



Study on Fostering Industrial Talents in Research at European Level

Final Report



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LIST OF ACRONYMS AND DEFINITIONS

Acronyms	Definitions and notes
AC	Associated Countries (countries participating in Horizon 2020 on an associated basis).
BERD	Business Enterprise R&D Expenditure
ER	Experienced researchers - defined as being researchers with at least 4 years' experience.
ESF	European Social Fund
ERDF	European Regional Development Fund
ESR	Early-stage researchers are defined as researchers having up to 4 years' post-doctoral experience.
ESIF	European Structural and Investment Funds - (formerly Structural Funds in 2007-2013)
EU-28	28 EU Member States
EU RTD FPs	EU Research and Development Framework Programmes (FPs)
FP	Framework Programme (also see entry above)
GERD	Gross domestic expenditure on R&D
HEIs	Higher Education Institutions.
IPR	Intellectual Property Rights (IPRs)
ISM	Intersectoral mobility.
MSCA	Marie Skłodowska-Curie Actions.
OP	Operational Programme (note - OPs have utilised Structural Funds support to fund ISM through the ERDF and ESF).
PGR	Postgraduate researchers
R&I	Research & Innovation.
RQ	Research questions
RTOs	Research and Technology Organisations
SMEs	Small and Medium-sized Enterprises.
STEM	Science, Technology, Engineering and Mathematics
STI	Science, Technology & Innovation
TRL	Technological Readiness Levels (concept that has become more widely used in Horizon 2020).
TTO	Technology Transfer Office

This report contains the findings from a *Study on Fostering Industrial Talents in Research at European Level*. The assignment was coordinated by EPRD, with the close involvement of the Centre for Strategy & Evaluation Services, inova+ and PPMI Group.

1. INTRODUCTION

Section 1 summarises the study objectives and scope, provides a definition of intersectoral mobility, an overview of the methodology, sets out the research questions and describes the report structure.

1.1. Study objectives

The overall objective is to **conduct a feasibility study as to whether there is scope for additional EU-level initiatives** to increase intersectoral mobility (“ISM”), with a focus on the mobility of academic and industrial researchers, academics and senior people from industry. The specific objectives are to:

- Produce an inventory of existing studies, reports and papers on intersectoral mobility in Europe and selected third countries;
- Identify up to 10 examples of intersectoral mobility schemes per country through a mapping exercise (and examples of mobility between sectors taking place through informal means);
- Develop a better understanding of the barriers and drivers of the uptake of the intersectoral mobility of researchers, including the availability of, and access to support structures, guidance and training and funding mechanisms;
- Ascertain the level of intersectoral mobility among researchers in the EU-28 Member States, EFTA/ EEA and candidate countries, and between the EU and third countries;
- Identify five examples of good practices in intersectoral mobility and critically evaluate these, highlighting strengths and weaknesses and examining the scope for replicability¹;
- Develop recommendations as to what form possible further EU-level interventions to increase the intersectoral mobility of researchers – if deemed necessary – might take.

1.2. Study scope and definition of intersectoral mobility

Intersectoral mobility refers to all possible bridges between university, industry and other sectors of employment. In a narrower sense, ISM is defined as the physical mobility of researchers between one sector (academia) and another.² Researcher mobility may therefore also be virtual, or involve partial mobility, for instance spending one day a week in an enterprise and four days a week carrying out PhD research at university. The mobility of researchers takes place between **academia** (e.g. universities, other types of higher education institutions and publicly-funded research institutes) **industry** (e.g. SMEs and large firms) and the **public sector** (e.g. national government, local authorities, and public institutions).

The different types of intersectoral mobility of researchers within focus are:

- Mobility between academia and industry;
- Mobility between academia and the public sector;
- Mobility between academia and the third sector;

This study has focused on the identification and analysis of examples of intersectoral mobility at **international, national, regional and sectoral levels**. Where possible, examples of

¹ It was agreed with DG RTD that it was appropriate to widen the scope of the case studies to incorporate a cross-comparative approach by type of mobility. This has still allowed for a focus on individual schemes.

² Definition adapted from Vandeveld, K.: “Intersectoral Mobility. ERAC Mutual Learning Workshop on Human Resources and Mobility”, 2014. https://cdn1.euraxess.org/sites/default/files/policy_library/report-intersectoral-mobility.pdf

bidirectional mobility have been identified in respect of each of the above. Whilst the majority of the research questions addressed through the study (see Section 1.4) focus on the “physical” mobility of researchers, this study has looked more broadly at the framework conditions and key enablers that help to support and encourage ISM, such as: the extent of awareness-raising about what intersectoral mobility is, and its potential benefits, skills and training, issues relating to the legal and regulatory frameworks, as well as the research funding situation, in so far as these enhance the quality and intensity of physical ISM.

Whereas international mobility schemes require a period of time in another country, intersectoral mobility predominantly takes place at the national level, reflecting the fact that intersectoral networks are often quite localised. There are however some ISM schemes that also involve an international mobility component, either through bi-lateral arrangements between EU countries, or through an international period of mobility. ISM also stimulates interaction and knowledge transfer between academia and industry in line with the Quadruple Helix model³ for the development of a knowledge-based economy. Such mobility experiences are vital in giving researchers a better understanding of the industrial aspects of research and in strengthening their skills and employability in industry, government and third sector, in each of which there is a need for more highly-qualified researchers. In many EU Member States, there are also insufficient numbers of academic positions to meet demand from doctoral researchers, especially since there has been an increase in the supply of doctoral students and post-doctoral researchers. Here, intersectoral mobility – both through formal ISM schemes and informal mobility - is a partial solution to addressing the challenge of a lack of sufficient employment opportunities in academia for all post-doctoral researchers.

The **geographic scope** covers the EU-28, EEA and EFTA countries, Associated Countries (“AC”) participating in Horizon 2020 and international comparator countries including the **USA, Japan, Canada, South Korea, China, Brazil, Australia, India, Singapore** and **Russia**.

1.3. Methodology

The methodology consisted of a combination of desk and field research and the use of both primary and secondary data and information sources. The different research sources were also triangulated against one another to check for consistency and to explain any differences between different sources. The methodology consisted of carrying out a number of tasks which were, in summary:

- **Desk research:**
 - **Development of an Excel-based inventory of previous studies and research on intersectoral mobility** – the extensive mapping of key literature is set out in a bibliographical summary in Annex B and in a supporting Excel database.
 - **Basic mapping of national ISM schemes in Excel database** (see Annex D) – desk research to identify and analyse schemes in countries within scope. 279 ISM schemes have been identified.
 - **Development of country overviews** – to inform the synthesis analysis, country researchers produced an overview of the situation in respect of domestic ISM scheme (see Annex C).
 - **Extended mapping of schemes** – an assessment of one ISM scheme across the EU-28 countries was undertaken to analyse how formal ISM schemes operate in greater depth, covering the set-up and design phase, implementation phase and evaluation and monitoring. This helped to identify good practices and has informed the development of the cross-comparative case studies (see Annex D).
- **An interview programme** - with relevant stakeholders, such as higher education institutions, research institutes, representatives from industry, national policy makers, research and innovation agencies, companies and individual researchers;

³ The Triple Helix approach, developed by Henry Etzkowitz and Loet Leydesdorff, is based in the perspective of University as a leader of the relationship with Industry and Government, to generate new knowledge, innovation and economic development. The Quadruple Helix is based on similar principles, but includes the involvement of civil society.

- **Three online surveys** – targeted at 1) research & innovation agencies, Higher Education Institutions, academies, Research and Technology Organisations and Research Institutes 2) individual researchers and 3) industry (start-ups, SMEs and large firms);
- **Cross-comparative case studies** - the development of five case studies in a separate standalone report. These focus on the following topics:
 1. Mobility between academia-industry;
 2. Mobility between academia-NGOs and the third sector;
 3. Mobility between academia-government;
 4. Mobility by researcher target group, tools and incentives;
 5. Preparation for mobility (e.g. professional development, entrepreneurship training and skills to enhance employability); and
- **Analysis and reporting** - the development of key study findings relating to the baseline situation to address the research questions and the development of a feasibility study based on the baseline and gap analysis.

An overview of responses to the **online surveys** is provided in the following table.

Table 0.1 - Overview of survey responses

Survey type	No. of survey responses
1. Research & Innovation Agencies, Higher Education Institutions, Academies, Research and Technology Organisations and Research Institutes	50
2. Industry and private sector research institutions	20
3. Individual researchers who have participated in an intersectoral mobility programme	35
Total	105

105 responses were received, of which 50 were from a combination of R&I agencies, individual HEIs and RTOs, 20 from companies and 35 from individual researchers. In addition, two written responses were received by HEIs and technology organisations.

1.4. Research questions

A number of research questions (“RQ”) were defined for this study grouped under two headings, firstly issues relating to the baseline situation and secondly, questions pertaining to the feasibility study part and possible future additional EU involvement in promoting intersectoral mobility:

Table 1.2 - Key research questions

Key research questions	Signposting to section
Baseline situation and gap analysis	
RQ1 - What are the main developments and trends in intersectoral mobility in the past 10 years regarding ISM taking place at national level?	2.2 Overview of national, EU-level and international ISM schemes
RQ2 - Which countries are involved in ISM schemes? Are there any gaps in terms of country coverage?	See RQ1 above
RQ3 - What type of academic institutions and organisations are involved in ISM schemes?	See RQ1 above

Key research questions	Signposting to section
RQ4 - What type of non-academic organisations are involved – large companies, SMEs, not-for-profit organisations, the public sector, etc.?	See RQ1 above
RQ5 - Which are the major intersectoral mobility schemes for researchers across the EU Member States and relevant associated countries?	Excel database of ISM schemes 2.2 Overview of national, EU-level and international ISM schemes
RQ6 - Are there any links between ISM schemes regionally, nationally and internationally? Do they complement each other and propose partnerships in order to enhance the effectiveness and quality of training offered?	2.2 Overview of national, EU-level and international ISM schemes
RQ7 - What funding (total amount, the public/private share etc.) is already being made available for ISM? What are the typical costs per individual researcher?	2.3.3 Funding sources for intersectoral mobility schemes
RQ8 - Are there a common set of core values followed by most schemes? Are there any common characteristics?	2.3 - key characteristics of national and EU ISM schemes
RQ9 - How much time is being spent by researchers in the non-academic host institution during the mobility period?	2.3 - key characteristics of national and EU ISM schemes
RQ10 - What measures are in place to ensure smooth coordination between academic and non-academic PhD supervisors?	2.3 - key characteristics of national and EU ISM schemes
RQ11 - If demand for researchers is relative to the research intensity of the private sector, is there enough absorptive capacity to bring in more researchers in the private sector?	2.3 - key characteristics of national and EU ISM schemes
RQ12 - What percentage of researchers received transferable skills training during their mobility experience? What impact did this training have on their future careers?	Section 2.5.3 - Transferable skills training during an intersectoral mobility experience
RQ13 - Is there a correlation between the size of the scheme (researcher numbers and funding) and the number of researchers who go on to find work in a non-academic setting?	Section 2.5.4 - Scheme size and future employability
RQ14 - What percentage of researchers who participate in these schemes successfully find work in a non-academic institution?	2.5 Outcomes from participation in intersectoral mobility
RQ15 - What are the main types of outcomes from participation in ISM schemes? What types of outcomes emerge at the level of outputs, results and impacts? And by type of participant?	2.5 Outcomes from participation in ISM
RQ16 - Is there a correlation between ISM schemes and the number of patents, innovative products and services created, spin-offs started by researchers?	2.3.7 Intellectual Property Rights and Intersectoral Mobility 2.5 Outcomes from participation in ISM
RQ17 - What were the main drivers of participation in ISM? How do these differ by stakeholder type?	4.1 Drivers and obstacles to intersectoral mobility
RQ18 - What are the main obstacles that can be observed in implementing intersectoral mobility schemes? What are the specific obstacles that have been encountered?	4.1 Drivers and obstacles to intersectoral mobility

Key research questions	Signposting to section
Possible EU-level follow-up	
RQ19 – Is there a need for a more holistic approach to promoting intersectoral mobility at EU level? What current shortcomings could such an approach help to overcome?	Section 4.1.1 – feasibility study
RQ20 – What steps need to be undertaken to strengthen framework conditions to foster the intersectoral mobility of researchers in the EU-28 at national level?	Section 4.1.2 – feasibility study
RQ21 - Is there a need for a new EU funding scheme to support ISM at national and regional levels so as to address the gaps identified in the baseline assessment? <ul style="list-style-type: none"> • RQ21.1 – If a new EU funding scheme were to go ahead, how could it be ensured that possible duplication and overlap with existing EU funding schemes be avoided? • RQ21.2 – How can existing EU initiatives⁴ to support the intersectoral mobility of researchers best be utilised? Is there an alternative to setting up a new EU scheme, such as expanding the scope of the existing EU scheme, looking ahead to the new Multiannual Financial Framework (MFF) in FP9, and through other EU programmes? 	Section 4.1.3 – feasibility study
RQ22– What role could the EURAXESS network play in relation to possible new EU funding or non-funding initiatives?	Section 4.1.5 – feasibility study
RQ23 - Is there a need for further EU intervention of a non-funding nature to support and strengthen intersectoral mobility in Europe? <ul style="list-style-type: none"> • RQ23.1 – Is there a need for an EU level scheme to provide support and overall coordination to promoting greater supply and uptake of intersectoral mobility? If yes, what form would an EU level scheme take)? • RQ23.2 – Is there a role for the European Commission in supporting intersectoral mobility (e.g. coordination role, communication and dissemination activities, promoting the exchange of good practices, building stakeholder partnerships)? • RQ23.3 – Could the EU provide a good practice model scheme structure around which regional, national and international schemes could model themselves on? How flexible would this need to be? • RQ23.4 - Do schemes work best when they are developed from the bottom-up, or is there a need for a top-down approach with more EU involvement? 	Section 4.1.4 – feasibility study

1.5. Report Structure

The structure of the main report and annexes is as follows:

- **Section 2 – Baseline assessment.** Outlines a typology of ISM schemes, identifies the main trends in intersectoral mobility and reviews demand and supply side provision of schemes. The challenges and obstacles and framework conditions are also outlined;
- **Section 3 – Key findings and conclusions.** Provides a summary of the main findings and conclusions from the research.

⁴ The main sources of EU support for researcher mobility including its intersectoral dimension are: the Marie Skłodowska-Curie Actions' Innovative Training Networks, in particular the European Industrial Doctorates); Research, Innovation, and Science Policy Experts (RISE); the Co-funding of regional, national and international programmes (COFUND); Individual Fellowships (in particular the 'Society and Enterprise' Panel), the H2020 SME Innovation Associate and the EIT's Masters and Doctoral Research Programmes).

- **Section 4 - Feasibility study and recommendations.** Assesses the research questions relating to the feasibility of possible further EU intervention and outlines the recommendations.

The annexes contain a number of elements, including:

- **Annex A – List of interviews**
- **Annex B – Bibliography**
- **Annex C – Country overview fiches** – summarising the situation in respect of intersectoral mobility in each EU Member State.
- **Annex D – Extended mapping fiches** – analysing one intersectoral mobility scheme in greater depth in each EU Member State.
- **Annex E – Basic scheme mapping** (provided in addendum as an Excel database).
- **Annex F – List of additional EU-supported schemes that foster ISM.**

2. BASELINE ASSESSMENT

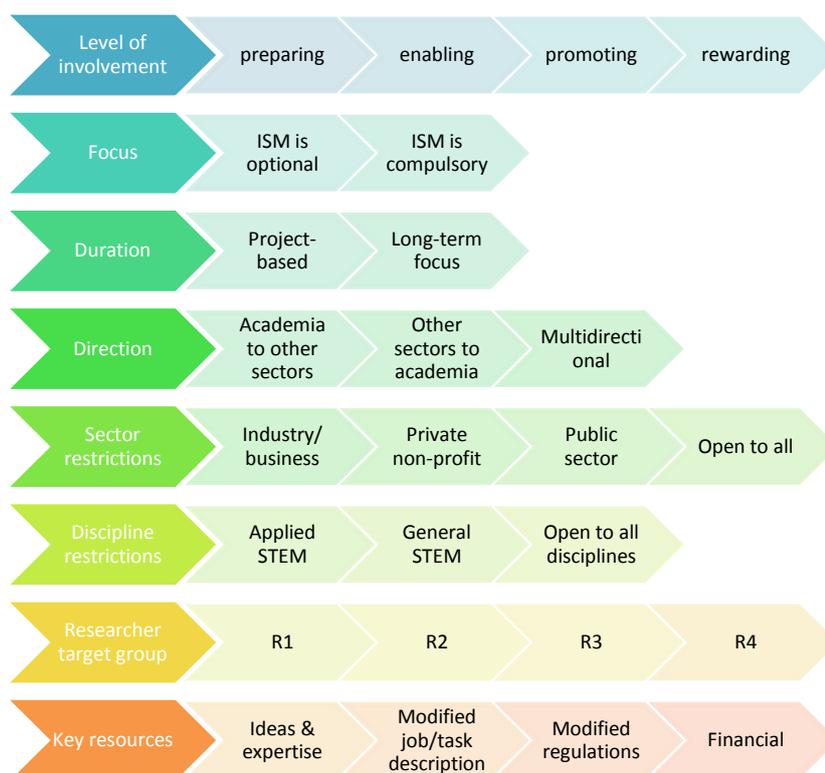
In Section 2, a baseline assessment is provided of formal and informal intersectoral mobility schemes taking place. The focus is on national schemes in the EU-28 and in Horizon 2020 associated countries, although some EU-funded and international schemes are also presented. A typology of ISM schemes is first outlined, followed by an overview of national, EU-level and international schemes. The main characteristics of ISM schemes are then considered (including a review of key trends). The outcomes of participation in ISM are then summarised.

2.1. Typology of intersectoral mobility schemes

This report focuses on the intersectoral mobility of researchers between the academic sector and other employment sectors. As noted in Section 1.2, which sets out a definition of ISM, the concept of intersectoral mobility extends more broadly than “physical” mobility alone, and includes other forms of cooperation, such as joint research projects and collaborative research between academia, industry, the public sector and the third sector. Moreover, the concept of ISM is taking shape very slowly. Many stakeholders engage in ISM without being aware of the term itself, or the attention given to promoting ISM at a policy level in some countries. There is consequently a risk of the under-reporting of national ISM schemes as many remain under the radar, since they may not be recognised as such, even by those directly involved in their management and implementation.

A typological framework setting out the different characteristics of ISM schemes is provided below. Each of the schemes identified in this report can be positioned somewhere in this framework. The schemes in which ISM is most deeply embedded can usually be positioned further on the right in the diagram, although that is no guarantee that they also generate more impact:

Figure 1.1 -Characteristics of ISM schemes



The schemes in which ISM is most deeply embedded can usually be positioned further on the right in the diagram, although that is no guarantee that they also generate more impact. The fact that there are many different types and forms of intersectoral mobility means that is not always easy to categorise schemes. The typology has been used to provide an analytical framework for the baseline assessment and gap analysis. It has also been used to structure the mapping and analysis of the various schemes, taking into account the different components of ISM. These components

group the major characteristics of each scheme into a comprehensive typology (also see section 2.3 on the “characteristics” of ISM schemes).

The Marie Skłodowska Curie Actions can be used to illustrate how this typology works in practice:

- **Level of involvement:** the actions are designed to prepare and enable researchers for intersectoral mobility (respectively through training and internship facilities), but only some of the scheme implementations also actively promote the uptake of intersectoral mobility activities, and very few of these reward researchers for their intersectoral mobility in the evaluation criteria that determine their chances of promotion / appointment. In contrast, guidelines that define recruitment or promotional criteria might focus particularly on the “reward” component, so that researchers who engage in ISM have equal, or better, chances to be hired/promoted as their non-mobile colleagues.
- **Focus:** in the MSCA guidelines, intersectoral mobility remains optional, but some of the schemes implement it as compulsory.
- **Duration:** MSCA are long-term actions, but the schemes funded through MSCA are project-based.
- **Direction:** MSCA does not specify any particular ISM-direction, but no MSCA-funded schemes were identified that focus particularly on the “non-academic to academic” direction.
- **Sector restrictions:** traditionally many ISM schemes have been focused on the industry sector. This sector still represents the majority of ISM-cases, but the MSCA funded schemes tend to welcome a wide range of non-academic partners.
- **Discipline restrictions:** ISM has been most embedded in engineering & technology fields, long before the term “ISM” became widespread. Many of the older ISM-schemes target applied research within the STEM⁵-disciplines, but MSCA has opened up the range towards STEM and non-STEM disciplines, depending on the project partners.
- **Researcher target group:** MSCA focuses on researchers at PhD (R1) or postdoc (R2-R3) level. Schemes targeting R3 and R4 level are scarce, but tend to focus on the commercialisation of research & university-business collaboration, or on bringing industry experience back into academia.
- **Key resources:** MSCA makes use of funding (and co-funding) to facilitate ISM, but schemes can also be effective with different, or additional means. Mentoring, for example, makes use of ideas and expertise. Alternative task descriptions may encourage researchers to spend more time on business interactions than on writing academic papers. Modifying regulations such as tax deductions, removing a ban on internships, writing entrepreneurship into a competency model for researchers or developing the principles for Innovative Doctoral Training, also illustrate the potential for tapping into cost-effective resources.

The additional aspects of the typology presented above draw inspiration from a policy report by the University of Salford⁶. It is also important to distinguish between the different target groups in ISM schemes, i.e. the **level of researchers** that a particular ISM scheme focuses on. The differentiation in target groups outlined in the above Figure corresponds to different phases in a researcher’s career as explained in the following table:

⁵ STEM - Science, Technology, Engineering and Mathematics

⁶ MAPPING THE POPULATION, CAREERS, MOBILITIES AND IMPACTS OF ADVANCED DEGREE GRADUATES IN THE SOCIAL SCIENCES AND HUMANITIES (POCARIM) Policy Report 9, Intersectoral mobility of Social Science and Humanities PhD graduates in Europe.

Table 1.3 -Typology of researchers by career stage

	Type of researcher	Definition of researcher stage
R1	Pre-PhD researchers	Doctoral students studying for a PhD, but also Master’s students wishing to undertake a research project.
R2	Early-stage researchers	Up to 4 years' post-doctoral experience
R3	Experienced researcher	Researchers with at least 4 years' experience
R4	Professors and leading researchers	Researcher leading his/her research area or field e.g. the team leader of a research group or head of an industry R&D laboratory. They have an international reputation based on research excellence in their field, demonstrate critical judgment in the identification and execution of research activities and make a substantial contribution (breakthroughs) to their research field or spanning multiple areas.

It is worth noting that approximately 80% of ISM schemes identified through the mapping of domestic schemes focused on R1 and R2, with limited numbers of schemes targeting experienced researchers, professors and leading researchers. This corroborates the findings in earlier studies, such as the MORE2 report which reports on data on researcher mobility patterns in respect of 1) intersectoral mobility during PhD and 2) intersectoral mobility in post-PhD careers⁷. The report found that *"R2 researchers are more likely to be mobile than their counterparts in later career stages"*. One of the case studies selected therefore focuses on mobility schemes by researcher target group, but with a particular focus on schemes in which R3 and R4 are explicitly targeted, where gaps in provision appear to be more pronounced.

2.2. Overview of national, EU-level and international ISM schemes

This sub-section provides an overview of national, EU-level and international ISM schemes identified through the study. It addresses a number of research questions:

RQ1 - What are the main developments and trends in intersectoral mobility that can be identified in the past 10 years regarding ISM taking place at national level?

RQ2 - Which countries are involved in ISM schemes? Are there any gaps in terms of country coverage?

RQ3 - What type of academic institutions and organisations are involved in ISM schemes?

RQ4 - What type of non-academic organisations are involved – large companies, SMEs, not-for-profit organisations, the public sector, etc.?

RQ5 - Which are the major intersectoral mobility schemes for researchers across the EU Member States and in relevant associated countries?

RQ6 - Are there any links between ISM schemes regionally, nationally and internationally? Do they complement each other and propose partnerships in order to enhance the effectiveness and quality of training offered?

⁷ MORE2 report for the European Commission's DG RTD. Support for continued data collection and analysis concerning mobility patterns and career paths of researchers

2.2.1. National developments and trends in intersectoral mobility

RQ1 - What are the key national developments and trends in respect of intersectoral mobility in the past decade?

The research has identified a number of key trends and developments in respect of intersectoral mobility at national level. The focus of the analysis was on both formal ISM schemes and on informal modes of mobility. These are, in summary:

- **Growing interest among universities and publicly-funded research institutes in using intersectoral mobility as a mechanism to strengthen cooperation with industry generally, and with individual companies.** Whereas there is longstanding recognition of the value of international mobility in strengthening researchers' careers and in promoting internationalisation, there has been less attention to ISM due to a lack of awareness about the term itself (although the term has become more familiar since its introduction in the MSCA guidelines) and the concept. This is gradually changing, as ISM has become more widespread.
- **Increasing interest in intersectoral mobility in industry, especially among larger companies.** Various ISM schemes have been in operation as part of larger university-industry collaboration initiatives, in the context of applied research and in countries/regions/institutions with a long-standing tradition of close academic-industry cooperation. Those involved in schemes may sometimes be unfamiliar with the term but easily recognise the key features of ISM nevertheless. There is evidence of growing awareness particularly among larger firms as to the benefits of taking part in ISM to be able to identify the brightest industrial research talents.
- **Dependency on ISM funding schemes:** In countries or institutions which lack this tradition of demand-driven collaboration, ISM tend to be more opportunity-driven by available funding, and therefore also more dependent on such schemes.
- **Collaborative or joint PhD supervision** is the most commonly observed intersectoral mobility scheme, with early-stage researchers moving back and forth between academia and industry.
- Nevertheless, in terms of numbers **the group of PhD graduates not pursuing an academic career composes the largest group of mobile researchers between sectors.** Many, but not all, have been prepared for this transition through broader skills training at their institution.
- **Their mobility is predominantly one-directional** and is not embedded within any 'scheme' as such. With the exception of those leaving various career options open in the first couple of years after completing the PhD degree, very few return to academia at a later stage in their career.
- **Uncertainty about adequate co-funding share:** many collaborative schemes expect some degree of co-funding from the industry partner, in particular schemes which may generate intellectual property benefits or other forms of competitive advantage. The percentage of industry co-funding varies from zero contribution (e.g. skills training for researchers) to 100% (e.g. internships fully funded by the industry host). In the case of joint PhD supervision, the variation seems to be limited to a range of 0% - 50%.
- **Stakeholders closely involved in ISM are very positive about their ISM experience,** in particular those acting as a host, a supervisor or a mobile researcher, as the benefits to their individual situation are very tangible. At the level of funders and institutions, real and perceived obstacles might carry more weight and benefits may less easily articulated.

2.2.2. Geographic coverage of formal intersectoral mobility schemes and gaps

RQ2 – Which countries are involved in ISM schemes? Are there any gaps in country coverage?

The study identified examples of formal dedicated intersectoral mobility schemes operating at national level as well as examples of broader researcher mobility schemes which allow scope for ISM in the countries within scope. The aim was to identify the approximate number and type of such schemes overall in the EU-28, associated countries and internationally. Mapping existing ISM

schemes was a crucial step towards identifying gaps in the provision schemes and / or unevenness in country coverage.

An overview of the ISM schemes identified through the mapping carried out through this study is first provided. The aim was to identify up to 10 schemes per country in the EU-28. In total, 279 ISM schemes were identified. The majority of ISM schemes –201 (72.0%) - were identified in the EU-28, although some associated countries were found to have a good number of schemes (e.g. Norway and Switzerland). In some third countries, schemes were identified in countries such as Australia, Brazil, Canada and India. The US was found to have the most formal schemes (16). It should be noted that whilst an effort was made to identify as many schemes as possible, the data is non-exhaustive in that it is possible that there are further schemes, such as smaller-scale schemes that are ‘below-the-radar’.

Table 1.4 - Overview - basic ISM scheme mapping

Geographic area within scope	No. of ISM schemes	%
EU-28	201	72.0
Associated countries in Horizon 2020	40	14.3
Wider third countries (including international comparators)	38	13.6
Total	279	100.0

Note – the mapping has sought to identify the main ISM schemes in the countries within scope. It may not be completely exhaustive, especially since many schemes may be below the radar, such as very small scale schemes.

Whilst some of these national schemes were found to be dedicated to intersectoral mobility alone, the main purpose of other mobility schemes identified was to facilitate academia-to-academia mobility but with scope for some researchers to move from academia to non-academia. In the case of other schemes, the main focus was less on intersectoral mobility and more on promoting industry-academic cooperation more generally. Such schemes were sometimes included in the mapping especially in the EU-13 countries, where there were found to be significantly fewer formal ISM schemes since there has historically been a lack of industry-academic cooperation.

In the following table, disaggregated data at the country level is provided as to how many schemes were identified in each EU Member State:

Table 1.5 - List of schemes in EU Member States

EU MS	Number
Austria	9
Belgium	13
Bulgaria	9
Croatia	7
Cyprus	10
Czech Republic	9
Denmark	5
Estonia	2
Finland	2
France	4
Germany	8
Greece	9
Hungary	10
Ireland	15
Italy	4
Latvia	6
Lithuania	12
Luxembourg	5

<i>EU MS</i>	<i>Number</i>
Malta	1
Netherlands	3
Poland	10
Portugal	4
Romania	9
Slovakia	4
Slovenia	6
Spain	6
Sweden	3
UK	16
Total	201

In the EU-28, the countries with the highest number of schemes identified were **in the UK (16)** followed by **Ireland (15) and Belgium (13)**. Earlier research, for example, a 2017 survey by Science Europe⁸ of its members confirmed that the UK and Ireland have “an especially large and diverse number of ISM schemes”. The number of schemes in each country needs to be interpreted carefully, since in some countries many of the schemes identified are EU funded, and there are either no nationally-financed schemes, or few. In **Bulgaria** and **Poland**, for example, whilst 9 and 10 schemes respectively were identified, there was found to be a lack of dedicated ISM schemes, so more general R&I and technology transfer measures have been identified which promote intersectoral cooperation between academia and industry. ISM may be a small but explicit feature of some measures as part of a wider package of measures to strengthen research and innovation ('R&I') capacity and to develop the careers of young researchers.

Some schemes identified operated in the past whereas most schemes are still operating. Some schemes that have been discontinued were included to illustrate the evolution of domestic schemes in a particular country over time (i.e. the mapping exercise has helped to trace both the predecessor and successor ISM scheme). Although this means that the actual number of current ISM schemes is lower than that in the database, these have been retained since older schemes (even if discontinued) or more likely to have been evaluated and/ or have monitoring data available. In some countries, it was difficult to identify relevant ISM schemes, either because dedicated schemes funded domestically are uncommon or non-existent, which was the case in some EU-13 countries, or due to difficulties in establishing whether the schemes concerned were genuinely intersectoral (for instance, when ISM was only a small part of a broader package of support measures). In the table below, an overview is provided of ISM schemes identified outside the EU.

Table 1.6 - List of schemes in Associated countries in Horizon 2020 and wider third countries

<i>Associated countries</i>	<i>Number</i>	<i>Other countries internationally</i>	<i>Number</i>
Georgia	2	Australia	3
Iceland	5	Brazil	2
Israel	5	Canada	6
Montenegro	1	China	2
Norway	9	India	4
Serbia	3	Japan	3
Switzerland	12	Singapore	1
Tunisia	1	South Korea	1
Turkey	1	US	16
Ukraine	1		
FYRO Macedonia⁹	0		

⁸ Intersectoral Mobility Schemes in Science Europe Member Organisations, January 2017

⁹ MSCA is the main instrument for mobility (there are no dedicated mobility or ISM instruments in FYROM, although mobility can be funded through project grants).

Total	40	Total	38
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The key findings from the assessment of the numbers of schemes in each country were that:

- There are variations in the number of formal ISM schemes across the EU-28 operating at national level, with few dedicated ISM schemes in the EU-13 Member States. Stakeholders in these countries do not necessarily perceive there to be a gap however, since researchers are still able to participate in EU programmes that foster international and / or intersectoral mobility, such as the MSCA. Moreover, many EU-13 MS use ESIF funding to foster industry-academic cooperation more broadly, even if ISM is rarely an explicit feature.
- Countries with a longstanding tradition of industry-academic collaboration, such as the UK, Ireland, Belgium, Luxembourg, Denmark, Sweden and Norway have a greater prevalence of ISM schemes than countries where such cooperation is nascent. However, the absolute number of schemes is less important since some countries with a small number of well-established national level schemes have fewer schemes than elsewhere, but these schemes have proved sustainable over the longer term (e.g. Denmark and Sweden).
- A correlation can be discerned between countries' performance against key R&I indicators and their corresponding ranking in the European Innovation Scoreboard and the existence of ISM schemes. This may reflect the fact that countries with a strong R&I system and overall performance tend to have strong industry-academic collaboration.
- Caution needs to be exercised in comparing the situation across the EU-28 in terms of the absolute number of ISM schemes, since in some countries, there may be few, if any dedicated ISM schemes and ISM may instead be a very small component of a larger R&D&I priority, often within a Structural Funds Operational Programme.
- Although there are some bi-lateral and multi-lateral schemes operating between some EU countries¹⁰, generally, schemes that combine international and intersectoral mobility tend to have an EU financing component.
- There are some gaps in country coverage regarding the availability of dedicated ISM schemes. For example, a number of smaller countries both within the EU-28 and in associated countries do not have any dedicated formal ISM schemes (e.g. Malta), but informal mobility and EU schemes offer alternative mobility opportunities in these countries.

2.2.3. *Types of academic institutions and organisations involved*

RQ3 - What type of academic institutions and organisations are involved in ISM schemes?

The research identified a range of academic institutions involved in ISM schemes, ranging from fully-fledged comprehensive universities to applied universities focusing on relevant STEM disciplines such as engineering, physical and life sciences, Public academic research institutions such as CNRS (France), Fraunhofer (Germany), Max Planck (Germany) or Cerca (Catalunya), or specialist colleges such as Business Schools or Grandes Ecoles (France) complete this list. Among newer academic institutions, there tends to be a stronger industry focus than on more traditional institutions.

However, there is a general trend towards all types of academic institutions becoming more actively engaged in industry-academic cooperation. The latter encompasses a range of activities, such as teaming up together in order to bid for EU and/ or national research project funding opportunities, co-authoring academic papers, clustering for example in a science park or business or technology incubator environment, but also includes the setting up and implementation of ISM schemes.

Some institutions have structures in place which are not only well-embedded but also cover a wide range of support for ISM, guaranteeing a more sustainable approach. For technical and applied

¹⁰ Examples are, *inter alia*, the DAADppp mobility programme Germany-Norway, the Greek-German bilateral R&I Cooperation Programme, and Greece - Israel Joint R&D Projects, Greek-Russian Joint R&D Projects

universities, university-business collaboration is at the core of their existence. ISM schemes may in such cases be more demand-driven (i.e. developing out of their own partnerships with non-academic partners, or out of their own specific research needs) than opportunity-driven (i.e. developing out of existing funding opportunities). The institutional response to the survey gives some indication towards this but is insufficiently representative to support this suggestion with evidence.

In some countries, in addition to participation by individual academic institutions and organisations, other types of intermediaries actively participate in the design and set up as well as the funding of ISM schemes. Funding agencies and Research Councils are usually well connected with the academic institutions in their country, and some also with the R&D sector. If there is appropriate government support as well as sufficient demand amongst their stakeholders, many of these funding agencies will play a key role in, for example, running ISM schemes in which PhD students and post-graduate researchers can apply. The UK Research Councils and the Luxembourg National Research Fund embed ISM in their overall national schemes, while France and Sweden, for example, have separate research funds for supporting academic-oriented versus industry-oriented research (ANRT, the National Association of Research and Technology in France; and VINNOVA, the Swedish Governmental Agency for Innovation Systems).

Other sectoral and scientific organisations also help to design and manage ISM schemes in an intermediary role. For example, in the UK, the Royal Society, an independent scientific academy, has been involved in setting up, managing and operating several ISM schemes, including the Industrial Fellowships scheme (see case study 4). In Estonia, the Archimedes education foundation is responsible for administering two successive ISM schemes which operate at national level, the DoRa programme in 2008-2015 and the Mobility Programme for Smart Specialisation in 2016-2022. Academic institutions can take part in the scheme by applying to an intermediary rather than having to set up schemes themselves, which they may lack human and financial resources to do.

2.2.4. Types of non-academic organisations are involved in ISM

RQ4 - What type of non-academic organisations are involved – large companies, SMEs, not-for-profit organisations, the public sector, etc.?

The research identified a range of non-academic stakeholders involved in ISM schemes, such as SMEs, large companies, not-for-profits and public sector organisations. Within these categories, there is considerable diversity in the types of organisations participating, for example:

- **SMEs** – whilst the distinction between micro, small and medium sized firms¹¹ is well known, the ability of firms to be able to provide mobility experience opportunities to PhD and graduate researchers from academia varies significantly depending on their size.
- **Large firms** – such firms engage in ISM in different ways. Some may simply take part in a scheme organised by an academic institution or by an intermediary whereas others may seek to gain visibility and access to highly talented researchers by sponsoring (or partnering with) a particular scheme.

Regarding the drivers and obstacles to participation in ISM by firm size threshold, reference should be made to Case Study 1 on mobility between academia and industry. Generally, **large firms** are better placed to take part in ISM than many SMEs since firstly they have more managerial resources available to coordinate relationships with academia, and secondly the necessary research infrastructure in place to be able to integrate researchers within teams. Thirdly, they are likely to be aware of the direct benefits of engaging with academia (e.g. identifying top research talents as future recruits) but also the strategic benefits (role of ISM in strengthening joint collaborative research relationships between industry and academia at an organisational level).

Many smaller firms are unaware about intersectoral mobility, although some SMEs are aware and recognise the benefits. SMEs are more likely than their larger counterparts to face internal resource constraints to absorb researchers for a fixed period of mobility. They may also lack the laboratory space to take on additional researchers.

¹¹ http://ec.europa.eu/growth/smes/business-friendly-environment/sme-definition_en

- **Other private sector actors** – private research foundations also take part in ISM as well as a small number of industry associations.
- **The public sector** – although some dedicated ISM schemes were identified through the mapping, they are less common in the public sector. These involve, or target the participation of a wide range of organisations such as government Ministries, education bodies, environmental agencies, Central Banks, local authorities and municipalities.
- **Not-for-profit organisations** – ISM schemes to promote mobility from and to not-for-profits such as local, national and international NGOs as well as CVOs are the least common type of mobility, with only several schemes identified. Nevertheless, previous literature has identified considerable need in such organisations to strengthen their research capacity.
- **Other entities** - independent bodies were also found to participate in ISM, such as those promoting scientific excellence (e.g. the Royal Society and the Royal Academy of Engineering in the UK both operate ISM schemes).

Overall, a key finding from the assessment is that existing schemes attract a diverse range of participants to in ISM both from the public and private sectors.

2.2.5. Identification of major national and EU intersectoral mobility schemes for researchers

RQ5 - Which are the major intersectoral mobility schemes for researchers across the EU Member States and relevant associated countries?

In addressing this RQ, it is firstly important to identify what is meant by a “major scheme” since this could refer to a number of characteristics such as the total funding allocation and/ or other key metrics such as the number of participant researchers. The focus of the analysis is on dedicated ISM schemes where intersectoral mobility is the *main* objective. In addressing this RQ, we first outline examples of national schemes and secondly provide an overview of the major EU schemes that support ISM. Even if these schemes are well-known, it is necessary to examine their scale and scope in order to identify gaps for the feasibility study part.

2.2.7.1. Intersectoral mobility schemes at national level

2.2.5.2.1. Introduction – national schemes

A detailed mapping was undertaken to identify relevant national ISM schemes operating in the EU-28, associated countries, and at EU and international levels. This identified many different schemes currently operating which are described in different parts of this report, namely:

- An excel database containing 279 different ISM schemes, circa 40 of which are EU co-financed, especially through the Structural Funds in the EU-13 countries.
- An extended mapping of one scheme in each EU-28 Member State (see Annex D).
- The case study report (see standalone report) which highlights a number of relevant national schemes for each type of mobility (e.g. academia-to-industry, academia-to-government etc.) but focuses on a single scheme/ case.

The above study outputs provide both factual information and a description of individual schemes and an analysis of good practices and an assessment of their potential replicability (in the case of the extended mapping of schemes and case study report).

2.2.5.2.2. Examples of nationally-financed intersectoral mobility schemes

A number of dedicated ISM schemes were identified, although it was also common for many national schemes to only include ISM as a small component within schemes that support a broader range of activities within a mobility scheme or other initiative to foster closer industry-academic cooperation.

A typical national dedicated ISM scheme is small-scale and only operates domestically. Consequently, the overall picture is one of fragmentation. However, a number of larger ISM schemes were identified such as those in **Austria, Belgium (Flanders) Denmark, Norway, Sweden** and the **UK**. Selected examples of the larger ISM schemes are now provided. Reference should also be made to RQ6 (Section 2.2.7) which analyses the total funding of national schemes, as well as the funding per researcher.

Examples of larger-scale schemes in different countries are now provided.

In the **UK**, the government announced in 2017 that they would allocate an extra £250 million over 4 years via the National Productivity Investment Fund to PhD places and fellowships as part of the government's industrial strategy. The purpose is to attract "high-skilled research talent"¹² The initiative is a good example as to how policy and funding initiatives at national level can have a useful demonstration effect and encourage other funding actors at national and regional level to devote greater resources to ISM. For example, in response to the industrial strategy, Research Councils UK (RCUK) (UK Research & Innovation (UKRI)) have developed a new fellowship programme to be supported through the National Productivity Investment Fund.

The Research Council (RCUK) / UKRI **Industrial Innovation Fellowships**¹³ will be targeted at early-career researchers (ECRs). The Fellowships are three-and-a-half-year research fellowship awards where the award holder undertakes a programme of research clearly aligned with the objectives of the industrial strategy - and particularly the core challenge areas identified within the green paper - whilst maximising the impact of this research through working in collaboration with users of research. 24 Industrial Innovation Fellowships will be supported through the first call.

In most other countries, however, there is an absence of a dedicated national strategy to promote ISM and very few countries have put in place appropriate national funding. This was evidenced in the detailed mapping exercise and in the response to RQ1, which found that only a small number of countries support dedicated ISM schemes with most relying on EU funding programmes and on EU co-funding to promote such mobility. Since such schemes require a compulsory transnational dimension in order to participate, the lack of nationally funded schemes is a current weakness of the European intersectoral mobility landscape, since there is ample scope for ISM activities to take place at national level. This is arguably a **missed opportunity**. However, there is evidence that in some countries there may be less need for public intervention in this area since intersectoral collaboration has evolved organically on its own. In Germany, for instance, there is intensive cooperation between universities, a dense network of research institutes, and industry both in regional clusters and on a national level without any major national-level publicly supported ISM schemes in place.

Further examples of relatively large-scale ISM schemes were identified. For example, in Norway, the **Public Sector PhD scheme (OFFPHD)** is examined in detail in Case Study 3. The scheme was launched in 2014, with calls for applications to the scheme in 2014, 2016 and 2017 (there was no funding available in 2015). Since the inception of the OFFPHD Public sector PhD scheme in 2014, the scheme has so far granted NOK 147.8 million (**€14.77 million**) to 92 projects. The scheme partially covers the costs directly related to the implementation of doctoral projects. This includes: 1) salary and staff costs for a candidate 2) salary and personnel costs for internal supervisors 3) what may be paid to the degree institution and 4) other operating expenses such as laboratory attempts, buying relevant literature, conference trips, etc. The Norwegian Research Council has overall responsibility for scheme management. The two main actors involved in taking part in the scheme are higher education institutions and public sector institutions.

In **Belgium**, Innoviris is a national scheme including a stream supporting PhD projects in industry (Doctiris), another stream supporting PhDs leading to the creation of a start-up (Launch), and a stream financing collaboration projects between companies and universities (Team-up). This funding is intended to encourage participation in ISM among higher education institutions and non-academic organisations, including from industry. The focus lies on PhD mobility because this is perceived as a strategic priority for the regional governments in Belgium.

The **Austrian** Strategy for Research, Technology and Innovation (RTI)¹⁴ includes a reference to improving intersectoral mobility and identifies a lack of scientific career options and the low proportion of women in industrial research as challenges to be tackled. The Austrian Research Promotion Agency (FFG) operates a couple of national ISM schemes including an Industrial PhD Programme targeted at PhD students, a Young Experts programme targeted at students and young

¹² <https://www.timeshighereducation.com/news/budget-2017-ps250-million-allocated-phd-places-and-fellowships#survey-answer>

¹³ <http://www.nerc.ac.uk/funding/available/fellowships/iif/>

¹⁴ <https://era.qv.at/directory/158>

scientists (including post-docs) and a specific programme targeting female researchers (FEMtech Career Paths). The FFG also runs a set of 'COMET' competence centres and Laura Bassi Centres of Expertise across the country involving temporary transfers of researchers between academia and industry with the latter focusing on supporting women. The Laura Bassi Centres, for instance, have been allocated € 25.5m over a 7-year period.

Cyprus operates a substantial programme named RESTART 2016-2020 with a total budget allocation of € 69.8m distributed across a range of funding streams. Particularly noteworthy are the funding line 'DOCTOR' funding research projects of postdocs in the framework of their employment in a research organisation, enterprise, or other organisation for the duration of the project. Another funding line 'Integrated Projects' supports multidisciplinary long-term cooperation projects in priority areas involving research centres and higher and higher education institutions, enterprises, policy makers and other interested organizations in the framework of joint ventures.

In the **Czech Republic**, the Knowledge Transfer Partnership (budget: € 42m) is an adaptation from the UK scheme with the same name. The scheme supports young graduates and PhD students employed by a university in becoming knowledge transfer assistants in enterprises for the period of a specific research project. Following a pilot phase, the programme has now been developed into a full national programme funded by the ERDF.

The Innovation Fund **Denmark's** flagship Grand Solutions programme (€ 35m per year) also contains an intersectoral mobility element supporting PhD candidates' placements in high-profile companies for a project with societal value.

An interviewee from **Finland** commented on it being unimportant whether intersectoral mobility takes place domestically or internationally (cross-border) since it is more important that intersectoral mobility opportunities exist than precisely how and where they take place. It also noted that *"organisations involved in applied science need to have. From an applied research organisation perspective, it is important to have mobility for academic institutions, RTOs and also for companies. Without active collaboration between parties, we cannot disseminate and create high impact research"*.

In **Ireland**, a range of research centres are supported by the government with €355m and another €190m from industry. These centres focus on particular research topics such as advanced materials or bio-engineering. While not a primary objective, intersectoral mobility does take place in these centres, and knowledge transfer is explicitly encouraged.

Some examples of mobility schemes were identified where there was previously a focus only on mobility from academia-to- academia, but where now changes have been made to schemes so that it is **possible** for researchers to propose an intersectoral mobility period or research project. For instance, the **Swiss Science Foundation (SNSF)**¹⁵ operates a number of mobility schemes, such as the Doc.Mobility fellowships, the Early Postdoc.Mobility fellowships and the Postdoc.Mobility scheme (the latter will replace the Advanced Postdoc.Mobility fellowships in 2018). It recently changed its policy so that academia-to-academia mobility schemes allow scope for academia-to-non-academia mobility. SNSF has recently changed the regulations concerning participation in different mobility programmes to allow for intersectoral mobility. However, the interviewee said that this has not yet led to changes in demand. It is up to the applicant to propose a mobility period in a different sector and to demonstrate in their application the usefulness of an intersectoral mobility experience for their career development. No specific requests have been received to date.

