4 is equal to 5.7% and thereby slightly higher than the one obtained in MORE3 but in line with the resulting error rate in MORE2. Our methodology thus leads to accurate indicators at the European and country level. In other words, for a country with a 5% error rate, this means that if the survey was to be repeated a hundred times, in 95 cases the outcomes for that country

would be deviating no more than +/-5% from the outcomes of the MORE4 survey (5% max error -p value of 0.05).

The indicators at other levels of analysis (field of science, gender, career stages, FTE) are not guaranteed to have the same degree of accuracy. Nevertheless, at EU level, the number of observations is sufficiently high to guarantee consistent and accurate results here as well. It is at lower level of subpopulations that the outcomes are to be interpreted with more care (e.g. R1 researchers' opinions in a particular country). Sample size is therefore key to obtaining accurate estimates. For this reason, we do not show subpopulation estimates in the report when the n-value of this subpopulation is below 30. Applying this threshold of 30 observations - the standard used in international reference like the OECD - avoids the publication of non-robust indicators due to low n-values. Moreover, it also ensures that the privacy of the respondents in this small subpopulation is not compromised.

One particular case are the FTE estimates, i.e. estimates at country level for FTE researchers instead of HC researchers. The data also allows us to express estimates in FTE, as the survey contains a question on whether the respondent is in full-time or part-time employment. However, these will always be less accurate than HC estimates: both incorporate the same sampling error, but FTE estimates are in addition based on a survey question and thus incorporate also the eventual errors due to codification of the information from this question. Therefore, in the indicator report, all estimates are expressed in terms of HC only and correspond to the above-mentioned accuracy level.

Similarly, caution is also needed in the interpretation of the career stage estimates. As with the FTEs, the information on career stages is based on a survey question (self-selection by the researchers). For the interpretation of the analyses referring to career stages, readers need to take into account the existence of certain biases in this factor: the data reflect higher shares of R3 researchers and lower shares of R1 researchers compared to what we can expect based on the information that is available in the literature and in Eurostat data on R1 researchers. These potential biases are minimised when applying post-stratification weights by career stage. This was tested in section 1.4 in the Annex, where we observe that differences between our main indicators and the career stage post-stratified estimates are relatively small and do not affect the conclusions of the report. Nevertheless, it is important to take this point into account when comparing MORE4 with MORE2 or MORE3 indicators, as each of the surveys show a slightly different distribution across career stages which may lead to sample-based differences in the estimates between the surveys. This will be further discussed in the next section on comparability with previous MORE studies.

2.6. Comparability with previous MORE studies

Comparability with the estimates obtained in previous MORE surveys was one of the main goals when designing the approach and developing the questionnaire in MORE4. For this reason, the sampling approach and data editing approach are the same as in MORE3 and MORE2. However, the implementation of the survey was improved based on lessons learned from these predecessor studies. This means that the methodology is the same to help ensure longitudinal comparability, but efforts have also been made to make changes to aspects of the data collection approach so as to maintain the same level of accuracy (e.g. to improve the response rate or to minimize linguistic barriers, see supra).

It is important to stress the fact that the three studies do not follow a panel design. This entails that MORE2, MORE3 and MORE4 are independent from each other in the sense that the three surveys do not include responses from the same individuals. MORE2, MORE3 and

MORE4 offer a solid ground for the study of the evolution of indicators at aggregate level between the points in time when the different respective MORE studies were carried out, but cannot serve to analyse the evolution of small subgroups (e.g. the abovementioned threshold of 30 observations).

Also, the questionnaire was based strongly on the MORE3 questionnaire. The evolving policy context did require a shift in focus towards, for example, the increasing importance of Open Science approaches in researchers' daily work. For this reason, a number of questions were deleted, replaced or added. Apart from this natural evolution, the key questions were not changed in any way and for questions where a change was needed, the team still took into account maximum comparability. A comparison between the questionnaires is provided as Annex to the Methodological Report complementing the MORE4 EU HE report. Any changes in the questions, whether or not having an effect on its comparability or interpretation, are mentioned in the relevant sections on analysis and results.