The Swiss example illustrates an important broader point. Several study respondents stated that they are very interested in the study outcomes since they had either recently opened up an existing international or domestic researcher mobility scheme to make intersectoral mobility an eligible option or were considering doing so in the near future. Whereas 20 years ago, there was only a limited focus on international mobility, today there is a very significant emphasis on such mobility as a mechanism to strengthen the internationalisation of research and to promote transnational networking. In the same way, universities and research institutes increasingly appear to be explicitly recognising the need to allow researchers the possibility of undertaking an intersectoral mobility experience by widening the scope of their existing mobility programmes to allow a wider range of organisations from different sectors to take part.

¹⁵ <http://www.snf.ch/en/Pages/default.aspx>

Although RQ5 focuses on major schemes at national level, the **important contribution made by smaller schemes** should not be overlooked since there is evidence of significant good practice at the level of ISM schemes, both those operated by intermediary organisations and those operated by individual academic institutions. Examples of good practice in respect of smaller scale schemes are provided in the case studies.

A further observation in relation to national schemes is that relatively few countries have dedicated national schemes. Many schemes are either strongly or exclusively reliant on EU funding programmes or in the case of EU-13 on Structural Funds for funding support. In the former new member states, although there were found to be many national level schemes funded through ESIFs to strengthen academic-industry cooperation, there were very few dedicated ISM schemes.

Even in larger Member States, such as **Germany**, there seems to be a strong reliance on EU funding schemes (in particular on RISE within MSCA) with fewer national schemes than in a smaller Member State such as **Austria** (see examples above). This raises question marks as to the sustainability of intersectoral mobility across the EU-28 without European ongoing funding support, despite evidence of growing demand for highly skilled researchers (see Section 2.6.2 – demand-side needs for PhDs and post-doctoral researchers).

2.2.5.2.3. Key findings – national schemes

The main findings in relation to the review of ISM schemes at national level are:

- Whilst examples of ISM schemes were identified, these were found to be few and far between, and often focused on promoting mobility for researchers following STEM subjects.
- Some large-scale ISM national schemes were identified, but some of these were EU co-financed, either through the MSCA COFUND or by Structural Funds.
- The dedicated intersectoral mobility schemes that were identified tend to be small-scale and operate at national, regional or local level. They often operate without an international mobility dimension.
- A number of national schemes to promote intersectoral mobility were identified that have been operating for up to 20 years and although the overall picture is fragmented, significant good practices in scheme design, management and operation were identified (see the case studies and extended mapping which elaborate on these).
- However, the EC is the only organisation which has consistently used the term "ISM" in its funding schemes. Many national examples never use/used this term so there may be significant underreporting of schemes that operate at domestic level only.
- There is a lack of data on scheme funding for many individual schemes, since universities, private research foundations were sometimes reluctant to share this information, which was seen as being confidential.
- A small number of examples of larger national schemes operating in **Austria, Belgium (Flanders), Cyprus, Denmark, Ireland, Norway, Sweden** and the **UK** were identified. However, these are not representative of the EU as a whole, where schemes typically lack budget and critical mass, unless they are EU co-financed.
- Some dedicated national ISM schemes are however administered by intermediary organisations rather than by individual universities or other types of higher education institutions. This has the advantage that individual HEIs do not have to design, manage and operate the scheme themselves but can instead apply to an umbrella scheme. This is attractive since designing, managing and operating ISM schemes effectively is human resource and financially-intensive.
- Many national schemes are limited in scale in terms of the number of researchers participating each year and such schemes lack critical mass. This has made it difficult to gain sufficient traction to ensure that some ISM schemes are sufficiently visible.

2.2.7.2. European-level ISM schemes

Although the study focus was on the identification of national schemes, as part of the gap analysis, existing provision at EU level was identified, since EU funding can address the gap in countries where no national schemes exist. For instance, in many EU-13 countries, there was found to be a lack of dedicated ISM schemes. In such instances, without the existence of EU programmes,

researchers would not be able to undertake an intersectoral mobility experience. A second reason why it is important to outline key EU funding programmes is that EU-level programmes and EU co-financed regional and national ISM programmes such as those supported under the MSCA COFUND are among the only examples of “major” ISM schemes since as described above, most national schemes are small-scale. However, since the European Commission already has a large body of available evidence on the effectiveness and impact of Marie-Curie through previous evaluations¹⁶, only a short description of each programme and summary of earlier evaluation findings is provided.

2.2.5.2.1. Marie Skłodowska-Curie Actions (MSCA)

The **Marie Skłodowska-Curie Actions (MSCA)** is the most well-established and largest EU-level funding programme to promote researcher mobility. Whereas the primary focus is on promoting *international* researcher mobility, the MSCA also supports *intersectoral mobility*. There has been an increased focus on the latter in 2014-2020 compared with 2007-2013 period, as explained in the following table, which reviews the relevance of the following different MSCA sub-actions (IAAP, IF, ITN, RISE and COFUND).

Table 1.7 - MSCA Actions benefiting industry in 2007-2013 (FP7) and 2014-2020 (Horizon 2020)

Scheme type	Researcher level targeted	Description	No. of participants in intersectoral mobility	Programming periods when funding was eligible
Marie Curie Industry-Academia Partnerships and Pathways (IAPP)	Open to early-stage researchers and experienced researchers.	<p>During FP7 IAPP provided help to commercial and non-commercial research organisations to forge partnerships through joint research projects between universities and companies. The IAPP aimed to enhance industry-academia cooperation through knowledge-sharing, skills exchange, research training and career development.</p> <p>Participants from the commercial and non-commercial sectors proposed a joint research programme focusing on knowledge transfer between two sectors, with the aim of overcoming intersectoral-challenges.</p> <p>The intersectoral dimension was promoted through knowledge transfer, mobility between participants’ existing staff members (students, researchers, technical staff, research managers) being seconded to another sector for between 2 months and 2 years. Participants could also recruit new researchers to bring in new expertise. In addition to transferring knowledge and developing new research skills in</p>	No data on the numbers of participants	FP7 only

¹⁶ https://ec.europa.eu/research/mariecurieactions/sites/mariecurie/files/fp7-marie-curie-actions-evaluation-2013-summary_en.pdf

Scheme type	Researcher level targeted	Description	No. of participants in intersectoral mobility	Programming periods when funding was eligible
		<p>the process, researchers are offered the opportunity to develop complementary and transferrable skills. The typical project budget is €500,000 – €2 million over 3 to 4 years.</p> <p>IAPP is no longer offered in H2020. Under H2020, the MSCA RISE scheme adopted some of the characteristics of IAPP, in particular, there is a strong focus on intersectoral mobility.</p>		
Individual Fellowships (IF)	Experienced researchers, exchanges may be of an intersectoral nature.	Support for experienced researchers undertaking mobility between countries within and beyond Europe and helping to attract the best foreign researchers to work in the EU. The grant usually covers two years' salary, a mobility allowance, research costs and overheads for the host institution. The primary focus of IF is not on ISM, but there is an option for IF Fellows to undertake mobility to the non-academic sector.	Circa 200 experienced researchers will receive funding for fellowships taking place in the non-academic sector over the duration of H2020.	FP7 and H2020
Innovative Training Networks (ITN)	Research training for early-stage researchers.	<p>Supports joint research training and/or doctoral programmes which are competitively selected, and implemented by European partnerships of universities, research institutions, and non-academic organisations. The research training programmes provide experience outside academia to develop innovation and employability skills. ITN provides support for:</p> <p>European Industrial Doctorates (EID), EIDs have the objective of training highly-skilled researchers and stimulating entrepreneurship, creativity and innovation in Europe. This is to be achieved in particular by involving the non-academic sector in doctoral training so that skills better match public and private sector needs. Non-academic organisations have an equal role to universities in terms of managing researcher's time and supervision arrangements.</p> <p>European Joint Doctorates (EJD) are delivered by several</p>	<p>European Industrial Doctorates (EID) started as a pilot in 2012 with funding of €20 million for 100 researchers.</p> <p>1000 doctoral candidates will benefit from the EID in the 2014-2020 period</p> <p>No data on the number of anticipated EJD recipients.</p>	H2020 for EID and EJD – piloted in 2012

Scheme type	Researcher level targeted	Description	No. of participants in intersectoral mobility	Programming periods when funding was eligible
		universities. Non-EU organisations can participate as additional partners in ITN, enabling doctoral-level candidates to gain experience outside Europe during their training.		
Research and Innovation Staff Exchange (RISE)	International and intersectoral staff exchange, of which some exchanges may be of an intersectoral nature.	<p>RISE supports the short-term mobility of research and innovation staff at all career levels, from the most junior (post-graduate) to the most senior (management), including administrative and technical staff. It is open to partnerships from universities, research institutions, and non-academic organisations both within and beyond Europe.</p> <p>It could be considered as the follow-up of the IAPP scheme in FP7.</p>	Over the period 2014-16 within Horizon 2020, there were ca. 23,000 planned secondments with staff exchanges to, or from non-academia, and to, or from third countries. Whilst around half (11,826) involve academia-to-academia exchanges, the remaining 11,000 exchanges involve non-academic partners. Some 6,510 involve staff exchanges from academia to non-academia, of which 1336 were to a third country and 498 were staff coming into the EU/AC from third countries. The latter categories are new features of H2020. In addition, some 4,302 involve mobility into academia from another setting.	H2020
Marie Skłodowska-Curie Actions COFUND¹⁷	Both early-stage and experienced researchers, exchanges	Individuals - both doctoral candidates and experienced research fellows - are supported in their research training and career development through co-	No data	H2020

¹⁷ https://ec.europa.eu/research/mariecurieactions/about/cofunding_en

Scheme type	Researcher level targeted	Description	No. of participants in intersectoral mobility	Programming periods when funding was eligible
	may be of an intersectoral nature.	funding. Participating organisations will receive a fixed amount for each researcher as a contribution to the researcher's living allowance and programme management costs. Selected programmes will receive co-funding for three to five years up to a total of € 10 million.		

Whilst the MSCA Innovative Training Networks are the most immediately pertinent sub-action in terms of the intersectoral mobility of researchers, there is a much stronger ISM dimension through Horizon 2020 in 2014-2020 within the MSCA than was the case in previous programming periods, as evidenced by the increased number of researchers taking part in research training programmes that provide experience outside academia.

The *Thematic assessment of the Marie Skłodowska-Curie Actions* was undertaken as part of the *Interim evaluation of Horizon 2020*. The report contains data which shows the growing importance of ISM in Horizon 2020 compared with FP7, and the strong relevance of MSCA instruments in which ISM is taking place beyond the ITN alone to include RISE and IF. Data on participation in RISE within MSCA is provided below to illustrate the fact that the different sub-actions within the MSCA are important in promoting ISM. The data shows that whilst the majority of secondments and staff exchanges (51.7%) involved mobility between academia alone, 28.4% of mobility experiences involved academia to non-academia and a further 18.8% from non-academia to academia. In total, 47.2% of mobility placements in RISE involved some form of ISM.

Table 1.8 RISE – planned secondments/staff exchanges 2014-16 by sector and region

	Moving from an EU or Associated country to another EU/AC	Moving from an EU or Associated country to a Third country	Moving from a Third country to the EU or Associated country	Total	Total %
Academia to Academia	<i>Not permitted</i>	7196	4630	11826	51.7
Academia to non-academia	4676	1336	498	6510	28.4
Non-academia to academia	3114	606	582	4302	18.8
Non-academia to Non-academia	<i>Not permitted</i>	162	93	255	1.1
Total	7790	9300	5803	22893	100.0

Source: DG EAC analysis based on CORDA data January 2017. Replicated from the *Thematic Evaluation of MSCA in the Interim Evaluation of Horizon 2020*

There are several different **MSCA COFUND schemes** being implemented at regional, national and international levels. It is worth drawing particular attention to the role of COFUND since such schemes are implemented at national and international levels rather than at EU-level. A good example is the "Collaborative Research Fellowships for a Responsive and Innovative Europe" (CAROLINE) scheme in Ireland.

Box 1.1 - Examples of MSCA COFUND schemes – CAROLINE (IE) and the Mobility for Growth scheme (SE)

Example 1 - Collaborative Research Fellowships for a Responsive and Innovative Europe (CAROLINE) <http://research.ie/funding/caroline2/> provides experienced researchers with the opportunity to obtain a prestigious research mobility and career development fellowship. Successful candidates will carry out research either in Ireland or abroad and will gain inter-sectoral and interdisciplinary exposure. CAROLINE is designed to attract experienced researchers from any discipline to conduct research relevant to the themes of the United Nations 2030 Agenda for shared economic prosperity, social development, and environmental protection. The 17 goals within Agenda 2030 are relevant for researchers across all academic disciplines and for researchers in academia, civic society, and working in industry. A key feature of the scheme is collaboration between the academic sector, non-governmental organisations (NGOs) and international organisations. The programme has an EU contribution of €4,602,000. The scheme's duration will be from June 2016 to June 2021.

Example 2 - The Mobility for Growth scheme is being implemented by VINNOVA, Sweden's Innovation Agency. The overall objective is to support the career development of individual researchers through their participation in a mobility experience. The programme has a funding mechanism for incoming and outgoing transnational mobility for experienced researchers (including a reintegration phase for outgoing mobility), and it promotes active international collaborations between the organisations involved in the scheme. The programme duration is from 2012 to June 2018. The scheme has an overall budget of € 35 million, of which € 10 million is co-funding from the MSCA.

Whilst the majority of EU funding for researcher mobility is channelled through the MSCA, several examples of research projects funded under other programmes were identified. For example, some Networks of Excellence allowed at least some scope for ISM to take place within the project context.

2.2.5.2.2. Other schemes supported through Horizon 2020

Further details about other EU funded schemes extending beyond the MSCA are now provided.

The **ERA-LEARN is a support action (CSA) funded by Horizon 2020** which started in January 2015 as a platform to support the development of Public Private Partnerships (P2P). The ERA-LEARN 2020 project is a 3-year initiative (2015-2017), which builds on its predecessors, the FP7 projects ERA-LEARN, NETWATCH and the Joint Programming Initiatives (JPIs). Some schemes funded, such as the transnational research project Manunet III¹⁸ (led by a Spanish innovation agency but involving Romania) also build on earlier successful ISM schemes.

The **Horizon 2020 SME Innovation Associate Pilot Scheme**, being managed by the EASME Executive Agency, is targeted at European SMEs and start-ups and funds the recruitment of post-doctoral research associates. The focus is on excellence in that the scheme is meant to attract "the brightest talents in the area of R&I globally". The purpose is to provide funding to European SMEs and start-ups to allow them to recruit researchers who can then work on research projects within their enterprise to explore innovative business ideas in. The SME Associate Scheme is accessible to all SMEs and start-ups established in the EU Member States and in countries associated to Horizon 2020. In terms of eligibility criteria, researchers must hold at least a PhD (or equivalent), have demonstrable expertise in line with the job advertisement, and comply with the transnational mobility criteria. Because of the experimental nature of the scheme, currently, the scheme applies for a fixed period for the recruitment of the researcher aligned to a single academic year in most European countries.

SMEs receive an individual grant covering their salary and the related costs of employing a post-doctoral research associate, including full training costs. The scheme presently supports ISM through the recruitment of PhD doctorates when there is a cross-border dimension.

The expected output of the grant is that the SME should be in a position to "realise innovation opportunities" through the temporary (year-long) recruitment of an academic Associate. This is

¹⁸ <https://www.era-learn.eu/network-information/networks/manunet-iii>

simultaneously both a very precise but arguably also an imprecise expected output. The output – and subsequent results – will of course be dependent on the nature of the SMEs’ activities and the sector and broader context in which the activities take place.

An evaluation of the SME Innovation Associate pilot scheme is not yet available, since the contractor was only appointed in January 2018. Assessments of similar initiatives (interventions providing direct support to SMEs to stimulate R&D investment) tell us that typical outputs and results can be measured through changes in R&D expenditure, firm growth, and profitability and employment, for example. Data on such quantitative indicators can be obtained fairly easily. Information about less tangible outcomes such as skills acquisition, innovation capabilities and capacities and spillover effects, etc. cannot be found in statistics and, in evaluations, are often assessed with the risk of bias.

A further EU funding initiative which supports intersectoral mobility is the **European Institute of Innovation & Technology (EIT)**, which operates Masters and PhD programmes across the different Knowledge and Innovation Communities (KICs) which are partnerships that bring together businesses, research centres and universities). Brief examples of such programmes, which include an ISM dimension since industry is always involved in Masters and PhD, are now provided. A more detailed description of courses being operated across the different EIT KICs is provided in Annex F.

- **EIT Climate-KIC Master's Programme** - through the course, there is potential for students to launch their own start-up business venture with support from the KIC-Climate's business coaches and a pre-incubation programme.
- **EIT Digital Master School** - 20 top European universities, renowned researchers and leading businesses work in partnership with the EIT Digital and provide cutting-edge ICT excellence in combination with innovation and entrepreneurship training, leading to a double Master's degree and an EIT-labelled Certificate. There are close links with industry during the including internship opportunities.
- **EIT Health CAMPUS** – innovative Masters and Doctoral programmes are available via four Working Groups. A broad range of firms, start-ups, healthcare providers, government organisations, etc. involved in the transformation of healthcare service provision are taking part in the scheme.
- **EIT InnoEnergy - an InnoEnergy Innovation Doctorate** is a joint doctoral training project that involves InnoEnergy, an academic participant and a company (either a major industrial player, a small specialist or an entrepreneurial start-up). It can also involve a local, regional, or national institution that is committed to promoting the Innovation Doctorate. Innovation Doctorates are carried out by a PhD candidate who is employed by the company involved.

According to the *Interim Evaluation of the EIT*¹⁹, approximately 820 individuals have graduated from EIT-labelled Masters and PhD programmes. Despite the progress made, the evaluation points out that there remains scope for improvement. “*The 2015 business plan assessment of EIT InnoEnergy recommends that the participation of industry in education should be further increased in the KIC's Masters and Executive programs. It also flags timing issues (duration of the innovation projects vs. program duration), as well as content issues (low TRL for PhD, higher TRL for innovation projects and business creation) with the KIC's PhD programmes as barriers to greater industry involvement in the Doctoral programmes*” (pg. 41).

It is also worth noting that the EIT puts a strong focus on Masters’ courses achieving educational excellence in order to be allowed to use the EIT label. It has developed a handbook on the labelling of educational programmes offered through the EIT. The handbook includes the ‘Quality for Learning’ EIT Quality Assurance and Learning Enhancement Model. “Quality Indicator 4 – Stakeholder Experiences” is a relevant metric in assessing the experiences of different stakeholders taking part in a scheme which involves some form of intersectoral mobility. In addition, it is interesting that the EIT puts a strong emphasis in its assessment of Masters’ courses on Masters’ students acquiring transferable skills to enhance their employability which is one of the strong contributions that can be made through an intersectoral mobility experience.

¹⁹ https://ec.europa.eu/education/sites/education/files/2017-eit-interim-evaluation_en.pdf

2.2.5.2.3. ISM and the European Structural Investment Funds (ESIFs).

A further important EU funding source in support of ISM is the **European Structural Investment Funds (ESIFs)**, implemented on a decentralised basis under shared management. Many examples were identified in the earlier 2007-2013 period of implementation and in the 2014-2020 period of the use of the Structural Funds to implement both dedicated intersectoral mobility schemes and schemes which seek to strengthen industry-academic cooperation more generally. Examples of schemes identified through the basic mapping that used ESIF are provided in Annex F. Both the **European Social Fund (ESF)** and the **European Regional Development Fund (ERDF)** have been used to support ISM.

In **Bulgaria**, the Bulgarian SMEs Promotion Agency (BSMEPA) implemented an ERDF-funded project under the "Development of the Competitiveness of the Bulgarian Economy" 2007-2013 (OPC) under the Priority "Support for Research and Development Activities in Bulgarian Enterprises". **Component 1 – the conduct of "industrial research" or "experimental development"** foresaw some activities that promoted ISM, in particular performing research, measurement, testing and R&D related to the development of innovative products, processes or services developed through the project by staff employed, by the applicant/partner or by an external contractor (remuneration, external services). Funding was provided to hire researchers from academic institutions and for the estimated employment costs (including health and social security contributions) for employers.

In the **UK**, the **Knowledge Economy Skills Scholarships (KESS 1) scheme** was implemented by Bangor University using ESF funding under a European Convergence programme. The scheme is coordinated by Bangor University on behalf of the Welsh higher education sector and involves collaboration between Welsh Universities. KESS offers collaborative research projects and links researchers undertaking a Masters or a PhD with a local company partner, with the scholarships supported through ESF. KESS achieved 230 PhD and 223 Research Masters projects across Wales (73 PhD and 84 Research Masters at Bangor). KESS closed at the end of September 2015. The KESSII Programme is a continuation of the KESS (2009-14).

In **Estonia**, the ESF-funded **DoRa Programme (2008-2015)** funded through the Human Resource Development OP supported an industrial PhD scheme with a budget of €2 million. In the 2014-2020 period, ESIF have again been used to fund ISM through the **Smart Specialisation (growth) scholarships scheme**²⁰ being implemented in the 2016-2022 period with a programme budget of €3 million. Whereas the DoRa Programme was ESF-funded, the successor programme is ERDF-funded. The Estonian government wanted to tie in the follow-up scheme in the current period closely to national R&I sectoral priorities identified in the Smart Specialisation strategy (ICT, health, resources and cleantech). The scheme is primarily intended for PhD students but was extended to include scholarships at the Masters and Bachelors levels. A similar programme is operating in **Latvia**, **Grants for applied research projects**, which promotes cooperation between enterprises, scientific institutions and higher education institutions, and promotes knowledge transfer in sectors identified as being priorities in Latvia's Smart Specialisation strategy.

2.2.5.2.4. Key findings - EU funding schemes

In summary, the review of EU funding schemes and their role in promoting intersectoral mobility found that:

- EU funding continues to play a major role in supporting ISM through the well-known ITN scheme within MSCA but also other actions notably IF and RISE.
- Although the foremost emphasis in the MSCA is on international mobility, partly as a result of the recommendations made in previous evaluations, there is evidence in 2014-2020 of a growing emphasis on intersectoral mobility, although international mobility is a formal requirement across all the actions.
- The SME Associate Pilot Scheme has strong potential, but it is difficult to assess its effectiveness at this early stage since there are only small numbers of participants, and it is presently undergoing its first evaluation (the results of which are not yet available).

²⁰ <http://haridus.archimedes.ee/node/366>

- Evidence was identified that Structural Funds (now ESIFs) were used in both programming periods (2007-2013 and 2014-2020) to promote intersectoral mobility. Both the ESF and ERDF are being utilised to support intersectoral mobility schemes.
- However, there are only a small number of dedicated ISM schemes being funded through ESIFs, and it was more common for intersectoral mobility to be one activity among a number of other activities to strengthen industry-academic collaboration.
- Schemes that have used ESIF to finance ISM emphasised that a key lesson was the need to maximise flexibility during the scheme implementation phase (for instance to ensure sufficient flexibility that PhD students may temporarily stop their PhD but continue it later on). However, the Structural Funds Regulations and national rules on ESIF implementation were regarded as a constraint in being adequately flexible.

2.2.6. *Links between ISM schemes regionally, nationally and internationally*

RQ6 - Are there any links between ISM schemes regionally, nationally and internationally? Do they complement each other and propose partnerships in order to enhance the effectiveness and quality of training offered?

The assessment of ISM schemes in RQ4 found that the majority of ISM schemes operating regionally, nationally and internationally were small-scale. There were some notable exceptions however, such as schemes that were EU co-funded such as the MSCA Co-Fund funded through Horizon 2020 and schemes that used Structural Funds alongside national co-financing. Several examples of Structural Funds supported dedicated ISM schemes were identified (see Appendix F) which operate on a larger scale with intermediaries playing a crucial role in implementing the scheme. For example:

- In **Estonia**, the Archimedes education foundation²¹ operated the DoRa Programme in 2008-2015 and manages the successor Smart Specialisation scheme in 2016-2020.
- In **Italy**, the PhD ITalents scheme is a national scheme being implemented by Fondazione Crui on behalf of the Ministry of Education, Universities and Research and Confindustria. Companies and researchers can apply to participate and take part in a process to match company's research needs within suitable researchers from across Italy.
- In **Wales**, the KESS 1 and 2 schemes being implemented in the 2007-2013 and 2014-2020 periods respectively are being managed by Bangor University in partnership with universities from across the University of Wales, a unitary institution.
- In the **UK**, there are several examples of further ISM schemes where the Research Councils (e.g. the BBSRC, the EPSRC and the AHRC) play a major role in scheme coordination and individual HEIs, and cultural organisations and museums in the case of the AHRC can apply to participate.

Several of these schemes are described in detail later in the report (also see Case study 1 for the detailed write up on the Estonian DoRa programme and case study 4 for the detail on the Royal Society scheme. Their relevance in addressing this RQ is that these schemes are being managed by a central coordinating agency which higher education institutions are able to apply to in order to receive funding support to take part in ISM.

The advantage of having an intermediary responsible for ISM schemes is that they can operate on a larger scale with greater scope for the sharing of experiences between institutions, for instance in relation to how to optimise support structures, how to deliver skills development and training to researchers during their mobility experience and how to attract industry participants).

However, it should be recalled that the majority of ISM schemes identified through the study are operated by individual universities and other types of academic institutions. Since these schemes are commonly small in terms of the numbers of PhD students benefiting annually, they tend to operate in isolation from other ISM schemes, with partnership working taking place at the *scheme level* rather than *inter-scheme*. There was limited evidence of the sharing of good practices through partnership working with other HEIs operating ISM schemes. Indeed, as noted earlier, there is a

²¹ <http://archimedes.ee/en/archimedes-foundation/>

lack of a common understanding of intersectoral mobility as a concept so it is unsurprising that many schemes operate largely independently.

An interviewee from the Research Council of Norway, which implements a number of ISM schemes (see Case Study 3, the **Public Sector PhD scheme (OFFPHD)**²²) mentioned that the transfer and exchange of information between schemes regarding the design and set-up phase, overall management / coordination arrangements and operational aspects during the implementation stage would be highly useful. The lack of networking between schemes and the absence of a culture of collecting monitoring data and information and in sharing such data between schemes was alluded to as being a limiting factor in being able to evaluate national schemes and compare them with similar schemes in other countries. There has not as yet been an evaluation of the OFFPHD scheme, but a thorough evaluation of the scheme's effectiveness is being planned in 2019. It was emphasised that the scheme managers would find it useful to have access to benchmarking data on other schemes in order to compare experiences, to identify good practices and to review the applicability and transferability of lessons learned.

There was no evidence of information-sharing between ISM schemes on a formalised partnership basis in order to enhance the effectiveness and quality of training offered. However, there have been initiatives by key EU-level associations in order to improve information on existing intersectoral mobility schemes. For example, Science Europe (SE) published a study in 2017²³ which examines the extent to which its members were involved in implementing such schemes. The report noted that there is a need for stronger linkages between schemes generally in order to share information on how to optimise scheme design and implementation. *"More interactions and coherent links with other funders that support the private sector might be an interesting approach in the future, in order to truly enhance intersectoral collaborations and mobility, by taking into account the needs of the other sectors when defining new support schemes"*.

No partnership working examples were identified of inter-scheme linkages between different international ISM schemes and national schemes, although there were examples of bilateral schemes involving specific EU countries and their international partners (and vice versa), and also of international schemes where scheme managers mainly operate the scheme domestically, but have sought to develop international partnerships. A good example in this regard is the A*STAR Graduate Academy (A*GA) in **Singapore** (see following box), where partnerships have been established with European universities, such as the Karolinska Institute in Sweden.

Table 1.9 - The A*STAR Graduate Academy (A*GA) in Singapore

Objectives: A*STAR supports PhD level education both locally and overseas. The objective is to identify young scientific talents and to help individual researchers to realise their full academic and professional potential.

Management and coordination arrangements: A*GA is an example of a scheme managed and coordinated by an intermediary organisation, the Agency for Science, Technology and Research, in which a number of universities²⁴ are participating and can therefore share experiences between each other within the scheme. Those awarded an A*STAR Graduate Scholarship (AGS) are able to undertake research at an A*STAR Research Institute and to register their PhD candidature at any participant university.

Partnership arrangements: A*STAR has established collaborative relationships with universities in Europe and elsewhere. The Karolinska Institute in Sweden has been a collaborative partner in the A*STAR scheme for more than a decade.

²² <https://www.forskningsradet.no/no/Utlysning/OFFPHD/1253995410398/p1173268235938?visAktive=true>

²³ Source: Science Europe, January 2017 'Intersectoral Mobility Schemes in Science Europe Member Organisations': D/2017/13.324/1 Author: Science Europe Working Group on Research Careers

https://cdn5.euraxess.org/sites/default/files/domains/nl/se_intersec-mobility_survey_report.pdf

²⁴ Participants include Nanyang Technological University (NTU), National University of Singapore (NUS), Singapore University of Technology and Design (SUTD) and Singapore Management University (SMU).

Overall, due to the small-scale nature and fragmentation of most ISM schemes, there is a lack of a culture of partnership working between schemes, and no evidence of a coordinated effort to work together to develop a common approach to particular aspects of scheme management such as skills development (including transferable skills for employability) and training (e.g. entrepreneurship skills, management know-how, IPR management and exploitation).

One of the study questions relates to the level of funding for intersectoral mobility schemes:

2.2.7. Funding for intersectoral mobility

RQ7 - What funding (total amount, public/private share etc.) is already being made available for ISM? How many researchers are participating in these schemes per year?

RQ7 addresses the following sub-questions:

- **RQ7.1 - Which are the main funding sources for intersectoral mobility schemes?**
- **RQ7.2 - What are the total costs involved in operating a dedicated ISM scheme? How does this vary between different types of schemes?**
- **RQ7.3 - What are the typical costs per PhD student of taking part in ISM? How do the typical costs of ISM schemes differ depending on the level of researcher taking part (i.e. PhD student, or post-graduate or post-doctoral researcher, more experienced researchers)?**
- **RQ7.4 - How many researchers are funded per year across the ISM schemes identified in aggregate and by country?**
- **RQ7.5 - What role does private funding play in supporting ISM and approximately what is the level of funding currently?**

2.2.7.1. RQ7.1 - Which are the main funding sources for intersectoral mobility schemes?

Different funding sources are being used to promote ISM in individual EU and associated countries. As noted in the definition of intersectoral mobility, not all schemes for early-stage or experienced researchers involve formal ISM. A distinction can therefore be made between:

1. Fellowship or other types of schemes that are expressly designed to promote the intersectoral mobility of researchers and / or academics;
2. Fellowship or other types of schemes where there is scope to undertake intersectoral mobility, but where this is an ancillary objective linked to broadening research horizons.

In analysing questions relating to funding, it is appropriate to concentrate on analysing funding arrangements relating to dedicated schemes, since for the second type of scheme, there is commonly a lack of disaggregated data as to what proportion of scheme funding is devoted to intersectoral mobility, as opposed to other types of activities to strengthen mobility. There are several different funding sources for dedicated ISM schemes, namely.

- **National public funding sources**
 - Some national authorities strengthen ISM by providing funding support, often tied into the achievement of national policy aims linked to improving cooperation and knowledge transfer between academia and industry. Whereas many countries have developed policies and strategies to promote researcher mobility, few countries have a strategy to foster industrial talents. Ireland and the UK are among the only examples.
 - Individual universities and research institutes are the most common current sources of funding at national level. Those operating ISM schemes recognise that supporting industrial PhD and Fellowship Schemes is crucial to bringing about closer cooperation with industry and to fostering scientific and research excellence.
 - In some countries (e.g. Ireland, Norway, the UK, and Estonia) intermediary organisations, such as research and innovation agencies and organisations which promote scientific excellence, play a key funding role.
 - In the case of schemes implemented jointly between the public and private sectors, whilst the private sector provides funding, many individual HEIs provide in-kind

financing contributions i.e. human resources, administrative support, access to laboratories and research infrastructure etc.

- **National private funding sources** – some private research foundations, such as the Wellcome Trust and other large corporate foundations such as those established by Microsoft and Volkswagen, also provide financial support for intersectoral mobility.
- **EU funding sources**, such as the Marie-Curie Skłodowska Actions, the SME Associate Pilot Scheme, the ESF and the ERDF, provide important financial support.

The analysis initially focuses on national schemes, which are the primary focus of this study. However, the scale of EU funding support for ISM through both dedicated intersectoral mobility schemes and through researcher mobility schemes that allow scope for ISM within a broader scheme are also identified. The purpose of the latter is to identify the relative scale and importance of such schemes compared with national funding which subsequently has informed the gap analysis, since any further EU intervention to be implemented by the Member States will need to take into account the current availability of ISM schemes (and any gaps) and the level of funding.

The main overall findings relating to the funding of ISM are that:

- **Different funding sources are being used to promote intersectoral mobility in individual EU and associated countries.** The most common type of ISM scheme is supported by public funding at the institutional level. In a small number of countries, there are national public funding schemes. The private sector is a further source of funding for some schemes, with a limited number of schemes entirely funded by the private sector or funded by private research foundations. Several examples of ISM schemes jointly funded by the public and private sectors were also identified.
- **In many EU-13, but also some EU-15 countries (e.g. Germany), the main source of funding to promote ISM is through EU-funded schemes**, especially the MSCA's ITN which provides European Industrial Doctorates and European Joint Doctorates, but also through the RISE and IF strands of the MSCA, where there is scope for mobility between the academic and non-academic sectors to take place.

2.2.7.2. RQ7.2 - What are the total costs involved in operating a dedicated ISM scheme?

In addressing this sub-question, the following questions have been considered:

- What are the total costs involved in operating a dedicated ISM scheme at national level?
- How does the level of cost vary between different types of schemes (e.g. fully-fledged industrial PhDs, versus Fellowship Programmes requiring a more limited period of mobility)?

Research has been undertaken to assess the costs involved in operating a dedicated ISM scheme. However, the difficulties in carrying out this assessment should first be highlighted. There were many data gaps in respect of scheme funding during the mapping exercise, although it was possible to obtain data on the funding allocation for a selected number of national ISM schemes.

The lack of data reflects a number of issues. Firstly, whereas schemes that are EU funded or nationally co-financed but also EU co-funded, are obliged to make information publicly available under EU visibility requirements about the level of EU funding they have received. It is therefore easier to obtain data for instance regarding ESIF-financed measure than a corresponding national scheme where no obligation exists to make information publicly available. Whilst some funding agencies, such as national research and innovation councils are generally transparent about the total budget for ISM schemes, this is often not the case for ISM schemes being implemented by individual universities. For the latter although scheme funding per researcher may be available, total scheme funding and basic monitoring data on the number of participant researchers was generally not made available. Some data was gathered on scheme-level costs (presented in this sub-section) and on the costs per PhD student or post-doctoral researcher per year (see RQ 6.3).

Secondly, a further data deficiency is that whilst funding for a particular year was sometimes made available via a website, since some schemes have been operating for up to 20 years, total scheme funding was often unavailable. Although an attempt was made to contact scheme managers directly to obtain cost information, not all were willing to provide the data. Thirdly, since there are data gaps, it is appropriate to highlight selected examples and to generalise about the typical costs for different types of schemes rather than to accurately quantify these.

In the following table, examples are provided of ISM schemes where either annual scheme funding or total cost data since inception / the beginning of the programming period was available:

Table 1.10 - Costs of ISM schemes

Country	Name of scheme	Lead coordinator / manager	Funding source	Financial information
AT	Laura Bassi Centres of Expertise	Austrian Research Promotion Agency FFG	National public financing	€25.5 million over 7 years from 2009- 2016 (average €3.64 million per year).
BE	VLIRUOS	VLIR-UOS	National public financing	1st phase = €1 Million for 3 years for research on several topics on financing to development;
BE	Innovation Mandates²⁵	Flanders Innovation and Entrepreneurship (VLAIO)	National public financing	Approximately €2.6 million (baseline of 22 projects) ²⁶ being funded per year, at €125.000 each
BE	Baekeland	Flanders Innovation and Entrepreneurship (VLAIO)	National public financing	€1.25M (approximately 30 projects ²⁷ funded per year, at 40.000/year)
BG	Science and Business Project			Total: €2.6 million (note – not all activities funded within the programme are concerned with ISM)
DE	Volkswagen - Science and professional practice in graduate education – research colleges and practice modules	Volkswagen Stiftung / Foundation	Private financing	Funding of €13.3 million across two funding streams.
EE	DoRa Programme 2008-2015²⁸	Archimedes Education Foundation	ESF and national public co-funding	Total: €2 million of total programme funding of €33.5 million was devoted to Activity 3 (an industrial PhD scheme). The scheme is funded by the ESF through the Ministry of Education and Research (73% EU Social Fund, 9% Estonian government, 18% contribution of participating universities).
EE	The DoRa Plus Programme²⁹	Archimedes Education	ERDF and national public	2014-2020 programming period (scheme running 2016-

²⁵ <https://www.uhasselt.be/UH/Research-funding/Funding-programmes/IWT-programmes/Innovation-mandates.html>

²⁶ note: number of financed projects can change from year to year

²⁷ Ibid.

²⁸ <https://rio.jrc.ec.europa.eu/en/library/programme-dora>

Country	Name of scheme	Lead coordinator / manager	Funding source	Financial information
		Foundation	co-funding	2022)
EE	Estonia Smart Specialisation (growth) scholarships for PhD students³⁰ (also Masters and Bachelors), 2016-2022	Archimedes Education Foundation	ERDF and national public co-funding	Total: €3 million for the 2016-2022 period
ES	Intersectoral Doctorate (Financial support for the training of researchers in companies)	State Agency for Research	ERDF and national public co-funding	€3 million for the period of 2018-2021 period
ES	Catalan Industrial Doctorates³¹	Secretariat for Universities and Research, Government of Catalonia	National public financing	€ 55,560 per project of 3 years
ES-RO	Spanish multi-country transnational research projects (Romania)			MANUNET III, €1.5 million (for RO participation)
FR	CIFRE (La convention industrielle de formation par la recherche)	Association nationale de Recherche et de la Technologie (ANRT)	National public financing	Provides assistance for the recruitment of a doctoral researcher in an enterprise 4886 CIFRE contracts in place, at €14.000/year each = total €68 million /year
HU	ISM Programme for Thematic Applications involving International Cooperation (NN_17)			Total: €3.3 million
IE	Employment Based Postgraduate Scholarship	Irish Research Council	National public financing	€15 million budget for Postgraduate Scholarships in 2016
IE	Collaborative Research Fellowships for a Responsive and	Irish Research Council	Ireland MSCA CO-FUND	Co-funding budget is €4 million.

²⁹ <http://haridus.archimedes.ee/en/dora-plus-programme>

³⁰ <http://haridus.archimedes.ee/en/smart-specialisation-phd>

³¹ <http://doctoratsindustrials.gencat.cat/en/>

Country	Name of scheme	Lead coordinator / manager	Funding source	Financial information
	Innovative Europe (CAROLINE)			
IS	Icelandic Institute for Intelligent Machines (IIIM)		National public financing initially now private funding	Approx. €500,000 p/a Funded by a grant from the national government during the first 7 years.
IT	PhD ITalents	Fondazione CRUI	National public and private financing	€16 million (including companies' co-financing). Fondo Integrativo Speciale per la Ricerca (National Fund)
LV	Grants for applied research projects (promotion of cooperation between enterprises, scientific institutions and higher education institutions, supporting knowledge transfer in the areas of smart specialization).	Ministry of Education and Science	ERDF, and national public and private co-financing	Total: €76.5 million (ERDF €65.04 million and national budget 1. €85 million, planned attracted private funding (until 2023) €9.63 million)
LT	State Support for Employment of Skilled Personnel in Companies	European Social Fund (ESFA)	ESF, national public co-financing	Total: €939,348 Competitive grants scheme
LU	Industrial Partnership Block Grant (IPBG)	Fonds National de la Recherche (FNR)	National public and private co-financing	Total: €5 million per year for PhDs and Post-doctorates; 500k per year for PPP.
NL	Industrial Doctorate scheme	Netherlands Organisation for Scientific Research	National public and private co-financing	Total: €10 million per year Government – €3.4 million Companies – €3.4 million – SME's are contributing with a less amount than big companies, companies' contribution are predicted to be largely in-kind Universities – €3.4 million
PL	„Zielone światło innowacji” - Green light to innovation	Małopolska Regional Development Agency	ESF, national public co-financing	Total: € 700,000
PL	Nauowiec w biznesie - staże pracowników	Poznan	ESF, national public co-	Total: PLN 523,032 (around € 125,000)

Country	Name of scheme	Lead coordinator / manager	Funding source	Financial information
	naukowych w przedsiębiorstwach - Researcher in business - internships of researchers in companies		financing	
PT	PhD Studentships in Industry (BDE)	Fundação para a Ciência e Tecnologia (FCT)	ESF, national public co-financing	Funding only for the PhD students: minimum of € 14 500 per year of project
SE	Mobility for Growth	VINNOVA (Sweden's Innovation Agency)	MSCA COFUND and national financing	2012-2017 - €35 million, of which €10 million is co-funding from Marie Curie.
SI	Young researchers in the business sector	SPIRIT Slovenia - Public Agency for Entrepreneurship, Internationalization, Foreign Investments and Technology	National public financing	2010 call for proposals: €20,423,529 (15% of funds provided by the Ministry of Higher Education, Science and Technology, 85% of funds provided by the European Social Fund)
SI	Mobility grants for researchers from public sector to enter business enterprises	SPIRIT Slovenia - Public Agency for Entrepreneurship, Internationalization, Foreign Investments and Technology	National public financing	2008 call for proposals: € 4,062,765 2009 call for proposals (funding available in 2009 and 2010): € 4,000,000
UK	Knowledge Economy Skills Scholarships 2 (KESS 2)	Bangor University	ESF	€39.1 million (£36 million) funding in the 2014-2020 period or an average of €5.57 million per year.
UK	National Productivity Investment Fund	The fund will be managed by Innovate UK and the research councils.	National public financing	£90 million for "an additional 1,000 PhD places in areas aligned with the industrial strategy", along with "a further £160 million to support new fellowships for early and mid-career researchers in areas aligned to the industrial strategy". Since the funding will mainly be used to fund industrial PhDs, this is an example of a larger-scale initiative to promote ISM.

The findings from the assessment of data presented in the above table are that:

- There are a number of significant-scale national (public) funding schemes to support ISM. Some national schemes provide as much as €10-15 million per year, for example in the **Netherlands, Ireland, Italy** and the **UK**.
- The highest level of funding for doctoral fellowships is the CIFRE programme in **France** (€68 million /year).
- In other countries, EU schemes which are part nationally co-financed also have major budget allocations to ISM of up to €20 million to €35 million over the lifetime of a 7 year programming period, i.e. €2.85 million to €5 million per year (e.g. **Sweden**, the **UK**).

- Several examples of national schemes that are privately funded were also identified. Whilst most of these are small-scale, a small number of large-scale private schemes were identified, such as the Volkswagen scheme to provide researchers with scientific and professional research experience in graduate education, which has funding of €13.3 million across two funding streams.

Scheme duration is an important factor influencing their costs. There is a difference between the costs associated with funding an industrial PhD requiring a full three or four year PhD programme and the costs of an industrial fellowship programme, which may require undertaking a mobility experience between sectors of between 3-12 months duration. The costs of funding an industrial PhD were found to be approximately €50,000 minimum (mainly salary costs).

A distinction in costs can also be made between the costs of Masters' schemes and of PhD schemes. For example, taking the KESS 2 Knowledge Economy Skills Scholarships as an example, whereas the KESS 2 Research Masters Scholarships involve a one year full-time scholarship (with a stipend of ~ £11,000), the KESS 2 PhD Scholarships lasts for three years and the annual stipend is ~ £14,000 for 2016/17 adjusted for inflation in subsequent years.

As a way of contrasting examples of costs from national schemes, the 2016-17 MSCA Work Programme (WP) provides EU contribution costs to MSCA fellowships. The WP states that the yearly reference rates for calculating the living allowance of researchers recruited under an employment contract/ equivalent direct contract are:

- for early-stage researchers (ITN): €37,320 /year
- for experienced researchers (IF): €55,800 /year

The above amounts include all compulsory deductions under national legislation. The beneficiary must pay to the recruited researchers at least the reference allowances (minus all compulsory deductions under national legislation in the context of the project). A top-up may be paid to the researchers in order to complement this contribution. In addition to the living allowance, the beneficiary must pay a mobility allowance and for some categories of researchers, a family allowance.

Source: MSCA 2016-17 WP

It was difficult to obtain information on funding regarding the specific ISM dimension for R&I-focused measures funded under the ESIFs where ISM may only be a small part of a large funding package at the priority or measure level. This was especially the case where this was relatively modest within the context of the whole series of activities being funded. This was the case in respect of countries using ESIFs to strengthen the R&I system and improve the framework conditions (investing in young researchers in BU, HU, CZ, PL) where the lack of an explicit focus on ISM made it even more difficult to find out what level of funding benefited ISM. A list of ESIF-funded schemes is provided in Annex F.

Among the research findings in terms of **trends and differences in approach to funding ISM between countries** are that:

- The size and scale of nationally-funded schemes varies significantly and it is difficult to generalise the typical costs involved in inter-sectoral mobility. Only a few countries, such as **Ireland, Denmark, Norway, Sweden and the UK** are presently investing significant resources into ISM.
- National government investments focus on PhD training, on bringing research-to-market (innovation fellowship, entrepreneurship skills), on increasing R&D levels in general by giving industry access to research talent (tax advantages for hiring researchers in **France, Belgium and Romania**) and by sponsoring university-industry joint PhDs.
- In stronger R&I countries, there are often many nationally-funded researcher mobility schemes, and some of these are either focused on ISM, or allow scope for ISM. However, funding availability in these countries varies significantly.
- In former Soviet countries and in newer Member States, there is a lack of domestically-funded ISM schemes, and a strong dependency on EU mobility schemes for formal intersectoral mobility to take place. This does not preclude informal ISM from occurring i.e. when young researchers choose to pursue a private sector career in industry and leave academia.

Good practice suggests that successful ISM schemes make adequate budgetary provision to ensure effective scheme management by allocating circa 5% of the scheme budget to pay for programme managers to design and be actively involved in scheme implementation, for instance to provide appropriate support structures, skills and training and to ensure that outcomes and impacts are monitored and to fund periodic evaluations. However, a key barrier to making sufficient budget available to embed monitoring and evaluation more systematically within ISM schemes from the outset is that many schemes are very small in scale.

Among the overall findings in respect of the costs of intersectoral mobility schemes are that:

- There is a lack of comprehensive data on the costs of operating dedicated ISM schemes. Although total scheme funding size was available for some countries, the data is insufficiently comprehensive to provide robust data estimates on average funding / scheme. In several cases, scheme funding was confidential.
- Since the characteristics of schemes vary significantly presenting and analysing the average or typical costs could be misleading. The costs of operating ISM schemes also vary significantly depending on the type of scheme and its characteristics, the category of participant researchers (e.g. R1 – R4), the duration of mobility etc.

2.2.7.3. RQ7.3 - How do the costs of ISM schemes differ depending on the level of researcher taking part (i.e. PhD student, or post-graduate or post-doctoral researcher, more experienced researchers)?