These general principles in the development of the approach and questionnaire have resulted in strongly comparable indicators across the three MORE studies, in particular in terms of what concerns the key indicators on working conditions and the mobility of researchers in Europe. However, it is important to point out that comparability may be limited in number of cases due to the following factors:

- Changes in the question which may have led to alternative interpretation (e.g. the addition of items on Open Science in the questions on motives or effects of mobility; although we expect this effect to be very limited to zero);
- Changes in the order of the questions which may have led to another position towards the question (1 case: the question on interdisciplinary mobility, where one introductory question was deleted compared to MORE3);
- Different sample composition (e.g. slightly different distribution in career stages with more senior researchers in MORE3 and, even more in MORE4)
- The introduction of new questions; i.e. that were not included in MORE2 (e.g. on Open Science and the effects of grants).

Lastly, the same principles have been applied across the three MORE studies also in the analysis phase. In a limited number of cases, MORE3 introduced new approaches and applied them also to MORE2 data in order to again obtain comparable results. This was, for example, the case in the calculation of composite indicators, when grouping types of working conditions or motives for undertaking mobility together. In the analysis of MORE4, the same approaches as in MORE3 have been applied so that consistency across the three studies is guaranteed.

Further points of attention or limitations in the interpretation of specific indicators are explicitly mentioned in the relevant sections on analysis and results.

3. SURVEY METHODOLOGY OF THE GLOBAL SURVEY

The Global survey focuses on mobility patterns, career paths, employment and working conditions of researchers currently working outside Europe. The topics are similar to those in the MORE4 EU HE survey, but the focus is different:

Indicator	MORE4 EU HE survey (Task1)	MORE42 Global survey (Task2) ⁴⁰
Target region of employment	Researchers currently working IN the EU	Researchers currently working OUTSIDE the EU
Target sector⁴¹	Researchers at higher education institutes	No specific sectoral focus (both researchers from higher education institutes and other organisations can participate)
Career stage focus	Differentiates between PhD-mobility (R1) and post-PhD mobility (R2-R4)	Does not differentiate between PhD mobility (R1) and post-PhD mobility (R2-R4)
Representative data	Provides representative data at the EU28 and country level	Does not provide representative data at the EU28 and country level

The target population of the Global survey consists of the following subgroups (in line with the analysis in MORE2⁴² and MORE3⁴³):

- TG1: European researchers currently working outside the EU⁴⁴;
- TG2: Non-EU researchers who have worked in the EU in the past;
- TG3: Non-EU researchers who have worked abroad but not in the EU;
- TG4: Non-EU researchers who have never worked abroad.

The following sections first present the main characteristics of the sampling methodology and the country focus followed for the Global survey. Then, an overview is given for the distribution strategy, the composition of the sample and the interpretation of the results.

3.1. Country focus

The Global Survey is directed towards researchers currently working outside the EU; it is therefore global in its outlook. The survey puts a special focus on those countries with whom the EU has an S&T agreement and those associated with the Framework Programme that are not covered by the survey under Task 1 – EU HE survey (see Table 21).

⁴⁰ Consistent with the MORE2 approach.

⁴¹ A broad definition of 'sector' is used here: it is based on the difference between Higher Education Institutions; private-not-for-profit organisations; public sector and government; large companies; and SMEs.

⁴² IDEA Consult et al. (2013). MORE2 - Support for continued data collection and analysis concerning mobility patterns and career paths of researchers, Extra-EU report (WP2). European Commission, DG Research and Innovation.

⁴³ IDEA Consult et al. (2017). MORE3 - Support for continued data collection and analysis concerning mobility patterns and career paths of researchers, Global Survey Report. European Commission, DG Research and Innovation.

⁴⁴ EU28 + 3 Associated Countries (Switzerland, Norway and Iceland).

Researchers who are currently working in countries that are not included in this list were not excluded from the survey, but they were not specifically targeted by the communication strategy.

Table 21: Countries with which the EU has an S&T agreement and/or associated with FP programmes.

S&T agreement ⁴⁵	Associated with H2020 ⁴⁶
Algeria	Albania
Argentina	Armenia
Australia	Bosnia and Herzegovina
Brazil	Faroe Islands
Canada	Georgia
Chili	Iceland*
China	Israel
Egypt	North Macedonia
India	Moldova
Japan	Montenegro
Korea	Norway*
Mexico	Serbia
Morocco	Switzerland*
New Zealand	Tunisia
Russia	Turkey
South Africa	Ukraine
Tunisia	
Ukraine	
United States	

* Not part of the scope of Task 2 as these countries are included in the EU HE survey.

Box 1: Limitations of the sampling and methodology.

As indicated, this Global Survey does not provide representative data at the level of the countries covered. This means that the dataset does not provide representative data on the number of researchers and their mobility patterns from and to specific countries. This sample does not reflect the proportion of researchers currently working outside the EU within the overall population of researchers currently working outside the EU. Therefore, results need to be interpreted with care and no generalisations/extrapolations can be made in this regard.

⁴⁵ <http://ec.europa.eu/research/iscp/index.cfm?pg=countries>

⁴⁶ <https://ec.europa.eu/research/iscp/index.cfm?pg=associated>

3.2. Sampling and distribution strategy

The sampling approach for the Global Survey is characterised as ‘convenience’ sampling (similar to the MORE2 and MORE3 Global Surveys). A multichannel approach was applied:

- Via a web-based contact collection approach, email addresses of researchers currently working outside the EU were obtained. These researchers were contacted via email, including a personalised link to the online survey;
- Via the EURAXESS Links (Officers), email addresses of researchers were obtained. These researchers were also contacted via email, including a personalised link to the online survey;
- Via an open communication strategy: A link to the Global Survey was included on the websites of MORE4 project, the European Commission and the project partners. Intermediary organisations were contacted with the request to distribute the link to the Global Survey via their own communication channels (website, newsletter, social media etc.).

Below, more details are provided on these different contacting and communication approaches (summary overview in Table 22).

Table 22: Overview of communication strategy.

Communication strategy	Panel versus non-panel	Focus
Targeted email approach towards researchers – contacts obtained via web-based approach	“panel responses”: the researchers received an email including a personalised link to the Global Survey.	Focus on HE researchers.
Targeted email approach towards researchers – contacts obtained via EURAXESS Links officers	“panel responses”: the researchers received an email including a personalised link to the Global Survey.	No focus on HE researchers. EURAXESS is open to HE and non-HE researchers, but there is a high bias towards HE researchers.
Communication via websites, intermediary organisations, etc.	“non-panel response”: there was a non-personalised open link to the Global Survey.	No focus on HE researchers. The open approach reaches both HE and non-HE researchers.

Source: The consortium.

Email to researchers using the web-based contact collection approach

Email addresses of HE researchers (working outside Europe) were collected using a web-based contact collection approach (similar to MORE2 and MORE3):

- The first step of the method is to collect a large sample of the URLs of academics’ home pages. This is achieved through Bing advanced site-specific searches of a list of thousands of university websites for keywords like “home page”, “homepage”, “CV” or “Curriculum Vitae”. The searches are conducted twice, once for normal HTML pages and once for PDF files, since it is common to post CVs online in PDF format. These searches can be targeted at academics with particular profiles by adding appropriate keywords. For example, to target academics that have moved to the US, the searches would be run with names of prominent US universities as additional keywords. This method is imperfect as it can match conferences listed in CVs instead of previous employment histories but in previous MORE studies it had a reasonable success rate.
- The second step is to automatically download all the home pages and CVs identified from the searches and to automatically extract email addresses from

them. A limitation of this step is that some academics omit or obscure their email address, but the method still gives reasonable results. The main limitation of this method is that it might under-represent universities that have a standard home page format for all their academics that does not include email addresses or that obscures their email address. In countries for which this method was insufficient (e.g. very large countries), efforts were made to extract additional email addresses from publications included in the Web of Science.

In MORE2, the main focus of this approach was on US researchers. MORE3 and MORE4 Global Surveys have a larger geographical scope (non-European countries) and therefore the strategy entailed a broader outreach.

Email to researchers via EURAXESS Links officers

EURAXESS Links is a networking tool for the community of European Researchers abroad.⁴⁷ As a part of the networking purpose, it also focuses on disseminating information and fostering collaboration with researchers in Europe and helping the expatriate researchers to return to Europe. EURAXESS Links was launched in 2006 in the US. Now there are EURAXESS Links officers in North America, Japan, China, India, Korea, ASEAN (Singapore, Malaysia, Indonesia and Thailand), Australia and New Zealand, and Latin America and Caribbean (LAC).

The contact details (email) of researchers who are connected with EURAXESS Links countries were obtained through the EURAXESS Links officers and the researchers received an email invitation to participate to the survey.