The costs per individual researcher is closely related to the previous RQ relating to the overall costs of dedicated ISM schemes. The majority of costs associated with operating ISM schemes cover researchers' salaries and/ or the additional cost for researchers of undertaking a mobility period. The costs of dedicated ISM schemes vary significantly and are dependent on a number of factors, such as:

- **The level of researcher taking part** – i.e. early-stage researchers through to experienced researchers and lead researchers;
- **The duration of the intersectoral mobility period** – dependent on whether the researcher's mobility experience is for a limited duration e.g. 3-12 months in industry or academia or whether the full duration of the PhD is undertaken in an intersectoral environment i.e. industrial PhDs where the researcher is based at the enterprise with only limited academic teaching time.

In the table below, examples of the costs of intersectoral mobility for individual researchers is provided. Examples are provided in the following table of selected schemes:

Table 1.11 – Funding levels for individual researchers – selected schemes

Country	Name of scheme	Lead implementer	Financial information
BE	Baekeland	Flanders Innovation and Entrepreneurship (VLAIO)	PhDs receive €160.000 for 4 years of study/industry collaboration.
BE	Innovation Mandates	Flanders Innovation and Entrepreneurship (VLAIO)	2 years' salaries of PhD + €40.000 for research costs = Total around €250.000/2 years of program
BE	Coming Back / BeWare (discontinued)	Belgian Science Policy (BELSPO)	depending on years of experience, it was paid as a full salary (brute wage + research expense + travel allowances + covered social security) = €180.000-€200.000 for two years/researcher;

Country	Name of scheme	Lead implementer	Financial information
CH	Pioneer Fellowships scheme	ETH Zurich	Annual salary costs for Pioneer Fellowships are: After MSc (percentage of employment: 100) first year between CHF 54,000 and 90,000 After PhD (percentage of employment: 100) first year CHF 99,700
DE	Volkswagen ISM scheme	Volkswagen	Funding stream 1 covers human resources expenses (65-100% of the salary of PhD students), travel expenses, and material costs. Funding stream 2 pays a lump sum of €1,000 per month to students for at least 6 and up to 12 months. Maximum funding per researcher: € 12,000.
ES	Catalan Industrial Doctorates	Secretariat for Universities and Research, Government of Catalonia	€ 55,560 per project of 3 years: Business sphere: €21,600 Academic community: € 25 488 Industrial doctorate student: € 8 472
ES	Programa de Doctorados Industriales	Universidad de Cantabria	€ 25,000 per research project: € 3 000 for the mobility of the student (seminars, events, mobility to other HEI or companies) <ul style="list-style-type: none"> • Subsidy for registration in PhD at University • Subsidy for the development of the research
FI	Post Docs in Companies – the PoDoCo programme	PoDoCo foundation	A one-year research grant is €28,000.
FR	CIFRE	Association Nationale Recherche Technologie (ANRT)	Grant given directly to the company is of €14.000/year (on the condition that the company recruits on a CDI or 3-year fixed-term contract a master's degree, with a minimum gross annual salary of € 23,484 (€ 1,957 per month), and entrusts him with research work that is the subject of his thesis. It receives from the National Association for Research and Technology (ANRT), which manages the CIFRE grants on behalf of the Ministry of Higher Education, Research and Innovation, an annual grant of € 14,000 for 3 years.

Country	Name of scheme	Lead implementer	Financial information
IE	Enterprise Partnership Scheme Postdoctoral Fellowship	Irish Research Council	The total value of a Postdoctoral Fellowship is up to a maximum of €45,895 per year. This consists of: <ul style="list-style-type: none"> - a gross salary of €31,275 per annum (prior to income tax and social deductions) - employer's contribution to Social Insurance of €3,365 - employer's pension contribution, of €6,255 - eligible direct research support expenses The Fellowship normally lasts for two years.
IT	Research Fellowships for Economists.	Bank of Italy	The fellowships are for 12 months, renewable for another possible 12 months, and provide fellows with a monthly stipend of €4,000.
LU	Industrial Partnership Block Grant (IPBG)	FNR	Total: €5 million per year for PhDs and Post-doctorates; 500k per year for PPP; Fixed training and mobility allowance of 6.500 € and 4.500 € is paid per PhD and Postdoc position, respectively.
NL	Industrial Doctorate	Netherlands Organisation for Scientific Research (NWO)	The Scholarship will be around €50.000/€55.000 per student.
PT	PhD Studentships in Industry	Fundação para a Ciência e Tecnologia (FCT)	Funding only for the PhD students: minimum of € 14 500 per year of project
PL	Doktorat wdrożeniowy/ Industrial PhD programme	Ministry of Science and Education	Monthly amount of doctoral scholarship for one PhD student: 2.450,00 PLN (around €600)
SE	Mobility for Growth,	VINNOVA (Sweden's Innovation Agency)	The repatriation grant may only be applied by university researchers who intend to do an exchange programme in industry for at least 12 consecutive months at least 80 per cent full-time. A repatriation grant may be applied for including overheads, but no more than €52,000.
UK	Knowledge Economy Skills Scholarships 1 (KESS 1)	Bangor University	KESS Research Masters Scholarships Awardees will be getting a stipend that values £10,130 in addition to support of project costs that values £5,000 for conferences/traveling, consumables, minor equipment and skills training.
UK	Knowledge Economy Skills Scholarships 2 (KESS 2)	Bangor University	KESS 2 PhD Scholarships - stipend of ~ £14,000 for 2016/17 (rising in accordance with inflation for subsequent years). KESS 2 Research Masters Scholarships - stipend of ~ £11,000 for 2016/17. Each scholarship has an additional budget for travel, equipment/consumables and training to support research

Country	Name of scheme	Lead implementer	Financial information
UK	<p>National Productivity Investment Fund</p> <p>Industrial Strategy Challenge Fund – a new cross-disciplinary fund to support collaborations between business and the UK’s science base.</p>	The fund will be managed by Innovate UK and the research councils.	<p>1,000 PhD places will be funded under the new fund which was announced in 2017 linked to the UK’s industrial strategy.</p> <p>The cost of funding each PhD place for a 3-4 year PhD is circa €90,000. An unquantified number of places are also being funded for early and mid-career researchers. Example of a research council scholarship – the EPSRC National Productivity Investment Fund doctoral scholarship</p>

The main findings were that:

- **The level of funding was found to vary considerably between schemes and between countries.** However, it is difficult to generalise about typical scheme costs since these vary depending on many factors, including the level of experience of the researcher participating, the duration of the mobility period, the direction of mobility, and where the mobility takes place (i.e. internationally, elsewhere in the same country, or locally).
- **The costs involved in supporting ISM per researcher can be significant.** Industrial PhDs are quite costly per researcher, ranging from €50,000 to €100,000, but it should be recalled that these are for a full three or four year PhD. Fellowship Schemes for more experienced researchers can also be relatively costly from €50,000 to €250,000 but this depends strongly on the length of the period of mobility.
- The costs of providing ISM opportunities are likely to be **lower per researcher for national schemes than for international mobility schemes** (on the assumption that less travel costs, additional allowances for living abroad, family relocation costs will be incurred).

For example, one of the case study schemes, the Industrial Fellowship Scheme being implemented by the Royal Society in the UK (see case study 4) noted that “Typical cost per researcher undertaking intersectoral mobility (total during mobility period) based upon researcher’s salary and length of Fellowship can vary from ~£50k to £200k+ (€56,500 to €226,000). However, it should be recalled that researchers benefiting from a Fellowship would in any case be employed on a similar salary were they not to participate in intersectoral mobility so arguably the costs that should be counted should mainly be the additional costs associated with ISM, rather than costs that would in any case arise for the employer of the intersectoral mobile researcher.

RQ7.4 – How many researchers are funded per year across the ISM schemes identified in aggregate and by country?

Since the data is very fragmented, it is not possible to provide an accurate estimate of the number of researchers who are funded per year across the ISM schemes identified either in aggregate or by country. Often, even in the medium-sized domestic schemes, there are only several researchers being funded per year and a lack of systematic monitoring data available in many schemes on how many researchers have been supported since scheme inception. There is however better data available in respect of participants in EU funded schemes that involve ISM (see section below on EU funding).

2.2.7.4. Private funding sources of ISM

RQ7.5 - What role does private funding play in supporting ISM and approximately what is the level of funding currently?

There are two ways in which private funding is being invested in ISM schemes: firstly, private co-funding contributions to publicly-funded ISM schemes and secondly, schemes that are entirely privately funded. Both types of schemes are considered in this section. It is worth highlighting ISM schemes that require a private sector co-financing contribution towards the costs of operating schemes. Such schemes are interesting since they arguably demonstrate stronger potential in terms of funding sustainability than schemes that are solely financed using national sources.

According to interview programme feedback, some industry participants stated that they value the benefits of participation more highly for those schemes that they actually have to pay for compared with schemes that are solely nationally funded. Benchmarking the typical percentage private contribution that companies are willing to pay is also useful in determining appropriate co-funding requirements in future.

ISM schemes that require a private sector co-financing contribution are summarised in the table on the following page. The first part of the table focuses on schemes requiring private sector co-financing, whilst the second part relates to privately-funded ISM schemes:

Table 1.12 - ISM schemes that require a private sector co-financing contribution and which are privately funded

Country	Name of scheme	Description	Funding source	Financial information
ISM schemes with a private sector co-financing contribution requirement				
AT	Industrial PhD Programme (Industriennahe Dissertationen).	<p>The programme is sponsored by the National Foundation for Research, Technology and Development (Nationalstiftung für Forschung, Technologie und Entwicklung) and aims at the systematic build-up and further qualification of research and innovation staff in companies and non-university research institutions. An Industrial PhD project is a three-year industrially focused PhD project where the student is working in a company and enrolled at a university at the same time.</p> <p>The company applies for a project funding from the Austrian Research Promotion Agency (FFG), and the student is employed by the company.</p>	National public - private	50% public, 45% private, 5% university.
BE	Baekeland	PhD scheme in collaborative university – industry setting, coordinated and cofounded by VLAIO. Researchers can take up a Baekeland position either full time (4 years) or part-time (max. 6 years). Researchers can request additional VLAIO funding for international mobility.	National public - private	<p>Employment costs and operational costs are shared between VLAIO and industry partner. VLAIO pays 50% of costs (companies pay the remaining 50%);</p> <p>For SMEs total funding can go up to 80%. Researchers are paid fully taxable salaries, not bursaries.</p> <p>The private sector contribution is 50% by default, but can be reduced to 40% (for medium-sized enterprises) or 30% (for SME's). An additional 10% reduction in co-funding applies in case of collaboration between various industrial partners.</p>
BE	Team-up	The lead coordinator is the Brussels government. The scheme finances collaboration projects between companies and universities in Brussels	National public - private	<p>The funding supports two researchers:</p> <ul style="list-style-type: none"> • 1 researcher coming from Academia (100% financing)

Country	Name of scheme	Description	Funding source	Financial information
				<ul style="list-style-type: none"> 1 researcher coming from industry <p>% of financing depends on size of company and type of project – can go from 25%-60% of total project costs</p>
FR	CIFRE	The lead coordinator is the Ministère de la Recherche in France. The scheme allows PhD to make their thesis in a public lab (university or research institute) or within industry.	National public - private	The Ministry of Research in France gives a grant directly to the company - of €14,000/year, for 3 years. The company must pay the difference between the financial support that researchers receive to take part on ISM and their wage, up to the minimum wage, to top up the state grant.
IT	PhD Italents	PhD Talents is three-year pilot project managed by CRUI (on behalf of the Ministry of Education) in partnership with Confindustria (i.e. the most important employer organisation in Italy). The project aim is to facilitate connections between universities and private sector companies, by supporting the inclusion of PhD students in companies to carry out innovative research projects.	National public-private	<p>The employment contract of the PhD students are co-financed for three years by the project (80% the first year, 60% the second year, 50% the third year).</p> <p>The private sector is required to make a co-financing contribution to meet the funding gap i.e. 20% in year 1, 40% in year 2 and 50% in year 3.</p> <p>€30,000 - €35,000 is the gross amount given to each company financed, with variations reflecting the fact that the scheme supports a diversified program. Confindustria co-funds to €30,000 gross annually.</p>
LU	The CORE scheme ³²	The specific objectives of the programme are to stimulate strong partnerships between public research institutes and companies, particularly activities that promote innovation and sustainable value creation.	National public-private	Private co-funding is required. If the company is Luxembourg-based, a minimum of 15% of the eligible project costs of the public institution must be covered directly by companies; if the company is international-based: minimum 30% of the eligible project costs of the public institution must be covered directly by the companies in terms of monetary contribution. Significant in-kind

³² <https://www.fnr.lu/funding-instruments/core/>

Country	Name of scheme	Description	Funding source	Financial information
				contributions are expected as well.
LU	The CORE scheme³³	The specific objectives are to stimulate strong partnerships between public research institutes and companies, particularly activities that promote innovation and sustainable value creation.	National public-private	Private co-funding is required. If the company is Luxembourg-based. A minimum of 15% of the eligible project costs of the public institution must be covered directly by companies; if the company is international-based: minimum 30% of the eligible project costs of the public institution must be covered directly by the companies in terms of monetary contribution. Significant in-kind contributions are expected as well.
LU	PRIDE programme	The programme targets research teams that have already a certain track record in doctoral training and wish to consolidate and develop long-term doctoral training programmes around strong research priorities. The main aim is to attract high potential PhD candidates to Luxembourg.	National public-private	Private co-funding is required. If the company is Luxembourg-based. A minimum of 15% of the eligible project costs of the public institution must be covered directly by companies; if the company is international-based: minimum 30% of the eligible project costs of the public institution must be covered directly by the companies in terms of monetary contribution. Significant in-kind contributions are expected as well.
LU	AFR PPP scheme	The goals are to prepare young scientists in acquiring the necessary skills and competences for the private job market, to support knowledge transfer between higher education institutions and Luxembourg based companies active in R&D and promote the development of industrial research capacity in Luxembourg.	National public-private	Private co-funding is required. If the company is Luxembourg-based. A minimum of 15% of the eligible project costs of the public institution must be covered directly by companies; if the company is international-based: minimum 30% of the eligible project costs of the public institution must be covered directly by the companies in terms of monetary contribution. Significant in-kind contributions are expected as well.
LU	IPBG	Similar to the previous (AFR) but the programme targets only research teams that have already a certain track record in doctoral training together with industry partner(s) that have successfully managed at least 7 doctoral trainings each in the	National public-private	Private co-funding is required. If the company is Luxembourg-based. A minimum of 15% of the eligible project costs of the public institution must be covered directly by companies; if the company is international-based: minimum 30% of the

³³ <https://www.fnr.lu/funding-instruments/core/>

Country	Name of scheme	Description	Funding source	Financial information
		past.		eligible project costs of the public institution must be covered directly by the companies in terms of monetary contribution. Significant in-kind contributions are expected as well.
NL	Professional Doctorate and Engineering Program	It is a practical oriented professional doctorate in engineering which is better suited to the direct needs of industry, whereas the PhD focuses on scientific research.	National public-private	Private co-funding is required of 25%.
NL	Flagship Data Science	The Flagship involves close collaboration between a number of research groups at Royal Philips Research and a number of research groups of various departments of TU/e. It involves a portfolio of related programmes. These programmes consist of inter-related projects covering the full range of descriptive analytics, predictive analytics and prescriptive analytics of people (not necessarily patients), processes and equipment.	National public-private	Private co-funding is required, but the percentage co-funding varies depending on the cofounding budget that each University department and company respectively is able to contribute.
NL	Industrial Doctorates	It targets different types of PhD in different fields, but is headed to young researchers and to researchers that make part of research groups from companies. The fields covered are not limited to technology, they can be psychology oriented or any other topic (a clear consequence from the Dutch Scientific agenda).	National public-private	The private sector is required to make a co-financing contribution of up to one-third (33.3%). Small companies are requested to make a smaller contribution, and in-kind financing contributions are accepted.
Privately-funded ISM schemes				
DE	Volkswagen - Science and professional practice in graduate education – research colleges and practice modules	The Volkswagen Foundation is supporting small graduate programs intended to pave the way for careers outside academia for doctoral students in the Humanities and Cultural Studies by integrating practice-based modules.	Private financing	Funding of €13.3 million across two funding streams. Maximum funding per researcher: € 12,000.
IT	The CORIMAV scheme	The University of Milano-Bicocca and Pirelli Company formed the Corimav Consortium to conduct research on materials. Such Ph.D. positions often foster	Private	Private funding provided by Pirelli, the tyres company

Country	Name of scheme	Description	Funding source	Financial information
		research activities related to tyres, but also more general topics such as nanotechnology and simulations of materials.		<p>Three PhD scholarships are funded per year for an Industrial PhD in Materials Science (or environmental science, computer science).</p> <p>The scheme funds three new and six ongoing PhDs annually. The salary of a PhD in Italy is €18,500/ year or circa €50,000 for a full PhD.</p> <p>Estimated annual budget is €232,000. The breakdown of costs is: PhDs - €162,000 (excluding admin costs) plus €50,000 for a full-time senior researcher to maintain high-level scientific contacts between the university and the company and €20,000 - €30,000 for other expenses e.g. laboratories and testing, admin costs etc.</p>
NO	Elkem Technical Trainee Program	It is a program established and managed inside the company (ELKEM). Students come from Norway to France and the other way around. It is real research program where researchers are integrated in the research teams and good coaching is given to them; the point is to identify the persons that are the right ones for the company.	Private	<p>It is 100% financed by the company.</p> <p>No data is available on annual or total funding.</p>

The data presented in the table above shows that:

- There is a national private co-financing requirement for ISM schemes in a number of countries, such as in **Belgium, France, Italy** and especially in **Luxembourg**, which has several schemes where private co-financing contributions are required. However, in other EU countries and associated countries, there were no such examples of ISM scheme requiring private funding.
- The private co-funding contribution is typically in the range of 15%-30% for dedicated ISM schemes.
- Interview feedback suggests that some scheme managers and industry representatives view ISM schemes requiring an industry contribution as being valued more highly than corresponding schemes that are solely publicly funded; and
- Several ISM schemes were identified that are solely privately funded, with in-kind funding contributions from universities and publicly funded research institutes were identified such as the examples cited from **Germany, Italy** and **Norway**.
- There are two main funding sources for privately-funded ISM schemes, private research foundations and individual industry sponsors. However, examples of privately-funded formal ISM schemes were only identified in a small number of countries, such as Germany (e.g. scheme funded by the Volkswagen Research Foundation) and **Italy** (e.g. the CORIMAV scheme³⁴ funded by Pirelli).

Examples were identified of a number of leading corporates sponsoring **ISM schemes**, motivated by two main factors:

- A recognition of the need to increase the supply of industrial talents i.e. to put in place the mechanisms for industry to access high-level researchers;
- The enhanced visibility of being associated with research excellence schemes, such as highly-selective fellowship programmes.

Securing private sector support is not only advantageous in terms of funding, but equally signals support and buy-in from industry, which may attract further private investment in the scheme and enhance the prestige and visibility of academia-to-industry ISM schemes.

Specific examples of the private funding of ISM are now provided. In the **UK**, there is a strong tradition of industry-academic cooperation. Some companies actively engage in the creation of ISM schemes, or participate in established schemes as sponsors. Large companies are especially interested in associating themselves with schemes to promote research excellence, for instance through research fellowships and industrial PhD schemes. These typically adopt a highly selective approach, with only the very best young researchers, experienced researchers and professors being funded to engage in research projects. For example, the **Industrial Fellowship (IF) scheme of the Royal Society** in the **UK** is a prestigious scholarship scheme that has attracted sponsorship from Rolls Royce, as described in the following table. The more detailed version of the case study below is provided in the separate case study report (case study 4 - mobility opportunities for experienced researchers at R3 and R4 levels).

Table 1.13 – Summary of Case Study 4 on the Industry Fellowships (IF) Scheme

Description and objectives: The Royal Society's Industry Fellowships scheme is for academic scientists who want to work on a collaborative project with industry and for industrial researchers and scientists who want to work on a collaborative research project with an academic organisation. The IF aims to enhance knowledge-transfer in science and technology between industry and academia.

Target group: The scheme is targeted at researchers with a well-established academic career or career in industry.

Eligibility criteria: The scheme covers academic disciplines across the life and physical sciences, including engineering, but excluding clinical medicine. There are two rounds / year with 5-6 fellows

³⁴ <https://www.pirelli.com/global/en-ww/life/the-growth-of-talent-at-bicocca-corimav-consortium-agreement-renewed>

/ round. At any one time, there are approximately 35-40 industry fellows in post. A broad range of sectors are covered, everything from the energy sector to the digital.

Funding sources and funding arrangements: There are two main funding sources, public funding from BEIS and funding from the Royal Society, an independent academic institution. There is also some financing contribution from the private sector (Rolls-Royce PLC). The IF scheme provides each scientist's basic salary for the duration of their secondment, which lasts for up to two years full-time or four years part-time. Most of the funding covers salary costs, with a small amount of money available for research and travel costs.

Scheme characteristics: The scheme duration is 2 years (full-time) or 4 years 50% (part-time). The scheme mainly attracts interest from larger firms since SMEs are not able to manage without key staff for such a long period of time.

Outcomes: Approximately 200 IF fellows have taken part over 20 years. The scheme is bi-directional, with 70% of participants moving from academia to industry, and 30% from industry to academia (although there are no fixed shares). Industry Fellows have either been employed by, or hosted at over 40 universities and about 100 companies since 2003. The applicants for mobility are distributed across the UK HE sector compared to purely academic funding schemes (in terms of both university mission group and location).

Evaluation and monitoring: Since the IF scheme has already been operating for 20 years, some evaluations have been undertaken of the scheme. Qualitative assessment of impacts has been undertaken through previous evaluations. Two case studies are available undertaken by the RS: 1) **Changing expectations**³⁵ – this project looks at research culture more broadly, with a number of case studies of researchers whose careers have spanned research and other sectors and 2) **Pushing the revolving door**³⁶ – focusing on ten individuals who have moved between academia and industry.

Good practices: it is important to be flexible in scheme design and implementation. The Royal Society took on board feedback from SMEs that they could not commit to recruiting a fellow for a full year located full-time at their premises hence other pilot schemes are being launched aimed at small firms which offer more flexible forms of participation for shorter mobility periods. Further evidence of good practice was identified through the use of innovative means of assessing the benefits of participation in ISM for later-stage researchers through a case study-based approach (see evaluation and monitoring section above). Quantitative assessment of the benefits of the scheme confirm that IFs lead to long-term university-business research collaborations, generation of intellectual property and academic publications, and significant follow-on funding. However, qualitative assessment of the intangible benefits of an intersectoral mobility experience on the individual researcher are also an important aspect of the scheme.

Lessons learned: Geographic considerations need to be taken into account in scheme design and planning. Many industry fellows work for host organisations that are not local to their current employer or where they live, which has implications in terms of travel time and costs, time away from home/family etc.

Schemes need to be as flexible as possible in accommodating the needs of different sectors as well as take into account the differences between micro, small, medium and large firms from industry, who may have different expectations as to the ideal duration of an intersectoral mobility placement by researchers.

Private research foundations are also an important source of funding to support researcher mobility including ISM. For instance, there are a number of foundation sponsors of ISM programmes, such as the **Microsoft PhD Programme**³⁷ and alternative intersectoral mobility programmes sponsored by Microsoft, such as the Catapult programme. In addition, further examples of private research foundations include the **Volvo Research and Educational Foundations, the Shell Foundation and Philips Research.**

³⁵ <https://royalsociety.org/topics-policy/projects/research-culture/changing-expectations/>

³⁶ <https://royalsociety.org/topics-policy/industry-innovation/case-studies/pushing-the-revolving-door/>

³⁷ <https://www.microsoft.com/en-us/research/academic-programs/>

In **Germany**, Volkswagen is a long-term sponsor of ISM. They provide scientists and researchers with professional researcher development opportunities through graduate education programmes which include internship opportunities as part of a module of the study programme. Earlier in 2017, they organized internships from social sciences into private companies. The Volkswagen foundation operates a scheme supporting PhD students. The aim of the scheme is to strengthen practical orientation of PhD programmes. According to VW, the majority of beneficiaries of the scheme take up employment outside universities after completing their PhD – either in business or by becoming self-employed. Support is provided to humanities and cultural studies students where employment opportunities outside university and teaching are not always easy to find. The level of funding to individuals depends on the funding stream. Funding stream 1 covers human resources expenses (65-100% of the salary of PhD students), travel expenses, and material costs. Funding stream 2 pays a lump sum of €1,000 per month to students for at least 6 and up to 12 months.

The **Wellcome Trust** in the UK provides support for doctoral and post-doctoral scholarships, and several examples of schemes it funds are listed in the scheme mapping database (e.g. Master's Fellowships in Public Health and Tropical Medicine³⁸, the Sir Henry Wellcome Postdoctoral Fellowships³⁹ targeted at early-stage researchers and Sir Henry Dale Fellowships⁴⁰ (Early-independent (intermediate) stage researchers will have significant postdoctoral experience and be ready to lead their own independent programme of research.))

In most countries in **Central and Eastern Europe**, no privately funded ISM schemes were identified, although it is possible that informal or highly localised schemes exist e.g. when a large firm needs to engage with the local university in order to increase the supply of highly-qualified researchers in a particular discipline. Some exceptions to this generalisation were however identified in EU-13 countries. For example, in **Romania**, the **Complex Internships Scheme for Masters' degree students** is privately funded by industry. The objective is to familiarise Masters' degree students with complex requirements in the workplace through an analysis of complex technological problems in cooperation within multidisciplinary teams. The aim is to develop transversal competences related to company communications, problem-solving and entrepreneurship. Although higher education institutions are involved, namely University Politehnica Bucharest and Renault Technologie Roumanie, both in designing the scheme and in the tutoring of students, private funding has been made available.

2.2.7.5. EU funding of ISM schemes

The main sources of EU funding which provide support *inter alia*, for ISM are:

- Several sub-programmes funded through Horizon 2020, which include:
 - The MSCA funded through the EU RTD Framework Programmes (FPs);
 - ERA-LEARN 2020, a support action (CSA);
 - The SME Associate Pilot Scheme;
 - The European Institute of Innovation & technology (EIT) runs some Masters and PhD programmes.
- The European Structural Investment Funds (ESIFs), both the ESF and ERDF (see following sub-section on EU co-funding).

A description of EU programmes which support ISM was provided in Section 2.2.5. It mentioned the crucial role of the Marie Curie-Skłodowska Actions (MSCA) in supporting international, but also increasingly intersectoral forms of mobility. In particular, it was emphasised that a number of sub-actions within the MSCA play an important funding role, notably the Innovative Training Networks (ITN), the Research and Innovation Staff Exchange (RISE), Individual Fellowships (IF) and MSCA COFUND.

³⁸ <http://scholarship-positions.com/masters-fellowships-public-health-tropical-medicine-2014/2014/01/24/>

³⁹ <https://wellcome.ac.uk/funding/sir-henry-wellcome-postdoctoral-fellowships>

⁴⁰ <https://wellcome.ac.uk/funding/sir-henry-dale-fellowships>

The scale of EU funding is significant under the MSCA. In total, €963 million is being devoted to researcher mobility although no disaggregated data is available as to what percentage will be used to support intersectoral mobility. Some limited data was nevertheless obtained on total funding and also typical project budgets both for the MSCA and for wider EU programmes. On some occasions, the data relates to particular strands within a sub-action and there is no specific disaggregated data for the ISM component.

Table 1.14 – EU funding to promote intersectoral mobility.

Scheme type	Funding in EUR (€)
Marie Curie Industry-Academia Partnerships and Pathways (FP7)	The typical project budget is €500,000 – €2 million over a project duration of 3 to 4 years.
MSCA Innovative Training Network (ITN), H2020, pilot in FP7	<p><u>2016 – total €375 million</u></p> <ul style="list-style-type: none"> • MSCA-ITN-2016 - MSCA-ITN-EID European Industrial Doctorates - €25 million • MSCA-ITN-2016 - MSCA-ITN-EJD European Joint Doctorates – €28 million • MSCA-ITN-2016 - MSCA-ITN-ETN European Training Networks – €322 million <p><u>2017 MSCA-ITN-2017 ⁴¹ – total €430 million</u></p> <ul style="list-style-type: none"> • MSCA-ITN-EJD European Joint Doctorates - €32 million • MSCA-ITN-ETN European Training Networks – €370 million • MSCA-ITN-EID European Industrial Doctorates – €28 million <p><u>2018 MSCA-ITN-2018 - total €442 million</u></p> <ul style="list-style-type: none"> • MSCA-ITN-ETN European Training Networks - €375 million • MSCA-ITN-EJD European Joint Doctorates - €35 million • MSCA-ITN-EID European Industrial Doctorates €32 million <p><u>2019 MSCA-ITN-2019 - total €470 million</u></p> <ul style="list-style-type: none"> • MSCA-ITN-ETN - €35 million • MSCA-ITN-EJD - €35 million • MSCA-ITN-EID €400 million <p><u>2020 MSCA-ITN-2020 - total - €525 million</u></p> <p>Note - indicative budget only (not yet disaggregated):</p> <p><u>Total projected budget for ISM over 5 annual calls within Horizon 2020 - €2,242 million</u></p>
MSCA Individual Fellowships (IF), H2020.	A Society and Enterprise panel within IF was introduced for the first time in 2016, with € 8 million for individual fellowships in companies or other organisations outside of academia.

⁴¹ <https://ec.europa.eu/research/participants/portal/.../en/.../calls/h2020-msca-itn-2017.html>

Scheme type	Funding in EUR (€)
MSCA RISE, H2020	<ul style="list-style-type: none"> • MSCA-RISE-2017 - €80 million • MSCA-RISE-2018 - €80 million • MSCA-RISE-2019 - €80 million • MSCA-RISE-2020 - €80 million • Data on the current ratio of staff exchanges that involve mobility between academia and non-academia suggests that an estimated ca. 40% of funding supports ISM.
Marie Skłodowska-Curie Actions COFUND, H2020	<p>Selected intersectoral mobility programmes receive co-funding for three to five years up to a total of €10 million for the co-funding of regional, national and international programme. These require PhD students to undertake a period of international mobility.</p> <p><u>2016 - MSCA-COFUND-2016 - total €80 million</u></p> <ul style="list-style-type: none"> • Fellowship programmes - €50 million • MSCA-COFUND-DP Doctoral programmes - €30 million <p><u>2017 - MSCA-COFUND-2017 - total €80 million</u></p> <ul style="list-style-type: none"> • MSCA-COFUND-FP Fellowship programmes €50 million • MSCA-COFUND-DP Doctoral programmes €30 million <p><u>2018 - MSCA-COFUND-2018 total €80 million</u></p> <ul style="list-style-type: none"> • Fellowship programmes - €50 million • MSCA-COFUND-DP Doctoral programmes - €30 million <p><u>2019 MSCA COFUND: Total: €90 million</u></p> <ul style="list-style-type: none"> • MSCA-COFUND 2019 - €35 million • MSCA-COFUND 2019: €55 million <p><u>MSCA-COFUND 2020</u></p> <p>Indicative budget only (not yet disaggregated): Total - €100 million</p> <p><u>Total budget for MSCA COFUND in the 2016-2021 period - €430 million</u></p>
SME Associate Pilot Scheme⁴²	<ul style="list-style-type: none"> • There has been one call in the WP 2016-2017 (INNOSUP-02-2016), for which the budget was increased from €7.20 million (2016 Budget) to around €8 Million • Call INNOSUP-02-2019-2020 (CSA): €4.00 million (2019 Budget) • Call INNOSUP-02-2019-2020-continued (CSA): €4.50 million (2020 Budget) • Total - €12.05 million
ISM schemes and industry-academic cooperation schemes under the European Structural and Investment Funds	<ul style="list-style-type: none"> • Estimated €100 million in the 2014-2020 period of which 50% co-financing <p>A detailed breakdown of the budget for ISM is provided in Annex F of funding schemes that promote ISM (only some are dedicated ISM schemes_. Although there is not always of disaggregated data on funding.</p> <ul style="list-style-type: none"> • Some data on total scheme funding was identified such as: <ul style="list-style-type: none"> ▪ Estonia, Smart Specialisation (growth) scholarships scheme, budget - €3 million, ERDF funded in the 2014-2020 period ▪ UK, Knowledge Economy Skills Scholarships (KESS 2), a major,

⁴² <https://ec.europa.eu/research/participants/portal/desktop/en/opportunities/h2020/topics/innosup-02-2016.html>

Scheme type	Funding in EUR (€)
	<p>ESF-funded European Convergence programme led by Bangor University on behalf of the Welsh higher education sector involving collaboration between all Welsh Universities. Budget - £36 million of which ESF accounts for £26 million (€29.12 million).</p> <ul style="list-style-type: none"> In the 2007-2013 period, we estimate that a similar level of expenditure was devoted to ISM, since there are several large
EIT Masters and PhD Programmes	<ul style="list-style-type: none"> No data available on expenditure on Masters and PhD courses with an ISM dimension.
Total	€3.1 billion (2014-2020)

As the table above shows, significant funding has been devoted to promoting ISM through the MSCA ITN in the 2014-2020 period with **€2.24 billion allocated** to support European Training Networks, Joint Doctorates and European Industrial Doctorates over the programming period. In addition, further resources have been available to foster academic-to-non-academic cooperation through other sub-actions within the MSCA including RISE, which provides secondments and staff exchanges and through the IF Fellowships. The data on the type of mobility being undertaken through RISE and IF points shows that there is a stronger emphasis on fostering intersectoral mobility in the 2014-2020 period than in the previous 2007-2013 period.

In relation to the funding of national, regional and international schemes through the MSCA CO-FUND, although significant resource is being invested (**€430 million** over the course of five annual calls for proposals), the average funding per scheme is significant. As an illustration, the Mobility for Growth scheme in Sweden received € 10 million co-funding from the MSCA and the CAROLINE scheme in Ireland received an EU contribution of €4.6 million. There is arguably a funding gap for smaller-scale schemes and / or for schemes that are unable to operate internationally.

A significant proportion of funding to strengthen ISM has been allocated to the MSCA ITN (76.0% of the total). This raises questions about the sustainability of formal ISM schemes without continued EU support, and the need for stronger attention to fostering ISM by national policy makers and funders.

Overall, according to our analysis, an estimated **€3.1 billion** in EU funding will be spent on ISM in the current 2014-2020 period (which excludes data on the EIT Masters and PhD courses where no data was available). Whilst this is a significant amount, it should be seen against the context of the overall scale of the Horizon 2020 programme (the budget in current prices is nearly €80 billion and in constant prices €70.2 billion). According to the EU Regulation establishing Horizon 2020⁴³, the MSCA budget (which is €6.162bn over the 2014-2020 period) overall makes up just under 8% of total H2020 funding (€77.03 billion). Considering that ISM projects only make up a share of the overall MSCA programme, it might be estimated that out of the overall H2020 budget, 2-3% is dedicated specifically to ISM.

The high level of EU expenditure on ISM contrasts with how little investment in ISM is being made in most countries in domestic schemes by national and regional governments and by the private sector, despite the benefits and outcomes generated through participation in ISM (see Section 2.5). This is perhaps all the more surprising given that previous studies have found that ISM works most effectively at a localised level where it may be easier to foster sustainable collaborative relationships between academia and industry.

⁴³ REGULATION (EU) No 1291/2013 of 11 December 2013 establishing Horizon 2020 - the Framework Programme for Research and Innovation (2014-2020)

2.3. Key characteristics of national, EU-level and international ISM schemes

2.3.1. Common characteristics of ISM schemes

RQ8 – Are there any common characteristics of ISM schemes? Is there a common set of core values followed by most schemes?

The main characteristics and differences between ISM schemes - are now described, taking into account the typology described in Section 2.1. Among the different characteristics considered are:

- Whether the scheme is mainly focused on ISM, or whether this is a subsidiary element of a broader scheme. An ISM experience may be either an optional or a compulsory component within a given scheme targeting PhD students or post-doctoral researchers;
- The geographic focus, namely the fact that most schemes are domestic, although some schemes also involve international researcher mobility;
- Differences in the mobility period's duration and as to how a mobility aspect is incorporated. Whereas some ISM schemes offer a placement or internship for a fixed period (e.g. commonly 3-12 months), others involve the researcher undertaking their whole PhD within industry (e.g. industrial PhDs) or within the public sector (public sector PhD schemes);
- Variations in the direction of ISM schemes e.g. from academia to industry and from industry back to academia and as to whether there is scope for bi-directional mobility;
- Differences in the target group in terms of the various stages of researchers' and academics' careers and as to whether there is scope for bi-directional mobility; and
- Variations in the costs of ISM schemes and in the level of resources available across different countries.

First of all, the **level of involvement in ISM** differs greatly between ISM schemes. The size and scope of ISM schemes vary greatly. Some schemes involve multi-million EUR funding allocations annually and involve relatively large numbers of researchers. More commonly, however, many researcher fellowship schemes that promote or at least allow scope for ISM, are much smaller in scale, reflecting the focus on rewarding research excellence but also the high costs involved in running many fellowship schemes. This does depend however on the type of scheme, since internship and secondment schemes where there are companies willing to host researchers are a lot cheaper to run than fellowship schemes that support a specific research project for 12-24 months.

In terms of the **numbers of researchers involved**, the many PhD graduates establishing careers outside academia generate the largest group of intersectorally-mobile researchers – many out of choice, many more out of necessity since the number of academic positions is limited. Although some such researchers may find a position in industry through participation in an ISM scheme, more commonly, they simply apply for jobs directly, either because they are keen to work in industry, or due to the over-supply of post-doctoral researchers in some EU countries.

Not surprisingly, the most widespread ISM-schemes aim at *preparing* the younger generation of PhD graduates for careers outside academia and *enabling* the transition to non-academic sectors, such as the researcher development work done by Vitae in the UK. In research environments where ISM is more embedded, the level of involvements steps up to *promoting and rewarding* ISM experience. However, not all schemes are designed as a pathway to a career in industry, some schemes only involve quite a short period of mobility – commonly 3-6 months, and are designed to broaden researchers' horizons and to give them exposure to working in different types of research environments. In other words, some HEIs and research institutes expect many of their researchers to return to an academic environment, but to benefit from the experience.

Secondly, the focus of ISM schemes varies between integrating ISM as an **optional component, versus ISM as a compulsory component**. Some innovative training networks (ITN's) funded through MSCA, for example, may provide opportunities for PhD researchers to spend some research time in industry, while other ITN's will embed such an internship as a compulsory component in every PhD researcher's personal development plan. This is also reflected in the *design and structuring of national schemes*. Whereas some schemes are explicitly designed to facilitate intersectoral mobility experiences, other programmes were found to offer researcher

mobility domestically and / or internationally, but to have recently open up their schemes to the possibility that ISM is one mode of undertaking researcher mobility, among others. This might be as simple as changing the eligibility criteria for applicant organisations to include a wider range of organisations, such as from non-academic institutions, government, private research organisations, industry and the third sector.

Thirdly, in terms of their **geographic focus**, whereas many researcher mobility schemes that involve HEI to HEI mobility are international in nature, many schemes with a strong ISM focus tend to be domestic schemes, and may be organised either at a national level or more commonly, on a localised level by individual universities and research institutes.

Fourthly, the ISM schemes can be distinguished in terms of their **duration**. The more embedded in the research system, the more *long-term* the initiative. Some schemes start out as pilots with *project-based* funding on a short-term basis or as a one-off initiative by a dedicated individual, but may become further integrated in the research system if and when successful. Some schemes may be long-term in themselves such as the Baekeland dual industry-academia PhD programme in Flanders, but consist of a series of calls for project-based collaborative PhD research.

A fifth characteristic defines the **direction of ISM** i.e. whether intersectoral mobility takes place on a bi-directional basis or only in one direction, for instance, from academia to industry. Ideally, the research system in a knowledge economy promotes exchanges *from academia to industry* and *from industry back to academia*, but in practice many of the initiatives and schemes focus on one direction only. For example, the Norwegian Professor II scheme invites industry experts into academia with part-time positions, while also in Norway and in France, the Elkem Technical Trainee Programme invites PhD researchers into their company as trainees with a view to potential recruit them on a contract basis.

Sixthly, some ISM schemes are open to all sectors and disciplines, or actively encourage a multidisciplinary approach, whereas others will have thematic disciplinary **restrictions**. Generally, for schemes funded by private companies, the target group will more often be restricted to the discipline and sector relevant for the company, while if supported by public funds, the schemes will more often be open to a wider range of disciplines and/or involve a wider range of employment sectors (not only industry but also the non-profit and public sector).

The seventh characteristic maps the **target group** on a different axis and makes a distinction between the various **stages of the research career**. Many ISM schemes focus on the direction from academia to industry, target researchers at R1 or R2 level. At the early stage of their career, their return-on-investment is more long-term for industry. ISM schemes focusing on bringing industry experience into academia, more often welcome a higher level of seniority. Such schemes tend to address R3 or R4 level researchers.

The **type of resources** available to support ISM schemes is a final key characteristic. Some schemes rely purely on an exchange of expertise and goodwill, such as mentoring schemes preparing early-career researchers for a career outside academia. Other schemes involve a modification in regulations at no cost, such as a change in PhD grant regulations facilitating internships, or a change in job description such as spending part of one's research time engaging with other sectors. It was found to be common for many universities to provide in-kind support to help implement ISM schemes, by making human resources and administrative support available, and by providing access for free to research infrastructures. Finally, many schemes rely on some form of financial support as means to lower the threshold for participation and other barriers.

2.3.2. *Typical duration of a mobility period*

RQ9 - How much time is being spent by researchers in the non-academic host institution during the mobility period?

The amount of time that researchers typically spend in a non-academic host institution during the mobility period varies between ISM schemes. This depends on the nature of mobility being undertaken, and a distinction can be made between:

- **Permanent intersectoral mobility** from academia to industry, government or the third sector or vice versa, either a job offer resulting from participation in a formal scheme (e.g. the Bank of Italy's Fellowship Scheme for PhD researchers) or taking place outside of schemes (e.g. the researcher applies for a job in the private sector).

- **Temporary intersectoral mobility** – a mobility experience either taking place through a formal scheme (e.g. a placement, an internship of 3-12 months duration) or organised informally.
- **Partial intersectoral mobility** - the practice of combining work in more than one sector simultaneously, without the intention of making a permanent move. An example is the KESSII scheme in Wales where those participating mainly remain in a university environment but go one day a week to work in an SME.
- **Multiple intersectoral mobility experiences** - some researchers' careers has involved multiple periods of mobility between different sectors. This has tended to take place between similar professional fields, e.g. between academia, government departments and research organisations in related fields.

There is a clear distinction between temporary ISM whereby the researcher will undertake a mobility experience, such as a placement, secondment or internship between sectors of between 3 and 12 months duration and a situation in which a PhD student decides to embark upon an industrial PhD which requires a three or four year PhD programme. There is also the situation of permanent mobility described above whereby the researcher moves to a non-academic institution permanently. Such mobility often takes place informally, since most ISM schemes are not explicitly designed to promote permanent mobility, although this happen in practice (i.e. when a firm decides to make a job offer to an intersectorally-mobile researcher).

2.3.3. Implementation arrangements

In this section, we examine how schemes are implemented, from the set-up and design stage through to implementation. Scheme monitoring and outcomes are addressed in Section 2.5 (outcomes from participation in ISM schemes).

2.3.3.1. Operating arrangements for individual ISM schemes

In this section, examples of common operating arrangements for individual ISM schemes are outlined. Most schemes analysed entailed some type of mobility, with Physical Mobility (during the entire period or partially) being the most common. The majority of schemes promoted in each country are national (domestic), especially in the bigger countries. The transnational schemes tend to happen usually in the smaller countries. This is a result of the diversity of stakeholders in countries with large dimension. In many EU-13 Member States in Central and Eastern and in Southern Europe, there was a lack of nationally financed schemes, and many schemes with an ISM dimension are either EU level schemes, or national schemes but EU co-financed i.e. schemes funded through the ERDF and ESF.

Half of the schemes were launched in the last ten years (since 2007), whereas for the remainder of the schemes, there was often no information on when the scheme started, and whether it has already ended. The mapping database also contains many examples of ISM schemes that either recently ended or have only recently commenced. In many cases, the database also contains examples of predecessor and follow-ups schemes. This is the case for instance of **Estonia** (see entries for the ESF-funded Dora programme which operated from 2008-2015 and the follow-up new programme which is ERDF-financed, the Smart Specialisation (growth) scholarships scheme, which will operate from 2016-2022). A further example of a scheme where one programme has evolved into a new generation programmes was identified in **Switzerland** (see entries for the Advanced Post.Doc Mobility Scheme operated by the Swiss National Science Foundation (SNSF), which is being replaced from 2018 by the Postdoc.Mobility fellowships scheme launched in November 2017).

From a broader perspective, funding and policy support on ISM in several countries (e.g. BE, BL, GR, LV, HU, CZ and HR) is underpinned by the goal of strengthening links between fundamental scientific research in HEI and experimental research in enterprises, helping industrial research and experimental development to become more fruitful while systematically building-up research capacity and the quality of the research itself. Governments and regional authorities aim to establish a research infrastructure at national/regional level upholding the strategy for targeting specific areas in their countries, priorities widely identified in their National strategies and plans on R&I policies. Some ISM schemes have resulted from efforts to strengthen smart specialization strategies which have been developed in each country benefiting from ESIFs in 2014-2020. ISM schemes in some countries have been explicitly designed to support the implementation of smart specialization strategies (e.g. Estonia).

Other ISM schemes are pursuing more general objectives of promoting /intensifying networking between the institutions involved; improving/increasing the number of linkages between academia and industry and motivating universities to become more open and responsive to the research needs of industry. Some schemes were created to help raise the level and market orientation of the research activities of scientific organisations.

2.3.3.2. The design of ISM schemes

Many ISM schemes identified were designed in a way that responds to companies' market and research needs as one of their key priorities. PhD candidates will often carry out their research in collaboration with industry partners having had the opportunity to incorporate a period of intersectoral mobility into their PhD research. Many examples were identified of ISM schemes where PhD students have the opportunity to work in an industry setting within an enterprise for a **short internship, placement or secondment**. The duration of company placements was however found to vary, with the most common duration of a mobility period being 3-6 months but 12-18 months also being relatively common.

In a limited number of cases, young researchers studying for a PhD are able to carry out their entire 3-4 years PhD within industry, but receive formal training and supervisory support from a university or research institute. For example, in **Estonia**, the DoRa Programme which operated from 2008-2015, requires participants to have an employment contract with a company for the full duration of their PhD and to carry out research in an industry setting. Further details about this scheme, which was examined in detail as the scheme in focus for the case study on mobility between academia and industry, is now provided (see case study 1 for the full case study):

Table 1.15 – Summary of Case Study 1 on Mobility between Academia and Industry

Description and objectives: The ESF-funded Doctoral Studies and Internationalisation Programme "DoRa" Programme in Estonia supported intersectoral mobility through one of seven activities. Activity 3 - Training doctoral students in cooperation with businesses – is an industrial PhD scheme. The objectives of the ISM component within DoRa (Activity 3 - Training doctoral students in cooperation with businesses) are to:

1. Assist innovative companies that are successfully applying research results, and integrating technologies into the design of their services and products by funding the creation of doctoral student places.
2. Make it possible for universities to train doctoral students in cooperation with businesses. Such partnerships will help to link research with practical problem-solving and to ensure that research results will find practical applications.

Scheme characteristics (e.g. where does mobility take place, the duration of mobility): The scheme lasts for the 4 year duration of fully-fledged PhD studies. The industrial PhD is industry-based with researchers spending the majority of their time in a company environment and only limited time in taught courses spent at an Estonian university. However, in addition, there is a 5 month international mobility requirement (which does not have to be intersectoral).

Target group: The scheme is targeted at PhD student researchers. There was a strong sectoral focus to the DoRa scheme (replicated in the follow-up successor programme in 2014-2020 to promote Smart Specialisation, although the latter is ERDF rather than ESF-funded). The six priority areas targeted were: ICT and health, biotech, energy, materials technology and environmental technology.

Eligibility criteria:

- Applicants must be employed in an Estonian enterprise for the 4-year duration of their PhD and must be in the process of applying to become a doctoral student.
- Partner universities must find a suitable partner in industry and assume responsibility for the quality and progress of their studies.
- The business where the researcher carries out their industrial PhD must have a reasonable prospect of still being operational in 4 years. It must therefore already have been established

for >3 years, and employ >11 people.

- PhD students are required to work in one of the six priority sectors identified and researchers must have an employment contract from a company throughout the 4 year duration of their PhD studies.

Scheme management: The scheme is being managed by the Archimedes Foundation Education Agency.

Funding sources and funding arrangements: Funded by the Estonian Ministry of Education and Research, which administers the ESF in Estonia. DoRa was supported through the European Social fund (ESF), which funded the Operational Programme for Human Resource Development 2007-2013, with national co-funding support. Funding covers the student's tuition fees, a monthly stipend and the remuneration of the student's company supervisor. Supported doctoral student places will be funded on the same terms that apply in relation to doctoral studies under the funding scheme established in Estonia in relation to government-funded provision of higher education. Successful applicants receive a double scholarship, consisting of both the DoRa scholarship and the equivalent amount they would otherwise have received if they had applied under the national PhD scholarship programme.

Outcomes: Some output data was available on the scheme. 52 new PhD places were created but only 11 successfully graduated from the PhD scheme, since a problem was identified in relation to the lack of flexibility in extending the timing of ESF funding beyond the envisaged four year duration. 47 different enterprises took part in the scheme. However, there was a lack of data on scheme outcomes in terms of the longer-term impacts on enhancing researchers' careers and strengthening their employability.

Evaluation and monitoring: An independent programme evaluation took place in 2016. Among the weaknesses are that 50% of respondents would have taken up a nationally-funded PhD anyway. The main reasons they took it up was that researchers applied for the scheme as they were already working in an enterprise but wanted to combine work and study in parallel. Participants perceived that in addition to the benefits of received additional funding through a double scholarship, more opportunities would open up from their PhD as a result of taking part in DoRa due to the 5 month international mobility component.

A further evaluation finding was that universities and industry differ in terms of their expectations from taking part in the scheme. Universities were mainly interested in what new funding the scheme could bring which would enable them to deliver taught short courses to industrial PhDs. Industry was more interested in the potentially useful research outcomes from their employees undertaking PhD level research whilst remaining at the enterprise.

Good practices:

- The scheme combines elements of international and intersectoral mobility, since all PhD students are guaranteed the opportunity to study abroad for a minimum of 5 months.
- The importance of incorporating flexibility into scheme design.
- The advantages of aligning sectoral eligibility criteria to meet the national economy's needs in small countries (e.g. tying in eligible research topics to national priority sectors).

Lessons learned:

The scheme was found to have been successful overall, but there are ways in which it could have been improved. The main lessons were to:

- Keep the eligibility rules as simple as possible.
- Ensure that the scheme is designed and implemented in as flexible a way as possible and avoid setting overly prescriptive rules at the design stage.
- Putting in place a more explicit targeting strategy to attract companies to participate that have not previously participated in EU funding schemes or cooperated with universities before.
- Recognise that different stakeholders take part in ISM schemes for different reasons.

Signposting to sources of further information: Brochure regarding the doctoral studies and internationalisation programme DoRa

www.ut.ee/sites/default/files/www_ut/oppimine/dora_eng_2010.pdf

Other schemes adhere to a similar model, although participants may not necessarily spend their entire PhD in industry, but a large part of it e.g. the Industry Doctorate Programme of the Government of Catalonia (Spain), the Industrial Ph.D. Scheme (NAERINGSPHD in Norway), and the Industrial PhD Programme (Industrienahe Dissertationen) in Austria.

On the other hand, the development of innovation abilities of staff in non-academic institutions (private and public sectors) is a relevant issue for several schemes. The main outcomes are to promote research-based ideas, wide knowledge and technology transfer and underpin collaboration between institutions of higher education, business and society.

According to the current study, many schemes are designed to support companies without R&D departments (mainly SMEs), we conclude that this is result of national/regional strategies.

A further feature of ISM schemes that was identified is that several EU countries such as **Denmark, Greece** and the **Netherlands** offer Industrial doctorates (industrial PhDs) in several disciplines, mainly in engineering but also in other subjects, such as Preservation of Cultural Heritage and the Tackling of Societal Challenges or Psychology.

The ISMs are planned to put doctorates, researchers, PhD students in real life working situations, facing problems to bring their knowledge to the companies while addressing challenges and endorsing solutions. Normally researchers are integrated in research teams with senior scientific surveillance.

A considerable number of schemes intend to support open innovation associated with entrepreneurship being managed by universities. These are focused on specific research topics and in supporting start-ups. They are complemented with efforts to attract industry stakeholders and entrepreneurs in order to contribute to the economic and technological development.

A few schemes pursue the strategy of attracting talented researchers from other EU and non-EU countries, experts (seniors), internationally acclaimed scientists and highly-talented young researchers. A higher number of schemes promote the displacement of researchers abroad.

Most ISM schemes have a key goal: boost the labour market and help career development. This is carried by promoting highly skilled sustainable jobs for researchers at companies, helping their integration in the labour market and some schemes have the objective of finding and training future leaders for their companies; some have a development plan of the skills of young scientists/researchers to increase their scientific capacity and ensure better their careers in scientific institutions and companies in future.

The devising of some schemes was directly influenced by the recent crisis, September 2008, with objectives of developing the economies of the countries and reinforcing specific sectors where they can become important players based on technology transfer from scientific research results leading to benefits for the companies leading to economic growth. The competitiveness of dynamic sectors of the economy will stimulate productive activity at regional and national level.

In general, the schemes entail basic research, applied research, experimental development and industrial research. The main fields associated with the above stated are ICT and health, biotech, energy, materials, technology, industry and environmental technology. Although areas such as social sciences, economics, cultural heritage and tackling of societal challenges such as environment, clean energy and health are under some of the schemes scrutinized. Support for the entry of women and young researchers in R&D projects for industrial research were two drivers in the definition of some schemes.

Most support for ISM promotes cooperation between R&D institutions and companies, so as to diversify the career prospects of PhD graduates and to contribute to capacity-building in research-

intensive industry sectors. Preference is given to applicants conducting their doctoral research that is responsive to industry needs, addressing the practical problems of specific sector/company or contribute directly to implementation of research findings in everyday industry practice (industrial PhD).

The importance of ensuring that schemes are designed in a flexible way was also emphasised. In Sweden, VINNOVA considers flexibility to be key to attracting applicants, for instance setting only broad eligibility criteria – in terms of content, not quality – and encouraging the applicant mobility researcher to customise the details of their mobility period in a collaboration agreement signed with the host institution. In VINNOVA's opinion, this helps to ensure that collaborative relationships are sustainable.

The UK's Royal Society has also adopted a flexible approach to scheme design and implementing arrangements to overcome difficulties in persuading SMEs to take part in the scheme as full industrial partners, since this meant making a major commitment to supporting a researcher during a scheme of 2-4 years. Accordingly, new pilot schemes of shorter duration are being designed to run in parallel with the main Industrial Fellowship scheme to ensure the necessary flexibility that SMEs need to be able to actively participate in future.

Although flexibility can clearly be argued to be a key element in programme design, on the other hand, looser rules and less standardised monitoring reports create challenges in measuring outcomes on a consistent basis across ISM schemes.

2.3.3.3. Intersectoral mobility and internationalisation

Whereas there are a large number of international researcher mobility programmes and schemes, intersectoral mobility schemes are primarily domestic in focus. However, the scheme mapping did identify a small number of bi-lateral international schemes, and a number of joint mobility schemes between Europe and Asia, and between Canada and Asia.

Some EU-funded cross-border schemes are outside of the MSCA. For example, the **MANUNET III scheme** is funded under the EU-funded ERA-LEARN scheme. Among the participants are the Spanish lead coordinator (Agencia Vasca of Euskal Agentzia Innovacion-Berrikuntzaren - INNOBASQUE) and in Romania, UEFISCDI (Executive Unit for Financing Higher Education, Research, Development and Innovation). The objective is to encourage transnational R&D projects oriented to improve manufacturing processes and higher-risk applied research that demonstrates a market orientation, the active participation of enterprises, the implementation and practical use of production-oriented new technologies and added value through transnational cooperation. Since the scheme is EU funded, it is aligned with European priorities relating to promoting smart and sustainable growth in the European manufacturing sector by coordinating R&I efforts in the field of advanced manufacturing with a focus in the key areas of new production processes, adaptive manufacturing systems and technologies for the factory of the future.

Funded research projects must show a high degree of innovation and scientific and technical risk. The target groups include representatives from universities and research centres engaged in knowledge transfer towards industry. Whilst the scheme is not only dedicated to ISM, it does provide scope for individual researchers to engage in mobility to industry.

There has been a bi-lateral scheme between **China-Canada** since 2005 in the area of health research, the CIHR China-Canada Joint Health Research Initiative. The aim is to promote the development of Canadian-Chinese scientific co-operation between universities, hospitals, research institutes or affiliated research organizations in Canada and China through the support of collaborative research grants.

There are many **bilateral mobility programmes for researchers generally**, but these often only involve academia-to-academia mobility. For example, **Norway** has many bilateral schemes that involve HEI-to-HEI mobility of researchers but which do not involve ISM (e.g. DAADppp mobility programme between Germany-Norway and the Aurora mobility programme France-Norway). However, there are also bilateral schemes that *do* involve intersectoral mobility. For instance, the French Norwegian Foundation promotes French/Norwegian cooperation by financing joint R&D projects in which both industry and research institutes/universities are involved with the aim of fostering sustainable cooperation. The Research Council of Norway operates the Japan-Norway Researcher mobility programme, some aspects of which involve ISM since researchers may undertake research projects not only within a university setting, but is open to mobility experiences

across a wide range of **non-academic research contexts centres of excellence, museums and independent research institutes.**

In addition, there are also examples of ISM schemes where there is an international mobility component. For instance, in **Singapore**, whilst the A*STAR Graduate Academy (A*GA) is primarily a national scheme, it has established joint cooperation arrangements, for example with Karolinska Institutet in Sweden who have been collaborative partners for more than a decade with collaboration in the field of genetic epidemiology especially active. All AGS awardees will gain exposure to industry R&D and will have opportunities for an overseas attachment of up to 12 months during the course of their studies. Upon graduation, awardees are eligible to apply for a further 2-year post-doctoral fellowship to further their research training at a top overseas university or research laboratory. They also undertaken industry placements.

Feedback from interviews has demonstrated that cross-border aspects of ISM have low salience for respondents who are only involved in national schemes, or for those respondents who operate as multinational organisations. Among those interviewees who could comment on the differences between national and cross-border mobility schemes, the following feedback was offered:

- International and cross-border ISM schemes (including EU financed schemes) may represent a risk of a brain-drain for the country of origin of researchers that are experiencing net outflows of researchers;
- Cross-border ISM schemes are perceived as more complex on the one hand, as they may require universities to form a consortium and/ or to establish cooperation agreements, but at the same time they are more attractive in terms of the size of funding, especially where funding is from EU sources (e.g. ITN and COFUND within MSCA Actions);

2.3.3.4. The internationalisation of research – macro-level linkages to intersectoral mobility

Whereas this study focuses on intersectoral mobility, there are broader issues pertaining to the internationalisation of research that impact on the capacity of different countries to be able to provide intersectoral mobility opportunities.

The added value of collaborating internationally in research is becoming increasingly apparent and the internationalisation of research is growing. According to research supported by the publisher Elsevier "*numerous studies have shown that research outputs that represent collaborations – particularly international collaboration – have a higher citation impact than those that do not*".⁴⁴ International collaboration can also foster the development of technological capabilities and innovations.⁴⁵ Globally, inter-country collaboration rates stood at 17% in 2011 (up from 14% in 2003).⁴⁶ The Elsevier report suggests that in 'both Europe and the US, there is a tendency for inter-institutional collaboration to increase at the expense of single author and single institution publications'⁴⁷ and on average (across disciplines). The nature of research collaboration is also changing, from a bilateral or multi-lateral approach which often tended to exclusively focus on the research community and on mobility from middle- and low-income countries to high-income countries, to international collaboration including cooperation among research funders.⁴⁸

A Commission Expert Group published an overview of EU internationalisation strategies for cooperation in Science, Technology and Innovation in 2012. This makes clear that

⁴⁴ See Comparative Benchmarking of European and US Research Collaboration and Researcher Mobility: A report prepared in collaboration between Science Europe and Elsevier's SciVal Analytics, September 2013.

⁴⁵ Penner-Hahn and Shaver (2004) Does international research and development increase patent output? An analysis of Japanese pharmaceutical firms. Strategic Management Journal. Volume 26, Issue 2, pages 121–140, February 2005

⁴⁶ Comparative Benchmarking of European and US Research Collaboration and Researcher Mobility: A report prepared in collaboration between Science Europe and Elsevier's SciVal Analytics, September 2013

⁴⁷ Comparative Benchmarking of European and US Research Collaboration and Researcher Mobility: A report prepared in collaboration between Science Europe and Elsevier's SciVal Analytics, September 2013

⁴⁸ Jacob Background document Research funding instruments and modalities: Implication for developing countries Draft report Research Policy Institute Lund University Sweden

internationalisation of R&I is a long-standing priority at EU level – defining internationalisation as both inward (attracting international talent) and outward (collaborating internationally – within and beyond the EU and AC). Although the EU-28 prioritises internationalisation too, capacity – and planning – for internationalisation at national level varies. This is partly a result of the concern that “economic and budgetary crisis in many European countries are increasingly resulting in a stagnation or even reduction of public spending on research, innovation and education in Europe at the same time as it undermines Europe’s ability to attract global talent and corporate STI investments.”⁴⁹

The EC’s Expert Group report calls for a strategic approach to internationalisation and international cooperation, involving both the Member States as well as Associated Countries. It also points to the Framework Programme’s unique position in promoting internationalisation and calls for the FPs (Horizon 2020) to be used to shape cooperation with other parts of the world.⁵⁰

Internationalisation and international collaboration in research not only enhances intellectual and cultural diversity, but also allows countries’ national research systems to specialise in that they do best. One of the most significant developments in research funding is the increased importance and means of international collaboration.⁵¹ It is generally argued that the **pooling of resources** is the most efficient way of solving common challenges. That said, research and research management is a key national policy. In 2011, 85% of publicly-funded research in the EU was undertaken at national level with the remaining 15% coordinated either through intergovernmental organisations or spent jointly through the FPs.⁵² There are however other perspectives on this issue.^{53, 54}

There are other methods of promoting internationalisation such as encouraging the mobility of researchers. According to the 2014 ERA Progress Report, just under one-third (31%) of EU researchers (post-PhD) have worked abroad within or outside of Europe, “as researchers for more than three months at least once during the last decade.”⁵⁵ Although difficulties can arise when working abroad, international mobility is largely considered to be a positive factor in developing new research skills:

The participation of individual researchers (and associated research teams) in grant schemes such as the ERC, MSCA are important for the internationalisation of research and for the mobility and exchange of knowledge. However, although the grants schemes primarily facilitate the mobility of individuals and small teams (e.g. ERC grants support a Principal Investigator and team), they are important for the host institutions as grant holders often attract further funding and open up opportunities and access to wider networks of excellence.

⁴⁹ DG Research and Innovation (2012) International Cooperation in Science, Technology and Innovation: Strategies for a Changing World: Report of the Expert Group established to support the further development of an EU international STI cooperation strategy

⁵⁰ DG Research and Innovation (2012) International Cooperation in Science, Technology and Innovation: Strategies for a Changing World: Report of the Expert Group established to support the further development of an EU international STI cooperation strategy

⁵¹ Jacob Background document Research funding instruments and modalities: Implication for developing countries Draft report Research Policy Institute Lund University Sweden

⁵² LERU. Advice Paper No.9, ‘The European Research Area: Priorities for Research Universities’, December 2011. LERU response to the European Commission Consultation: “The European Research Area Framework, Untapped areas of potential”

⁵³ Science Europe Position Statement On the Role and Future of Joint Programming August 2015

⁵⁴ A recent Science Europe Opinion Paper argues that European figures underestimate the real level of research co-ordination in Europe. The paper argues that the data are misleading as they include university and research institutional block spending as ‘funding which risks fragmentation of resources’. This disregards the possible use of these funds as a strategic part of collaborative efforts at institutional level. Science Europe’s analysis leads to the conclusion that fragmentation is not a widespread issue. On the contrary, the analysis finds several reasons for supporting multiple research teams, including the importance of reproducibility of research results, the role of competition between research teams, and the importance of local knowledge networks and the need for place-specific research.

⁵⁵ ERA Progress Report 2014

However, international collaboration in research is a broad concept as the type and length of interaction varies according to the specific sciences and actors involved. Some research fields or disciplines, such as medicine or physics, are **more used to collaborating on a cross-sectoral basis than others**.

Only a few non-EU funded schemes were found to **combine international researcher mobility with intersectoral mobility**. Most of these related to bilateral or multilateral cooperation programmes, for example, bilateral programmes between Canada and China, Japan and the US, Japan and Switzerland and Japan and India.

An example of a transnational FP-funded scheme is the **Dual Career and Qualification in Sports (AMID) project**, coordinated by the University of Salzburg. The scheme is innovative since it has created a network through which practices can be exchanged and it has identified the most cost-effective measures to support Dual Career and transnational exchanges, and guidelines have been developed as to how to implement such measures. The project has a transnational character and is closely linked to European initiatives (EAS, www.dualcareer.eu). The most innovative aspect of the project is its multidisciplinary character and the holistic understanding of Dual Career, especially in winter sports. Another innovative aspect of AMID is the cooperation between academic organisations and non-academic associations from the fields of sports and Dual Career services.

2.3.3.5. Management and partnership arrangements and analysis of implementers of ISM schemes

Among the questions examined are:

- What types of management and partnership arrangements have been put in place in order to manage the implementation of ISM schemes?
- What was the role of each partner in the design/planning phase?
- Which institutions were involved in the implementation of the scheme?
- What role have different partners involved in management played in ensuring that an appropriate evaluation and monitoring framework is put in place in respect of ISM schemes?

The variety of ISM schemes comes with a variety of responsible organisations for such schemes. Generally, typologies can be differentiated according to the nature of the organization implementing the scheme.

Research & Innovation Agencies tend to fund the broadest schemes, not specifying any particular sector, often targeting mobility towards industry but in quite a number of cases also including the non-profit or public sector. The majority of their ISM schemes target early-stage researchers through the form of Industrial PhDs or industry internships. In order for such schemes to be successful, academic and non-academic partners must be involved in the planning and implementation phase. Without awareness-raising campaigns supporting ISM schemes, they risk being unknown or unpopular.

Higher Education Institutions tend to focus their initiatives on two elements: firstly, the preparation for ISM through doctoral schools training modules or development programmes, sometimes in collaboration with non-academic partners: soft skills training, employability training, IPR training, project management, etc. In addition, many HEI's invest in long-term collaboration, sustainable partnerships, trust and regional networks, which creates an environment in which ISM can thrive and become the norm rather than exception. Co-location initiatives, for example, bringing academic and industry labs together on the same campus in order to maximize 'random' intersectoral mobility. (Take, for example, the Cambridge Science Park in the UK, the Vikki Science Park for biosciences in Helsinki, or the AREA Science Park in Trieste.) **RTO's and Research Institutes** share the HEI's focus on long-term collaboration and develop similar initiatives. With the exception of a few reports, HEI's tend to be quite autonomous when taking new initiatives. Many out-of-the-box examples develop bottom-up, are monitored informally, and involve minimal cost, such as for example mentoring schemes with non-academic mentors (Ghent University) or internships on a demand-driven or needs-driven basis.

Industry takes responsibility and/or initiative in quite a number of industrial PhD schemes (co-funding research costs, providing a supervisor/mentor) and internship programmes, the latter quite often is a convenient shortcut to recruitment in competitive fields. These schemes are an investment in new knowledge and skills for the company's own benefit, to increase their own levels

of innovation. Also, the actual recruitment of PhD graduates into industry, the public sector and the private-non-profit sector must be regarded with this purpose in mind.

A limited number of **private research foundations or charitable foundations** fund intersectoral mobility schemes from a philanthropic motivation: their support contributes to overall levels of innovation or generates a broader social impact without direct return-on-investment to the funder. Notable illustrations are the Europe and Global Challenges Scheme of the Volkswagen Foundation and the Secondment Fellowships of the Wellcome Trust.

Last but not least, **governments** play a crucial role in enabling or supporting the schemes through tax incentives or co-funding. Examples were found of governments co-funding ISM schemes directly with the help of European Structural Funds or Regional Development Funds (Slovenia), and of co-funding PhD/postdoc employment contracts in industry through tax incentives (France, Belgium).

Mechanisms for implementing ISM through partnerships and between academic and non-academic organisations to facilitate ISM

Partnership arrangements for ISMs can be summarised according to the following classifications: bi-lateral partnerships (between two countries); partnerships between governmental agencies and universities; government/industry/university partnerships; and industry-university partnerships. Below are several examples that serve as illustrations.

Bilateral: The Greek-German bilateral research and development and innovation cooperation programme is managed by the General Secretariat for Research and Technology (GSRT) of the Ministry of Education, Research and Religious Affairs of the Hellenic Republic, and the German Federal Ministry of Education and Research. The programme supports research collaboration in innovative areas of research involving research or higher education institution and commercial companies from both countries. Although it does not presently involve intersectoral mobility consideration is being given to allowing such mobility in future.

National/regional agency-university partnership: The Catalan Industrial Doctorates is a partnership initiative between the Government of Catalonia and the Catalan University. The initiative aims to strengthen the competitiveness of Catalan industry through the retention of regional cadres and the attraction of international talent.

The Lithuanian “Innovative business promotion” (INOVEKS) project was established with the aim of helping students and young researchers to establish new companies. The project was implemented by the Lithuanian Agency for Science, Innovation and Technology (MITA) in partnership with several universities.

Government/industry/university partnership: MIC Malta is a partnership between Microsoft, the government of Malta and the University of Malta, which provides support for start-ups in terms of training courses as well as access to facilities and software/hardware.

Industry-university partnership: A range of partnerships between Hungarian universities and companies such as Ericsson Hungary, Nokia Siemens Networks Hungary, CISCO, Telekom Hungary, Mercedes-Benz Hungary Ltd. and KnorrBremse Ltd, has led to a number of initiatives aimed at integrating industrial experience in the curriculum.

Strategic Partnership between German Karlsruhe Institute of Technology (KIT) and SAP University Alliance (SAP global programme) is an initiative aimed at developing cutting-edge approaches to teaching in a range of subjects such as energy networks, autonomous driving, big data, etc., as well as cooperating in entrepreneurship activities and research.

The Italian PhD Talents project is managed by the Conference of Italian University Rectors (CRUI) in partnership with Confindustria (Italian organisation representing the country’s main industries). The project seeks to facilitate cooperation between universities and private sector companies, by supporting industry placements of PhD students in innovative projects.

Are co-location and dual-learning approaches the only options for researcher mobility? Or could the exchange of knowledge and know-how between researchers in the university sector / publicly funded research and industry also take place without physical mobility (i.e. through outreach, clustering etc.)?

There are two dimensions to these questions: a narrow dimension concerning the exchange of knowledge and know-how between researchers and industry, and a broader dimension regarding the multi-faceted nature of aims and expected outcomes of intersectoral mobility schemes. When respondents narrowly engaged with the question of the exchange of know-how, they maintained the opinion that physical mobility is not necessary. However, when respondents approached the question of co-location and dual-learning approaches as components of researcher mobility in its broadest sense, the dominant opinion emerged that physical mobility is very important, in some cases essential and beneficial in several respects.

Some respondents maintain that physical mobility is a must and that ISM schemes they are involved in specify physical mobility as a condition of participation in the scheme. One of the reasons behind a prerequisite nature of physical mobility is the need to bridge the skills gap between the education received by students and the needs of employers. An example was given of a scheme of mobility from academia to industry that was initially launched without any specification of co-location, but that subsequently introduced physical mobility in response to feedback from researchers and companies and a request from industrial partners.

There is also a consensus that while ISM schemes may not require physical mobility and co-location and dual-learning approaches, these options provide significant added value, e.g. working in both places allow researchers to, as one interview respondent noted, *"unlock different type of knowledge that can be activated during research"*. Some respondents maintain that while physical mobility may not be necessary (virtualisation aspect of collaboration), or may not be feasible (some companies may not have research departments), it is still very beneficial from a variety of perspectives, e.g. team building, cross-fertilisation of ideas, *"getting closer to the subject"*. One respondent also pointed to the fact that physical mobility makes it easier for researchers to work for industry, as researchers are far more likely to work for industry as part of ISM scheme than set up their own enterprise.

What are the differences between the characteristics of transnational ISM and national/regional schemes? What is the feasibility of adding an international dimension to domestic schemes?

Only a select number of intersectoral mobility schemes collected in this study were transnational by design and of these, most were MSCA-funded. In these cases, ISM is mostly an optional component within an international mobility programme, in correspondence with the nature of the MSCA guidelines. In the case of training and development in preparation for an intersectoral career change, there may be an international dimension as part of the training programme (e.g. PhD researchers participating in an international entrepreneurial workshop). However, these situations can hardly be called 'schemes' since the ISM-component involves preparation or enabling (see section 2.2. for "typology") not intersectoral mobility itself. Researchers may seek employment in other sectors in other countries, and employers may scout for researchers with specific expertise across the globe. In such cases, the researcher's personal career development transition and the organisation's recruitment strategy combines intersectoral and international mobility.

The above examples illustrate that when international and intersectoral mobility are combined, the cases are more often ad hoc and demand driven.

The lack of funding for schemes combining international and intersectoral mobility may explain this scarcity, but there may not be much demand for such schemes either. Many stakeholders being interviewed emphasised the significance of trust, of long-term partnerships and of shared objectives when engaging in ISM schemes, all of which are easier to forge in close proximity. Even when such schemes involve internationally mobile researchers they will usually be initiated, facilitated and supervised by more senior and more locally embedded academics, entrepreneurs, R&D managers or employers, all of whom keep a close eye on the benefits and the impact of the scheme.

Do mobility schemes work best when companies are embedded in academic campuses or when academic researchers are embedded in industry? Or can both approaches be effective?

The majority opinion among respondents is that both approaches can be effective. Analysis of the interview data shows that there might be a stronger rationale for the second option. There is a perceived need to bridge the gap between academia and industry, for researchers of all levels to get first-hand experience of industrial environment. As one respondent put it, *"Campuses must go to companies. The other way around is also possible, companies may come to campuses when they*

have a need, but the first mobility is critical, universities do not know what the economic environment means. We have here such an example: our training programme at the faculty of business management is not appropriate to SMEs, but only to large companies, I hope we can adapt it soon, we must open to the market needs."

Another view in favour of an option for academic researchers embedded in industry rather than the other way around, has a very practical consideration: *"It is easier to send our researchers to existing companies because they already have established teams, business concepts, regular income, experience as to how to sell the product etc. When we try to establish a company in a university environment from scratch, we have to build a new team and the return of such a scheme will become evident later."*

2.3.3.6. Supervision arrangements

In relation to supervision arrangements, among the issues considered are:

- How do overall supervision arrangements work?
- Do regular meetings take place between industry and academia in relation to scheme implementation?
- To what extent can examples of effective approaches to joint supervision be identified?
- To what extent is the geographical location of participants in ISM schemes an issue in terms of coordination in scheme management?

Practice varies significantly in terms of whether meetings take place between industry and academia. In some ISM schemes, evidence was identified of close cooperation between the academic supervisor and their industry counterpart responsible for monitoring researchers during their internship / placement in industry. However, in other instances, interviewees stated that there had been no contact between the academic supervisor and industry supervisor at all during the period of mobility.

According to some interviewees, good practice suggests that periodic dialogue should take place between the academic and industry supervisors, since this will help to build closer institutional cooperation between partners taking part in schemes, and allow any problems or practical challenges relating to individual researchers' mobility periods to be raised and resolved promptly. In the case of industrial PhD schemes and some other types of schemes, the work of PhD students, researchers and post-doctorates is often carried out in close cooperation with industry, under the joint supervision of an academic and/or a business supervisor consolidating an active interaction between science and business.

Over the longer term, cooperation between academia and industry participants in ISM schemes at a managerial level is crucial in terms of fostering closer industry-academic links.

In terms of **examples of effective approaches to joint supervision**, in **Belgium**, the Baekeland-programme was formerly run by the (now disbanded) Flemish government agency for Innovation by Science and Technology (IWT); its management has been transferred to VLAIO (Flemish Agency for Innovation and Entrepreneurship). The PhD scholarship offers researchers the opportunity to obtain a PhD-degree in close cooperation with business and industry, under the joint supervision of an academic and business supervisor.

In **Finland**, Tampere University of Technology (TUT) establishing the Doctoral School of Industry Innovations (DSII) in 2014. Innovative doctoral students are required to complete four-year dissertation projects. TUT hires the doctoral student to complete a four-year, company-sponsored dissertation project under the **joint supervision of a TUT professor and a company representative**.

The role of putting in place effective supervision arrangements was emphasised even in the case of informal forms of intersectoral mobility. For example, in **Iceland**, since it such a small country, there are no official ISM schemes as such (researchers instead participate in Marie-Curie). However, Matís, a biotechnology and food research institute connects PhD students and representatives of local industry by **inviting relevant industry representatives to supervise the PhDs of students**. This enables industry to keep abreast of current developments in academic research and gives students an opportunity to get to know the available opportunities, to carry out applied research in an industrial context, and often leads to post-doc researchers securing jobs in the companies involved in supervision.

In **Estonia**, difficulties in ensuring a consistent approach to supervision within a programme was highlighted as a problem. Within the DoRa programme 2008-2015, some instances were identified of researcher participation in mobility periods where their academic and industry supervisors had never met, yet in other instances within the same programme, the two supervisors had not only met face to face but coordinated via email and phone on a regular basis to discuss the progress being made by participant researchers. A programme evaluation noted that there may be a link between scheme effectiveness and the extent of cooperation between supervisors. Sometimes there is less interest from supervisors from universities than from industry.

Regarding the **geographical location of participants in ISM schemes**, as noted in the section on transnational researcher mobility, there are clearly some coordination challenges relating to scheme management in the case of schemes that operate between different institutions in several countries. Clearly, well-established EU programmes namely the different sub-actions within the MSCA, are better able to address some of these challenges than ad hoc bi-lateral and multi-lateral schemes where the management arrangements need to be determined between partners in a number of different countries. Some stakeholders regarded it as already being a sufficient challenge to manage ISM schemes domestically, given that there is often a significant cultural gap between participants from industry and academia within the same country, given different expectations of what different types of stakeholders will get out of schemes, differing views on how research projects should be structured etc.

2.3.3.7. Support structures for intersectoral mobility

The EURAXESS initiative facilitates the matching of researchers and open positions across Europe. The initiative promotes open, transparent and merit-based recruitment in research positions and has developed guidelines and a checklist for research institutions to help them in ensuring that their recruitment practices meet these criteria. However, whilst this initiative is a positive step forward, various evaluations for DG RTD and for national authorities responsible for research within Ministries of Research and Education have identified a relatively low level of R&D intensity in many EU MS, a need to increase the number of researchers in the private sector and to increase two-way mobility between academia and publicly funded research (i.e. HEIs and RTOs).

There have also been efforts to develop a tailored business interface through EURAXESS. For example, EURAXESS Ireland recently launched a new Industry User Interface for business users. Companies can advertise vacancies, search an online database of researcher CVs, access the fast track research visas system and search for funding support opportunities. Consideration is being given to rolling out this scheme more widely. The Horizon 2020 programme also makes use of EURAXESS as relevant MSCA opportunities are published on the portal.

At a European level, analysis of interview data demonstrates that awareness of the EURAXESS network as a support structure for supporting ISM is relatively low among researchers and representatives of industry (there are respondents in these groups who have not heard of EURAXESS, in fact). However, many other interviewees had heard of EURAXESS and thought it played a valuable role in promoting awareness about mobility opportunities, although it was recognised that there is a perception that EURAXESS is more closely concerned with international mobility, and only to a lesser extent ISM.

Representatives of national agencies, or implementers of ISM schemes, interviewed for the current study and who are familiar with the work of EURAXESS, confirmed the relatively low visibility of EURAXESS services in their respective countries among researchers and in particular, in industry. Among those who are aware of EURAXESS, the pattern is that respondents either do not use EURAXESS services or use them in a limited fashion, primarily for hiring researchers originating from third countries. This can be attributed to the fact that a lot of national ISM schemes involve participants from their respective countries, whilst EURAXESS supports cross-border mobility as a core activity and does not have a separate approach for supporting intersectoral mobility and, in particular, at a national level of EU Member States. It is within the confines of support to cross-border mobility, in particular, such as assistance with hiring researchers from third countries that ISM schemes benefit from EURAXESS support.

A broad consensus emerged among respondents that whilst the EURAXESS portal is a very valuable resource, it has been underutilised due to its low visibility among researchers and industry.

A number of other support structures for researcher mobility were identified at national and international level. The most common support mechanism exists however not at a national level

but rather within the research grants offices of individual HEIs and research institutions. A number of examples were identified of research grants offices that play a proactive role in developing an appropriate framework for researcher mobility schemes including ISM schemes.

Regarding support structures in **Finland**, for instance, VTT, the Technical Research Centre of Finland, supports outbound mobility through the HR Mobility team. *"This enables VTT to gather information about best practices and to support our researcher mobility from both an employer point of view as well as considering the employee point of view related to mobility"*.

For instance, the management of the **Accelerate Research Internship Program** in **Canada** have developed a **Code of Conduct**. The Accelerate scheme was launched in 2003 by Mitacs, a not-for-profit organisation that has designed and delivered research and training programs in Canada for 18 years and which builds partnerships between academia and industry. The scheme is designed to increase the deployment of highly educated graduates to the private sector. The Code incorporates a number of common sense principles, such as developing guidelines – or codes of conduct – for researchers taking part in ISM schemes as a mechanism through which scheme managers can help to ensure that the right framework is in place to support the implementation of schemes and to help embed these at an institutional level.

In **Singapore**, a good example was identified of a scheme that is supported by a support structure to facilitate the employment of researchers in industry after they have completed a Masters or PhD through their automatic enrolment in a graduate academy as part of the A*Graduate Academy.

2.3.3.8. Skills and training for intersectorally-mobile researchers

The European economy is increasingly demanding higher-level research skills, with strong demand from some emerging sectors for high-quality research talents to be applied in an industrial setting. Ensuring that academic researchers are suitably equipped to work as industrial researchers demands improving skills development and training across the EU. Among the issues considered through the research are:

- To what extent is formal skills and training being provided to intersectorally-mobile researchers i) before they take part in a mobility scheme through preparatory training and ii) during a mobility scheme?
- How far is skills development and training taking place on a formal basis during mobility experiences, or does this mainly take place "on the job"?
- To what extent – and why – is there a focus on strengthening attention to equipping mobile researchers with skills for employability and transferable skills between sectors?
- Are there any differences in terms of skills and training delivered during ISM schemes between schemes that target early-stage and later-stage academic researchers respectively?

2.3.3.8.1. Skills development by implementation stage in intersectoral mobility schemes

Some training takes place prior to PhD researchers engaging in intersectoral mobility activities. The aim is to equip researchers with the skills and competences they need to work in another sector and to broaden their research horizons. For PhD students and researchers at an early stage in their career development, making the transition towards another sector from a positive motivation and not as second choice, and making sure that the investment in their skills and expertise pays off in the non-academic labour market, often requires preparatory training, expectation management and behavioural change, as highlighted in the case study summary below. The more detailed case study is provided in the separate case study report (see case study 5 on preparing for intersectoral mobility at the R1 and R2 levels).

Table 1.16 – Summary of Case Study 5: Preparation for ISM - the case of VITAE

Description and objectives: VITAE is a membership organisation in the UK which provides skills training to researchers; offers training to trainers and supervisors; carries out in-depth studies of researchers' careers; organises events, conferences and networking activities; and influences the development and implementation of policy. The majority of UK universities and some overseas ones are members of VITAE and thus benefit from their services. Intersectoral mobility is not at the core of their activities, but its focus on employability makes Vitae's activities instrumental in preparing researchers for intersectorally-mobile careers.

Target group: VITAE targets all researchers (level 1-4) through their institutions or funders, but is particularly focused on the target group of R1-R2.

Eligibility criteria: As a membership organisation, VITAE charges a membership fee to institutional members. Researchers within these institutions acquire full access to VITAE's services.

Funding sources and funding arrangements: Initially, VITAE was jointly funded by the UK Research Councils and the UK Higher Education Funding Bodies. Since 2015, they have been a self-sustaining international membership organisation with over 183 institutional members – most of whom are based in the UK.

Scheme characteristics: VITAE covers a broad range of activities. ISM is optional in these, but through awareness-raising and behavioural change, VITAE's activities prepare researchers for an intersectorally mobile career, regardless of discipline, sector or career stage. Occasionally, specific ISM-related initiatives, research projects or activities are set-up.

Outcomes: VITAE's surveys (see below) map the various outcomes of researcher development activities. Modest progress has been observed in terms of the availability of training programmes, reasonable progress in terms of research culture and an interest in personal development; marked increases in the proportion of researchers undertaking training/CPD on certain themes relating to research and academic practice; however, only slight increases in those undertaking training/CPD in communications, collaboration and team working and, critically, career management – elements which can be crucial in preparing for ISM. Modest progress is observed in the form of higher proportions of research staff who undertake developmental activities, including external interactions, research management and preparation for academic practice.

Evaluation and monitoring: Two specific surveys help to monitor VITAE's activities overall and help institutions to gain insight in their own researchers' development, career expectations and career outcomes: the Careers in Research Online Survey (CROS) and the Principal Investigators and Research Leaders Survey (PIRLS). The Vitae Impact and Evaluation Group (IEG) was established in order to map the outcomes of researcher development activities. Their Impact Framework was designed to foster, support and guide existing and new ways of effectively evaluating researcher training and development across the sector.

Good practices: The collaboration between a national coordinating agency, academic institutions and non-academic stakeholders helps to identify expectations and needs, to change a research culture, and to embed activities in a sustainable environment. In order to obtain this, VITAE developed an ambitious and well-managed business plan as well as a close link with policy makers in the national government, in funding agencies and internationally. An extensive evaluation and monitoring scheme provides useful feedback and guidance for further development.

Lessons learned: The examples of VITAE (UK), ABG (France) and OJO (Flanders) illustrate that national policy support, a long-term strategy, wide stakeholder involvement and regular monitoring, are crucial framework conditions for successful career development initiatives. These help to prepare researchers for ISM experiences later on in their career. MSCA-funded schemes have similar goals in terms of researchers' career development at individual researcher level. However, the time limitations imposed by project funds impede any long-term or broader impact on the research culture and reduce the potential for a sustainable, embedded ISM-friendly research culture.

In addition, many schemes also provide training and skills development during the mobility scheme. As explained in the sub-sections below, such training includes both formal and informal training.

2.3.3.8.2. Formal vs. informal training and skills development

Surprisingly, few ISM schemes combined the internship or dual PhD with formal training or learning. There were however exceptions to this finding where schemes have strongly embedded training and skills development within schemes, such as:

- The MSCA-funded schemes (in which the training provided is an important element in the selection phase);
- The funding reserved for training of participants in FNR-funded ISM schemes in **Luxemburg**;
- The work of organisations providing employability / ISM-related training to PhD and post-doctoral researchers outside of funding mechanisms, such as the activities developed by Vitae in the UK, or the Association Bernard Gregory/ L'Intelli'gence in **France**;
- The Doctoral School of Industry Innovations (DSII) in **Finland**, which has operated since 2014 and is run by Tampere University of Technology which provides support and supervision to students working towards their doctoral degree and offers doctoral students **monthly follow-up meetings, training opportunities** and DEMOLA projects that support research work; and
- In **Italy**, the **CORIMAV scheme in Milan** is being implemented in cooperation between Pirelli and Bicocca University. The university's doctoral school provides taught courses to PhD students on management, IP and bringing products, innovations and ideas to the market (see the case study provided in Section 2.2.7.4 on private funding sources of ISM for further details about the scheme.

Formal skills development and training was highlighted for several types of academia-to-industry schemes, such as in some industrial PhD schemes, and company internships during the PhD and in some fellowship schemes.

In terms of the processes involved in skills acquisition and transfer, in the majority of cases, the ISM schemes expect the learning curve to be triggered and steered rather organically by the local mentor, the day-to-day challenges, or through the research project itself and the specific scientific and research challenges being addressed. The skills gain for schemes addressing intersectoral mobility from industry to academia, or in a later stage of a researcher's career from academia to industry, either remained underreported in the findings, or was considered less notable by the respondent/interviewee.

2.3.3.8.3. Skills development and training needs by researcher stage

It is important to differentiate between skills development and training needs by researcher stage, since these differ markedly depending whether the researcher is still at an early stage of their career development (the phase when the extent of skills gain is potentially largest) or if the researcher is already at R3 or R4 levels, in which case academic researchers may already have a wide range of research skills and know-how but lack business skills and competences, or vice-versa for industry-based R&D experts.

The research found that **early-stage academic researchers** spending time in industry had acquired new skills both "on the job" and through formal training and skills development through taught university courses. On a general level, these skills are related to an understanding of the work ethics and cultures of the new employment sector, such as: deadline management, team work, project management, communication and an appreciation of non-academic economic or social impact. This skills gain is reported to increase their career outcomes and employability rate. ISM schemes which were clearly embedded in a much broader and mainstream culture of collaboration and knowledge exchanges more often identified skills gain than 'isolated', 'short' or 'marginal' schemes involving a mobility experience without much preparation, reflection or follow-up for the participant.

In more specific cases, the intersectoral mobility experience is an opportunity to learn a particular methodology, to acquire the skill to work with specific software or technical tools, or to perform a task that one hadn't been exposed to before, such as for example proposal writing in a collaborative context.

A further way in which researchers develop relevant skills and competences is through the supervision process, since ISM schemes commonly appoint both a supervisor in academia and a

supervisor during their research stay in industry to oversee and mentor the PhD researcher. This can be highly beneficial in terms of opening up researchers' professional development horizons.

Turning to ISM schemes targeted at more experienced **researchers** at R3 and R4 levels (see case study 4), in the **UK**, the Royal Society's **Industry Fellowship scheme** is long-established. The aim is to enhance the individuals' career through obtaining new knowledge and skills both through informal means (i.e. skills acquired whilst conducting research in another sector) supplemented by formalised skills and competency development through short training courses, organised for Fellows during their fellowship on subjects such as entrepreneurship, innovation, IPR etc.

Little or no skills needs were brought to the surface in the case of industry-to-academia mobility at R3-R4-level. On the contrary: these intersectorally-mobile researchers were expected bring new skills into the academic environment.

2.3.3.8.4. Training and skills development to enhance researchers' employability

The research identified evidence of an increasing focus in many ISM schemes on the **provision of skills and training to enhance employability** through a focus on non-academic skills needed for today's researchers to succeed in industry or indeed to continue their career as an academic researcher. This may include, for instance, training to develop entrepreneurship skills know-how in setting up a new business, competences relating to IPR management and bringing new products and innovations to the market. Skills training to enhance employability may take place during preparatory training for ISM (see case study 5), and whilst researchers are undertaking a mobility period.

The emphasis on strengthening skills development and training to enhance researchers' employability has been supported at an EU policy level for some time. A Commission Communication⁵⁶ from 2008 notes that researchers "*often lack the skills and competences necessary to manage intellectual property, bid for project funding or set-up their own start-up company*" and furthermore notes that "*most researchers in Europe are still trained in a traditional academic setting*". Although this policy Communication dates from 10 years ago, the situation has changed insufficiently since then. The policy message has been reiterated in the Innovative Doctoral Training Principles in 2011⁵⁷ and in the Modernisation Agenda in 2017⁵⁸. Many academic researchers lack the necessary skills to make the transition to undertaking research in an industrial research environment. Although there is evidence of a limited increase in take-up of intersectoral mobility, this remains the exception rather than the norm.

The skills for employability agenda also puts a strong emphasis on the **acquisition of transferable skills (e.g. leadership/ management skills, communication skills and networking skills)** to make it easier for researchers to move between sectors. However, the concept of transferable skills, whilst common parlance in countries with a strong tradition of industry-academic cooperation (e.g. Ireland, the UK) is not widely known, especially in many EU-13 countries.

As outlined earlier in the report (see Section 2.2.5 – describing key EU programmes that support intersectoral mobility), through its Knowledge and Innovation Centres (KICs), the European Institute for Technology (EIT) runs a number of Masters and PhD programmes. It is worth mentioning these since a strong importance is placed on fostering skills for employability through a close relationship with industry partners in designing courses and the effort made through taught courses to provide researchers with the entrepreneurial and innovation skills, knowledge, attitudes and aptitudes needed to succeed in an entrepreneurial setting once they have graduated.

⁵⁶ *Better Careers and More Mobility: a European Partnership for Researchers*, COM(2008)317 final

⁵⁷ <https://euraxess.ec.europa.eu/belgium/jobs-funding/doctoral-training-principles>

⁵⁸ Communication From The Commission To The European Parliament, The Council, The European Economic And Social Committee And The Committee Of The Regions. On A Renewed EU Agenda For Higher Education , COM(2017) 247 final https://ec.europa.eu/education/sites/education/files/he-com-2017-247_en.pdf

The Quality Assurance framework⁵⁹ developed by the EIT to assess the quality of Masters and doctoral programmes also recognises the importance of checking whether courses equip researchers with skills that will enhance their future employability. The EIT's approach to assessing whether Master Programmes qualify for the EIT Label includes a review of learning outcomes based on a template which lists different general skills and competences that Masters' students are expected to acquire through participating in an EIT-labelled Masters provided by KICs and their academic partners. These include: creativity, innovation, entrepreneurship, research skills, leadership, and making value judgements. All EIT Masters programmes involved intersectoral mobility.

Overall, then, the picture is one in which intersectorally-mobile researchers are benefiting from some formal training and skills development, but there remains a strong focus on informal on the job training. Intersectoral mobility provides a significant opportunity to ensure that researchers are as adaptable as possible and able to work across sectors through the acquisition of transferable skills. This increases the chances that their scientific skills and expertise become a bonus to future employers in any sector, or a starting point for their own innovative or entrepreneurial pursuits.

2.3.4. Intellectual Property Rights and Intersectoral Mobility

Navigating the challenges relating to sharing Intellectual Property Rights ("IPR") in formal ISM schemes was raised in a number of interviews. In some schemes, the industry partner owns the IP generated during research projects whereas in other cases, the IP is shared between the industry partner and the university or research institute providing the research fellow or scholarship. In other cases, the university owns all the IP generated.

In **Italy**, for example, under the **CORIMAV scheme** funded by Pirelli, the major tyres company, patents generated through the ISM scheme are registered as co-patents, but Pirelli has the right to buy the rights and to compensate the co-inventors from the university. Approximately one patent per year has been registered since the scheme started in 2001. A press release by Pirelli notes that the two most recent PhD scholars were both hired and their research contributed to two patent applications being made on new materials for tyres and to reduce energy consumption.