Open communication strategy

Aside from contacting researchers directly via email including a personalised weblink, there was also an "open" weblink to the online survey. This allowed all those interested to participate in the survey. A drawback of the approach is that the research team did not have control over who participates in the study and was not able to address/remind them personally. It was thus not possible to support or steer the response rate for specific countries through this channel. In addition, a certain self-selection bias is possible: researchers that participated in the study might present some characteristics that distinguish them from the general population. This type of bias is, however, difficult to measure in the absence of population data (i.e. the population of researchers in the world).

There are different channels through which the open weblink was distributed:

- A dedicated website on the MORE4 project with information on the context and set-up of the study was developed. The link to the online Global Survey was placed visibly on the main page of the website so that all visitors could easily access the survey. In addition, if researchers had questions on the survey or required more information on the project, they could contact the project team via the designated email address: surveyGLOBAL@more-4.eu.

⁴⁷ <https://euraxess.ec.europa.eu/>

- The open weblink has been communicated via the EC’s own communication channels, more specifically EURAXESS Worldwide website and social media accounts.
- Aiming at a broad outreach, the online Global Survey link was disseminated as widely as possible. Therefore, relevant intermediary organisations were asked to distribute the link, among which were national research funding agencies and EU Centres of Excellence across the world. The link was also shared on the company websites of the MORE4 partners.

Snowballing

In addition to the different approaches explained above, “snowballing” was also used as a source to increase the survey sample. All respondents to the survey had the opportunity to forward the survey link to other researchers (these are then included in the non-panel responses).

3.3. Survey implementation

The survey was launched on the 5th of March 2020 and was closed on the 3rd of July 2020. The survey was composed of 85 questions and was available in English.

The entire panel size (collected email addresses) consisted of 312,755 people identified by the sampling method mentioned above. If we only consider the responses that are taken into account for the analysis – i.e. complete questionnaires coming from researchers that are part of the target population – the total number of responses reaches 3,011 respondents. Of these, 53% are obtained via the panel and 47% via the non-panel approach. These shares demonstrate that the combination of both channels has been a successful methodological choice and that both were well implemented.

3.4. Sample composition

3.4.1. Target groups

Researchers were classified ex-post in four subgroups based on the information provided in the questionnaire. An overview of the number of responses by researcher/target group is provided in Table 23 below.

A total of 3,011 complete questionnaires were collected from researchers that are part of the target population. Of these, 165 were obtained from EU researchers who have been mobile more than 10 years or who have not been mobile. To remain focused on the topics of mobility and career paths in the past ten years, these responses were not considered for further analysis (this is also consistent with the approach of the MORE2 and MORE3 Global Surveys). Therefore, a total of 2,846 responses are considered within the scope of the MORE4 Global Survey. Table 23 shows the distribution of responses across target groups.

Table 23: Survey responses per target group (completed responses).

Target groups		Total (n)	Share (%)
TG1: EU researchers currently working abroad	2017	630	32.5%
	2020	492	16.3%
	2017	263	13.6%

Target groups		Total (n)	Share (%)
TG2: Non-EU researchers who have worked abroad in the EU in the last ten years	2020	463	15.4%
TG3: Non-EU researchers who have worked abroad but not in the EU	2017	178	10%
	2020	271	9%
TG4: Non-EU researchers who have never worked abroad (or have done so more than ten years ago)	2017	869	44.8%
	2020	1,785	59%
Total	2017	1,940	
	2020	3,011	
Of which: Responses outside the scope	2017	213 (81+132)	
	2020	165 (87+78)	
Total sample within the scope	2017	1,727	
	2020	2,846	

Source: MORE4 Global Survey (2020), MORE3 Global Survey (2017)

*Note: There were 78 researchers currently working outside the EU, who have never been mobile, and who have an EU citizenship (132 in MORE3). These cases can refer to very diverse circumstances, e.g.:

- People with double citizenship (EU and non-EU) but who have never been to the EU (e.g. people who were born outside Europe or that moved as a child but retained EU citizenship).
- People who moved to another country to do their Master degree, these are not considered "mobile" in this study.
- Due to the heterogeneity of this group, these researchers are not considered for the analysis.