An interviewee from the above scheme stated that it can be challenging to arrive at a common understanding on IPR due to cultural differences between academia and industry. It required a lot of technical work between the legal offices of the university and the company respectively to strike the right balance in IPR-sharing arrangements. A further challenge is that industry is often concerned with ensuring high levels of confidentiality whereas in universities, there tends to be a culture of open science researchers (with researchers under pressure to produce publications to further their academic careers). However, it was agreed between the parties that strict confidentiality is needed for the scheme to work effectively and to build mutual trust.

Sometimes, the universities own all the IPR directly. In the **UK**, for instance, the **Knowledge Economy Skills Scholarships (KESS) scheme** is an ESF-funded European Convergence programme that operates in Wales and involves all Welsh Universities. There were 230 PhD and 223 Research Masters projects across Wales by the close of the scheme in September 2015, involving over 500 businesses with which academics and postgraduate research students developed innovative research projects aiming to achieve business growth. However, project results and any Intellectual Property arising are owned by the relevant university, which can then make licencing arrangements with the firms concerned.

In practice, the usual arrangement is that each party takes away from a project what they have contributed, but in some schemes, since the university researchers tend to make most of the original contributions, it is the universities, under arrangements with their staff and students, that own most of the IPR arising.

Interview feedback has suggested that most large firms working in an **open innovation environment** are quite relaxed about an arrangement where the university owns the IP, seeing broader advantages from the interaction, and being prepared to pay any necessary licencing fees. But smaller firms may be more sensitive, feeling that their own contributions to the project may be under-estimated and being frustrated that they are not able to make use of the project's results

⁵⁹ The EIT Quality Assurance and Learning Enhancement Model is described in further detail in Section 2.2.5 – see RQ5 on EU funding schemes.

without paying for what they have helped to achieve. This, it was reported, sometimes inhibits SMEs from participating in ISM schemes.

Of course, the situation is different if the firm actually employs the researcher. Schemes which encourage the take-up of graduates and those who have completed a doctoral programme get around the problem perceived by SMEs in particular, in that if the IPR is generated by one of their employees, then the firm will generally own it.

There are also variations in the general model. In **Croatia**, for instance, the IRCRO scheme managed by the Croatian Agency for SMEs, Innovations and Investments (HAMAG-BICRO), provides co-financing to support collaboration of SMEs with public scientific and research organisations (including public universities and research institutes) in carrying out R&D projects. Collaboration takes the form of a research and development contract with the scientific/research organisation and the SME owns all the IPR arising from the results of the project. In **Germany**, through the Germany Research Campus (Forschungscampus) scheme, there are provisions built into the co-operation arrangement between research institutions and industry that allow for agreements to be reached on how to share intellectual property.

An example from **Iceland** suggests that despite the efforts of universities and Intellectual Property Offices to address IPR issues, by developing model agreements, there are still issues that can complicate the arrangements between partners in ISM schemes and reduce their effectiveness. The **Icelandic Institute for Intelligent Machines** aims to accelerate the rate of innovation by strategically bridging academic research and industrial engineering needs. Much of the work that it does with business partners involves software and other developments that have a wider application. As a public body, the Institute is interested in maximising its impact across these other applications. Its approach is therefore to retain control of the software developed (and not to make the software open source), and to licence the use of the software by the business partner, with an understanding that licences will not be granted to other businesses in the same sector as the partner, but that they can be granted in non-related sectors.

It is still the case that many enterprises in particular do not anticipate IP issues until they encounter them. At a European level, the **European IPR Helpdesk** (<https://www.iprhelpdesk.eu/>) exists to assist those involved in EU projects to manage their IPR more effectively and, as part of its services, offers to mediate between parties when there are IP problems. A suggestion was made as to how improve the management of IPR issues within schemes by an individual researcher interviewed in Spain who suggested that "*cross-sectoral model IPR agreements could be formulated at a European level to make it easier for researchers taking part in ISM schemes or moving informally temporarily to work in industry*".

The **US provides a good practice model** in respect of IPR-sharing arrangements to foster industry-academic collaboration. The University-Industry Demonstration Partnership in the US has developed different schematic options for universities and industry to cooperate together and these address IPR-related issues. In addition, they have developed a guidance manual⁶⁰ to facilitate university industry research contracts. This covers contractual relations between the two parties, and differentiates between background IP and foreground IP.

Challenges relating to IPR can also be an **obstacle to industry participation in ISM schemes**. For example, an interviewee from a government Ministry in the **Czech Republic** stated that IPR issues can be problematic. There is usually a formal agreement signed between the HEI/RO and the company concerned which is prepared by themselves. There is often no other party involved, and no formal support available at national level. A common problem is that the HEI/ROs are concerned that they may lose their intellectual property if it is not sufficiently protected, but they often cannot define the IP sufficiently or what constitutes its misuse. The result is that draft IPR agreements provided by publicly-funded research organisations may deter companies from participating since proposed agreements are often "*misleading, unclear or difficult to accept by companies*".

Although countries with longstanding experience in academic-industry cooperation also tend to have stronger experience in IPR, there appears to be growing expertise at least in some EU-13 countries in relation to putting in place IPR agreements between universities and companies. For

⁶⁰ Contract Accords for University Sponsored Agreements, the UIDP, 2012. All rights reserved. <https://www.uidp.org/publication/contract-accords/?download=422>

instance, in **Lithuania**, an interviewee from a university commented that *"questions relating to IPR are settled during the negotiations. We are not a profit-seeking organisation and therefore we have a flexible view as to how to share IPR. Our main goal is to implement projects, to develop new products and to contribute towards the country's overall development. We have experience, processes and structure on dealing with IPR inside our university"*.

An interviewee in **France** pointed out that IPR is not generated through all types of ISM schemes and may not be an objective. *"Visibility was the main objective of participation and there was also a strong focus on open science and innovation and therefore on publishing the scientific results"*. Also, in the social sciences, it was pointed out that *"it is harder to protect IPR"*.

As noted in the section on evaluation and monitoring, in relation to the outcomes of participation in ISM, **indicators relating to IPR are commonly used as metrics in ISM schemes**, such as the number of patents registered and the amount of fee income generated through licensing.

In conclusion, it varies as to whether industry or academia is in the driving seat regarding the management and exploitation of IPR generated during placements, internships and research projects undertaken by PhD researchers. Universities benefit in different ways from their researchers taking part in ISM schemes, either by owning the IPR directly, or when the IPR is instead shared or owned by industry, they still benefit through being a co-inventor, and deriving a share of the benefits through licensing arrangements. The variety of practice in terms of how IPR is shared, managed and exploited demonstrates that there is no golden rule. However, it would be worth considering in the case of a new ISM-related scheme that the possible options are defined from the start and in close consultation between academics and non-academics.

A further finding was that commercial sensitivities around the confidentiality of research projects can be problematic for academic researchers working temporarily in industry, since in many countries, they are under pressure to publish scientific publications under academic career appraisal systems.

2.4. Analysis of ISM schemes by level of researcher

2.4.1. ISM schemes by level of researcher

The schemes have been analysed according to the typology set out in Section 2.2. The typology starts at R1-level of a research career (the level usually associated with PhD research), includes R2 (corresponding with the early postdoctoral phase) and continues with R3 and R4 level of "experienced" and "leading" researchers. However, it should be noted that a large number of ISM schemes integrate the undergraduate and postgraduate students level in their programme. In particular, internship programmes designed to strengthen strategic partnerships with universities or to potentially recruit talented interns on the basis of a successful mobility experience, include the pre-research phase of undergraduate or postgraduate student career. For those purposes and expectations, the exchange of research skills or research experience may be less relevant.

The majority of ISM schemes focus on R1 and R2 level researchers and take the direction from academia to industry. At this stage of a career, maximum benefits can be reaped from the ISM experience, and none of the stakeholders lose out. If future employment is the direct outcome of an industry internship, the researcher gains a job and industry gains talent and access to new knowledge. The university meets its objectives of providing suitable employment outcomes for its PhD graduates and strengthens its alumni network for future research collaboration. The government in its turn witnesses the impact of its policies to enhance a knowledge-based economy.

A select number of ISM schemes target **R2 and R3 level researchers** with also in the direction from academia to industry, but with the expectation **to bring innovation to market**. These schemes require a more advanced and certainly more specialised level of research skills than R1. Typical schemes are aimed at solving a particular problem in industry, meeting a specific demand in government, or filling a niche position for long-term R&D employment.

Examples are the "innovation cheques" for SME's in Romania to hire a researcher to tackle a particular research question, incubator facilities or spin-off support for innovations by academic researchers with commercial potential, as is the case with many innovative universities, and the many collaborative initiatives and networking events which serve to create opportunities for scouting, stealing and hiring talent.

At **R3 and R4 level**, the number of mobility schemes is more limited as the individual's career becomes more settled, but the variation in ISM schemes targeting mid-career researchers is nevertheless wide. Some schemes continue to support the **transition from academia to other sectors**, as described above, but a number of schemes take the opposite approach. At R1-level of a research career universities take charge of the training, but at R2 and R3 level a large number of researcher have already made the transition to non-academic sectors. Subsequently, at R3 and R4 level, this provides an **opportunity to return to academia** and bring their business skills to educational programmes, or innovation skills to R&D focused labs. This can be done through part-time appointments, endowed chairs, or full-time recruitment at senior level. The Somopro scheme in the Czech Republic, for example, which is funded by MSCA COFUND, helped to recruit an experienced researcher from industry back to academia, while the guidelines of the Norwegian Association for Higher Education Institutes also support the recruitment of industry-based researchers into education by highlighting the benefits of their experience in an academic environment. An alternative example is the appointment of business developers at Ghent University, whose job profile requires a PhD as well as industry experience in order to liaise between research departments and industry partners on a long-term basis, to exploit the commercial potential of new research results and to support the entrepreneurial potential within the academic community.

Some schemes target employees who left university at MA-level and have established a non-research career elsewhere, in order to pursue PhD research at a later stage of their career. These "potential researchers" do not fit easily within the R1 to R4 categories as these are suited to map research careers, but they nevertheless bring a greater element of maturity and/or high levels of business experience into the academic environment. When they start their research career after a number of years of employment in the non-academic sector, they combine some of the characteristics of an R1 research position with the maturity of an R2 or R3-level researcher.

The different types of mobility identified by type of researcher have been integrated into the case study approach. These are, in summary:

- Mobility between academia and industry;
- Mobility between academia and the public sector; and
- Mobility between academia and the third sector.

2.4.2. *Coordination measures*

RQ10: What measures are in place to ensure smooth coordination between academic and non-academic PhD supervisors?

Many ISM schemes focused on R1 and R2 level researchers ensure equal involvement by the academic and industry partner through double supervision or through a combination of supervision and mentoring. On the one hand, an academic supervisor within academia will take responsibility for academic quality assurance, such as being the gatekeeper for PhD-level research. On the other, a mentor or joint supervisor in industry, in the public sector, in NGO's or in hospital, will focus on the relevance of the research outcomes for their respective sector of activity. A number of respondents being interviewed indicated that these expectations may sometimes differ, in particular if these collaborative schemes do not build on earlier partnerships.

Many schemes have introduced a number of measures in order to smooth coordination, such as:

- **Guidelines and standards on supervision:** the MSCA assessment criteria, for example, check whether applications are in line with the MSCA-guidelines on supervision and research development.
- **Joint applications** by the academic and industry partner ensure proper preparation, formalise an equal commitment on supervision and ensure early-stage negotiations on IPR.
- **Process evaluation:** most institutions have annual reporting mechanisms in order to monitor PhD progress. Any problems in supervision coordination may be addressed during these moments of evaluation
- **Scheme regulations:** some ISM-schemes set out clear rules of engagement from the start in order to minimize the risk that problems in supervision may occur

2.5. Outcomes from participation in intersectoral mobility

This section explores the outcomes of participation in intersectoral mobility. The types of outcomes discernible will vary depending on the timeframe in question and on the type of participant in mobility schemes. The following research questions are considered:

- RQ13 – What are the main types of outcomes from participation in ISM schemes? What types of outcomes emerge at the level of outputs, results and impacts? And by type of participant?
- RQ14 - Is there a correlation between ISM schemes and the number of patents, innovative products and services created, spin-offs started by researchers?

2.5.1. Evaluation and monitoring

Before examining the specific outcomes of participating in ISM by stakeholder type, the extent to which monitoring information and data is available on outcomes is first considered. In particular, we assess how far current ISM schemes have been subject to evaluation, and whether monitoring data has been collected systematically. Where data gaps are identified, qualitative evidence is instead used in the subsequent sub-sections on outcomes.

2.5.7.1. Evaluation of ISM schemes

The desk research and interviews point to **only a few ISM schemes having been evaluated**, and where schemes have been evaluated, with a few exceptions, there has often only been a single one-off evaluation rather than regular evaluation. The **absence of a culture of evaluation** is closely related to the fact that many ISM schemes are diverse in nature and tend to be bottom-up, small-scale, unstructured or demand-driven initiatives, or the fact that some schemes involve/support ISM without being familiar with this concept. This poses major constraints in terms of information and data availability.

Among the exceptions to this finding include industrial PhD schemes and some nationally co-financed, EU co-funded schemes, such as those that have made use of ESIFs/ Structural Funds, where evaluation may be mandatory. At macro-level, Eurostat and OECD data (the OECD's Careers of Doctorate Holders Survey⁶¹) gives some indication of the absorption capacity of doctorate holders in the non-academic labour market.

Selected examples of evaluations that have been carried out of ISM schemes (and broader researcher mobility schemes that involve an ISM dimension) are now provided.

In **Austria**, the **FEMtech Career Paths programme** was initiated in 2004 by the Austrian Federal Ministry for Transport, Innovation and Technology (BMVIT). The programme was initiated in 2004 and targets women researchers and creates equal opportunities in industrial research at non-university research institutions, at universities of applied sciences and in research and technology programmes. An evaluation was commissioned by BMVIT of the programme⁶² in 2011. The aim of the evaluation was to assess the medium-term effects and the directions of impact (based on a term of about 7 years) as a contribution to the further development of the programme. The evaluation design combined quantitative and qualitative methods.

During the first seven years of its existence, FEMtech was found to have already gone through three different phases of programme priorities and organisational structures, with the fourth phase commencing in 2011. These changes involved conceptual redesign of the programme and changes to its content with some negative effects on continuity and coherence. However, this did not have a detrimental impact on effectiveness and impacts since there was extensive continuity in terms of the management and implementation team and in terms of the organisations implementing the programme. The key evaluation findings were firstly that the level of awareness in the RTI community about the FEMtech scheme (44%) is high, and secondly that FEMtech's experimental nature was a key added value. If particular companies and research institutions are to be mobilised

⁶¹ www.oecd.org/sti/inno/oecdunescoinstituteforstatisticseurostatcareersofdoctorateholderscdhproject.htm

⁶² https://www.bmvit.gv.at/innovation/humanpotenzial/downloads/femtech_evaluation_summary.pdf

and promote equal opportunities, their needs and "leverage mechanisms" must be addressed with more differentiation and customisation to reflect available research opportunities – including intersectoral mobility.

In **Bulgaria**, the "Science and Business" project supported a series of measures that included support to strengthen the qualifications of young researchers and to provide them with mobility opportunities to bring about closer cooperation between academia and industry. There was only limited scope for ISM, but the measure generally sought to tackle barriers to greater mobility across the knowledge triangle and to strengthen the underlying framework conditions in which intersectoral cooperation and mobility can thrive. However, the Ministry of Education and Science (MES) has not yet released an evaluation of the outcomes, so it is difficult to ascertain what has been achieved.

In **Estonia**, the **DoRa programme (2008-2015)** funded through the Structural Funds (ESF), and complemented by national co-funding, was implemented as a pilot scheme. An evaluation of the DoRa programme's implementation was carried out. Among the findings were that the scheme has been successful overall, but its effectiveness and impact could be further improved, for instance by involving more companies that have not previously participated in EU funding schemes or cooperated closely with universities before. A further finding was that universities and industry differ in their expectations from schemes. It was emphasised by programme managers involved in DoRa that a key success factor is to keep the scheme as flexible as possible and not to have too prescriptive rules. Only basic rules have been introduced such as a requirement for a PhD scholar to be working in one of the six priority sectors - ICT and health, biotech, energy, materials technology and environmental technology). In addition, the type of business that can participate has been specified (start-ups were excluded, since participants must have been established for a minimum 3 years, and have at least 11 people working there to minimise the risk that participant businesses do not go bust).

Whilst the ERDF-funded successor programme, the new **Smart Specialisation Scholarships Scheme 2016-2022** in **Estonia** only got underway recently, the programme will be subject to a mid-term evaluation of its implementation in 2018. The fact that both Estonian schemes will be subject to an evaluation as a conditionality of funding illustrates the importance of EU funding in instilling evaluation rigour into schemes, since this is often a mandatory requirement.

In **Sweden**, the **Flexit Programme** seeks new, flexible solutions to spread research and researchers outside higher education institutions (HEIs). The main purpose is: 1) to build bridges between humanities and social sciences (HSS) research and companies and organisations outside academia; 2) to facilitate knowledge exchange and encourage contacts so that more non-academic organisations can perceive and profit from the expertise of postdoctoral HSS specialists; 3) to highlight alternative career opportunities for HSS researchers. After an evaluation of the Flexit pilot project, the programme implementer, Riksbankens Jubileumsfond (RJ), an independent foundation with the goal of promoting and supporting research in the Humanities and Social Sciences, opened the programme to senior researchers and organised the positions so that the researcher is employed at the host establishment (company or organisation) for two years, followed by a year at an HEI.

A further example from **Sweden** is the Swedish Governmental Agency for Innovation Systems (VINNOVA) and Swedish Energy Agency (STEM) which commissioned the first evaluation⁶³ of the second generation of Competence Research Centres (CRCs). The VINN Excellence Centres (2004-15) have been developed through the **Swedish Competence Centres Programme (Centres of Excellence in Research and Innovation)** and aim to strengthen the crucial link in the Swedish innovation system between academic research groups and industrial R&D. Among the findings were that "personal mobility of researchers between industry and university, demonstrably the most efficient way of transfer of knowledge and experience" had not previously been given sufficient attention by management. Among the recommendations were that the VINN Excellence Centres should adopt measures to facilitate the mobility of researchers between industry and university. The VINNPRO programme operated from 2006-2014. In order to address the findings from the 2007 evaluation, VINNOVA was granted EUR 10 million by the government for doctoral candidates to increase the number of industry-based doctoral students.

⁶³ First Evaluation of the Vinnova Vinn Excellence Centres Ngil, Helix, Samot and Eco2 together with the Stem Competence Centre Cicero, Douglas Reev, Anne H. Anderson and Per Stenius, 2007

In **Denmark**, the **Industrial PhD and PostDoc schemes**, run by the Danish Agency for Science, Technology and Innovation are perceived to be useful in **improving researchers' employability and earning potential**. Several evaluations of the PhD scheme have been able to quantify outcomes for participants in terms of high employment rates (95-99%) and higher incomes: in 2010 the average annual income was DKK 636,000 (€86,000), compared with conventional PhDs whose average annual income was DKK 38,800 lower (€5,250 or 6%)⁶⁴. Industrial PhDs with a degree in social sciences/law earned up to €106,000 on average. Some 80% of Industrial PhDs are employed in the private sector, but if they are employed in the public sector, incomes are the same.

In the **UK**, a number of ISM-related evaluations have been undertaken by the UK Research Councils. For example, the BBSRC has carried out a lot of evaluation of the Professional Internships for PhD Students (PIPS) programme. At regional level, evaluations of PIPs internship programmes have also been undertaken, such as an evaluation of the East of Scotland Doctoral Training Partnership Professional Internships for PhD students⁶⁵. The evaluation assessed the experiences of doctoral researchers participating in the doctoral internship programme and their views on whether the programme developed their employability skills and influenced their career plans and aspirations. The findings were that participants developed self-awareness skills and the ability to critically evaluate personal, social and professional capabilities.

At **EU level**, regular evaluations are required of the MSCA under the Programme Regulation. The *Interim Evaluation of the FP7 Marie Curie Actions (2013)*⁶⁶ has been undertaken in 2013 and a further *Thematic assessment of the Marie Skłodowska-Curie Actions* was undertaken as part of the *Interim evaluation of Horizon 2020* in 2016. The Marie Skłodowska-Curie Actions were acknowledged as being unique in terms of the overall mix of instruments (linking research mobility with training, career development and inter-sectorial cooperation). A key finding was that "no other nationally or internationally funded programme covered a similar array of activities to those of the MSCA". Whilst acknowledging the positive evaluation findings relating to the MSCA overall, including the important role played by the ITN, weaknesses were identified in FP7 due to the "lack of a significant transfer of knowledge and insufficient two-way mobility of researchers between academia and non-academic research organisations"⁶⁷.

Accordingly, in the 2014-2020 period, the MSCA have increased the opportunities available for researchers to gain exposure to industry and other non-academic sectors. The thematic evaluation of the MSCA undertaken as part of the *Interim evaluation of Horizon 2020* notes that "Private organisations account for 43% of all MSCA beneficiaries whereas they make up 16% of all participations in projects. This reflects the small number of times (1.2 on average) that a private organisation participates in MSCA compared with an average of 6.5 times per HEI".

A stakeholder interviewed argued that there are some weaknesses in the approach to evaluating the MSCA - for instance (according to this respondent), there is insufficient follow-up, that would allow the EC to assess the extent to which the host institution was actually able to deliver in terms of training and professional career development, cf. the plans embedded in the original proposal. The interviewee commented that "whereas all MSCA projects have to include a career development plan but when audited, were asked whether they had a career development plan treated as a tick box exercise. Research projects to evaluate Marie-Curie too often depend on survey work, but lack qualitative assessment of what researcher mobility experiences - including intersectoral - were like, whether these were valuable, and what impact this has had in terms of changes in the career expectations and motivation level of researchers". However, given the increased focus on ISM in

⁶⁴ Danish Agency for Science, Technology and Innovation: The Effect of the Industrial PhD Programme on Employment and Income, December 2012. Oxford Research A/S https://innovationsfonden.dk/sites/default/files/the_effect_of_the_industrial_phd_programme_on_employment_and_income_v4_1.pdf

⁶⁵ Evaluating the EAST of Scotland Doctoral Training Partnership Professional Internships for PhD students scheme, Caroline Pope, Joshua Stapp, Lisa Scattergood, Sharon Maguire, Susan Bird, Tania Morgan Alcantarilla, http://www.docs.hss.ed.ac.uk/iad/Learning_teaching/Oct_2015_small_grant_POPE_final_report.pdf, University of Edinburgh Principal's Teaching Award Scheme

⁶⁶ https://ec.europa.eu/research/mariecurieactions/sites/mariecurie/files/fp7-marie-curie-actions-evaluation-2013-summary_en.pdf

⁶⁷ Avramov, D. (2015) 'FP7 ex-post evaluation PEOPLE Specific Programme (2007-2013): rationale, implementation and achievements' Final Revision 13 August 2015.

Horizon 2020, the lack of detailed attention to such issues may reflect the fact that the stronger focus on intersectoral mobility is relatively new.

These examples demonstrate the value of conducting evaluations of ISM schemes, since several studies have led to follow-up actions such as: reconfiguring the set-up and design of ISM schemes, modifying the eligibility criteria in terms of the level of researchers that the particular scheme is aimed at (e.g. young researchers, experienced researchers, research leaders/ professors), or expanding scheme eligibility from HEIs and research institutes alone to include non-academic institutions and companies. Several instances were also identified where scheme funding for ISM was significantly increased as a result of either a formal evaluation or a stocktaking exercise (e.g. see the VINN competence centre evaluation). In other cases, e.g. the Estonian DoRa programme evaluation, this provided an opportunity to embed lessons learned in the design of successor programmes.

Some countries, regions or organisations have developed extensive **monitoring systems** to assess progress towards the achievement of these policy priorities (UK, Flanders, and the OECD's Careers of Doctorate Holders Survey) but collecting reliable data on a national level proves to be particularly difficult and labour-intensive. A high number of graduates employed outside academia, for example, is not always a reliable indicator for intersectoral mobility initiatives, and may in some cases be an unwelcome outcome of limited career opportunities within academia or poor remuneration conditions in academia. Nor is employment outside academia an indicator that preparatory skills training paid off. More quality-driven information is required to assess this, but intersectorally-mobile researchers – just like internationally mobile researchers – can be hard to track.

Finally, small-scale ISM-schemes or initiatives tend to be **evaluated informally and case-by-case by those most closely involved** (organisers, participants and other beneficiaries). For instance, in **Switzerland**, the Swiss Science Foundation has undertaken an internal review of its various researcher mobility programmes, which did not previously allow scope for ISM. Following the review, it was decided to amend the regulations of the various researcher mobility schemes being operated to allow scope for ISM. However, to date, there has been limited if any take-up of this possibility, although it is too early to evaluate⁶⁸.

The expected outcomes from schemes are given consideration at the outset of planning ISM schemes in order to gain the necessary commitment and funding from all parties involved. Schemes which do not bring about the desired outcomes to those immediately involved stand a high likelihood of being discontinued. Those schemes that do prove to be successful, on the other hand, can be used by the stakeholders to convince funding agencies and governments of the need to upscale these initiatives by increasing their funding.

2.5.7.2. Indicator systems to monitor the implementation of ISM

As was noted above, industrial PhD schemes and those funded through ESIFs are more likely to have put in place a monitoring framework supported by indicators (and sometimes quantified targets) to monitor the implementation of ISM schemes and to measure key achievements in terms of outcomes (results and impacts indicators). Examples of indicators are:

- PhD completion rates (academic value system)
- the number of patents generated (industrial value system)
- employment outcomes (the number of PhD graduates subsequently employed in industry)

A number of schemes focus on **skills training** and increased **employability of early-stage researchers** (PhD – postdoc level), employ related indicators:

- number of PhD / postdoc researchers participating in training schemes
- number of PhD graduates becoming entrepreneurs

⁶⁸ Examples of ISM schemes include the SNSF mobility fellowships scheme, the Postdoc.Mobility scheme, which is gradually replacing the early Postdoc.Mobility fellowships and the Advanced Postdoc.Mobility fellowships scheme.

- number of PhD graduates employed in non-academic sectors (industry, government, private non-profit, NGO, etc.)

Some ISM schemes have put in place programme monitoring indicators, but these typically focus on **output** and only limited **outcome** indicators. For instance, for the DoRA programme in Estonia, which funded an industrial PhD scheme from 2008-2015, the indicators used were outputs such as the number of PhD students funded, the number of enterprises participating with the main outcome indicator, the number of PhDs graduating. The original aim was to fund 35 industrial PhD students, of whom 20 were expected to graduate. However, 52 PhD students were funded over the 7 year implementation period but only 11 managed to graduate before the end of the funding period, due to inflexibility under the way in which ESF rules were interpreted at national level. 47 different enterprises hosted the 52 students (see case study 1 on academia-to-industry mobility for further details).

Schemes in many countries included the “number of patent applications” as an indicator to measure the outcomes of participation in ISM. Whilst this indicator is a narrow measure of the success of ISM schemes at an aggregate level, it can be relevant in shedding light on the impact of academia-to-industry mobility. It can furthermore be noted that the number of patent applications is viewed by the European Commission’s DG EAC as being one of the success indicators of the MSCA programme. Whilst it is a very successful programme and has been subject to recent evaluation, one of the future perspectives for consideration is whether given that the MSCA in the 2014-2020 period have a much stronger focus on supporting intersectoral not only international mobility, this raises the issue as to which additional indicators should be used in order to capture programme achievements.

Presently, the level of international mobility is the only KPI for monitoring the MSCA’s implementation⁶⁹. Intersectoral mobility, however, while strongly promoted, is not being monitored systematically yet. This illustrates that ISM is still a concept-under-development, an optional by-product, or a nice-to-have, but a systematic approach to assessing its impact within the MSCA, as distinct from other types of international researcher mobility needs to be built into the approach to future programme monitoring.

The findings from other countries (e.g. Austria, Sweden, UK) show that monitoring data is often limited and often includes only ‘general’ indicators, such as the number of publications and/or number of conferences attended. Although these are useful indicators, they are insufficient for monitoring any more substantive outcomes. However, the research also indicates that the light-touch monitoring may in a few cases stem from a wish from the managing agency’s side to keep the administrative burden light in order to attract applicants.

2.5.2. *Absorption capacity for more intersectoral researchers*

RQ11 - If the demand for researchers is relative to the research intensity of the private sector, is there enough absorptive capacity to bring in more researchers in the private sector?

This question implies there is a causal link between the research intensity of the private sector in a country (i.e. the level of R&D spending expressed as a percentage of gross domestic product) on the one hand, and the demand for researchers on the other. The degree of the demand for researchers, in turn, determines the capacity of the private sector to absorb researchers, and in particular PhD graduates that may not (wish to) find employment in academia or the public sector. However, the link between demand for researchers and absorption capacity is not entirely straightforward, as the actual ability of the private sector to bring in more researchers depends on the degree to which these match the skills requirements of enterprises. For instance, it may be the case that there is great demand for researchers with a skills-set in science, technology and mathematics (the so-called STEM subjects) but that the private sector cannot absorb researchers with a different skill-set. In this case, there would be a skills mismatch leaving the private sector’s demand for researchers unmet and its capacity to absorb researchers limited. Skills mismatch can be avoided if students and industry get to know each other early on through work experience or placements, and companies use such schemes as recruitment channels to satisfy their demand.

⁶⁹ <https://www.ffg.at/sites/default/files/downloads/page/horizon2020indicators.pdf>

Apart from academic subjects, there is a wider point in that higher education does not always support development of the skills needed by the private sector. For instance, a major healthcare company interviewed for this study pointed out that managerial and leadership skills become ever more important for researchers in the private sector, but are not being developed in universities sufficiently. It was suggested that researchers be given more autonomy in managing projects to develop such skills.

When assessing private sector demand for researchers, it is important to **distinguish between different sectors** which may have different levels of demand. Typically, high-tech industries, manufacturing, digital and ICT sectors are more research-intensive than other sectors such as agriculture or retail, and can thus be expected to have greater need for researchers.

Firm size also matters. While large firms may be able to identify and recruit researchers independently, and may prefer to run their own schemes to collaborate with researchers on a temporary or permanent basis, small and medium enterprises (SMEs) may lack the resources to reach out to and attract the researchers they need to remain innovative and competitive. SMEs thus are the key private sector target group for publicly support ISM schemes. This was confirmed to be the case in Germany, according to an interviewee familiar with the national ISM support landscape.

The **capacity of firms to participate in ISM schemes** is impaired by the fact that these usually require a commitment of a certain time-period (typically three years in the case of industrial PhD programmes) and consistent engagement with participating researchers. This is difficult for firms who are required to change or adapt their business strategy on a regular basis who may feel uncomfortable committing to a longer time-period. Survey feedback suggests that around one-third of companies participating in ISM schemes recruit PhD-level researchers on a regular basis, whereas the others do not recruit PhDs every year. Demand varies greatly by academic subject, with the demand being greatest for mechanical engineers, followed by physics, mathematics and health and medical sciences.

Interviews carried out suggest that **ISM schemes can play a role in increasing the absorption capacity of the private sector for researchers**. What is evident from the responses is a general belief in a strong correlation between enhanced skills acquired during ISM, and strengthened employability prospects. Where respondents could provide data, these were supportive of such positive correlation. For instance, according to a representative of one scheme: *"Labour market status of 80% of researchers has improved. This concerns academic advancement, postdoctoral degrees, R&D activity, and the creation of spin-offs. There was no information that anything has deteriorated as a result of participation in ISM."* Another example of a success story: *"From the 5 projects that have been finished, there has been a 100% hiring rate for researchers – meaning they all ended up being engaged with the companies (or sector) in which they conducted research."*

Overall, the interview data supports the claim that taking part in ISM schemes results in many researchers subsequently moving into industry. The survey data is more ambivalent: of 30 respondents who provided an answer to this question (no. 21), while 33% stated that 'yes,' there has been an increase in the number of researchers moving into industry from academic following a mobility experience, 30% stated that 'no', there has not been an increase, and 37% stated that they 'do not know.'

From the interview data, as was put by one of the respondents, the flow goes in the direction of industry from academia, not the other way around. Aggregate quantitative assessment would be difficult to achieve, given the very diverse nature of ISM schemes. Moreover, data is not available for new or ongoing schemes. Where data is available, it can range significantly. For instance, the employment rate of participating early career researchers by participating companies was 20% upon the completion of the scheme, whereas according to the data received from one industrial PhD scheme, some 80% of Industrial PhDs are employed in the private sector. There is also a time factor, as transition from sector to sector can take time.

2.5.3. Transferable skills training during an intersectoral mobility experience

RQ12 – What percentage of researchers received transferable skills training during their mobility experience? What impact did this training have on their future careers? Different reward systems in and outside of academia result in different skills training. There is a focus on research and teaching skills in universities, and less on skill development in terms of management, entrepreneurship and other skills linked to exploitation of results and commercialisation, including

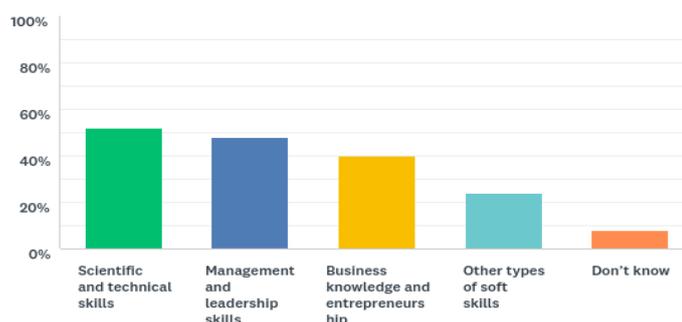
intellectual property rights (IPR). This increases the barrier to transitioning into other sectors after a certain period has been spent in one sector. Hence, supporting the development of transferable skills early on, preferably during a PhD, improves graduates' employability outside academia later on, and also allows them to transition to non-academic sectors later on in their career.

While the **percentage of researchers having received transferable skills training** during their mobility experience could not be ascertained across the ISM schemes analysed for this study, responses to the three online surveys carried out are interesting regarding the prevalence of non-research skills development and their transferability. Out of 30 higher education institutions responding to this online survey question, 18 stated that researchers from their organisation gained general entrepreneurial skills and skills in applying knowledge, and also strengthened their ability to exploit, communicate, and commercialise research results during their participation in an ISM scheme. Language skills were highlighted by 17 respondents. Sixteen out of 30 respondents also believed that researchers from their organisation gained project management skills and knowledge about IPR.

The survey of individual researchers participating in ISM schemes revealed that roughly half the respondents (out of a total of 25) believed they had gained management and leadership skills and skills relating to business knowledge and entrepreneurship. Knowledge of industry standards was also mentioned as a transferable skill by one respondent.

Figure 1.2 – Individual researchers' perception of skills acquisition in ISM schemes

Q21 What type of skills and competences gained during a mobility period in industry were transferable upon returning to academia? (tick one only). Note - transferable is when a skill acquired in one context can be applied or is portable to another.



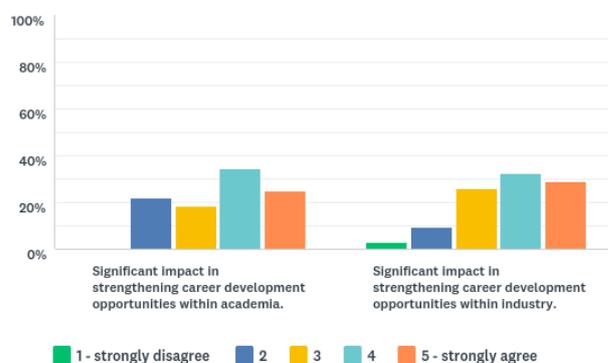
Transferable skills were largely acquired through a **combination of formal and informal training** (56% of higher education institution respondents/54% of individual researcher respondents/70% of industry respondents), or through informal training alone (28% of higher education institution respondents/38% of individual researcher respondents/20% of industry respondents).

Asked about the **degree of transferability** of skills and competences gained during a mobility period in industry when moving back to academia, respondents to the online survey of higher education institutions believed that these were either highly transferable (45%) or somewhat transferable (54%) while no one believed these were not transferable at all. The rationale behind ISM schemes is that **development of transferability skills should have a positive impact on researchers' career prospects**. The online surveys carried out through this study provide some useful feedback in this regard.

A majority of industry respondents to the survey believed that participating in a mobility experience had a high or medium impact on researchers' future career development opportunities. In the case of the survey of HEIs, the majority agreed that researchers from their organisation participating in ISM schemes have had a significant impact on strengthening their career development opportunities within industry, whereas there was less of a consensus with regard to the impact on strengthening career development opportunities within academia.

Figure 1.3 – Higher education institutions’ perception of impact of participation in ISM scheme on career prospects

Q20 What impact has participating in an intersectoral mobility scheme had in respect of strengthening the future career development trajectory of researchers from your organisation?
Please indicate on a scale of 1-5 the extent to which you agree with the following where 1- disagree strongly and 5 – strongly agree



The feedback from the actual individual researchers participating in the schemes is slightly less optimistic, with responses spread more evenly across the scale from 1 to 5 both in case of career opportunities in academia and in industry.

The observation that ISM schemes appear to benefit researchers wishing to return to academia less than those pursuing a career in industry was also highlighted in an interview with a German ISM scheme provider, according to which culturally, it is easier for academics to transition to industry than vice versa. This was explained by the interviewee by the fact that (in Germany) positions in academia are rather limited and there is thus a tendency to reward 'loyal' researchers who did not venture out of academia rather than those who spend some time in industry or the public sector.

While transferable skills obtained through an ISM scheme are important to future career prospects of researchers, some literature also suggests that the skills gained in academia are valuable in non-academic sectors. A study carried out in 2013⁷⁰ surveying PhD graduates 3.5 years after graduation showed that the overwhelming majority of PhD graduates, irrespective of occupational sector, believed the skills and competencies they had developed during doctoral training were highly important in gaining their job, whereas a formal requirement for a doctorate was rare outside HE. This suggests strong transferability of the skills obtained by PhD students in general, irrespective of whether they participated in an ISM scheme before working outside higher education.

To conclude, it was not possible to determine the percentage of researchers having received transferable skills training but stakeholder feedback suggests that skills facilitating the transition from academia to industry, such as entrepreneurship, applying knowledge, commercialisation of research results were acquired by researchers in mobility periods through informal and formal training. While higher education institutions believed that these skills are highly transferable to the academic sector, some stakeholder feedback suggests that the impact of transferable skills on improving researchers’ career prospects is greater in industry than in academia. This may point to a lack of appreciation of the value of such skills by decision-makers in academia.

⁷⁰ Mellors-Bourne, R., Metcalfe, J., and Pollard, E. (2013) What do researchers do? Early career progression of doctoral graduates, Vitae. Available at: <https://www.vitae.ac.uk/vitae-publications/reports/what-do-researchers-do-early-career-progression-2013.pdf/view>

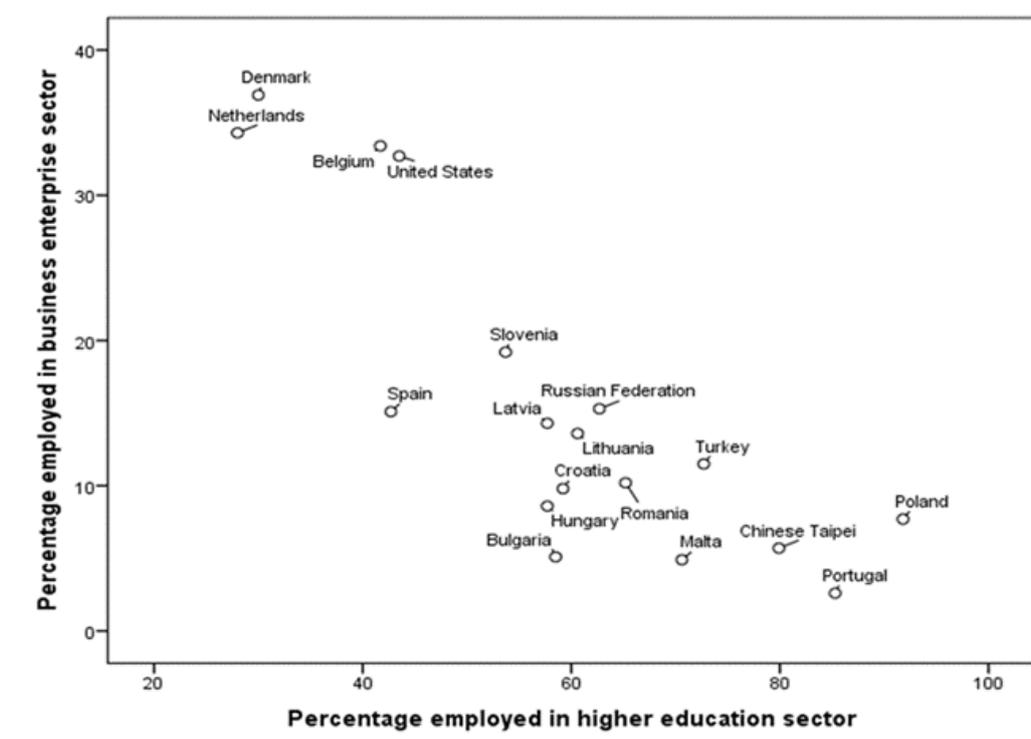
2.5.4. Scheme size and future employability

RQ13 - Is there a correlation between the size of the scheme (researcher numbers and funding) and the number of researchers who go on to find work in a non-academic setting?

There is some evidence to suggest that high investments in ISM schemes (i.e. a large capacity in terms of funding and number of researchers) correlate with a higher share of researchers employed outside academia. However, the nature of this correlation remains unclear. Higher R&D intensity creates a greater demand for researchers in the non-academic labour market, which may encourage governments and academic institutions to invest in training more researchers and preparing them more particularly for a wide range of careers. Alternatively, a surplus of researchers not being able to become professors may result in more non-academic careers and knowledge transfer to industry, and therefore higher R&D intensity. Both dynamics may reinforce one another, and may even occur regardless of the availability of ISM schemes.

The OECD has also undertaken statistical work on human resources in science and technology, more specifically the OECD/UNESCO Institute for Statistics/Eurostat project on careers of doctorate holders based on the Careers of Doctorate Holders (CDH) international survey undertaken in 2009. The OECD data was used in the study Careers of Doctorate Holders survey of 2010⁷¹. This indicates that countries with a larger share of PhD graduates working in the private sector are also the countries with higher R&D intensity as shown in the following Figure.

Figure 1.4 - Percentage employed in the higher education sector



Source - the excel file OECD 2009 CDH indicators, table 11⁷²

Through the Careers of Doctorate Holders survey undertaken internationally, the OECD, UNESCO Institute for Statistics (UIS) and Eurostat have previously cooperated in order to measure

⁷¹ Careers Of Doctorate Holders, Survey 2010, R&D and innovation in Belgium Research Series, Karl Boosten, Karen Vandeveld, Hanne Derycke, Adriana te Kaat and Ronan Van Rossem. R&D and innovation in Belgium. Research Series, <https://www.belspo.be/belspo/ScienceConnection/012/CareersDoctorateHolders.pdf>

⁷² <http://www.oecd.org/sti/inno/oecdunescoinstituteforstatisticseurostatcareersofdoctorateholderscdhproject.htm>

demographic, employment and career characteristics of these persons, as well as their international mobility and driving forces behind this mobility. The survey was undertaken in 2006, 2009 and 2013 only. The OECD is currently trying to set up a CDH “light” repeat, and has repeated its data collection in 2013 – however lacking resources to develop and publish these data. However, as internationally comparative surveys – for this target group of doctorate holders in particular – are labour-intensive and expensive to organise, alternative methods making use of existing national statistics on doctorate holders seems to have become the preferred method.

Some research also suggests that researchers who have been exposed to non-academic work environments – whether through ISM schemes or through collaboration with industry – are more interested in developing careers outside academia. However, impact monitoring of ISM-schemes is scarce, and seldom compares the outcomes of ISM-schemes with similar schemes that are academia-focused (take, for example, the outcomes of academic-based PhD schemes versus the outcomes of PhD schemes which involve ISM). This makes it difficult to disentangle the impact of the ISM-component from the overall impact of the research scheme.

2.5.5. The percentage of researchers finding work in a non-academic institution

RQ14 - What percentage of researchers who participate in these schemes successfully find work in a non-academic institution?

It is difficult to determine what percentage of researchers who participate in ISM schemes find work subsequently in a non-academic institution due to the lack of monitoring data. As noted in the previous sub-section on evaluation and monitoring, there is a lack of systematic monitoring as to the employment outcomes of participants in ISM by academic institutions. There are however proxy data sources for the career destinations of doctoral researchers as explained in the previous RQ.

2.5.6. Key outcomes from participation in ISM schemes

RQ15 – What are the main types of outcomes from participation in ISM schemes? What types of outcomes emerge at the level of outputs, results and impacts? And by type of participant?

This section describes the outcomes observed from participation in formal ISM schemes. The findings should be read with a number of considerations in mind.

Firstly, the types of outcomes discernible will vary depending on the timeframe in question and on the type of participant in mobility schemes. Indeed, the original objectives of the programmes in question should be taken into considerations – as different interventions aim to stimulate different types of ISM. For example, the **Public Sector PhD scheme (OFFPHD) in Norway** aims not to stimulate physical mobility between public sector and academia, (although this may happen), but rather to strengthen and improve the transfer of knowledge and competence between sectors and to increase this interaction.⁷³ Thus, although unintended consequences may occur (positive and negative), the outcomes observed should be gauged bearing in mind the actual aims to be achieved and activities involved in the ISM.

Some country-level interviews pointed to the importance of ensuring an effective ISM scheme design in order to improve outcomes and in particular the sustainability of outcomes. For example:

- Ensure all parties (public and private institutions/firms and the individual researcher) are all involved in the process to encourage buy-in and planning for the mobility period. This could involve developing a joint research plan, which is regularly monitored, is helping to create sustainable partnerships between academic research communities and public institutions focused on strategic challenges.
- The requirement for applicants to demonstrate how the research project will contribute to strengthening research capacity within the public institution should over the medium-longer term help to develop the public sector’s capacity to deliver innovation.

⁷³ <https://www.forskningsradet.no/no/Utlysning/OFFPHD/1253995410398/p1173268235938?visAktive=true>

Clearly also the length and overall timeframe of the ISM period is of significant, not only when considering the types of outcomes that may be observed, but also in terms of differentiating between outputs, results and impacts (longer-term outcomes).

Secondly, as this study has shown, ISM schemes are not available in all countries covered by this study (e.g. FYROM), which includes the H2020 Associated Countries. Some of these are lower-capacity R&I countries, i.e. are countries with less capacity to participate in international research, and – crucially – are likely to have fewer internationally experienced researcher and/or industry with little or no experience in participating in academic collaboration schemes more generally.

Another illustration of differentiated outcomes is that smaller-capacity R&I countries may be put more efforts into engaging in ISM schemes (and international R&I more generally) as this is a prerequisite for maintaining competition. In contrast, academic and industry actors located in larger R&I capacity countries (e.g. Germany and France) may see international cooperation as an important component but one which is less obvious in an already international environment. Therefore, outcomes from ISM participation will vary considerably and limited outcomes can be of importance – in particular for participants in smaller-capacity R&I countries.

2.5.7.1. The benefits of participating in ISM – different stakeholder perspectives.

Overall, the interviews conducted, along with the findings of the questionnaire surveys, show that the ISM schemes studied lead to several benefits within the knowledge triangle ecosystem for researchers, industry and academia. Examples are:

- The establishment of fruitful **personal connections** that lead to achievement of knowledge and knowledge spill-overs;
- **Professional career development**, including through the development of new skills and competences and by opening up researchers' horizons to other sectors;
- A **better understanding of the research needs of different sectors** among researchers;
- The **discovery of new areas of research to pursue and commercialise** (as the researcher gaining industry mobility is then already familiar with industry topics which can facilitate a transition between research and innovation stages);
- The submission of **joint research grant applications** submitted by academia and industry for new projects taking place outside the ISM scheme as a follow up and/or the development of **joint research publications** as a result of collaboration which would otherwise have been difficult in an industrial research environment;
- **Improvements in academic teaching** - gaining hands-on experience in an industrial research setting has led to improvements in teaching once back in academic, for example, through a greater focus on research-led teaching approaches;
- Participating in ISM schemes was also found to have contributed to **enhancing economic growth**, although further research is needed to gather evidence on this aspect.

Many researchers and representatives of the stakeholders involved mentioned that the most relevant benefits are: networking, internationalisation, the development of new innovations in products and services and commercialization of the research.

As reported above, in some cases there is no evidence of positive outcomes. However, programme agencies like KOWI in **Germany** see an annual rise in the number of applications as a positive indication of the attractiveness of their ISM programme (in addition to anecdotal feedback from individual research participants that is overall positive. Furthermore, many institutions supported submit follow-up applications).

Overall, the outcomes observed – regardless of the type of actor – are positive and mostly expected outcomes (i.e. in line with objectives and expectations). Some anecdotal negative outcomes (results) were reported from interviewees in **Bulgaria**, who reported **that academic researchers undertaking mobility periods in industry rarely returned to academia due to the significant salary differences** between the public and private sector in the country.

The more detailed findings in relation to the benefits identified by stakeholder category are now presented:

2.5.7.2. Benefits for individual researchers

The general consensus, expressed by interviewees from universities, industry, Ministries and government agencies overseeing ISM schemes, as well as researchers themselves interviewed during the current study, is that participation in ISM schemes has a strong positive impact on researchers (a finding corroborated by the survey data). This is noted with regard to the development of their scientific and research skills, the development of new research ideas, strengthening their employability in the private sector through the acquisition of transferable skills, making new contacts, and developing a first-hand understanding of how industry works, given that bridging the gap between industry and academia is often identified as a gap.

For instance, in ISM schemes that involve PhD students, many questioned stated that researchers acquired more practical and transferable skills compared with a conventional PhD. The participation in these schemes has a considerable impact on their future careers because they are getting an education that is industry oriented with several years of practical experience that gives them a much better career basis than traditional PhDs give.

In several interviews conducted we have collected strong hints of the ISM schemes' usefulness for researchers. The number of applications is rising each year, being an indication of positive results and the attractiveness of the programmes.

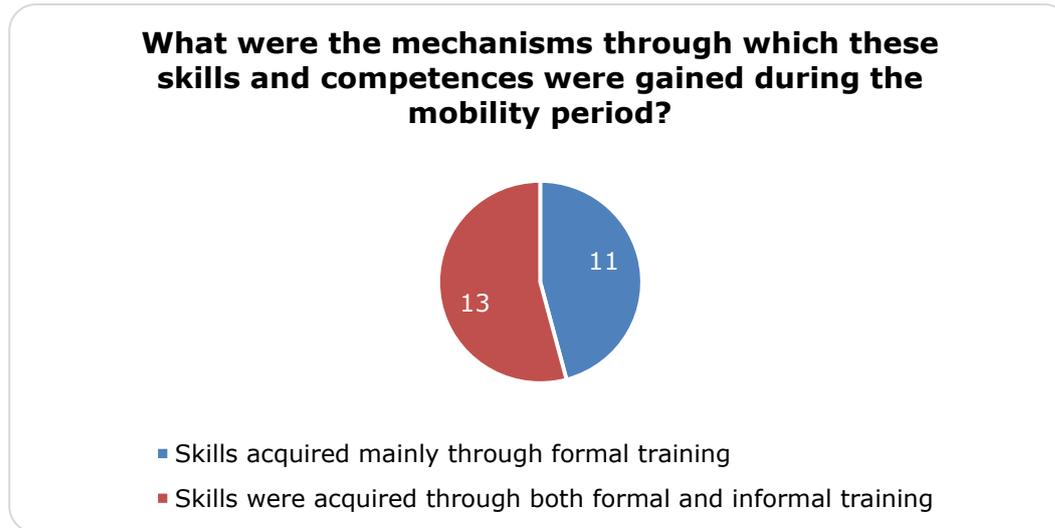
Another issue explored was the employment rates and incomes that are higher than the average of other PhDs or Doctorates. Other relevant key feature, mentioned several times, is that it becomes accessible to find employment in the specific areas that the researchers desire. In several of the cases assessed the company participating in the scheme offered a possibility of employment to the participating researcher or these were directly employed after the end of the mobility period.

The development of their skills and expertise is another advantage mentioned frequently in the interviews conducted. These researchers can be in touch with critical subjects while exchanging valuable information, learning good practices and gaining experience, which facilitates their transition to industry afterwards. This gives them the opportunity for a solid career development, to build useful partnerships, space for applying research results in practice, thus satisfying different social needs. Thus, they can enrich their careers, establish relationships and enhance their future collaborations. For instance, in ISM schemes that involve PhD students, many of those questioned stated that researchers acquired more practical and transferable skills compared with a conventional PhD. The participation in these schemes has a considerable impact on their future careers because they are getting an education that is industry-oriented with several years of practical experience that gives them a much better career basis than traditional PhDs give.

In **Denmark**, participation in industrial post-doctoral schemes has been proven to significantly boost career outcomes, both in terms of employment rates and income.⁷⁴ Participation in ISM schemes was viewed as having had a considerable impact on the future career prospects of PhD researchers. Getting an industry-oriented education and already having 3 years' practical industry experience will give them a much better career basis than traditional PhDs have, especially given the very limited number of posts available at Danish universities. Although limited in number, our survey results indicate that skills gained during a mobility period were the result of both informal and formal training.

⁷⁴ Danish Agency for Science, Technology and Innovation: The Effect of the Industrial PhD Programme on Employment and Income. December 2012, Oxford Research A/S

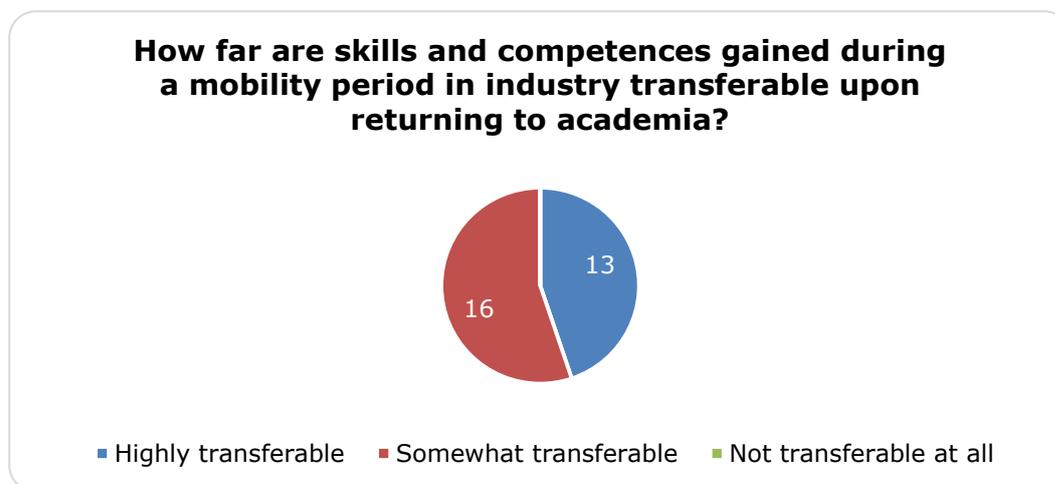
Figure 1.5 Mechanisms through which skills were gained



Source: Study survey

Moreover, the skills gained during the mobility period were equally considered to be highly or somewhat transferable once the individual returned to an academic environment, as indicated in the figure below.

Figure 1.6 Transferability of skills gained



Source: Study survey

National and international ISM schemes have also helped to strengthen the reputation of experienced researchers and of the organisations taking part in such schemes. From a researcher perspective, taking part in a mobility experience is a means of strengthening networks and enhancing the professional career development process.

Another advantage we have determined is related to the circumstance of working with different research groups and having access to different methods and broadening research horizons by experiencing research realities and problem-solving in different settings.

Although some universities pointed out that a disadvantage of ISM is that researchers tend to neglect their academic responsibilities whilst working in an industrial setting. However, this was generally seen by most interviewees as being compensated by the overall benefits, such as acquiring new knowledge, skills and competences. Examples were identified of researchers and academics at different research returning at the end of an intersectoral mobility period and being

able to establish new research groups and to transfer knowledge, skills and competences to their colleagues.

With regard to the main drivers, respondents have identified the following factors:

- Global trends, such as better opportunities and financial prospects;
- Effects of the economic crisis felt in some countries, resulting in researchers either leaving their home countries in order to work in industry abroad, or working remotely for foreign companies;
- Lack of employment prospects in academia, and over-supply of doctoral researchers in some countries;
- Improved financial rewards in the commercial sector.
- Improved financial rewards in the commercial sector.

2.5.7.3. Benefits for academia and publicly-funded research

In this section, a number of benefits of taking part in ISM from the point of view of **academia and publicly funded research institutes** are examined. This relates to benefits seen from the perspective of the broad spectrum of stakeholders participating in ISM. This ranges from Research & Innovation Agencies (RIAs), Higher Education Institutions (HEIs), Research and Technology Organisations (RTOs) and Research Institutes. Among the main benefits identified are:

- **Fostering a closer relationship between academia and industry through networking and the establishment of sustainable partnerships between scientific and business institutions.**
- **Promoting the internationalisation of researchers.** There is evidence that HEIs and RTOs that internationalise perform better on key scientific metrics.
- **Strengthening and broadening the skills and competences of researchers** – although from the point of view of academic institutions, there is a risk that top researchers leave for more attractive prospects in industry (especially in countries where brain drain is a problem), many researchers will return to an academic research setting upon completion of an intersectoral mobility period.
- **The ability to catalyse new potential sources of revenue through closer links with industry** and through a greater emphasis on supporting applied research projects which allow researchers the flexibility to go out into the research and business community on an arms-length basis to develop new innovations in products and services and through the commercialisation of research (including licensing and other IPR exploitation).

One of the main benefits for academia is the fact that early-stage and more experienced researchers on the research staff of a particular department can gain critical experience for current business challenges in different industries and incorporate this into the design of educational course content for Masters' students and PhDs. This can make the universities more appealing for students who want to be better prepared for achieving success in a competitive world. Universities face the challenge of retention of researchers, since the difference in salaries between academia and industry is extremely high, especially in countries with lower salaries where public universities cannot compete with big corporations.

Access to funding is another key benefit from these schemes, since this funding can create the right conditions for undertaking new research and for ensuring that research activities can be carried out over a sustainable time period. The number of proposals for research has augmented because academics want to ensure more funding coming from these partnerships with private sector. Another point raised was that participation in ISM schemes can lead to improvements in the quality of research. Some academics mentioned that the number of research publications has increased, once researchers have returned from embarking on an intersectoral mobility experience.

The survey results support this evidence, and draw attention to a number of quantifiable benefits noted by respondents, with the following highlighted in particular: Increased research funding;

increase in the level of contract R&D (e.g. through enhanced visibility of R&D capabilities); a rise in the number of scientific publications, and in the number of citations.

From the perspective of the public sector – public sector innovation has become a bigger priority in some countries (e.g. Norway) in order to strengthen innovation capacity and to develop an improved knowledge base as to how to solve strategic challenges and problems faced by different types of public sector institutions across different sectors. Improved collaboration with academia is thus an important channel for improving performance.

2.5.7.4. Benefits for industry

2.5.6.4.1. Overall benefits for industry

The research identified a number of benefits for industry of taking part in ISM. In analysing these, it is necessary to distinguish between different types of benefits and advantages seen from the point of start-ups, SMEs and large firms respectively. Overall, there are multiple benefits for companies as a result of taking part in ISM, such as:

- Serving as a recruitment mechanism for industry to identify highly-talented industrial researchers, especially in sectors where there are skills shortages;
- Supporting human resource development within companies by investing in the qualifications and career progression of highly-skilled industrial researchers (this applies mainly to industrial PhD schemes where the researcher spends more of their PhD working in a company environment).
- Strengthening the technical expertise of R&D departments in specialist research areas;
- Enriching the internal research capacity and know-how of firms;
- Enhancing the capacity of enterprises to innovate and improving their ability to create new and innovative products and services
- Improving process and organisational innovation; and
- Promoting technology-transfer through spin-offs and start-ups creation, mainly from universities to innovative clusters such as in science parks and incubators, often located in proximity to higher education and publicly financed research infrastructure.

Many companies interviewed said that ISM schemes are an **effective mechanism for the recruitment of highly-skilled researchers**. Although it was acknowledged that there can be challenges in overcoming stereotypes about doctoral researchers in some countries (i.e. that they may be too academic in their orientation), the majority of interviewees considered academic researchers or researchers carrying out an industrial PhD already working in industry to be an important pool of research talent. Some benefits, especially those involving the development of new innovations and technologies and new firm creation may require a long-term approach before outcomes fully materialise. It may therefore take some time before the desired effects of taking part in ISM schemes are fully visible.

Offering mobility experiences through an ISM scheme was seen as beneficial by firms since researchers gained transferable skills that enhance their future employability, and gain experience of working practices in industry. This is especially the case for those participating in industrial PhDs and in longer-term mobility placements in companies. Researchers that undertake mobility periods in industry demonstrate that they are used to working under tight deadlines and time pressure.

2.5.6.4.2. The benefits for large firms and SMEs

Regarding **differences in the perception of the benefits large firms and SMEs**, larger firms generally found it easier to participate in (and benefit from) ISM schemes due to having stronger managerial and human resource management capacity. Moreover, commonly within large firms, applied research projects are ongoing and doctoral or post-doctoral researchers can be slotted in relatively easily. The interview feedback found that large companies taking part in ISM have well-defined objectives from participation, such as identifying future recruits, generating patents and the commercialisation of research results. These big companies tend to invest in a long-term approach to R&D with research projects designed to foster incremental innovation but sometimes also disruptive innovation.

A common constraint within **small firms** is that R&D activities are overly-dependent on the degree of personal commitment of the individual researcher participating in the mobility period, making it difficult to institutionalise intersectoral mobility as an effective approach at the organisational level. That being said, some successful examples of ISM being implemented within SMEs as part of nationally and EU funded ISM schemes were identified.

Some national authorities stated that **many SMEs need guidance about the advantages they can derive from collaborating with academia**. Almost every company referred to networking and access to research know-how as one of the most important benefits. In addition, companies gained access to competent researchers at a reasonable price and were able to conduct research to solve concrete research/development challenges. Researchers bring new approaches to conducting industrial research, a different perspective and new approaches and solutions to identified problems. Participating in these schemes is therefore a “cost-effective” way for companies to gain access to new knowledge and to R&D outcomes. Industrial fellows were found to have established durable relationships with universities that they have partnered with.

Small companies are also interested in recruiting the brightest researchers but also benefits from the new approaches that academic researchers can bring to address internal challenges and research into new innovations. Some national authorities mentioned that many SMEs need guidance about the advantages of collaborating with academia in general and of participating in intersectoral mobility in particular. An SME in France mentioned that especially with the support of not-for-profit organisations such as ABG which help to prepare researchers for ISM and to raise awareness about the benefits among companies, SMEs gain a better understanding of the competences and capabilities of researchers. SMEs that have already taken part in an ISM scheme increasingly appreciate the advantages of recruiting PhD students since they are adaptable at working in different areas of the business and are able to undertake research projects working in relative autonomy (the SME may lack the managerial resources to adopt a more hands-on approach to managing researchers).

2.5.6.4.3. Industry perspective on the benefits of local, regional and transnational ISM schemes

As explained earlier in the report (see RQ5 on the major types of schemes), many formal intersectoral mobility schemes operate either at national level or on a localised basis. There is a logic to companies engaging with universities and public research institutes locally or regionally in order to meet their future recruitment needs. Multinational companies such as Philips stated that collaboration in domestic schemes is quite useful in leading to the creation of **regional hubs** which are useful in identifying and hiring young researchers at a local and regional level. Transnational collaboration was also seen as being useful however in terms of fostering learning and the development of new approaches and in meeting new specialist partners.

However, some stakeholders interviewed mentioned that **transnational ISM schemes** bring a wider perspective and help to identify research solutions to problems and facilitate international networking. ISM schemes help to strengthen the absorption of new technologies that would have otherwise been difficult to develop and bring to the market within a smaller research and innovation ecosystem and / or a small domestic market.

Transnational ISM schemes are important for gaining access to, and participating in established international research/innovation communities, especially in smaller countries. In smaller countries and in countries with less well-developed R&I systems, it was seen as being particularly important for researchers to take part in international researcher mobility schemes, including those with an intersectoral dimension, in order to gain a better overview of global developments in R&I in particular scientific and research disciplines.

2.5.6.4.4. Other outcomes from an industry perspective

A few ISM schemes examined have led to the **creation of spin-offs and new start-ups**. For instance, the **ETH Zurich Pioneer Fellowships scheme in Switzerland** provides an opportunity for researchers to develop their own research ideas within a different setting, through funding for research projects to commercialise new innovations. Provision is made for the exploitation of IPR relating to new innovations and technologies through licensing and spin-off creation. In the case of several other schemes, patents were filed and innovative products were licensed. Indeed, the initial review of indicators commonly used in ISM schemes found that patents are among the most commonly used indicators in monitoring scheme implementation.

The different stakeholders interviewed agreed that most companies that participated in ISM schemes are very satisfied. Since the applied research sector is close to business the innovation path from idea through to research results and commercialisation can be accelerated and innovations can be transformed into innovative products, services and applications more quickly to address societal challenges. Such collaborative research tends to lead to the establishment of sustainable forms of cooperation between academic institutions and industry.

Another benefit is that companies often lack suitably qualified human resources and those employing industrial researchers may find it difficult to identify relevant expertise in the labour market. Having access to academic researchers that have already been prepared as PhD students to be flexible and equipped with the transferable skills to work in an industrial research environment can help to mitigate any resourcing shortages. Here, reference should be made to Case Study 5 on preparing researchers for ISM.

Some companies prefer to sponsor and organize the entire scheme themselves in order to be in control of how the researchers are involved, and to customise the training in a way that allows them to identify the right candidates for future leadership positions inside their organisation.

2.5.6.4.5. Differences between sectors in the nature of benefits

It is also important to note that the experiences of firms (irrespective of their size) of taking part in formal ISM and / or recruiting PhD and post-doctoral researchers across different European sectors and industries. The perceived benefits – and extent of engagement – by industry is partly dependent on how research-intensive the particular sector is, the extent to which there are supply-side challenges in recruiting appropriate industrial talents and on the demand side, is influenced by which industries have greatest demand for PhD and post-doctoral level researchers. A number of examples of the perspective of firms from across different industries are now provided.

In the **pharmaceuticals sector**, PhD level recruits are crucial to many companies which are R&D oriented. Researchers recruited at PhD and post-doctoral level are mostly employed in R&D, but also in the manufacturing and quality control divisions. Most of the PhD recruits come from the fields of pharmacy, chemistry and biotechnology.

In software development, for some companies, developing research proposals for projects helps them to enhance their market valuation. The development of new algorithms requires staff with programming skills, and it is therefore necessary to recruit PhD-level researchers with the necessary skills. For large industrial companies, such as **Philips, Volkswagen, and Pirelli**, providing intersectoral mobility experiences has served both as a recruitment channel and had benefits stemming from the research projects themselves. Having skilled PhDs or academic researchers in their laboratories allows them to check whether researchers fit in with the company culture, analyse their skills and identify the brightest industrial talents. For Philips Health Sector, gaining access to clinical data from universities and research institutes that would otherwise be difficult to access is seen as valuable. Furthermore, it is important to have good relations with hospitals because they are potential clients. Additionally, whereas hospitals tend to focus on basic research due to funding constraints, cooperating with companies is beneficial for universities and hospitals since it allows them to conduct more applied research, which they would find difficult to fund without joint cooperation.

The following scheme from Italy is a privately funded scheme, which has been operating since 2001. The CORIMAV scheme involves close academic-industry cooperation using ISM as a mechanism to promote broader forms of research collaboration.

Table 1.17 - The CORIMAV scheme in Milan, Italy, cooperation between Pirelli and Bicocca University

Description: The CORIMAV scheme in Milan, Italy, was established in 2001. The scheme is targeted at PhD students seeking to develop a career in industry. Pirelli, the tyres company, finances PhD fellowships for Materials Science students at the Bicocca University (a relatively new university, which is only 20 years old). The scheme has now been operating for 17 years. When the scheme began, CORIMAV was a one-year post-doctoral fellowships programme, with 5-6 fellowships awarded per year. This approach worked for the first 5 years, but a transition was subsequently made towards funding full 3 year industrial PhDs. The rationale was that this allows Pirelli to stipulate industry-relevant research topics relating to tyres and to fully exploit the research outcomes. Since 2010, the focus has shifted to working only on technologically-

relevant research.

Objectives: The evolution in scheme objectives over time is interesting. The initial objective was to *"develop cutting-edge technologies in the field of new materials, to support research and experimentation with the aim of producing patents, and to promote initiatives for training and professional updates for new researchers"*. The first phase of the CORIMAV programme provided scholarships aimed at three principal areas: nano-composite materials, energy transfer (superconductivity and distributed generation) and molecular modelling. The consortium has evolved over the years, as have the research aims and needs of Pirelli as the company itself evolved and split into two separate companies. Since 2010, research is therefore increasingly focused on tyre production. The rationale for this is that when the scheme was set up, Pirelli had two divisions, tyres and cables with research labs but the firm now has an exclusive focus on tyres. In the last six years, CORIMAV has transformed itself into the preferred mechanism to channel knowledge and resources between the university and the company.

Scheme management and governance: The industry-academic consortium agreement between Pirelli and Bicocca University is renewed once every 5-6 years and was most recently renewed in 2017. A board has been established which is responsible for taking key strategic decisions regarding the scheme including overseeing spending of its annual budget.

Eligibility criteria: When the scheme started, the focus was mainly on attracting applicants from materials sciences, but today the target group is broader and open to PhDs in other disciplines including biotechnology, environmental and computer sciences.

Funding source: In terms of cash funding, the scheme is entirely privately funded by Pirelli. However, in-kind financing contribution has been provided by the university in terms of making personnel and administration available to support scheme implementation, and infrastructure.

Costs: Whilst the total scheme costs are confidential, the approximate costs can be estimated. In any one year 9 PhDs are funded (3 new PhDs and 6 ongoing PhDs in their second and third year). The salary of a PhD in Italy is €18,000/ year or circa €50,000 for a full PhD. This implies annual funding of €162,000 plus any administrative costs. It should however be noted that the costs of PhDs are relatively low compared to other countries. CORIMAV also supports the salary costs of a full-time researcher position, with a cost of 50,000 Euro/year. The researcher position is higher than a post-doc and assumes a key role in supervising the activities and ensuring regular scientific research related contacts between Pirelli and the University. In addition, there are also running costs for laboratories and for research experiments.

Skills development and training: The university's doctoral school provides taught courses to PhD students on management, IP and bringing products, innovations and ideas to the market.

Supervision: PhD students are allocated both an academic and industrial supervisor during their studies and having an input from both sectors was regarded as an important characteristic of effective practice.

Scheme outcomes:

- **Scheme participation:**

- Between 2001-2016, 44 student scholarships and 36 doctoral scholarships were supported.
- Whereas 5-6 fellowships were awarded per year for the one-year fellowships, following the transition to a 3 year PhD, 3 new PhD Fellowships schemes are supported each year (meaning 9 ongoing PhDs)
- Around 20% of fellowships historically were hired but since 2010 and the recovery from the crisis 40-50% of scholars have later been hired by Pirelli. The most recent two PhD scholars were both hired and their research contributed to two patent applications on new materials for tyres to reduce energy consumption;

- **Impact on employability:** Although there are no statistics available on the employability of PhD graduates completing PhDs, industrial PhDs are attractive to

industry and Pirelli has recruited many of those completing the scheme.

- **IPR:** Since the scheme was set up, approximately one patent has been filed per year. Patents are registered as co-patents with the University as a co-inventor but Pirelli has the right to buy out the industrial rights and to compensate the inventors.

Evaluation and monitoring: No external evaluations have been undertaken but the Board established regularly reviews the outcomes achieved through the research fellowships schemes.

Success factors: Physical co-location at the same site has facilitated the scheme since Pirelli and the university are located in close proximity which has meant that it was more easily feasible for researchers to work part-time carrying out research at the university site and part-time at the enterprise.

Lessons learned:

1. It takes considerable time through an industry-academic consortium to build up reciprocal trust and to develop a common cultural understanding as to what can be achieved through joint cooperation if you want to be effective in undertaking collaborative research together.
2. Time is also needed to allow IPR-related rules to be homogenised. The company funding the scheme has strict rules on IPR and it has taken some time for the legal offices of the two respective parties to strike the right balance in terms of IPR sharing arrangements.

Elkem, a large firm in the production of metals and materials field, has set up an ISM scheme which is 100% financed by the company. Through the scheme, researchers are integrated into research teams and receive mentoring and coaching support. The purpose is to identify and recruit researchers that are identified as being the right cultural fit for the company. As a result, Elkem is able to have the opportunity to assess the abilities and cultural values of skilled researchers before hiring them. Large companies that want to hire people with the right skills and give them a proper training are normally willing to pay the full costs associated with taking part in the scheme.

2.5.7. Correlation between ISM schemes, IP generated and start-up/ spin-off creation

RQ16 - Is there a correlation between ISM schemes and the number of patents, innovative products and services created, spin-offs started by researchers?

As described in the section on monitoring and evaluation (2.5.1.1), our desk research and primary investigations show that only a handful of ISM programmes are evaluated – and even fewer collect appear to collect data which can be used as a basis for assessing commercialisation of research results (e.g. patents, innovative products and services created, spin-offs). This is also confirmed by investigations done by the JRC in 2016,⁷⁵ which concluded that “policies to foster intersectoral mobility are in place in almost all [Member States]. Many of them have been implemented for several years now, yet readily available evaluations are scarce. In the small sample of the evaluations we have analysed, the evaluations provide evidence of the positive impact of those measures on researchers' skills and employability. Also, there are some evaluations which report some limited positive impact on patents' and publication propensity as well as the R&D intensity of companies” (see also RQ11).

Even if outcomes relating to the commercialisation of research and innovations are not always measured and/or achieved, ISM programmes do help to improve industry awareness of knowledge transfer, and also increase the absorptive capacity of firms for internal and external R&D, strengthen academia.

Vice versa, the JRC also suggests that policy measures supporting spin-off creation have had an indirect (positive) impact on intersectoral mobility. “By fostering a culture of entrepreneurship in

⁷⁵Hristov et al (2016) Intersectoral mobility and knowledge transfer. Preliminary evidence of the impact of intersectoral mobility policy instruments. JRC Science Hub

university teaching, research and management; developing the potential for business ideas at universities and research institutions in a targeted manner; and promoting the translation of research findings into economic value; they have helped increasing the number of innovative business enterprises and created employment for public sector researchers in the private sector.”⁷⁶

As consistent data are not available, the evidence of correlation between ISM and commercialisation of research is by and large anecdotal. Cross-references should be made here to the above sections 2.5.3.4 on ISM benefits to industry and to 2.5.1.1 on monitoring and evaluation, which also provides some anecdotal outcome examples.

Although evidence is somewhat scarce, anecdotal information was identified in a range of EU Member States, although the extent of outcomes varies – just as there are stark differences in Member States’ performance across a number of widely adopted knowledge transfer indicators. The investigations suggest that (*inter alia*):

- Short placements may increase awareness among companies of knowledge and technology-transfer activities and helps to build trust between the actors. However, although commercialisation-like outputs do occur, evaluations do not point to significant tangible outputs such as increased patenting activities or co-publications.
- In contrast, longer post-doctoral placements create a personal relation with the company and more often result in prolonged collaboration, including larger-scale R&I projects with commercialisation prospects and/or in the offer of permanent employment in the host company.
- Programmes targeting specific groups (e.g. women, SSH researchers) are mostly pilots and too limited in scope to yield sufficient measurable impact for these types of outcomes.

2.5.7.1. Benefits for government and the third sector

Section 2.5.4 provided examples of mobility between academia and government and public institutions. Mobility opportunities into government are diverse, and range from secondments of young researchers, as well as experienced researchers to the civil service to work on specific policy-focused research projects to schemes for Masters’ graduates and post-doctoral researchers to undertake medium-term internships within government bodies and institutions. There are a number of benefits for government and the third sector of participating in ISM schemes, as evidenced by the following table which provides examples:

Table 1.18 - Benefits for government

Examples of benefits	Country	Scheme implementer	Specific schemes where benefit was identified (non-exclusive, illustrative only)
Supporting innovation in the public sector through focused and application-oriented research projects Supporting knowledge exchange between public sector organisations and research institutions.	DK	Danish Innovation Fund	Industrial Postdoc in the public sector. Seeks to develop researchers with knowledge about R&D in the public sector and to build networks.
Accessing high-quality interns and potential future recruits.	IT	Bank of Italy	Two fellowships schemes 1) Research Fellowships for Economists and 2) a Scholarships Scheme for Graduates). Some fellows showing strong potential are offered full-time permanent positions following

⁷⁶Idem.

			the completion of internships.
Opportunity to strengthen research capacity to improve policy-making in government	UK	Royal Society	Policy Secondment Programme. Provides researchers with placement opportunity to work in a science policy environment in government.
Accessing high-quality research support to support research activities	UK	Parliamentary Office of Science and Technology (POST)	POST Fellowships Scheme (for PhD students) and Parliamentary Academic Fellowship Scheme (for academics)

In addition, in Section 2.5.5, examples of mobility to the third sector were identified. A number of **benefits for the third sector** can be discerned from an examination of schemes involving third sector participation. Some of them are similar in nature to the benefits experienced by firms and government, but NGOs and third sector organisations often face considerable human and financial resource constraints too. They can therefore benefit considerably from having PhD or post-doctoral researchers undertake a period of mobility within their organisation for instance in terms of:

- Having access to high-quality researchers to support the development of internal research capacity.
- Supplementing available human resources for ongoing research projects, leading to the development of new publications.
- The opportunity to identify talented potential recruits with a genuine interest in developing a future research career working in the third sector, for instance through offering internships, secondments and placements to researchers.

More generally, the NGO sector is often involved in areas that are addressing significant societal challenges, ranging from the environment to health care. These have become the focus of policy debate in the last ten years and considerable research efforts at an EU and national area. There is therefore significant scope for knowledge transfer across a wide range of disciplines in these areas and schemes that encourage academics to work with NGOs in ISM arrangements have an important role in promoting this knowledge transfer, not least in supporting the development of evidence-based practice within the NGOs.

2.6. Drivers and obstacles to intersectoral mobility

The purpose of this section is to provide a summary of the main drivers and obstacles to participation in intersectoral mobility schemes. The findings draw on a combination of different evidence sources: desk research, interview feedback and data from the questionnaire surveys. In this section, two specific RQs are addressed:

RQ17 - What were the main drivers of participation in ISM? How do these differ by stakeholder type?

RQ18 - What are the main obstacles that can be observed in implementing intersectoral mobility schemes? What are the specific obstacles that have been encountered?

These may regard *inter alia* recruitment, joint supervision and training, mutual recognition of training acquired in the private sector, mutual supervision, communication channels between the researcher and supervisors in the academic and private sectors, and Intellectual Property Right (IPR) issues?

2.6.1. Drivers of participation

RQ17 - What were the main drivers of participation in ISM? How do these differ by stakeholder type?

The drivers of participation were found to vary according to the stakeholder type concerned, i.e. individual academic and industrial researchers, universities, companies, government and public sector organisations, etc.

Among the drivers of participation in intersectoral mobility schemes identified from a **researcher perspective** are:

- **Lack of opportunities to develop a rewarding academic career, given the over-supply of highly-qualified persons produced by higher education systems.** In countries such as Ireland, the UK and France, there is arguably an over-supply of highly-qualified researchers relative to the number of academic posts available. Researchers are thus looking for ways to apply their research skills outside of traditional research settings. Promoting inter-sectoral mobility is one way of overcoming problems such as post-doctoral unemployment, whilst boosting industrial talents through research and innovation in local industry. France, for example, uses a mixture of tax credits, industrial research contracts and capacity-building measures to try and increase the number of post-doctoral researchers working in industry. Vitae in the UK encourages researchers in academia to think more holistically about their future career as a researcher, and to undertake professional development training in order to broaden their research horizons beyond the academic world.
- **Professional career development opportunity to enhance research careers –** a further common reason why researchers take part is in order to strengthen their career as a researcher by broadening their research horizons by gaining exposure to different types of research environment. This relies however on their academic institution and career appraisal system recognising the value of time spent within industry or otherwise outside academia, which is not always the case (e.g. **France**).
 - In the **UK, Denmark and Sweden**, an effort has been made to explicitly recognise time spent in a research environment within industry as part of researchers' career appraisal and development.
 - In **Bulgaria**, a significant proportion of people already working in industry apply for PhDs in order to improve their qualifications and thus their career opportunities within their own organisation or sector.
 - In **Portugal**, some medium and large companies consider strategic to incentive their workers in investing in PhD Studentships in Industry (BDE), at two levels: i) in the motivation and career's development of their workers in the company and ii) in the promotion of conditions and expertise for the development of innovative products for the company.
- **Interest in developing a future career in industry, government or the third sector –** some researchers participate in ISM since they would like to pursue a career outside academia in future and view participation in ISM as being an essential stepping stone. ISM schemes give them the opportunity to strengthen their CV and research credentials, and to gain an insight into the opportunities available in other industries.
 - In **Austria**, for example, students viewed ISM schemes as a way of trying out careers outside of academia on a temporary basis, before deciding whether or not to make the transition more permanently.
 - In **Israel**, the Israeli Tech Challenge (ITC) Fellows Programme is an accelerated professional development programme for Cyber Security or Engineering graduates with at least two years' experience in industry to acquire advanced tech skills in Israel. The 10 month programme involves 5 months' rigorous training in Data Science and Cyber Security, followed by a 5 month paid internship placement at innovative tech companies in Israel. Teaching staff are recruited directly from industry and the objectives are to accelerate the career development of researchers and to provide them with a conduit into high-tech industry.

- In **France, Spain and Luxembourg**, the intersectoral mobility of researchers is seen as a strategy to strengthen and expand the career opportunities of researchers and PhD students outside of Universities.
- **Interest in pursuing a specific research project that would be difficult to pursue within an academic environment.** Some research projects pursue commercial objectives, and involve transferring knowledge and new innovations to the marketplace. Whilst in principle it is possible to conduct such projects whilst remaining within a research environment, it can be difficult to do so (for instance because the university encourages spin-off creation, and for licensing and IPR reasons, it may be more appropriate to support such research projects through mechanisms that allow research to take place through the use of flexible mechanisms and structures at arms-length from the university itself – see Section 2.4.5 on IPR and ISM). Some researchers are looking for innovative structures to enable them to bridge the gap between industry and research.
 - In **Iceland**, the Icelandic Institute for Intelligent Machines (IIIM) allows researchers to apply their skills to developing prototypes, which are commercially viable whilst still allowing them some of the freedoms associated with pursuing research in an academic context.
 - In **Switzerland**, the Pioneer Fellowships scheme operated by ETH Zurich awards research grants to an individual or groups of individuals to independently develop a highly innovative product or service to be exploited commercially and/or for the benefit of society. They are awarded to candidates who want to become entrepreneurs based on their own research carried out during their Master or Doctoral Thesis at ETH Zurich (i.e. during the Master or the PhD). Successful candidates receive money for the 1.5-year test phase of their idea, before bringing it to the market.
 - In **Portugal**, especially in what concerns higher education institutions with a wide activity in ICT, R&I&D, Engineering and other emergent areas, there is an increased interest in taking part and benefit from program promoting intersectoral mobility of researchers or PhD students. By these, researchers and PhD students can have access to equipment and tools that they don't have in their Universities and to perform applied research, with real impacts in different industry sectors
- **Under-developed research and innovation systems.** In some countries, previous studies have found that R&I systems are less well developed and have less internal capacity. They may be dependent on attracting international researchers (including intersectorally mobile researchers) to strengthen their competitiveness. This can serve as both a driver and inhibitor of participation in ISM. If a researcher wishes to pursue a project at a high Technological Readiness Level (e.g. at TRL 6, 7 or 8 which involves 'close to the market' demonstration projects and the development of prototypes), it may not be realistic to pursue such a project within academia, necessitating the researcher finding a way of carrying out the research project within industry.
 - In countries in the **Balkans**, such as **Bosnia and Herzegovina** and in **Serbia**, although it is possible to take part in H2020 as associated countries, there are weaknesses in the R&I system, and a lack of sufficiently well-developed
 - In **Malta**, it is not uncommon for university professors to take sabbaticals in order to work in industry in order to pursue more commercial research goals.
- **Strong demand from industry for doctoral and post-doctoral researchers in industry in some countries (see section 2.3.2 which explores the level of demand in further detail).** As noted earlier, although a supply-demand imbalance may paradoxically spur temporary and permanent recruitment of PhD level and post-doctoral researchers, by encouraging public programmes and measures to tackle the problem, there is a problem in other countries of under-supply of highly-qualified researchers, especially in new and emerging sectors where industry demand is greatest.
 - In **Iceland**, the pull of industry is so intense that it can cause a real problem for academia. Evidence from the interview programme suggests that Icelandic computer science students are so sought-after that they are moving to industry before completing their undergraduate studies – thus creating a brain drain from academia to industry.
 - In **Bulgaria**, the **Czech Republic**, **Lithuania**, **Romania** and elsewhere, there is a large dichotomy between the salaries of researchers working in publicly funded

research, and equivalent salaries in industry. This serves as a pull factor towards industry, especially since salary multiples of researchers employed on EU RTD FP projects have been restricted in Horizon 2020⁷⁷. It can be noted that young researchers – including post-doctoral researchers may not always leave to pursue a research career, and may either emigrate or pursue a career in another sector that does not necessarily fully utilise their research skills (i.e. the problem of brain drain).

The findings of the questionnaire surveys corroborate the findings listed above, and also point to the opportunity to acquire new skills and competencies as a strong driver.

Among the main drivers of participation in intersectoral mobility schemes identified from a **government**, as well as a **higher educational institution / research institute/ RTO** perspective are:

- **An important policy driver is the desire of governments to obtain a greater economic and social return for their investment in higher education**, especially when it is widely believed that European universities are capable of producing world-class research, but European societies are less able to translate this into economic leadership. This can be seen particularly where inter-sectoral mobility schemes are linked to solving broader societal challenges (e.g. in the Netherlands and France).
- **The opportunity to strengthen industry-academic cooperation and to generate income.** Many universities and research institutes have established mechanisms in order to strengthen cooperation with industry in order to generate increased funding opportunities (e.g. from future licensing of IP, spin-off creation etc.) as part of their wider knowledge-transfer activities. Facilitating the flow of researchers to meet industry's needs is one way of strengthening relationships with industry, encouraging support for joint research projects etc.
 - In **Bulgaria** and **Poland**, many schemes identified were not strongly focused on ISM but rather on strengthening industry-academic cooperation and improving the research base, for example by investing in measures to help young researchers.
 - In **Croatia, Belgium** and **Portugal**, for example, cooperation with industry in intersectoral mobility schemes is seen as a method for universities to secure additional financing for and interest in their research activities.
- **Traditions (or growing practice) in some universities of valuing good working relations with industry**, and encouraging staff to contribute to such developments. Conversely, other universities continue to have a culture that is hostile to such engagement, especially where career paths do not recognise this experience.
 - In the **UK**, for example, government targets have recently been introduced in relation to ensuring that HEIs actively cooperate with industry on research projects. The government has introduced a pre-condition that 25% of research grants funding must be made available to research projects that involve joint academic-industry cooperation.
 - In **Malta**, too, a condition attached to research funding allocation is that this must involve cooperation between the private and public sectors respectively.
 - In the **Netherlands**, is clear that the cooperation between Universities and industry is relevant to assure that the qualification and training provided by Universities is in line with the real needs and state of art of the market.
 - In **Portugal** and **Spain** is needed to promote, even more, the cooperation between Universities and companies that traditionally are working separately. Some investment was made to change this ant to strengthen this cooperation, but is important to promote more and better opportunities to support his.

⁷⁷ Problems relating to low researcher salaries were a clear finding from many national country reports produced in Central and Eastern Europe and in South-Eastern Europe in respect of a study for DG RTD "CSSES and Oxford Research (Forthcoming) Evaluating the uptake and impact of participation in the European Framework Programmes for Research in the Member States and Associated Countries. Report for the European Commission Directorate-General for Research and Innovation, 2017.

- **Accelerating the career development of researchers** – although some academic institutions are reluctant to see their best researchers recruited by industry, others are keen to strengthen links and recognise the role played by ISM schemes in strengthening the research skills and employability of PhD participant researchers.
 - This is clear in **Netherlands**, where ISM are seen as a way of Universities support their students and researchers in the acquisition and development of key-skills for their career development outside academia.
 - This is also evident in transnational ISM identified to **Portugal**, that allows to PhD students to i) cooperate with best Universities and companies operating in their area of study; ii) have access to equipment and tools that they don't have in their Universities; iii) perform applied research, with real impact in economic sector and based on real needs and problems of the companies.
- **Boosting brand identity** for universities and research institutions in an increasingly competitive research market. This can help both to attract new students, who may be interested in the career opportunities presented by studying at a university associated with a reputable company. This is the case in Lithuania, where HEI representatives interviewed believed that ISM enhanced their reputation and provided commercial success through the creation of IPRs.

In terms of the key drivers from an **industry perspective**, although many businesses are unaware of the opportunities to strengthen the quality of research provided by intersectoral mobility schemes, others are already participating in, or are sponsoring such schemes. Among the advantages that they have identified are:

- **Securing access to highly qualified researchers and human capital.** In some sectors, such as engineering, ICT (including in emerging sectors such as AI, blockchain), there are skills shortages in key areas (e.g. in ICT, cryptography, cybersecurity). Leading firms have recognised that in order to secure access to industrial talents, they need to engage with HEIs and research institutes in order to access and help to foster new talent pools. Further information about engagement by the private sector and by private research foundations is provided in Section 2.4.4 on Funding sources for intersectoral mobility schemes.
- **Fostering closer relationships between academia and publicly-funded research.** Some industry players also recognise the need to cooperate more closely with academia generally, not only to access talent pools, but also for other reasons, such as interest in undertaking joint research projects in highly specialised scientific and technological areas, etc. In France, for example, industry representatives interviewed saw the recruitment of PhDs as a method of enhancing their credibility and reputation within their sector.

2.6.2. *Obstacles to participation*

RQ18 - What are the main obstacles that can be observed in implementing intersectoral mobility schemes?

In addressing this question, we consider both the main obstacles as well as to specific obstacles encountered, which may concern *inter alia* recruitment, joint supervision and training, mutual recognition of training acquired in the private sector, mutual supervision, communication channels between the researcher and supervisors in the academic and private sectors, and Intellectual Property Right (IPR) issues.

There were found to be a number of obstacles to participation from the point of view of key stakeholders involved in ISM. Regarding **researchers** themselves, among the barriers identified are:

- **Issues around lack of formal recognition and accreditation of time spent in industry.** Whilst in some EU countries, academic institutions recognise the importance of their researchers participating in ISM, in other countries, there is a lack of an appropriate framework in place, and difficulties in getting time spent in industry formally recognised in career appraisal systems. For researchers who responded to the questionnaire survey, this issue was considered the main obstacle – with participation in inter-sectoral mobility regarded even as a potential risk with regard to future academic career opportunities and job security.

- In **France, Netherlands, Portugal and Spain (and elsewhere)**, the desk research/ interviews show an over-dependency on assessing the career performance of researchers within academia based largely on traditional metrics of scientific and research achievement, such as the number of citations and research publications. There is limited scope to take time spent undertaking research in industry into account in researchers' and academics' career development appraisal, serving as a disincentive to take part in ISM.
- In some newer Member States, conversely, although this issue can be a problem, evidence was identified of reforms being undertaken to better recognise intersectoral mobility and cooperation within individual researcher career appraisal systems and as a mechanism for determining the research funding of universities and research institutes. In **Lithuania**, for instance, HEIs that undertake joint research projects with industry benefit from ESIFs support measures. They have therefore adapted academic and research appraisal methods to reflect the need to cooperate more closely with industry.
- **Funding uncertainties and financial considerations for the researchers themselves** – although funding to facilitate ISM is available for leading researchers in some countries, there is evidence of funding discontinuity of some national schemes. This may dissuade some prospective participants. Examples were identified in the country level analysis of a reluctance among some researchers to participate in ISM unless there was greater funding certainty, with such evidence supported as well by the responses to the questionnaire survey.
 - In **Finland**, funding uncertainties with regard to continuity of funding were seen as being a deterrent to participating in ISM, especially in households where two incomes are needed.
- **Precarious career status** – it was reported that the growing tendency not to give staff tenure, but employ them on a series of short contracts, makes longer term planning more difficult, including in making applications for ISM schemes, both from the point of view of the researcher and the host institution. Combined with the lack of formal recognition given to time spent in industry in some areas, this can serve as a barrier to ISM participation. Again, this obstacle featured prominently in the responses to the questionnaire survey.
- **Gender equality** – evidence was identified of some ISM schemes where women found it very difficult to complete their PhD research, due to a lack of flexibility in the scheme duration. This was especially the case for ESIFs funded schemes, where funding arrangements are driven by the programming period cycle, with limited scope to take into account the need for flexible timing for women to complete a PhD programme.
 - In **Estonia**, the Doctoral Studies and Internationalisation Programme (DoRa), which operated from 2008-15 was constrained when offering 4-year PhDs to tie in the duration of funding to the ESF programme cycle, and restricted the duration of PhD funding to 4 years. However, an evaluation revealed that many women did not complete their PhD since they had had children and needed a career break during their PhD but there was insufficient flexibility to accommodate this.
 - In **Austria**, the FEMtech Career Paths programme was initiated in 2004 by the Austrian Federal Ministry for Transport, Innovation and Technology (BMVIT). It targets women researchers and to create equal opportunities in industrial research, at non-university research institutions, at universities of applied sciences and in research and technology programmes. Companies wishing to attract more female technicians and scientists and to develop the potential of their female employees may apply for a FEMtech grant. Funding is given to research and technology-oriented companies and to non-university research institutions.
 - An interviewee in **Finland** pointed out that there are difficulties for researchers with families to take part in international researcher mobility, irrespective of whether this includes an intersectoral dimension. Presently, for most schemes, family-related costs, for example accommodation and travel costs are ineligible. Consequently, recognising this problem, the VTT's policy is that *"if the family is not accompanying the researcher they employ on a mobility experience abroad, the possibility for the researcher to fly back to Finland more frequently is provided as this supports researchers with a family in undertaking research assignments abroad"*.