3.4.2. Geographical profile and comparison MORE3-MORE4

Respondents to the MORE4 Global Survey were asked to indicate their country of citizenship, residence, current employment and country where they obtained or will obtain their PhD. This information provides valuable insights into the geographical profiles of the researchers, and at the same time enables the comparison of the sample composition of the different MORE Global Surveys, which has implications for comparison of results over time.

When we look into the overlap between the different geographical variables per individual researcher (country of citizenship, residence, current employment and country where they obtained or will obtain their PhD), this percentage of overlap is high between the different variables. Specifically, the overlap between country of current employment and country of residence is as high as in MORE3 (98%, cf. Table 24). We focus the analysis on country of current employment, country of citizenship and country of PhD (consistent with the MORE4 EU HE Survey).

Table 24: Overlap between reference countries in the MORE4 Global Survey.

	Country of citizenship	Country of residence	Country of current employment	Country of PhD
	(n = 2,846)	(n = 2,846)	(n = 2,846)	(n 2,490) ⁴⁸
Country of citizenship ⁴⁹	-	82.6%	82.2%	69.3%
Country of residence	82.6%	-	97.9%	67.5%
Country of current employment	82.2%	97.9%	-	67.0%
Country of PhD ⁵⁰	60.7%	59.0%	58.6%	-

Source: MORE4Global Survey (2020).

Sample composition and weighting procedure for the comparison MORE3-MORE4

The total sample within the scope of the Global Survey consists of 327 EU citizens and 2,519 non-EU citizens (i.e. total of n= 2,846)⁵¹. In 2020, there were more respondents and a higher number of countries represented in the sample than in the MORE3 Global Survey (2017). This means that the quality of the data has improved in terms of a more global scope. There are, however, some differences worth noting:

- The number of Australian researchers included in the sample is much smaller in MORE4 than in MORE3 despite the increased efforts to reach to researchers in this country (i.e. more invitation emails have been sent).
- The number of Ukrainian respondents in MORE4 is much higher than in the MORE3 Global Survey. The Ukrainian government, through the Ministry of Education and Science launched a communication campaign both from the Ministry and from universities inviting researchers to fill in the MORE4 Global Survey. As a result, this group of researchers represents 21.1% of the total sample. This unusually high number of responses could jeopardize the comparability of the results across MORE studies.
 - The research team therefore analysed different alternatives to address this and it was decided to calibrate the sample in such a way that the number of Ukrainian respondents would have the same weight in the sample as the average share of respondents in the 5 non-EU countries with a higher number of respondents in MORE4.
 - This entails that, in the analyses presented in this report and in the MORE4 Global Survey report, Ukrainian respondents are attributed a weight that makes them represent 6.2% of the sample (the average share of respondents across: India, Brazil, Canada, United States and Mexico), instead of 21.1%. This weighting procedure constitutes a balanced solution to ensure the comparability of the overall results of the MORE studies over time, avoiding the overrepresentation of researchers from a

⁴⁸ 112 respondents indicated that they did not obtain a PhD or that they are currently not working on a PhD.

⁴⁹ Double citizenship is possible (195 respondents indicated that they have dual citizenship).

⁵⁰ It is possible to obtain a joint degree officially issued by two institutions located in two different countries. As such, two countries of PhD are possible.

⁵¹ More information can be seen in Table 8 in the MORE4 Global Survey report: this table shows the distribution of researchers across countries of current employment and target group.

single country, while maintaining the information provided by these researchers in the study.

- The total sample size after weighting is also indicated in Table 25 below, resulting in a total sample size of n=2,369 within scope and taking into account the weighting procedure.⁵²

Table 25: Survey responses per target group after weighting (completed responses).

Target groups		Total (n)	Share (%)
TG1: EU researchers currently working abroad	2017	630	32.5%
	2020	492	16.3%
	2020 (weighted**)	492	19.4%
TG2: Non-EU researchers who have worked abroad in the EU in the last ten years	2017	263	13.6%
	2020	463	15.4%
	2020 (weighted**)	407	16.1%
TG3: Non-EU researchers who have worked abroad but not in the EU	2017	178	10%
	2020	271	9%
	2020 (weighted**)	254	10%
TG4: Non-EU researchers who have never worked abroad (or have done so more than years ago)	2017	869	44.8%
	2020	1,785	59%
	2020 (weighted**)	1,380	54,5%
Total	2017	1,940	
	2020	3,011	
	2020 (weighted**)	2,534	
Of which: Responses outside the scope	2017	213 (81+132*)	
	2020	165 (87+78*)	
	2020 (weighted**)	165 (87+78*)	
Total sample within the scope	2017	1,727	
	2020	2,846	
	2020 (weighted**)	2,369	