In terms of barriers to participation from a **HEI/ Research Institute / RTO** angle, the main barriers identified were:

- **Lack of funding at national level and the high cost per assisted PhD or post-doctoral researcher.** Many of the schemes that incorporate an ISM dimension are quite costly to operate, such as fellowship and scholarship schemes. The number of participants is often relatively low, reflecting their orientation as excellence schemes. Many HEIs and research institutes cannot support such schemes without external funding support. Funding support at national level is often non-existent, or only very limited funding is available to support small-scale schemes. The survey data of these stakeholders indicates that this issue was viewed as the number one obstacle from the perspective.
- **Challenges in identifying suitable industry counterparts.** Although in some countries industry has been either proactive in setting up ISM schemes, or at least receptive to approaches from academia to develop schemes involving industry placements and secondments, in other countries there is the problem of a lack of awareness of ISM schemes – and their potential benefits – among firms. This makes it difficult for HEIs to identify suitable industry participants.
- **Differences in work cultures between academia and industry** – this was seen as hampering involvement of both “realms” in existing ISM schemes.
 - This issue is clearly stated in many of the interviews carried out with key-stakeholders in **Belgium, France, the Netherlands, Portugal and Spain.**

A number of barriers were also identified within **industry**, such as:

- **The length of time that industry participants have to commit themselves for.** Although many prospective industry participants are attracted to the idea of having a high-level researcher support delivery of their research projects, they often prefer committing themselves to a short-medium term commitment to take on PhD and post-doctoral researchers, since they may not have foresight beyond that time horizon (i.e. financial viability especially in the case of start-ups and SMEs).
- **The time and human resources needed to submit a funding proposal to participate in a collaborative joint research project (1-2months) or to participate in an ISM scheme with academia** was seen as time-consuming effort that turns companies off, especially as industry timings are often more pressing;
 - Industry representatives interviewed in some countries mentioned that the time needed to fully operationalize a PhD student is often lengthy and demotivating, and is therefore more suitable for large firms, which have the resources to supervise PhD students during their internship, secondment or placement, than SMEs.
 - In the **Netherlands**, interviewees mentioned the administrative burdens related to the submission of project and its management as being a constraint.
 - In **Portugal**, some Universities and researchers mentioned the need of having a call open at any moment as one aspect to be improved and as constrain the bureaucracy associated to the calls, especially in what concerns the time of selection of the projects.
- At the same time, the process of agreeing on a research matter can be demoralizing for industry in some countries, such as France, where a barrier identified was that this has to involve a compromise between industry, universities and researcher interests. This may sometimes lead to companies dropping out of the process altogether.
- **Whether there is sufficient flexibility to make changes with regard to funded research projects.** Many businesses change their strategy quite regularly and are concerned as to whether there is scope for flexibility in-built within a given scheme or ISM project to adapt the research project accordingly.
- **Doubts about IPR arrangements**, if the university assumes the IPR. This can be a problem especially for small firms
- **Inappropriate focus of PhD and post-doctoral schemes:** Some firms, especially in the service sector are not looking for highly qualified researchers in narrow areas, but intelligent individuals, with broader capabilities, such as may be associated more with Master’s level programmes.

2.6.3. Demand-side obstacles for PhD and post-doctoral level researchers

The findings in respect of the demand side obstacles are now summarised (reference should also be made here to RQ11 regarding the level of demand for PhD level and post-doctoral and post-graduate researchers across different sectors):

- Whilst attitudes are changing, a significant percentage of companies view PhDs as being driven by academic considerations, and the research skills acquired as being too theoretical to be applied in industry.
- Nevertheless, in countries with a stronger tradition of industry-academic cooperation such as Ireland, Italy the UK and Scandinavia, evidence of growing demand for PhD and post-doctoral researchers was identified, especially in countries that have adopted a competence centre approach.
- STEM disciplines, including ICT, physical and life sciences were found to be in especially strong demand from industry.
- Within particular industries, there are emerging high-growth sub-sectors that have strong demand for PhD and post-graduate level researcher skills sets. For instance, in ICT, there are skills shortages in areas such as programming and cryptography, driven by developments relating to Industry 4.0 such as blockchain.
- However, in many other industries, demand for post-doctoral researchers to carry out R&D projects in a company setting is relatively limited. There is rather a more generalised need for industry to recruit bright Masters and PhD graduates with transferable skills to strengthen their employability to work on company-specific challenges.
- Most previous studies and evaluations on intersectoral mobility have not examined the demand-side from industry for PhD and post-doctoral level researchers in detail.
- There is, in some countries, a lack of interest among researchers in having a professional career in non-academic organisations.

Research on the demand side was carried out through the present study, both through desk research and interviews with industry participants. For instance, **France** is an advanced country in terms of fostering researcher mobility (including intersectoral mobility). The state views such mobility as a priority and channels funding and support through the ANRT (*Agence Nationale de la Recherche et de la Technologie*) to support industry's R&D efforts by making it easier for firms to recruit PhD researchers through the tax subsidy scheme *jeune docteur* programme within CIFRE (*Conventions Industrielles de Formation par la Recherche*). This means that PhDs are valued and brought into industry with relative ease. The focus is on creating the right conditions for companies to be able to attract high-qualified PhD and post-doctoral researchers by offering them good working conditions, career advancement and the possibility of undertaking an industrial experience at a fraction of the market cost. PhDs seem to be aware of this and are supported towards this "awareness" by several independent organizations that benefit from support from the French State.

In **Estonia**, there are a number of sectors where there is demand for PhDs and post-doctoral researchers (e.g. the bio-tech sector, ICT especially in new and emerging areas e.g. blockchain, software development, high-end electronics, physical sciences). There is also a need for practical problem-solving skills and for Master's level graduates with an engineering background compared with demand for researchers to undertake scientific research. There may in future be demand from firms for PhDs and post-doctoral level researchers stemming from the small, but growing number of university high-tech spin-offs. In addition, a Technology Development Centre has been established as a Joint Venture between Tallinn University of Technology and several companies. Since the companies involved are all very science-oriented and in future, spin-offs could be created within these centres, this may create additional demand for PhD level and doctoral training opportunities within companies.

In **Poland**, there are no studies that indicate the level of demand for PhDs and post-doctoral researchers in industry. The information obtained during the interviews, however, suggests that such demand exists in specific sectors (e.g. ICT, some engineering fields, etc.). It is important to the companies to hire the person who will be skilled and efficient in the subject from the beginning and a university or public research background in a specialised topic provides researchers with the necessary skills and knowledge to apply their skills from the outset. A further driver underlying demand for PhDs relates to the need of Polish firms to make effective use of the appropriate research equipment (which is in possession of the HEIs since the purchase of such equipment is often EU-funded using ESIFs) and companies need researchers who are able to use it.

Another driver of demand for highly qualified researchers at PhD level and post-doctoral is researchers themselves. One of the respondents in Poland indicated that in their opinion, about 20-30% of scientists are currently working in business and 5-10% have set up their own businesses. There is therefore strong human potential for the transfer of workers between academia and industry. There is in addition a large number of young doctors and doctoral students who would be willing to take part in a project bringing them closer to the private sector.

In **Romania**, many companies in the industrial sector outsource their innovation and research. Demand is therefore generally low for PhDs, and mainly relates to universities and research centres, which are mainly public institutions. Nevertheless, in recent years, interest in strengthening innovation capacity has increased in the private sector, following the establishment of a growing number of high-tech domains companies (e.g. IT, electronics, bio-technologies) and also of private excellence centres, especially in the health domain). This has not yet translated into much higher demand for PhDs, since doctoral studies are perceived by many companies as providing doctoral students with a good theoretical background but being insufficiently practical and applied research oriented. Doing a PhD is still seen as an academically-driven qualification with uncertainty as to whether it strengthens an individual's ability to contribute to enhancing research capacity in a company environment.

In **Portugal** and **Spain**, traditionally high qualified researchers and PhDs usually have the desire to have a full career in an academic organisation and sometimes, meaning that a career in non-academic organisations is not always an option to these researchers. This is also a challenge to the countries, Universities and industries and to the goal of raising the number of PhDs and doctorates in non-academic organisations.

2.6.4. *Implementation challenges for ISM schemes*

An assessment of challenges in the implementation of ISM schemes were identified through the scheme mapping, with this evidence supplemented by the findings of the interviews and questionnaire surveys – in the case of the latter, some 80% of HEI respondents confirmed that challenges of various kinds had been experienced in the implementation of ISMs. These findings are now examined to shed light on the different types of implementation challenges which may serve as an obstacle to wider participation in ISM either by researchers or companies. Whereas the previous sub-section identified high-level obstacles, in this sub-section, more detailed examples drawing on the scheme mapping undertaken are provided.

What were the main implementation challenges for ISM schemes? How far do these challenges vary between different scheme types?

Differentiation can be made between different types of implementation challenges for ISM schemes:

- Scheme-specific
- Country-specific (e.g. small countries vs large, funding difficulties in EU13 – i.e. new Member States very dependent on EU funding sources)

In this section, scheme-specific barriers are within focus, since country-specific barriers are addressed under framework conditions. An analysis of interview and survey data identified the following interlinked implementation challenges across the sample covered by the study:

Recruitment of participants to ISM schemes: This has proven to be a challenge, according to the evidence – as the following illustrations demonstrate:

- Challenges in recruiting students onto industrial placements were reported by a representative of a **Bulgarian** company;
- A **Polish** scheme supporting mobility from the entrepreneurial sector into academia faced challenges in recruiting entrepreneurs;
- Matching the supply (competencies of researchers) and demand (needs of a company) has proven to be a challenge in one of the internship schemes supported by MARR;
- Involvement of not-for-profit organisations into ISM was the biggest challenge for the Industrial Doctorates Plan run by the **Regional Government of Catalan**;

- A shortage of industrial supervisors was reported as the main challenge in the schemes managed by the National Research, Development and Innovation Office (NRDI Office) in **Hungary**;
- Recruitment of practising industrial researchers into academia was highlighted as a serious challenge by a representative of **Hungarian academia**;
- In the Research in Industry and Academia Grant scheme, funded and managed by the **Croatian** Unity through Knowledge Fund (UKF), the main challenge was a lack of interest in the scheme among companies and researchers;
- The Knowledge Transfer Partnership programme, run by the **Czech** Ministry of Industry and Trade, MA OP Enterprise and Innovation for Competitiveness, has found it difficult to motivate HEIs to take part in the scheme.

Administrative burden: A number of interviewees, representing academia, industry, as well as implementers of ISM schemes, have indicated an “administrative burden” as a serious implementation challenge, and a barrier for potential participants to join ISM schemes. This primarily concerns the nature of reporting, including financial reporting. In the most difficult cases, this indicates, according to some respondents, a lack of trust: *“Requiring the financial and administrative reports every quarter, detailed regulation etc. shows the mistrust of the project participants, which deters researchers from participation.”*

Interview findings have also highlighted implementation issues related to **researchers’ skills gap and differences in work cultures**: according to industry representatives, researchers often lack project management and other transferable skills necessary for the smooth implementation of ISM initiatives. *“When you establish an enterprise, you need to know the basics of accounting, paying taxes, writing financial reports etc. Often, researchers lack knowledge in these areas. Sometimes, researchers lack responsibility related to project administration (the reports are often provided late, with significant mistakes etc.)”*

A further challenge in some countries was the difficulty in **identifying national funding sources**. Funding uncertainties undermine the sustainability and continuity of human resources dedicated to supporting intersectoral mobility. In many Central, Eastern and Southern European countries, an absence of any national funding sources for domestic ISM schemes was identified. In many countries, EU funding (including co-funded) ISM is the only possible source of funding to take part in formal mobility schemes. Furthermore, even when public funding is available, there may still be a funding gap, or question mark as to future funding sustainability which can leave schemes vulnerable to being discontinued. The **Icelandic Institute for Intelligent Machines**, for example, received an initial 7 year grant from the Icelandic government agency Ranis which enabled it to become established and begin to develop a good reputation with local industry. However, since the funding ended, the Institute struggled to identify alternative funding sources. It is estimated that a minimum 7% “bootstrap funding” is required to meet the gap between basic research and projects funded by industry.

More information on funding-related issues and funding availability through national and European schemes is provided in Section 2.2.7 (RQ7).

Another implementation challenge is the **relative lack of maturity of the R&I system**. This is an issue in **Malta**, which comprises just one university and one technical college. It was not until the early 2000s that the main government body responsible for R&I - the Malta Centre for Science and Technology – was created. A national research programme was begun in 2004, of which a key funding criterion was the inclusion of at least one industry and one research partner in any project application. This has led to a great deal of recent collaboration between industry and academia, which it is hoped will open the door for more formal mobility in the future. However, the current view expressed by the MCST is that the R&I system is too immature and the interests of industry and academia not yet sufficiently well-aligned to justify investing in setting up dedicated ISM schemes yet.

A further barrier to fostering greater participation is that a lot of ISM schemes are informal and are therefore “below the radar” with **low visibility**. Formal schemes may also suffer from low visibility since research fellowship and similar excellence programmes are relatively costly and the number of researchers participating in each scheme tends to be low. It is common for there to be only 2-5 industrial PhDs or shorter fellowships awarded per year even for some of the better-known, longer-established schemes (see mini case studies on the Industry Fellowships scheme of the Royal

Society and also the privately-funded CORIMAV scheme in Italy and also see Section 2.2.7.3 (RQ3) which includes data on the estimated numbers of researchers taking part in each scheme).

In addition to the challenges outlined above, the survey data indicates that the questions of joint supervision and training (including effective communication between academic and industry supervisors), and the mutual recognition of training provided by the private sector, are seen as challenges that affect implementation of ISM schemes.

2.6.5. Framework conditions for inter-sectoral mobility schemes

The country level research has identified a number of framework conditions common to many European countries, which can influence the extent to which particular countries create ISM schemes, and also impact on their successful implementation. Many of the conditions discussed here can both help and hinder the success of ISM schemes.

1. Public Policy

One of the most important preconditions for a successful ISM scheme is a supportive policy framework. This is equally true at the national level, the regional level (particularly in countries with devolved government and autonomous regions, such as Belgium and Spain) and the European level. Dedicated national policies providing explicit support for collaboration between industry and academia can create an enabling environment for other organisations to be supportive of and open towards ISM.

In Bulgaria, for example, an analysis of national policy documents has identified support for ISM in strategies focused on economic growth (including the Investment Promotion Act and the Smart Specialisation Strategy) and scientific development.

In Spain, too, national and regional governments are very supportive of ISM schemes, with three clear ISM objectives identified in their innovation strategy documents. These are:

- i) increase the level of cooperation and partnership between University and enterprises;
- ii) promote a higher number of PhD graduates in enterprises and other non-academic organisations;
- iii) enhance the career opportunities of researchers in non-academic organisations (and by this way avoid the brain drain).

A supportive policy environment lays a strong groundwork for ISM by making a clear case for its benefits and integrating it into the broader R&I framework. It is important, however, that policies are backed up by concrete support to ensure schemes can function effectively.

2. Relationships between industry and academia

The development of familiarity and trust between academia and industry is an essential precondition to successful ISM. This enables partners to identify mutual benefits, shared goals and to develop a mutual appreciation of their complementary skills and resources. In countries where formal ISM schemes are lacking, this is particularly important. Professors at the University of Malta will often take sabbaticals in order to work within industry for brief periods. In Iceland, as well, personal relationships between representatives of government bodies, industry and academia allow for industrial collaboration in post-graduate study. This is often reinforced where there are longstanding relationships between industry and academic and research institutions, often allowing less formal arrangements to promote at least short-term interchange of staff. Both Malta and Iceland are small communities predominantly based on a small firm economy, and this informal mobility is perhaps more appropriate than formalised schemes, which would impose onerous administrative burdens on researchers and business alike.

Where formal ISM schemes do exist, these informal person-to-person arrangements have usually already grown into longstanding partnerships between industry and academia. This greatly facilitates discussions over intellectual property arrangements and such partnerships may also have led to co-location campus initiatives where familiarity, trust and ISM thrive.

3. Government incentives and R&D tax incentives

Most of the countries investigated provide some type of support for ISM, usually in the form of financial support, including direct financing and a range of tax incentives. Government funding may be linked to specific programmes covering defined topics, often aimed at solving specific challenges identified, or it may be in the form of more bottom-up, open-topic funding with the onus on individual or institutional applicants to develop their own research strategy and goals. Most bottom-up funding schemes identified target PhD research in collaboration with industry.

In countries where no formal national schemes exist, EU programmes such as the Marie-Sklodowska Curie fellowships offer an opening for researchers to work on large international and intersectoral research projects. Similarly, ESIF programmes provide scope for funding ISM schemes, with several examples identified, for instance in **Estonia, Latvia, Lithuania, Slovakia** and the **UK**. However, ESIF funding has tended to promote industry-academic cooperation more broadly as part of a broader innovation strategy (see Section 2.2.7.5 on EU funding of ISM schemes). In **Slovakia**, for example, the research found no dedicated national ISM schemes. The ESIF OPs (particularly the human resources and research innovation OPs) are therefore considered as the *de facto* national policy and financing mechanism for promoting ISM.

Tax incentives can be used to provide support for R&D investment in infrastructure (e.g. development of laboratories), the purchase of equipment, but also in a limited number of cases currently investment in human resources specifically devoted to R&I activities, such as the recruitment of doctoral and post-doctoral researchers. Tax incentives can also indirectly be expected to increase industrial requirements for academic researchers, hence creating a more conducive environment to mobility between sectors.

According to a September 2017 DG RTD Working Paper on R&D tax incentives: “*EU governments increasingly use R&D tax incentives, especially since the outset of the financial and economic crisis, to stimulate business investments in R&D, boost productivity and economic growth.*”⁷⁸ The annual RIO reports produced by the JRC on the situation in respect of R&D&I in each Member State (plus in five Associated countries and five countries internationally) have found that in some countries, there is an insufficient level of Business enterprise expenditure on R&D (BERD). Tax incentives can play an important role in stimulating investment in R&D&I to addresses under-investment by the private sector. However, there is no specific mention in the WP of the role of tax incentives in supporting intersectoral mobility, or in encouraging the recruitment of PhD and post-doctoral researchers by industry.

Nevertheless, the use of tax incentives to promote private investment in R&I is gaining ground. **France, Ireland, Hungary, Belgium** and **Austria** score best of all European countries in the OECD league table for tax-related R&D incentives⁷⁹. **Ireland** for example has a well-established tax credit system, which is credited with driving business investment in R&I. In **Slovenia**, companies are entitled to claim a 100% tax credit on expenses related to investment in R&D.

However, the lack of tax incentives explicitly aiming to support intersectoral mobility by allowing industry to offset the costs of recruiting PhD and post-doctoral researchers was identified as a barrier to ISM by the ERA-SGHRM Working Group,⁸⁰ since there is only an explicit R&D tax allowance for expenditure on human resources (including the recruitment of PhD and post-doctoral researchers) in a small number of countries, **Belgium, France, Italy** and the **Netherlands**.

In the **Netherlands**, for instance, there are a series of tax incentives for investment in R&D&I, and one scheme encourages the employment of researchers, by permitting deductions from the payroll tax. In **Belgium**⁸¹, 100% tax rebates are provided towards the employment costs of

⁷⁸ European Commission DG RTD (2017) R&D tax incentives How to make them most effective? Working Paper Series – September 2017

⁷⁹ <http://www.oecd.org/sti/rd-tax-stats.htm>

⁸⁰ ERA-SGHRM working group "On the intersectoral mobility of researchers, their conditions and their competences, October 2016

⁸¹

Belgium:
https://finances.belgium.be/fr/entreprises/personnel_et_remuneration/precompte_professionnel/exonerations/recherche_et_developpement

researchers. In **France**⁸², there is both a general research tax credit for R&D&I investment since 1981 through the *Crédit d'impôt recherche* (CIR). These cover R&D activities and laboratory equipment etc. as well as a tax credit explicitly designed to encourage the recruitment of doctoral researchers. The *dispositif jeunes docteurs* is part of the R&D tax credit system but provides additional rebates (costs worth up to 60% of a researcher's salary) to businesses which hire young PhDs.

Italy has also introduced a national measure - PhD ITalents - and high-level apprenticeship contracts are offered by the Italian regions. The uptake of researchers in business is also supported by a tax credit for hiring 'highly-qualified' personnel, the *scheda di sintesi credito d'imposta*⁸³ which falls under the responsibility of the Ministry of Economic Development. The scheme involves a tax credit of 50% on incremental R&D expenses, up to an annual maximum of €20 million / year per beneficiary and calculated on a fixed basis based on average expenses in R&D in the 2012-2014 period. The tax credit can be used, even in the case of losses, to cover a wide range of taxes and contributions. All expenses related to fundamental research, industrial research and experimental development are eligible: costs for highly qualified and technical personnel, research contracts with universities, research institutions, companies, start-ups and innovative SMEs, the amortization of instruments and laboratory equipment, technical skills and industrial investments. The measure is also applicable for expenses in R&D which will be incurred in the period 2017-2020.

Lastly, it is worth examining a detailed example of how R&D tax credits can strengthen investment by industry by encouraging the recruitment and employment of young researchers in France by industry through a tax credit approach. A short case study on the 'Young Doctors' scheme (DJD)⁸⁴ within the *Crédit d'impôt recherche* (CIR) scheme is provided below:

Box 1.2 -Case study on tax credits for R&I investments and for the recruitment of young doctoral researchers

Scheme title: Crédit d'impôt recherche (CIR) –the 'Young Doctors' recruitment scheme

Background on R&D tax credits: The scheme operating in France provides tax relief to allow companies to finance their R&D and innovation activities. The scheme provides a financial incentive to utilise the industrial talents and skills of young researchers with a doctoral-level qualification. CIRs can be declared by the company after the recruitment of a new PhD entry-level researcher starting their career. The tax credit can cover all of the first 24 months of the period of employment. The CIR is determined after defining the R&D projects eligible for the scheme and reconstituting an R&D expenditure base for the company (including personnel costs, purchases of external R&D services, depreciation of R&D equipment, etc.). Increasing the hiring of young doctoral level students by companies in R&D activities has been a public policy objective since the beginning of the 1980s.

Relative demand for PhD level researchers and barriers to their recruitment in France: The difficulty of integrating PhD level researchers into R&D positions in companies is largely due to their perceived over-specialisation, which differs from those of engineers, and across different scientific disciplines. Statistical analyses indicate that doctors have less access to R&D positions functions in firms than engineers, due to more engineers fitting in with the relevant profiles being sought by industry. Doctors, including scientists, tend to choose different specialties from engineers. Chemistry is a specialty in which post-doctoral graduates have experienced a high unemployment rate. These results corroborate the findings from previous studies that stressed that the doctoral curriculum can have a negative impact on the characteristics of their professional insertion in the R&D activity in companies, especially if the researcher has chosen a specialty which is relatively unrepresented in private R&D activities.

Tax credits for recruiting young doctors: Two incentives have been put in place through the setting up of the CIFRE in 1981 and the 'Young Doctors' scheme (DJD) as part of the

⁸² See more specifically for France: <https://www.tresor.economie.gouv.fr/Ressources/File/409099>

⁸³ http://www.sviluppoeconomico.gov.it/images/stories/documenti/Scheda-di-sintesi-credito-dimposta-R&S-29_05_2017.pdf

⁸⁴ <http://www.sogedev.com/blog/2015/05/19/cir-et-recrutement-de-jeunes-docteurs/>

research tax credit (CIR) in 1999. Since the reforms were introduced (between 2004-08, a company can benefit for 24 months from a tax credit of 60% of the salary cost for a doctoral student to engage in R&D activities who must be hired through the CIR. 60% of the salary costs for operating costs can be covered through tax credits. Approximately 200 companies reported expenditures under an earlier scheme, the MDG, which operated in the early 2000s. There has been strong growth since 2007, with more than 1,500 PhD researchers being hired in 2013, with some companies hiring several doctoral students. The 2008 Finance Act strengthened firms' incentives to recruit young doctoral researchers to R&D positions since such expenditure can be used to calculate their R&D expenditure, which lowers their tax obligations. Recruiting a young doctor allows the company to benefit through reduced taxes under the CIR. The benefit of this tax credit can cover the first 24 months of the doctor's salary – up to 108% of the salary, compared with 47% in the case of 'regular' recruitment outside the *jeune docteur* scheme.

Source: adapted by study team from www.service-public.fr/professionnels-entreprises/vosdroits/F23533

4. Robust support structures

Multi-level reinforcements at the national, regional and institutional level are vital to the creation and continuation of ISM. This means combining funding with opportunities for inter-sectoral liaison, exchange, meetings, technology transfer, training and development. In more economically developed countries, the existence of a dedicated Technology Transfer Office, often employing those with an industry background, can help to foster relationships with industry. However, where funding is limited it can be difficult to attract people of a high calibre with a relevant business background.

Networking and knowledge exchange opportunities can help to build relationships between researchers and industrial representatives, laying a strong foundation of trust and mutual understanding which will make them more positively disposed to formal ISM structures. Furthermore, such exchanges can increase the benefits of ISM beyond the narrower aims of the specific scheme. An interviewee in **Malta** explained that an industry partner embedded in their research lab for the duration of a project had helped to improve the coding skills of everyone in the lab, bringing them up to industry standard and providing informal training on the latest developments in computer science. Although secondary to the goals of the project, this was a tangible long-term benefit which was enabled by the opportunities provided for informal exchange.

There are also new initiatives to promote the development of communities of good practice in respect of knowledge exchange, such as a consultation launched in December 2017 by HEFCE in the **UK**, the Knowledge Exchange Framework (KEF)⁸⁵ which is being developed and coordinated by HEFCE to measure Knowledge Exchange. The framework will provide a way to "*benchmark performance from university-business collaboration and knowledge exchange*", and will encourage universities to do more to commercialise research and innovation. The KEF metrics system will provide more information for the public and businesses on the performance of universities in knowledge exchange – how they share knowledge, expertise and other assets for the benefit of the economy and society.

5. Researcher mobility

Europe's open borders and policy of free movement has had a significant impact on the academic community. In some countries it can be viewed as a boon, allowing universities to attract the brightest and best researchers to their programmes and enabling international collaboration on cutting edge research. It can also exacerbate the phenomenon of brain drain, whereby leading researchers are tempted abroad by better opportunities, working conditions and salaries. In countries with a small population, such as Iceland and Latvia, brain drain from academia to industry can also pose a difficulty, with students reportedly moving into well-paid industry positions before even completing their undergraduate, postgraduate or PhD-level courses, in some cases. This can cause long-lasting damage to a country's research base.

⁸⁵<http://www.hefce.ac.uk/ke/kef/>

In countries with weaker R&I support mechanisms and/ or a lower R&D baseline, such as **Lithuania** and **Croatia** (where national support for R&D has been decreasing), the flow of researchers to other countries can exacerbate the difficulties of building a stable and engaged research community. However, there are several initiatives to reverse brain drain. In countries such as **Ireland** and **Iceland**, attracting researchers from around the world is an important strategic goal to overcome limitations in their human capital (e.g. to overcome the constraint of having a small population or to address gaps in research specialisations) and to strengthen critical research mass. ISM schemes have been identified as a way to counter fears of potential brain drain, providing researchers who may feel limited by the scope of research activities within the academic sphere to broaden their horizons and increase their career opportunities by moving into industry rather than feeling obliged to move abroad.

6. Flexibility of implementation

In order for intersectoral mobility to be effective and to generate lasting impact through more sustainable forms of cooperation between academia and industry, flexibility is vital at all implementation stages from the design phase through to implementation.

The importance of flexibility was identified as a key lesson learned in some of the case studies. For example, case study 1, which focused on the DoRa programme in Estonia, stressed the importance of being flexible and in making changes to scheme design where necessary. The rigidity of national interpretation of the ESF rules posed a problem for the scheme, since not all PhD candidates were able to complete their scheme within the allocated time period so in future, flexibility was seen as being central to ensuring that schemes are effective. Secondly, in case study 4, the interviewees from the Royal Society's Industry Fellowships scheme also stressed the need for flexibility, since the scheme's managers had discovered over time that it was difficult to attract SMEs to take part since they were unwilling to commit themselves to taking on researchers for a longer time period. A solution was found whereby a separate new pilot scheme will be launched specifically to allow SMEs to take part which allows for a shorter mobility period.

The KESSII scheme in Wales also allows researchers the possibility of undertaking a one day a week visit to work on-site at an SME with four days a week being spent continuing the research on campus. This makes it easier for SMEs to commit, and highlights the need for flexibility in scheme design.

Furthermore, flexibility is needed since many academic staff work on short-term temporary or fixed duration contracts rather than contracts of indeterminate duration. This makes it difficult for staff and their institutions to commit to rigidly structured schemes with long application procedures and commitments over several years. Commercial companies also sometimes need to seize an opportunity for securing competitive advantage at short notice when a particular situation arises or a particularly talented researcher presents herself. Flexible forms of intersectoral mobility, which emerge bottom-up and are demand-led and customised to suit participants can be a better alternative than more rigid structures. A flexible approach on the part of university employers is therefore vital in offering opportunities for deferments, portability between institutions, flexibility within recruitment (not enforcing mandatory requirements for intersectoral and international mobility) and keeping bureaucratic application and management processes as simple as possible. This helps to ensure access to a broader pool of talent.

An example of a situation where flexibility is needed relates to **intellectual property** where arrangements need to be determined for individual schemes. They may also necessitate customising IPR arrangements on a case-by-case basis to address the specific needs of participant universities and companies, which may vary depending on the nature of the research project being undertaken and the type of IPR being generated.

Flexibility is also needed to ensure that schemes take into account **gender equality considerations**, and potential barriers for women researchers in taking part in formal ISM, unless there is flexibility built into scheme design. Interviews with stakeholders in **Finland**, where most households require two salaries, identified problems with funding for PhDs that was too rigidly tied to a specific time period. This effectively blocked women from participating: in case they went on maternity leave during the time allocated to complete their PhD, the funding would run out and there was no option to postpone and complete the PhD later. A similar challenge was identified in **Estonia** in relation to the **DoRa programme**, where the constraints of using ESF funding meant that there was a strict time limit on PhDs being completed within a four year period, such that many women were unable to complete their PhD due to having been off on maternity leave. However, it was unclear how far this problem results from the way in which the ESF is being

implemented in **Estonia**, and the requirements put in place by the ESF implementing agency, as opposed to EU-level rules.

2.7. Cross-comparative review of intersectoral mobility schemes

This section provides a cross-comparative review of intersectoral mobility schemes. Examples of ISM schemes by scheme characteristic are first provided, taking into account the typology of schemes and their main characteristics (see Section 2.2). An analysis of scheme design and set-up is then provided, followed by a review of scheme implementation arrangements. Funding sources to support ISM – both from the EU and national levels are then outlined. Based on the limited data available, selected examples of programme funding and the level of funding per researcher are then provided. Lastly, we provide a summary of typical arrangements for managing IPR during ISM schemes and schemes where research projects are carried out at arms-length from a university setting in order to catalyse spin-off creation.

2.7.1. Scheme design and set-up

ISM schemes are designed and shaped by a number of forces. The interaction between these explains much of the difference between approaches in different countries and between individual schemes. **Governmental or institutional policies** make their mark on a large number of schemes, in particular if they make funding available for promoting or supporting ISM. Their objectives cover a range of issues. Multiple objectives may provide the foundation for particular schemes:

- Increasing researchers' employability and contribution to the knowledge economy: this usually gives shape to schemes focused on general skills development, business acumen and entrepreneurship. Typical examples are the doctoral schools or graduate schools set up at a large number of universities across Europe, taking care of researcher development beyond the production of a PhD thesis. **Governments or institutions either provide funding, write guidelines or define training regulations in order to set up such ISM schemes.**
- Strengthening the R&D fabric in a region or country: this incentive inspires schemes which give businesses easier access to new knowledge in the form of internships or joint PhD's. Examples of these initiatives can be found in countries with very different levels of R&D intensity, such as **Latvia, Luxemburg, Bulgaria, Romania, Switzerland** and the **UK**. Although the schemes may not differ very much in nature, their implementation and their success will depend on the R&D intensity of a country and the commitment of stakeholders involved.
- In Luxemburg and France, for example, funding agencies and other institutions engage in **multilevel interventions such as awareness campaigns and networking events to strengthen ISM schemes** such as internship or joint PhD policies. In the Netherlands, the technical universities embed joint PhD's within **long-term partnerships** with specific multinational or large companies – Philips and TU Eindhoven are cases in point. Without symbolic or financial measures from the government, the involvement of industrial stakeholders can be difficult to sustain long-term. Many national/regional governments, funding agencies and individual institutions pool resources (ESF, MSCA, national funds), set up **a scholarship, fellowship or internship programme and leave it up to the stakeholders to get involved or not**. Quite often, co-funding from industry is a requirement in order to ensure full commitment.
- Strengthening regional hubs of knowledge by maximising collaboration: this objective lies behind a number of **co-location or regional interaction initiatives**. Facilitating the establishment of science parks, for example, is an effective policy which fosters collaboration through proximity and maximising the opportunity for chance encounters.
- Promoting a European labour market for research has been the key policy objective for the Marie Skłodowska-Curie Actions (MSCA). Since intersectoral mobility was included in its proposal guidelines, a number of individual MSCA internationally mobile fellows and institutional beneficiaries have taken the opportunity to engage also in non-academic networks. In a number of reported examples, **the MSCA funding incentive for ISM works well**, in particular in ITN or COFUND proposals including industry partners as key stakeholders from the start, such as the "Solar Energy to Biomass" ITN in the **Czech Republic** or "Caroline", the COFUND scheme in Ireland focused on the United Nations 2030 agenda. While a number of

interviewees pointed out the difficulty of combining international and intersectoral mobility simultaneously, the MSCA' financial attractiveness has overcome this hurdle.

- A number of academic institutions seek to enhance the skills of personnel from industry, business, government or NGOs, using their own human resources to broaden their horizons and facilitate future exchanges. In order to facilitate industry-into-academia mobility, a number of institutions were found to have changed their recruitment guidelines to lower the threshold for senior industrial researchers to become academics or have improved their remuneration policies or increase their attractiveness.
- Being associated with academia can grant prestige to people employed in other sectors, but academia must be willing to broaden its value system based on academic output in order to appreciate their added value. The Norwegian Association for Higher Education Institutions has attempted to develop holistic career guidelines which explicitly value teaching skills and innovation skills as part of merit-based recruitment in order to make industry previous experience more valued in academia.
- However, there can be onerous financial requirements for universities to create chairs or professorships for senior industrial researchers that act as an impediment to industry-to-academia mobility. For instance, in **Italy**, there is a requirement for any academic institution setting up a new industrial chair to put up a financial guarantee which demonstrates that they can fund the chair for 12 years upfront. This is financially prohibitive and therefore, with the exception of the medical and health areas, where there is strong funding available from the medical research and pharmaceuticals industries, very few positions have been created to facilitate mobility from industry to academia.

Secondly, a large number of schemes are **initiated bottom-up by industry or by long-term university-industry partnerships**, either with or without financial incentives from local or international government. Industry's main objectives are gaining first access to new knowledge, maintaining their strategic relations with knowledge centres, and gaining first access to new talent. This may be different for large companies as opposed to SMEs: a limited number of respondents indicated firmly that future recruitment is not an objective for their intersectoral mobility scheme (Philips in the Netherlands, for example), while others identified the value of ISM-schemes precisely on the basis of their potential for future recruitment. An example of this is in **Lithuania** where key players in the ICT and FinTech industries identified a need to improve industry's access to Masters level graduates in the ICT domain, and particularly in programming. Industry therefore engaged with relevant higher education institutions in order to develop an appropriate industry-responsive syllabus that would deliver appropriate ICT and programming skills and increase the supply of available well-qualified graduates with relevant vocational skills. The Masters students were also able to take advantage of internship opportunities although this has not been formalised as an ISM scheme.

- **A first step in setting up such schemes consists of gathering mutual trust and tuning expectations.** Long-established university-industry partnerships or ISM schemes with strict guidelines and procedures can bypass this step, but reported examples of setting up such schemes highlight their significance. A Novartis employee who is also an MSCA graduate, pointed out in one of the interviews that the value of confidentiality, characteristic of industry, can be hard to combine with the value of making research results public, characteristic of publicly-funded research. A Polish respondent testified to the lack of trust, which can only be overcome by making the mutual benefits of ISM more tangible to all stakeholders involved.
- Secondly, **appropriate matchmaking** is key to success, in particular for SMEs engaged in intersectoral mobility initiatives. Unlike large multinational companies, they cannot accommodate mobile researchers whose knowledge or expertise is only peripherally related to their core activities. An interview with an SME start-up based in Spain, and jointly founded by an MSCA graduate, illustrates that local and international networking events are crucial for finding the right match with interested interns or future employees who possess the research skills their company needs. In many of the broad university-industry partnerships, university departments play an intermediary role in guaranteeing successful matchmaking from the moment they involve or recruit a PhD candidate or a postdoctoral researcher in an intersectoral mobility scheme.
- Thirdly, all stakeholders involved need to agree on their financial contribution, unless the scheme is fully funded by external sources such as MSCA schemes or national schemes. A number of respondents testify that institutions and governments struggle to **find the ideal**

funding leverage. Sometimes the co-funding level is not set by the company but depends on the type of scheme. For industry 'receiving' academic researchers their contribution may vary from 5% in one scheme to 25% in others, as made clear by an interviewee from Siemens. If industry contributes to financing the scheme, they usually claim the rights to full or partial intellectual property. Other forms of funding leverage work the other way around, where industry contributes to the salary of an academic staff member responsible for exchanging knowledge and application in research or educational programmes, as is the case in TU Eindhoven's collaboration with Siemens.

- Finally, and perhaps most importantly, settling **intellectual property (IPR) agreements** is crucial. If not agreed in advance or regulated through the funding schemes they can be the source of major disagreement, early exit from the scheme or frustration on behalf of key stakeholders. In some cases, the advantages of a case-by-case agreement in terms of flexibility does not compensate for the risk of disagreements at a later stage or even of participants losing what they regarded as their intellectual property. For a more detailed discussion on IPR-related issues, see Section 2.3.4.

3. KEY FINDINGS AND CONCLUSIONS

In Section 3, the key findings and conclusions are presented, drawing on evidence collected through the desk research, interviews and online surveys.

3.1. Key findings - Baseline assessment

3.1.1. *The supply of intersectoral mobility schemes*

Overall, a large number of programmes and schemes to foster intersectoral mobility - 279 ISM schemes in total - were identified. However, although there are many dedicated national schemes, a significant percentage of schemes are not primarily focused on strengthening ISM but are rather oriented towards promoting mobility more broadly (with some adaptation to allow ISM to take place in the case of ISM schemes that were previously focused on academia-to-academia to mobility).

This reflects similar developments at a European level, where the MSCA's RISE and IF sub-sections have also evolved between the 2007-2013 and 2014-2020 periods and these now more explicitly allow scope for intersectoral mobility whereas previously only the MSCA's ITN really prioritised ISM. A further range of schemes identified allow for ISM but their main activities related to strengthening industry-academic collaboration more broadly with only a small or negligible ISM dimension. These were still included in the mapping since some countries are starting from a different baseline situation and are further behind other countries in terms of fostering ISM. Ensuring adequate and sustainable forms of industry-academic collaboration was found to be a pre-condition in terms of the necessary framework conditions in which ISM can flourish.

The majority of ISM schemes focused on early-stage researchers at R1 and R2 levels although there were also found to be a number of schemes focusing on attracting more experienced researchers and lead researchers to take part in ISM. Examples of schemes focusing on later-stage researchers are provided in Case study 4 which examines schemes focused on R3 and R4. A number of national schemes focus on the PhD-level, either through an industrial PhD scheme providing joint academic/industry supervision, or through more temporary internships and placements in industry. Usually the funding is provided by the government, sometimes co-funded by the hosting company.

In terms of geographic coverage, evidence of dedicated domestic schemes to facilitate intersectoral mobility were identified in most, though not all EU-28 MS. Whilst in some countries, there are at least several formal ISM schemes available to researchers interested in participating in intersectoral mobility, in others, only EU-funded programmes are available for those interested in taking part in international and intersectoral mobility due to a lack of dedicated national R&I funding. Several of the national schemes also support international alongside intersectoral mobility but most ISM schemes do not require any form of international mobility.

In some countries, particularly in Central and Eastern Europe, there is a lack of dedicated intersectoral mobility schemes, since the main focus to date has been on strengthening the framework conditions in which ISM could be implemented in future i.e. through investment in strengthening the qualifications of young researchers, improving the R&I infrastructure, and measures to foster technology transfer and closer academic-industry cooperation. In countries such as Hungary, Lithuania and Poland, whilst Structural Funds (ESIFs) are being used to strengthen academic-industry cooperation, there is presently limited evidence that intersectoral mobility is explicitly within focus.

Examples of relevant EU funding programmes to promote intersectoral mobility identified as part of the gap analysis include the ITN/ RISE strands within the Marie Skłodowska-Curie Actions (MSCA), the SME Associate Pilot scheme which enables SMEs to recruit a PhD researcher for 12 months, and other funding possibilities under the European Framework Programmes for Research and Technological Development, such as the ERA-LEARN 2020 support action (CSA) within Horizon 2020. A further important source of funding to promote the intersectoral mobility of researchers was found to be the ESIFs. Both the ESF and the ERDF were identified as providing funding support for researcher mobility - including in some cases intersectoral - in several EU countries (e.g. **Bulgaria, Estonia, Latvia, Romania** and the **UK**).

Interestingly, there was found to be growing interest among universities and research institutes across Europe in setting up an ISM scheme in future. In some instances, there was evidence that adjustments are being made to adapt existing Fellowship Schemes and other types of mobility schemes to allow scope for researchers to take part in intersectoral mobility in future.

3.1.2. Demand for intersectoral mobility schemes

Whereas national policies in the fields of education and research and innovation tend to formalise the promotion of researcher mobility in general (through a strong focus on the international mobility of researchers), policy makers in many EU countries and national funding agencies have not yet formulated a clear national policy framework to foster intersectoral mobility. Indeed, the research found that informal mobility between sectors by researchers is very common, especially for researchers during the early stages of their careers (R1 and R2). Formalising a clearer policy framework – one which recognises the value for individual researchers of participating in intersectoral mobility for the individual's career progression but also for the participant academic institutions and companies through fostering more sustainable collaborative research – could help to stimulate demand from the bottom-up for intersectoral mobility schemes.

3.1.3. The benefits of ISM

It was widely recognised by interviewees and survey respondents that there are benefits of taking part in an intersectoral mobility experience. Perceptions as to the nature and magnitude of these benefits however varies depending on the type of stakeholder. The research found that for universities and research institutes, intersectoral mobility is not only about providing opportunities to undertake mobility to broaden the research horizons of researchers themselves. Such organisations view their participation in the design and set-up of intersectoral mobility schemes as a means of strengthening research collaboration and fostering the development of sustainable relationships with industry (and other sectors).

From an industry point of view, participating in intersectoral mobility is seen as a useful mechanism to foster closer cooperation with academia. However, the research found evidence that large firms are more willing and able to engage with universities, RTOs and research institutes since they recognise it is in their strategic interest to do so both to help identify the top industrial research talents of the future to work in their industry, and to foster closer collaborative research relationships with higher education institutions, which can bring major benefits, such as being able to tap into academic knowledge and being able to access research excellence funding.

Researchers – especially early-stage researchers – recognise in the context of an over-supply of post-doctoral researchers that taking part in a mobility experience is an effective means of gaining exposure to working in industry and experience of industrial research, which could be invaluable in future. Researchers also identified significant benefits from participating in ISM through acquiring transferable skills and knowledge to enhance their employability overall. Several researchers mentioned that their universities' careers office and academic supervisors were often ill-equipped to provide sufficient practical insights into the skills and competences needed to work in industry due to a lack of direct contact with firms, and cultural barriers between academia and industry. It was therefore seen as being very important that researchers are given an opportunity to spend time in industry, for instance through a placement or internship.

However, it was emphasised that for a more widespread culture of researchers undertaking intersectoral mobility, it is essential that barriers to participation are addressed both for early-stage researchers (R1 and R2) and their more experienced counterparts (R3 and R4). In particular, the lack of formal recognition of temporary placements in industry in academic career appraisal and accreditation procedures remains a fundamental problem, and researchers seeking to develop their longer-term career in academia are reluctant to jeopardise their academic track record by leaving academia for a short-term industry placement, where due to IP reasons, they may not be able to share confidential research materials, and therefore be unable to publish scientific publications and gain citations. Indeed, it often appears to be easier to transition from academia into the private sector than the other way around.

3.1.4. Evaluation and monitoring of the performance and impacts of ISM schemes

Although a large number of intersectoral mobility schemes were identified through the research, there is as yet a lack of a culture of systematic evaluation of ISM schemes, even if many schemes have been implemented over a period of at least several years. Indeed, evaluations were available for very few ISM schemes, and most evidence of impact was limited to the number of patent

applications or employment rates. Such results are not very convincing for potential partners who are still reluctant to participate in ISM or apprehensive about the many obstacles. The real impacts on researchers' individual career progression and their future earnings, and the extent to which post-doctoral researchers are making the transition to working in an industrial researcher environment across different academic disciplines is not generally being tracked.

There was found to be a lack of systematic monitoring data on impacts at the company level, for instance in terms of improving R&D performance and strengthening internal R&I capacity. However, there are challenges in measuring organisational outcomes, such as the need for longitudinal data over a 10-15 year timeframe to be able to properly assess longer-term impacts on career development and salaries. Moreover, there are wider measurement challenges. For example, An NGO's intervention scheme or a university's regional network can only be assessed over a longer period of time and taking into account the multiple aspects of an ISM experience.

3.1.5. Framework conditions - conclusions

An analysis of the necessary framework conditions to promote increased uptake of intersectoral mobility was carried out (see Section 2.6.5). Among the overall findings as to the necessary precursors to facilitate increased participation in ISM at national level are:

- The importance of having a supportive national policy framework and/ or strategy in place to promote improved researcher mobility in general and intersectoral mobility in particular.
- The importance of national funding - either direct financing support or other government incentives such as R&D tax incentives to recruit PhD and post-doctoral researchers.
- The imperative of longstanding collaboration between academia on the one hand - and other sectors such as industry, government and the third sector on the other.
- The need for a culture that is favourable and open to cooperation between the various sectors in general; and to the mobility of researchers in particular.
- The need for relationships between industry and academia to be forged on a sustainable basis, rather than being dependent on one-off funding.
- The importance of robust support structures being in place at national level. Many ISM schemes are small-scale and fragmented and they need support mechanisms to help share experiences and lessons learned, and to exchange benchmarking data and information.
- The importance of ensuring that there are domestic - and not only international - ISM opportunities open to researchers to prevent brain drain.

A further lesson was that whereas for larger-scale national initiatives to get off the ground, the framework conditions conducive to fostering ISM need to be in place, for small-scale informal ISM, this is arguably less important - since demand and supply mechanisms for PhD and post-doctoral graduates will suffice to ensure a two-way intersectoral flow of researchers. Such informal mobility has operated successfully in the past two decades - at least in some EU countries, in a number of R&D sectors and at a good number of institutions. However, the EU-wide potential of more formalised national schemes will remain underdeveloped without action being taken to strengthen the framework conditions in which ISM is able to flourish.

3.1.6. Conclusions – supply of ISM and levels of awareness

Whilst there are a good number of dedicated formal ISM schemes at national level, there is uneven supply of intersectoral mobility schemes across the EU-28, with some countries overly dependent on EU funding schemes (especially those eligible for widening participation) which require taking part in international mobility not only intersectoral. This may exacerbate the risk of brain drain in many EU-13 and some associated countries.

Overall, there are low levels of awareness about the concept of intersectoral mobility, because the term is not widely used. Linked to this, there is a lack of awareness as to the tangible and intangible benefits of intersectoral mobility and to strengthen the visibility of ISM, this would need to be addressed through more proactive communication and dissemination activities.