Source: MORE4 Global Survey (2020), MORE3 Global Survey (2017)

*Note:

There were 78 researchers currently working outside the EU, who have never been mobile, and who have an EU citizenship (132 in MORE3). These cases can refer to very diverse circumstances, e.g.:

⁵² The small differences with the total number of weighted observations in some of the analyses presented in this report and in the MORE4 Global Survey report are due to rounding (e.g. when rounding the number of observations in each target group).

- People with double citizenship (EU and non-EU) but who have never been to the EU (e.g. people who were born outside Europe or that moved as a child but retained EU citizenship).
- People who moved to another country to do their Master degree, these are not considered “mobile” in this study.
- Due to the heterogeneity of this group, these researchers are not considered for the analysis.

** Note: Number of respondents after the application of weights.

3.5. Interpretation of the results

3.5.1. Potential and limitations of the resulting sample

The Global survey did not provide representative data at the level of the countries covered. The dataset does not provide representative data on the number of researchers and their mobility patterns from and to specific countries. This sample does not reflect the proportion of researchers currently working outside the EU within the overall population of researchers currently working outside the EU. Therefore, results need to be interpreted with care and no generalisations/extrapolations can be made in this regard.

3.5.2. Comparability across studies over time

A direct comparison between the MORE Global Surveys is not as accurate as in the case of the MORE EU HE surveys, primarily because the Global Surveys are not based on a representative sample of researchers currently working outside the EU. In addition, the geographical scope of the MORE Global surveys has increased over time. While in the MORE2 Extra-EU survey the main focus was on US researchers, the scope was broadened in MORE3, and continued in MORE4, with (large) countries with which the EU has an S&T agreement, ASEAN countries, as well as other Associated Countries with Horizon 2020 and FP7.

The composition of the sample is also different in MORE4 with respect to MORE3: the number of countries is higher in the 2020 sample and the number of researchers is more homogeneously distributed. A comparison of the geographical composition of the samples across MORE studies is provided in the table below. It shows the top five countries (of current employment) with the highest number of respondents. The figures for MORE4 include both the shares for the weighted numbers and the raw figures (i.e. without correction for the high number of Ukrainian citizens in the sample).

Table 26: Comparison with MORE2 extra-EU survey and MORE3 Global Survey.

MORE2 EXTRA-EU SURVEY RESPONSE BY COUNTRY OF CURRENT EMPLOYMENT (N=4,090)		MORE3 GLOBAL SURVEY RESPONSE BY COUNTRY OF CURRENT EMPLOYMENT (N=1,727)		MORE4 GLOBAL SURVEY RESPONSE BY COUNTRY OF CURRENT EMPLOYMENT (N=2,846) N=2,369	
United States	55.3%	Australia	17.2%	Brazil	(7.9%) 9.4%
Australia	10.9%	United States	13.7%	India	(7.6%) 9.2%
Turkey	6.7%	Canada	12.9%	Canada	(7.4%) 8.8%
Brazil	3.6%	New Zealand	8.3%	United States	(6.0%) 7.2%
Israel	2.3%	Brazil	6.9%	Ukraine	(22.1%) 6.6%

Source: MORE4 Global Survey (2020), MORE3 Global Survey (2017), MORE2 Extra-EU Survey (2013)

Notes:

- Data in parentheses for MORE4 indicates the shares before weights are applied.

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The EU Open Data Portal (<http://data.europa.eu/euodp/en>) provides access to datasets from the EU. Data can be downloaded and reused for free, for both commercial and non-commercial purposes.

The MORE4 study aims to update, improve and further develop the set of indicators used in previous MORE studies in order to meet the need for indicators over time and to assess the impact on researchers of policy measures introduced to develop an open labour market for researchers. This study gathers data to highlight emerging policy needs and priorities with regard to mobility patterns, career paths and the working conditions of researchers.

The study carries out two surveys: one addressed to researchers currently working in the EU (and EFTA) in higher education institutions, the other addressing researchers currently working outside Europe.

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