However, when the concept is explained, many stakeholders are aware of what it involves, since ISM takes place not only through formal schemes but through the natural two-way flow of researchers between different sectors. This has long been a reality in many countries since there are insufficient numbers of full-time academic positions available for all PhD students, and

consequently, a need for them to consider alternative professional development options. Where ISM takes place in such organic fashion, it could nevertheless benefit from public support schemes that would ensure all researchers potentially interested are made aware of these opportunities, and that they are not reliant on personal connections to find out about their existence.

3.1.7. Conclusions – the benefits of ISM

Among the major benefits for universities and other types of academic institutions identified were producing new knowledge and bringing ideas to market in a way that meets their KPI's (e.g. the number of PhDs, the number of patents, the number of academic publications and social/economic impacts). Furthermore, taking part in ISM was found to support the strategic goals of HEIs relating to fostering long-term partnerships with industry, strengthening the level of activity in terms of collaborative research projects and generating an income through licensing and the commercialisation of research.

The main benefits for individual researchers were strengthened employability and opening up researchers' careers by giving them new horizons as to what it is like to work in another sector. Researchers benefited in particular when there was formalised skills and training modules during their mobility period but also benefited from "on-the-job" training from gaining exposure to working in a new sector, which made them more adaptable and therefore enabled them to gain a range of soft skills (communication skills, networking, etc.) making them more employable.

Among the major benefits for industry identified were: strengthening their competitive advantage in the context of the knowledge economy through first access to new knowledge, access to potential future employees, and the strategic role of ISM in fostering long-term partnerships with both individual researchers and long-term collaboration with the institutions they are studying at. Some academic partners are very positive about international collaboration with industry, others experience nothing but obstacles when working cross-border and see only value in domestic schemes.

Organisations focusing on the professional career development of researchers were found to play an invaluable role in building awareness about ISM and its benefits, promoting cultural change within HEIs and companies, creating a collaborative / open culture and in encouraging researchers to think outside the box regarding a possible career as a researcher in sectors other than academia. Schemes need to be designed in such a way that the benefits of participation are maximised for all stakeholders.

3.1.8. Conclusions – skills and training

A number of schemes were found to provide formal skills training for PhD's and their supervisors usually motivated by national guidelines and institutional policies but the majority of schemes relied on a combination of formal and informal training. Among the benefits for researchers and HEIs of such training was that by strengthening transferable skills for employability, it helped to ensure positive employment outcomes, including from academia to non-academic sectors.

A number of schemes identified the need to establish the ideal funding leverage to be able to attract industry and individual companies. Benchmarking suggests that where co-funding mechanisms have been put in place requiring the private sector to contribute towards scheme costs, about 15-20% appears to be realistic although some schemes analysed for this study have a private co-funding rate of up to 50%.

3.1.9. Conclusions - funding and incentives

A further key finding was that there need to be sufficient funding incentives put in place to make schemes attractive to researchers, academic institutions and industry. For example, some dedicated ISM schemes offered not only a salary but also a package of support to include relocation for themselves and if necessary due to physical relocation to another city, also for family relocation.

Only one Member State (France) was found to be offering tax incentives to support the recruitment of doctoral researchers by companies, although several countries such as the UK also offer broader R&D tax incentives. Therefore, there is arguably scope to widen the usage of tax incentives to promote ISM at national level.

3.1.10. Good practices and the characteristics of successful ISM schemes

The most successful examples of ISM schemes are those that have been operating long-term. Many of the best-known schemes that are cited as representing good practice have been ongoing for 15-20 years. Such schemes usually operate in countries with high levels of R&D intensity, and a long tradition of universities engaging in research and innovation with a close collaborative relationship with industry.

Among the characteristics of good practice in scheme design and implementation are: **integrating virtual and physical mobility, colocation, interaction and collaboration**. Those schemes that have appointed liaison officers to coordinate supervision arrangements for researchers or have involved intermediaries appear to be successful.

There is a **need for flexibility in implementation**: some countries have good experience with demand-driven ad hoc measures such as "Innovation vouchers" in Romania (internships in companies to solve/contribute to particular projects, by hiring PhD or postdoc researchers on a short-term basis).

4. FEASIBILITY STUDY OF A EU-LEVEL INTERVENTION ON INTERSECTORAL MOBILITY

4.1. Feasibility study

Through this feasibility study, a number of research questions (RQs) have been analysed relating to how the European Commission could best follow up in future, in order to foster intersectoral mobility. The forward-looking research questions have been examined through the feasibility part of the study (Section 1.4 provides a complete list of RQs). These include consideration of possible additional EU-level funding and non-funding initiatives. Alternative funding and non-funding options have been developed relating to possible future action at EU level.

Since the different options were developed in the final reporting phase, these options have not been directly tested on stakeholders. Rather, those participating in the interview programme and online survey were consulted about their experiences in the implementation of existing ISM schemes (and any lessons learned). They were also asked how the EU could play a strengthened role in future, through an overarching EU-level initiative and by encouraging the Member States to take further actions. The reaction of different stakeholders to the options should be followed up in order to operationalise the recommendations.

4.1.1. *The value of a holistic approach to intersectoral mobility*

RQ19 – Is there a need for a more holistic approach to promoting intersectoral mobility at EU level? What current shortcomings could such an approach help to overcome?

4.1.4.1. Existing EU support for ISM (funding, non-funding)

In order to assess whether a more holistic approach is needed, an analysis was first conducted of existing EU initiatives (funding, non-funding) which support ISM either *directly* or through dedicated schemes (e.g. European Industrial Doctorates within the MSCA ITN, the SME Associate pilot scheme etc.) or *indirectly* (e.g. the MSCA RISE and IF schemes are not focused explicitly on ISM, but they allow scope for ISM experiences and placements involving academic to non-academic mobility). However, since ISM takes place across a number of EU programmes, it is difficult to get an overall picture, hence the study's focus on describing EU funding opportunities for mobile researchers (see RQ4 in Section 2.2.5 and RQ7, which provides an analysis of EU funding for ISM in Section 2.2.7.5).

The EU provides other types of support to strengthen EU level coordination of researcher mobility policies and programming initiatives. The focus of some of the initiatives identified however is typically broader, with limited work specifically focusing on intersectoral mobility, such as:

- **Supporting the work of the Steering Group on Human Resources and Mobility (SGHRM).** The SGHRM has undertaken various steps conducive to strengthening ISM, such as:
 - **Development of quality HR strategies throughout European academic institutions and funders through the HRS4R process.** The process itself creates a culture of change and self-reflection. Through its coordination, the EC facilitates the exchange of good practices and has a channel for steering policy development. The HRS4R could facilitate the mainstreaming of ISM initiatives, and in particular researcher development initiatives preparing for ISM.
 - **Development of guidelines on promoting open, transparent and merit-based recruitment in research positions**⁸⁶ and a checklist for research institutions to follow to ensure that they are implementing the guidelines. Having transparent recruitment criteria open the door for an appreciation of ISM-experiences relating to academic positions.

⁸⁶ The 'Open, Transparent and Merit-Based Recruitment Checklist' - https://cdn5.euraxess.org/sites/default/files/policy_library/otm-r-checklist.pdf

- **Support for a study by the SGHRM on intersectoral mobility**⁸⁷. This identifies drivers and barriers to participation in ISM and the skills and competences that mobile researchers need to acquire. It also makes suggestions regarding funding, skills and training, etc.
- The SGHRM promotes, monitors and reports on the implementation of the various initiatives mentioned above and researcher-related activities (*e.g. the European Charter for Researchers and Code of Conduct for the Recruitment of Researchers and EURAXESS activities*).
- Since the members of the SGHRM have a role to play in reporting back to the EU-MS on key developments and trends, the SG is therefore crucial in strengthening the EU's coordination role in respect of researcher mobility by ensuring that appropriate linkages are made between the national and EU levels. The fact that the SGHRM is not explicitly focused on ISM but rather covers a broad range of issues relevant to researcher mobility, only strengthens its role in embedding ISM in the current research culture of every EC member state. Nevertheless, a dedicated expert group solely focused on strengthening ISM from policy to practice and long-term impact, could perhaps be set up in future as an additional valuable initiative.
- However, whilst the SG plays a positive role, it is important to note that voluntary take-up of the Charter and the Code of Conduct has been slow.

Further EU-level initiatives

- **Supportive EU policy developments**, such as frequent references to the importance of the international mobility of researchers across borders and sectors in European Commission Communications and Council conclusions since the launch of the European Research Area (ERA) in 2000. An EU policy framework focusing on researcher careers and mobility⁸⁸ was also adopted in 2008 which focused on four priority areas: 1) open recruitment and the portability of grants 2) meeting social security and supplementary pensions for mobile researchers 3) attractive employment and working conditions and 4) enhancing the training, skills and experience of European researchers. Of these, the second and fourth objectives are pertinent to supporting ISM. However, whilst it is encouraging that researcher mobility has been recognised as an EU policy priority, there remains a lack of a dedicated policy to foster the intersectoral mobility of researchers at EU level that could encourage MS the development of corresponding national policies.
- **The Bratislava Declaration of Young Researchers**⁸⁹ calls on the EC and the Member States to "provide structured opportunities for non-traditional career trajectories, such as recruiting permanent staff researchers, and mechanisms for better mobility between the public and private sectors". It also calls for better recognition by academic institutions of the benefits of such mobility in career appraisal criteria. Moreover, the Declaration calls for more opportunities for young researchers to work in a collaborative, inter-disciplinary research environment, which again suggests the need for further ISM opportunities. There is a problem in being unable to secure jobs in academia.

4.1.4.2. Assessment of the need for a more integrated approach

Having mapped and analysed existing EU initiatives, the extent to which there is a need for a more integrated and holistic approach to promoting ISM at EU level was then researched. The findings, in summary, are:

- There are a number of different EU programmes which fund researchers' participation in ISM through dedicated schemes and wider mobility schemes which allow scope for ISM.
- Whilst these schemes are valuable, there is a need to strengthen EU-level coordination across these programmes to ensure a coherent approach to promoting increased participation in intersectoral mobility.

⁸⁷ ERA-SGHRM working group study "On the intersectoral mobility of researchers, their conditions and their competences", October 2016
https://cdn2.euraxess.org/sites/default/files/policy_library/final_report_sghrm_intersectoral_mobility_final_report_0.pdf

⁸⁸ May 28th 2008, EC Communication: Better careers and more mobility: A EUROPEAN PARTNERSHIP FOR RESEARCHERS (EPR), COM(2008)317 final

⁸⁹ Bratislava Declaration of Young Researchers - <http://www.eu2016.sk/data/documents/bratislava-declaration-of-young-researchers-final.pdf>

- These funding programmes play an important role in promoting participation in intersectoral mobility but there is a need to complement funding initiatives with broader measures to implement sustainable change in research culture.
- In addition, there are a number of non-funding initiatives at EU-level, which are conducive to supporting increased participation in intersectoral mobility, even though this may not be their main focus (e.g. the work of the Steering Group on Human Resources and Mobility (SGHRM), the development of guidelines promoting open, transparent and merit-based recruitment in research positions, the adoption of the Bratislava Declaration of Young Researchers and funding studies on ISM).

However, in spite of the positive progress being made across these various initiatives, there is a **lack of an overarching EU policy framework** focusing solely on ISM and/ or an umbrella initiative to bring together these diverse funding schemes and wider initiatives into a single framework. A multi-level approach can support this overarching framework. This should consist of:

- Repeated and widespread use of the term intersectoral mobility using a common definition (see Section 1.2 – study scope and definition of ISM) and support measures for ISM in all HR-related and research-related policy documents (Commission communications, Council conclusions, Recommendations, funding calls, etc.);
- Continuation of specific funding instruments under the MSCA that facilitate and support ISM (e.g. European Industrial Doctorates, European Joint Doctorates) since there is a risk that without continued significant EU funding support, there is presently a lack of sufficient national funding of ISM schemes to achieve the objective of strengthening participation at EU level in ISM);
- Introduction of a requirement to mainstream ISM in other FP9 instruments, so that there is strengthened visibility of ISM within the MSCA and other EU financed researcher mobility schemes;
- Introduction of new funding instruments targeting any gaps in the availability of intersectoral mobility opportunities in existing EU schemes (for example, sub-actions explicitly targeting the participation of the public sector and the third sector not only industry);
- Publication of good practices and/or sharing of experiences through mutual learning seminars, workshops or conferences relating to the design, management and operation of schemes, so these can build on previous initiatives.
- A starting point in strengthening communication and dissemination of examples of good practice in ISM should be to disseminate the results of the mapping exercise and case studies identified in this report; and
- Awareness-raising to strengthen the visibility of intersectoral mobility through focused initiatives, e.g. an ISM-related award such as the European Researcher-Innovator of the Year, in the annual Researchers' Night.

It should be noted that the suggestions presented above are explored in further detail in the responses to the RQ linked to the Feasibility Study, as presented below. The recommendations stemming from the analysis relating to the feasibility of different funding and non-funding options are then elaborated in Section 4.2. Any new EU initiative will need to stress the importance not only of specific new forms of support but also ensure that the general principles underpinning ISM in terms of appropriate framework conditions are built into the holistic approach (see RQ20 below).

4.1.2. Means of strengthening framework conditions

RQ20 – What steps need to be taken to strengthen framework conditions to foster the intersectoral mobility of researchers in the EU-28 at national level?

Although some countries already have in place the framework conditions conducive to promoting the intersectoral mobility of researchers at national level, the baseline situation was found to be sub-optimal in many EU-28 countries. In Section 2.6.5, a number of weaknesses were identified in respect of the prevailing framework conditions present in some countries. Conclusions relating to these conditions are then outlined in Section 3.1.5. The main weaknesses identified were: the need for a sufficiently long period of industry-academic (and broader inter-sectoral) cooperation before stakeholders from different sectors are willing to engage in ISM, the absence of a national policy framework and/ or strategy in place to promote ISM, and unevenness in the availability of R&D tax incentives as a mechanism to strengthen investment in the recruitment of doctoral level researchers.

The shortcomings identified raise a number of questions as to what steps need to be undertaken to strengthen framework conditions in the EU-28. Firstly, improving framework conditions by definition requires a strategic approach and long-term commitment to tackling obstacles to participation in intersectoral mobility at national level. Many interviewees stressed that creating the right conditions cannot be achieved overnight. For example, in many EU-13 countries, there is a lack of a culture of industry-academic cooperation and low levels of business expenditure on R&D (BERD). Where such cooperation does take place, it is often linked to ESIF funding, which raises a question mark as to the sustainability of cooperation between academia and industry without continued EU funding. This problem appears to be especially prevalent in the countries that are generally under-represented in terms of their participation in the EU RTD Framework Programmes, which are eligible for widening participation.

As explained in Section 2.6 on drivers and obstacles to ISM, barriers of a structural nature also need to be resolved in many EU countries. The first step is for Member State authorities to identify the main weaknesses and gaps relating to framework conditions in their country and then to set out an action plan for addressing these. Among the minimum steps that Member States could take to strengthen framework conditions are: ensuring that a national policy framework is in place either dedicated to intersectoral mobility, or focusing on researcher mobility more broadly, but mainstreaming ISM as a key issue, and ensuring that R&D tax incentives are available for companies considering recruiting doctoral and post-doctoral researchers and promoting the usage of such instruments. Policies to address this issue should be integrated into national R&I policy frameworks / strategies as a horizontal issue.

The following aspects constitute a solid framework to increase the supply and uptake of large-scale and formal intersectoral mobility schemes and to derive maximum benefit from such schemes:

1. **The presence of EU-wide and national policy frameworks** in order to stimulate demand for researchers in the private, public and third sectors, and to improve skills training;
2. **Adequate (co-)funding** to support the implementation of EU/national policies, to bring stakeholders together and to remove some of the perceived obstacles;
3. **Awareness-raising** - according to the interview programme findings, the benefits of ISM are insufficiently well-known among industry and HEIs. Awareness should therefore be strengthened, and the benefits for all stakeholders made more tangible, thereby embedding formal ISM on a more sustainable basis;
4. **Training for PhD & postdoc researchers** through national or private funding targeted at non-academic career opportunities, preferably by means of integrating "non-academic exposure" into research training. This should include entrepreneurship and commercial awareness, skills to improve employability, and making internships and temporary placements in other sectors the norm rather than the exception;
5. **Adequate stakeholder engagement facilities** that bring academic and non-academic institutions together around joint research interests, the facilitation of networking, etc. (e.g. colocation initiatives, sector federation events bringing together academic and non-academic experts, etc.); and
6. **Building trust between academic and non-academic partners.** Trust is crucial for ISM scheme success and is typically built up over a long time and reinforced through a range of partnership commitments. These may take the form of joint research project applications, co-funding, joint supervision, regular exchanges, etc., and facilitating the matching of individual researchers and projects with companies and non-academic organisations.

The above principles relating to ISM should be mainstreamed into all research funding schemes, similar to the integration of international researcher mobility as a priority for most (if not all) funding opportunities for academic research over the last couple of decades.

4.1.3. Needs assessment for, and feasibility of a possible new EU funding scheme

RQ21 - Is there a need for a new EU funding scheme to support ISM at national and regional levels to address the gaps identified in the baseline assessment?

In addressing this EQ, we firstly outline the findings from the gap assessment and then present possible options for a new EU scheme to promote intersectoral mobility.

4.1.4.1. Gap analysis

The research has identified a number of **gaps in relation to the provision of existing ISM schemes**. In summary, the main findings from the gap analysis were that:

1. There is a lack of national funding support for domestic schemes not requiring an international mobility period in most countries.

Whereas there is already extensive EU funding support for international researcher mobility schemes, some of which allow scope for intersectoral mobility (see RQ7/ Section 2.2.7), there is arguably a lack of EU funding support for national and regional ISM schemes. For instance, although the MSCA COFUND provides significant funding support to national schemes (€80 million/year in Horizon 2020), the main focus of funding is on the provision of support for 'showcase schemes' which are quite large-scale with funding varying from circa €3 million to a maximum of €10 million per scheme⁹⁰. MSCA COFUND also requires an international mobility component to be built into the scheme and does not presently fund the many smaller-scale schemes being run either by individual universities or intermediaries (e.g. research and innovation or education agencies, scientific organisations and private research foundations).

There is arguably a policy case for setting up an EU scheme to provide 'top-up' co-funding to support the many smaller-scale, merit-worthy national ISM schemes. Additional EU funding would allow them to significantly scale up their activities and to increase the number of researchers able to participate in schemes managed and operated domestically. However, if a new pilot EU co-funding scheme to support existing smaller-scale regional, national and international ISM schemes were to be set up, this would need to identify the EU added value, bearing in mind the fact that Member States have competence for their education systems (including funding of doctoral education) and research and innovation systems.

In the case of a purely national fund, one possibility would be to adopt a similar approach to the funding of the ERA-NETs, whereby national funding is a pre-condition before the EU will make top-up funding available. An alternative would be to fund ISM schemes that are primarily domestic but which include a requirement for a shorter international mobility period to ensure that there is a clear EU added value. Examples of such EU co-financed national schemes already operating were identified through the basic mapping of schemes and cases studies, such as the ESF-financed Estonian industrial PhD scheme within the DoRa programme 2008-2015 (see case study 1). ISM mainly took place in Estonia, but with a five-month period spent abroad.

2. Although ISM schemes are targeted at PhD students and post-doctoral researchers with both a STEM and non-STEM background, there are insufficient numbers of ISM schemes that seek to recruit PhD researchers to work on non-STEM subjects.

Prioritising non-STEM subjects through a dedicated new scheme (or a new sub-action within an existing EU funding scheme) could be advantageous, since it would open up the career horizons of PhD students and PhD graduates with a background in social sciences or the humanities to the possibility of a non-academic career in the third sector or public sector (where graduates have traditionally focused on career opportunities in academia alone). The VW scheme in Germany is a good example of attempting to increase ISM for non-STEM PhD students and graduates.

3. There are insufficient numbers of national (or indeed European) ISM schemes targeted at the public sector and third sector.

Although the research identified some schemes targeted at the public sector and third sector respectively, most formal schemes involve mobility between academia and industry. Examples of relevant schemes in the public sector are the Public Sector PhD scheme in Norway (see case study 3) and a scheme run by the Bank of Italy to provide mobility opportunities to both graduate and post-doctoral researchers in economics. Dedicated schemes for the third sector and schemes targeted in the arts and cultural sectors were also found to be few and far between. Yet some schemes were however identified, such as the CAROLINE and New Foundations schemes operated by the Irish Research Council (see case study 2 on mobility to the third sector) and the Collaborative Doctoral Partnerships (CDP) in the UK run by one of the Research Councils, the AHRC. Yet there could potentially be major benefits from enhancing the level of two-way mobility in these sectors.

⁹⁰ http://ec.europa.eu/research/participants/portal/doc/call/h2020/msca-cofund-2017/1765107-h2020-msca-cofund-2017_guide_for_applicants_en.pdf

4.1.4.2. Options analysis relating to funding

In the previous sub-section, it was demonstrated that there are a number of gaps in the provision of funding for intersectoral mobility to enable specific target groups to participate in mobility experiences, but there are gaps of a non-funding nature as well.

A number of different alternative funding and non-funding options could be considered. The possibilities for a new EU funding scheme are summarised below. They range from:

- Not changing anything in terms of ISM;
- Introducing ISM horizontally across all existing funding programmes in H2020 and FP9;
- Introducing a separate ISM-targeted funding scheme;
- Introducing a funding scheme targeted at high-quality ISM-preparation (including professional career development and training and skills).

Table 0.1- Funding options for a possible new ISM scheme

Options	High-level Description of Options
Option 0 – No change.	Under the “status quo” option, intersectoral mobility would continue to receive support through EU programmes such as the MSCA’s ITN, RISE and IF, the SME Associate Pilot and the EIT Master’s and PhD programmes. However, there would be no particular policy focus on ISM.
Option 1 – Mainstreaming intersectoral mobility as a horizontal theme.	Intersectoral mobility would be mainstreamed in all relevant European funding programmes as a horizontal priority and explicitly referred to in all aspects of programme implementation, including in the call documentation for annual calls for proposals. Mainstreaming could initially be implemented in the current generation of researcher mobility programmes in Horizon 2020, and then systematically integrated into the new generation of programmes in planning for FP9.
Option 2 – Set up a new EU funding umbrella programme dedicated to promoting intersectoral mobility.	A new dedicated umbrella ISM programme could be set up. Through the umbrella, a number of new sub-schemes could be introduced to address some of the gaps identified through this study. Its objectives <i>inter alia</i> should include the following: (1) promoting research excellence (using ISM as a delivery mechanism) (2) increasing the level of participation in ISM across the EU, and (3) making ISM a more common feature of researchers’ professional development. Different sub-options could be considered within Option 2. These have been designed to not be mutually exclusive and several could be implemented in parallel.
Option 2.1 – Sub-action: Industrial Fellowships for Excellent Researchers.	This new funding sub-action could promote researcher excellence through the establishment of a new Industrial Fellowships scheme with compulsory ISM. The scheme could be targeted at the doctoral and post-doctoral levels and aim to be highly competitive. Other similar schemes typically offer fellowship awards of either 12 months’ or 24 months’ duration.
Option 2.2 – Sub-action: Intersectoral mobility placements and internships.	A further sub-action could be set up to promote much wider participation in ISM by making small grants available to encourage HEIs, companies, public and third sector stakeholders to offer mobility placements and internships of 3-12 months. Such a sub-action would be less concerned with excellence (although quality would still be an important criterion to ensure some degree of competition since not all researchers would be funded). The possibility of offering part-time placements in other sectors from academia (of say 1-2 days / week) could also be considered. The assessment of good practices found that offering ISM on a flexible basis makes it easier for start-ups and SMEs to participate in schemes.
Option 2.3 – Sub-action: Intersectoral mobility between academia and the public sector and third sectors.	If a new scheme were set up, then a clear gap is the lack of explicit provision within existing ISM schemes to facilitate mobility between academia and the public sector and third sectors. Whilst there are a small number of such schemes at national level, they are few and far between. Many countries do not have any schemes explicitly targeting the public sector or the third sector, even though they could benefit from having talented doctoral and post-doctoral researchers working on research

Options	High-level Description of Options
	projects and on specific problems and societal challenges.
Option 2.4 – Intersectoral mobility sub-action to increase opportunities for researchers in non-STEM subject disciplines to undertake mobility experiences	<p>A further gap identified was the lack of sufficient numbers of national schemes targeted at non-STEM subject disciplines. Although some schemes did offer mobility opportunities to non-STEM researchers, these were few and far between. Therefore, it may be appropriate to operate a dedicated scheme for such researchers. However, a further possibility would be to combine this option with Option 2.3, since many PhD and post-doctoral researchers in non-STEM subjects may be especially well-placed to pursue mobility opportunities between academia and the public sector and third sectors.</p>
Option 2.5 – Set up a dedicated EU and national level support structure	<p>A dedicated EU and national level support structure could be established (using the national contact points already operating through Euraxess to avoid having to set up new structures). The purpose of a new support mechanism would be to:</p> <ul style="list-style-type: none"> • Provide advisory support to scheme managers in the setting up and implementation of intersectoral mobility schemes, as well as in their monitoring and evaluation. • Provide a centre of expertise and excellence on intersectoral mobility, for instance through the dissemination of good practices. • Strengthen cooperation and promote partnership working between scheme managers, and encourage the sharing of experiences and good practices; • Strengthen the culture of evaluation and monitoring in intersectoral mobility schemes across the EU by promoting the exchange of benchmarking data on scheme performance and the sharing of good practices in the use of indicator systems (qualitative, quantitative) to measure such performance. • Strengthen cooperation on intersectoral mobility between different EU and associated countries. <p>The new support structure could be coordinated overall by the European Commission with active support from the Euraxess national contact points. Their role could be expanded to include a specific remit to assist the EC in achieving the objectives outlined above.</p>
Option 2.6 – Streamline the MSCA by folding in the cross-sectoral aspects into a new umbrella EU scheme dedicated to intersectoral mobility along with the SME Associate Scheme.	<p>It would be possible to streamline the MSCA through radical reform in planning for FP9. There is a risk with the current programming architecture that since cross-sectoral mobility is incorporated within the MSCA, intersectoral mobility does not have particular prominence (the ITN excepted). This means that the MSCA may be seen by external stakeholders – especially industry – as being more of an international researcher mobility programme targeted at academia. Consequently, the intersectoral dimension – and the tangible benefits for researchers and participants in strengthening industry-academic cooperation on a sustainable basis – may get lost.</p> <p>Although radical, one option could be to incorporate all EU programmes that support ISM within a single umbrella programme from FP9 onwards to give ISM greater visibility and to ensure that it attracts the same high profile as international researcher mobility has done among research actors and industry.</p>
Option 3 – Sub-action to provide preparatory training and professional career development, skills and training support to intersectorally mobile researchers	<p>The research identified a need for both preparatory training and skills and training support during an ISM experience. A key research finding was that although some ISM schemes provide formal training during or prior to an ISM period, supplemented in some cases by professional development support, many others do not. There is consequently a need for greater consistency. Researchers were also found to lack many of the skills needed to prepare themselves for a career outside academia. There is a need for training to enhance both skills for employability and specific skills areas relevant to working intersectorally (e.g. entrepreneurship, commercialisation of innovation and IPR, leadership and management and skills).</p> <p>Making professional development available through a funding action would</p>

Options	High-level Description of Options
	help to better prepare researchers not currently engaged in ISM for future intersectoral mobility experiences. This would also strengthen the professional career development of researchers as well as opening up their horizons to the full spectrum of researcher careers across different sectors (see case study 5 on the role of preparatory training in fostering ISM). The focus on skills development is consistent with the findings of the FP7 final and H2020 interim evaluation report for MSCA, which recommends that "secondments" and "skills development" receive further promotion. ⁹¹
Option 4 – Expand the SME Associate Pilot Scheme	The scale and scope of the SME Associate Pilot Scheme could be expanded so that mobility experiences can also take place between post-doctoral researchers and the public and third sectors, not only with industry. Strong consideration should be given to making changes to the current pilot since the duration of the mobility period (fixed at 12 months) is prescriptive. The research found that a more flexible, bottom-up and demand-led approach is more effective in meeting the real needs of different sectors for high-quality researchers.

The managerial implications of these different options are now briefly considered and analysed in greater detail later on (see analysis relating to each specific option). Under **Option 1**, the EC, supported by the Euraxess network, would be responsible for mainstreaming intersectoral mobility into existing and future generations of EU researcher mobility programmes. Several DGs and Executive Agencies would need to be involved namely: DG EAC (MSCA and the EIT), DG RTD (mainstreaming into Horizon 2020 and FP9) and EASME (the SME Associate Scheme). Under **Option 2**, if a new EU level scheme were to be given the green light, it would be necessary to consider how best such a new scheme might be managed. There are a number of different sub-options in this regard, namely:

1. **An EU-managed top-up funding scheme** to which individual ISM schemes across the EU-28 and associated countries can apply.
2. An EU co-financed scheme **managed on a decentralised basis operated under shared management** organised in each participant country on a national or regional basis.

There are various advantages and drawbacks of these approaches, as described under Option 2.

Under **Option 3**, since the EASME Executive Agency is responsible for the SME Associate pilot Scheme, the Agency would need to liaise closely with DG EAC and DG RTD to ensure that any changes made to the operation of the pilot enhance opportunities for intersectorally-mobile researchers. Several options could be considered alongside one another, since most options are not mutually-exclusive.

A more detailed assessment of the different proposed options, including their relative advantages and disadvantages, is now provided.

4.1.3.2.1. Option 0 – No change

Under the "no policy" option, no new changes to the existing programming architecture would be made. Rather, the status quo option would be retained and the existing programming approach being adopted in Horizon 2020 would be continued. As shown in Section 2.2.7, there is already significant EU funding support for dedicated ISM across a number of different EU programmes, especially through the MSCA's ITN and the smaller-scale SME Associate Pilot Scheme, as well as through the EIT Master's and PhD programmes. Indeed, taking into account not only dedicated ISM schemes but also researcher mobility schemes that allow scope for mobility from academia to non-academia (e.g. the MSCA's RISE and IF), EU funding for intersectoral mobility already amounts to an estimated €3.1 billion in total in the 2014-2020 period, of which €2.56 billion through the various relevant MSCA sub-actions. The detailed workings regarding the aggregation of current EU funding of such mobility were provided in Section 2.2.7.5.

⁹¹ <https://publications.europa.eu/en/publication-detail/-/publication/27e546f6-c847-11e7-9b01-01aa75ed71a1/language-en>

It is therefore potentially viable to focus on non-funding options rather than setting up a new dedicated EU intersectoral mobility funding scheme. Under this Option, the gaps identified in the baseline assessment could instead be addressed by introducing new sub-actions within existing programmes (e.g. the MSCA and / or SME Associate Scheme in FP9). However, a disadvantage with the current approach is that intersectoral mobility is often below-the-radar within EU programmes (except the MSCA's ITN). The tangible and intangible benefits of undertaking a period of intersectoral, as opposed to solely international researcher mobility, are therefore being given insufficient prominence. If no action is taken, intersectoral mobility would therefore continue to have poor visibility at EU level and therefore there would be a missed opportunity in terms of showcasing how intersectoral mobility can be beneficial to national policy makers (who in many countries the research found are also giving insufficient attention to ISM).

4.1.3.2.2. Option 1 – Mainstreaming intersectoral mobility into the existing generation of researcher mobility programmes in Horizon 2020 and in FP9

Under Option 1, the EC would strengthen attention to, and heighten the visibility of intersectoral mobility through a mainstreaming approach in the current generation of researcher mobility programmes in Horizon 2020, and secondly in the new generation of programmes being planned for FP9. Under such a mainstreaming option, ISM would be given stronger prominence at all levels of programme implementation, such as:

- The preparation of annual calls for proposals;
- The collection of monitoring data on programme outcomes (e.g. disaggregating data on researcher mobility to differentiate between intersectoral mobility and other forms of international mobility);
- Meetings to present the outcomes achieved through researcher mobility programmes to stakeholders to raise awareness about the benefits of ISM.
- Giving extra weight during the application stage to stakeholders in the MSCA that are applying to take part in intersectoral mobility.
- Communication and dissemination activities relating to the ISM dimension within the MSCA could also be strengthened as part of a mainstreaming approach.

Some stakeholders interviewed mentioned that it could be especially beneficial to promote ISM using a mainstreaming approach at the application stage. For example, a stakeholder interviewed in Ireland suggested that one possibility would be to adopt the following approach:

- Give additional points to MSCA applications that are both international (compulsory presently) and intersectoral;
- Consider waiving the mandatory international mobility requirement for applications that involve intersectoral mobility.

Although the latter suggestion would be a radical departure from the current approach, many stakeholders pointed out that most intersectoral mobility takes place locally and it may not always generate added value to incorporate an international dimension. Although this could raise issues relating to how to ensure EU added value, researchers taking part in such mobility would still be expected to engage internationally over time in their careers, for instance through international conferences, publishing joint publications with international partners etc.

Regarding the rationale for mainstreaming, it could be argued that it is unrealistic to continue the status quo (Option 0), since there are low levels of awareness among researchers and stakeholders (HEIs, SMEs) about intersectoral mobility opportunities available through formal schemes and informal means of researchers taking part in mobility experiences and of the associated direct and indirect benefits.

4.1.3.2.3. Option 2 – Set up a new EU funding scheme dedicated to promoting intersectoral mobility.

Under Option 2, an EU funded top-up scheme could be launched to which all EU Member States would be eligible to apply. The rationale for setting up a top-up fund to support existing, and to incentivise the establishment of new ISM schemes is that:

- Whilst there is evidence of good practice in smaller-scale ISM schemes, such schemes lack critical mass, making it difficult for them to gain sufficient visibility and to realise economies of scale in scheme management;
- Scaling-up existing ISM schemes could have an important 'demonstration effect' through increased critical mass in scheme size which would further enhance the visibility of ISM.

- This in turn could persuade more individual HEIs nationally to set up their own ISM schemes, or to participate in regional or national umbrella schemes coordinated by an R&I funding agency or other form of intermediary.

Among the objectives of setting up a new scheme could include: (1) promoting research excellence, using ISM as a delivery mechanism (2) increasing the level of participation in ISM across the EU, and (3) making ISM a more common and integral feature of researchers' professional development pathway. However, it should be noted that the objectives will necessarily differ according to which among the specific sub-options within Option 2 presented below are being implemented in parallel. Most of these sub-options have been designed not to be mutually exclusive.

- **Option 2.1 – Set up an Industrial Fellowships Scheme for Excellent Researchers engaged in intersectoral mobility.**
- **Option 2.2 – Set up an intersectoral mobility placements and internships sub-action.**
- **Option 2.3 – Set up an intersectoral mobility sub-action to promote mobility between academia and the public sector and third sectors.**
- **Option 2.4 – Intersectoral mobility sub-action to increase opportunities for researchers in non-STEM subject disciplines to undertake mobility experiences.**
- **Option 2.5 – Set up a dedicated support structure at EU and national level focusing on intersectoral mobility.**

In considering which of the sub-options should be implemented in future, it is important to keep in mind that a new scheme may lack the necessary critical mass to achieve visibility unless it were to be rolled out on a significant scale. However, this depends on the nature of a new scheme and in particular whether it is designed more as:

- 1. An Excellence programme** – see sub-action 1, industrial fellowships could be awarded to top-class PhD candidates and post-doctoral researchers.
- 2. A programme to promote (mass) participation in intersectoral mobility** - see sub-action 2, small grants could be given to facilitate the ISM of PhD and post-doctoral researchers by topping-up existing funding schemes at regional and national levels to promote increased participation in ISM. The research identified a problem that ISM is often seen as an exception rather than the norm.
- 3. A hybrid model combining elements of both excellence and mass participation.** An alternative is that a new EU scheme could be structured in a way that incorporates two funding streams, a highly competitive scheme to promote researcher excellence and reward successful applicants with a competitive salary, with a further sub-action offering modest funding to encourage a significant increase in participation in intersectoral mobility.

If the new scheme were to be designed and implemented as an excellence programme which only focused on attracting the brightest academic and industrial researchers, then the number of participant researchers per year would likely remain relatively low. A possible comparator here is the Erasmus Mundus programme⁹² (which is eligible for both Masters' students and PhDs), which was designed to rival the Fulbright Scholarship, although this has become better-known over time, since competition for places is very high, reflecting generous funding per successful applicant.

The research found that ISM schemes operate most effectively when developed from the bottom-up (since this allows for the customisation of schemes to meet the identified needs of industry, academia and the public sector, which are often local-specific. It may therefore be a risk that an EU scheme based on annual calls for proposals may be too prescriptive and not flexible enough. This does not exclude an EU-level approach, but the calls for proposals would need to be written in a way that reflects the importance of flexibility in scheme design, set-up and implementation. The different sub-options are now considered in further detail.

⁹² Erasmus Mundus Masters courses (Action 1A) and Erasmus Mundus Joint Doctorates (Action 1B)

Option 2.1 – Set up an Industrial Fellowships Scheme for Excellent Researchers engaged in intersectoral mobility.

An Industrial Fellowships Scheme could be set up for Excellent Researchers across the EU and associated countries as a sub-action within a new EU scheme dedicated to intersectoral mobility (or an existing scheme which could be adapted to create an additional sub-action e.g. within the MSCA or the SME Associate Scheme). The scheme would fund Fellowships between academia and industry and reward research excellence through a grant which would cover their salary and other research costs and allow researchers the opportunity to spend between 12 and 24 months pursuing a collaborative research project which would include a mobility period to another sector. The purpose would firstly be to strengthen research excellence through ISM and to encourage strong competition for Fellowships in a way that would heighten the profile of ISM.

Regarding existing provision at EU level, there is already a scheme under the MSCA to promote Excellent Researchers, the Individual Fellowships (IF) scheme⁹³. However, the main objective is promoting research excellence rather than intersectoral mobility (although those awarded an IF may spend their mobility period either in an academic or non-academic setting). A key distinction between a potential new Industrial Fellowships Scheme and IF is that the former would explicitly focus only on ISM whereas under the IF, academia-to-academia fellowships are possible.

There are a number of existing national industrial fellowship schemes which promote bidirectional mobility, such as the Industrial Fellowships scheme operated by the Royal Academy of Engineering and the Industrial Fellowships scheme operated by the Royal Society in the UK (see case study 4). Such schemes are competitive and the fact they receive a higher number of applications than places available helps to foster research excellence through selectivity.

The main advantage of funding an excellence programme is that it would help to ensure that intersectoral mobility is associated with high quality standards and with promoting research excellence among early-to mid-career academics (i.e. R3 and R4), which is where a gap was identified in provision (only a small percentage of the total number of national ISM schemes identified target later career stage researchers (again, see case study 4 which focuses on this topic).

A potential disadvantage of funding an excellence programme on intersectoral mobility is that the cost per researcher will typically be higher than for a programme offering shorter mobility periods which involves either virtual mobility or a shorter placement or internship. It is difficult to estimate the costs involved precisely, since these vary *between* and even *within* ISM schemes, depending on the type of research involved, the academic discipline etc. However, the typical costs are estimated at being some €30,000 - €100,000 per researcher with the typical duration (which mainly covers salary costs) over 6 months – 12 months.

Option 2.2 – Set up an Intersectoral mobility placements and internships sub-action.

A further sub-option would be to fund a new scheme to promote wider participation in intersectoral mobility through the provision of small grants to mobile researchers for the purpose of undertaking short collaborative research projects, and undertaking short mobility placements and internships. Consideration could also be given to awarding small-scale grants directly to companies and public and third sector organisations who could then be matched with a suitable researcher, which is the approach that has been adopted through the Italian PhD iTalents scheme (<http://www.phd-italents.it/>), which commenced as a pilot in 2015. The Italian scheme manager at national level, *Fondazione Crui* provides a computer-driven matching service to match suitable researchers and companies, with researchers accepted onto the list having to meet a quality threshold as part of the process of two annual calls for proposals which are used as a filter mechanism for drawing up the selection lists from among potential applicants. The duration of a mobility experience under a sub-action offering “mass” participation should typically be shorter, for instance between 3-9 months, although the duration should be kept flexible and driven from the bottom up.

The advantage of offering more numerous, smaller grants to encourage wider participation is that it would overcome the current problem that although existing EU funding schemes provide support for ISM, the costs per funded researcher are relatively high, with a strong focus on pursuing research excellence by funding top-tier researchers. Whilst a highly selective approach, as currently being adopted under the MSCA ITN has some benefits, such as enhancing the prestigiousness of a joint doctorate through strong competition to take part in European Industrial

⁹³ There are two types of Fellowships, European Fellowships and Global Fellowships – see https://ec.europa.eu/research/mariecurieactions/about/individual-fellowships_en .

Doctorates and European Joint Doctorates, there are drawbacks of targeting only the brightest and most talented researchers. Examples of disadvantages are the lack of visibility of intersectoral mobility as well as the missed opportunity of not opening up PhD researchers' horizons earlier to the possibility of a career in another sector, taking into account the large pool of talent among PhD and post-doctoral level researchers not currently participating in intersectoral mobility.

A further argument for a dedicated scheme is that it would strengthen the sustainability of industry-academic collaboration. Although the MSCA works very well overall and is long-established, some interviewees argued that industry-academic collaborations supported may be somewhat artificial compared with national ISM schemes in the sense that the partnerships were created largely to apply for EU funding and cross-sectoral partnerships have been formed on a transnational basis bringing together diverse partners from different countries. Although some partnerships may prove sustainable, others may be less sustainable than those supported through national, often more localised ISM schemes, where co-location helps to embed more sustainable, longer-term partnerships.

From the supply side, researchers themselves could potentially benefit from having their career horizons opened up to working in different sectors. On the demand side, making ISM the norm rather than the exception would help draw industry's attention to the advantages of recruiting intersectorally mobile researchers, especially among SMEs who are less likely to take part in excellence programmes due to the time commitment involved.

In terms of scheme design, one possibility would be to set up a new funding scheme that is primarily domestic-focused, but to require participants to undertake a short international and intersectoral mobility period through a placement in a company. However, organising short intersectoral placements or internships in another country can require considerable administrative effort, as previous evaluations of EU programmes such as Erasmus for Young Entrepreneurs have shown.

Option 2.3 – Set up an intersectoral mobility sub-action to promote mobility between academia and the public sector and third sectors.

One of the gaps identified in the research is the absence of enough dedicated ISM schemes that facilitate mobility between i) academia and the public sector and ii) between academia and the third sector. Here reference should be made to case studies 2 and 3 respectively, since these highlight examples of good practices in the setting up and operation of schemes facilitating mobility between academia and these sectors. The case studies show that whilst there are several examples of schemes in these sectors and evidence of good practice, overall, such schemes are relatively uncommon.

Consideration should therefore be given by the European Commission as to whether a dedicated sub-action should be set up expressly to ensure that there are sufficient opportunities for mobile researchers to undertake mobility experiences in the public sector and third sector respectively, and conversely, from a bidirectional mobility point of view, for senior decision-makers within public sector and third sector organisations to take time out from their organisations to undertake research projects in an academic setting. Given the pressing importance of tackling different societal challenges, which are strongly emphasised within Horizon 2020 (and look likely to continue to be a major priority in FP9), increasing the two-way flow of researchers between these sectors would be appropriate.

The advantage of having a dedicated sub-action to foster such mobility is that it would guarantee that mobility opportunities are available for researchers wishing to undertake a mobility experience in these sectors or looking to move from these sectors to academia.

However, some researcher mobility programmes already allow scope within their eligibility criteria for academia to non-academia mobility, but the possibility of taking part is not widely known. It could therefore be argued that a new sub-action may not be necessary if more is done to ensure that existing programmes are adapted to accommodate the participation of the public and third sectors respectively. An argument in favour of a new dedicated sub-action is that the needs of prospective participants are different depending on the sector.

In case study 2, for instance, which focuses on the CAROLINE MSCA COFUND and the New Foundations schemes, both targeted at the third sector, it was observed that the ability to absorb the costs of taking part in an ISM scheme vary significantly between sectors, with the public sector and in particular the third sector less able to co-fund part of the costs of participation compared with companies. This should be reflected at a programming level either through different sub-actions for different sectors or by differentiating the % co-funding that applicants from across different sectors can receive. Whereas schemes commonly cover the salary costs, there can be

significant additional costs of participation for participants such as administrative and research overheads, the human resource costs of ensuring that mentors and supervisors are in place etc. Since NGOs often have a very limited budget, there is arguably a need for schemes to cover these additional costs otherwise they will be unable to participate and benefit from the high-level research skills that doctoral researchers bring.

Option 2.4 – Intersectoral mobility sub-action to increase opportunities for researchers in non-STEM subject disciplines to undertake mobility experiences. A share of the funding allocated to a new EU scheme to foster increased levels of intersectoral mobility starting in FP9 could be dedicated to non-STEM subject disciplines, or to mainstreaming ISM-opportunities in all disciplines. Although through the basic mapping, examples were identified of ISM schemes targeted at PhD students and post-doctoral researchers with both a STEM and non-STEM background, there were found to be many more schemes aimed at STEM subjects than non-STEM. Prioritising non-STEM through a dedicated sub-action could be advantageous since it would open up the career horizons of PhD students and PhD graduates with a background in social sciences or the humanities to the possibility of a non-academic career in the third sector or public sector (since they traditionally tend to focus on career opportunities in academia alone). The VW scheme in Germany is a good example of attempting to increase ISM for non-STEM PhD students and graduates.

Option 2.5 – Set up a dedicated support structure at EU and national level focusing on intersectoral mobility.

An analysis of existing support structures for mobile researchers is provided in Section 2.3.3.7. The existing Euraxess (<https://euraxess.ec.europa.eu/>) network provides EU-wide support to facilitate researcher mobility. Euraxess already provides an important support function since it provides 1) jobs and funding 2) partnering both within the EU28 and internationally and 3) general information and assistance to mobile researchers. However, although the industry section of the portal has recently been improved, it does not presently have an explicit remit to support intersectoral mobility. The objectives of setting up a dedicated support structure could therefore primarily be to:

- Provide advisory support to scheme managers in the setting up and implementation of intersectoral mobility schemes, as well as in their monitoring and evaluation;
- Provide a centre of expertise and excellence on intersectoral mobility;
- Promote the dissemination of good practices;
- Strengthen cooperation and promote partnership working between scheme managers, and encourage the sharing of experiences and good practices;
- Strengthen the culture of evaluation and monitoring in intersectoral mobility schemes across the EU by promoting the exchange of benchmarking data on scheme performance and the sharing of good practices in the use of indicator systems (qualitative, quantitative) to measure such performance; and
- Strengthen cooperation on intersectoral mobility between different EU and associated countries.

The research identified a lack of appropriate support structures specifically dedicated to intersectoral-mobility. In particular, the main gaps identified were at the level of:

- **Intersectorally-mobile researchers** – whilst most researchers undertaking a mobility period are appointed both an academic supervisor and a supervisor from industry (or another sector), there is a lack of national level support structures to support them during their mobility period in responding to queries, for instance relating to ensuring that their mobility period is formally recognised within career appraisal systems, skills and training, etc.;
- **Individual current and prospective scheme managers** already involved in managing ISM schemes or considering setting up new ISM schemes in the near future. Since scheme managers often manage small-scale schemes in which only a small number of researchers take part annually, they often work in relative isolation from other scheme managers, with limited scope for networking and the exchange of experiences between schemes; and
- **Other stakeholders taking part directly in mobility schemes or considering getting involved in an ISM scheme in future.** A wide range of different types of organisations⁹⁴

⁹⁴ Examples are higher education institutions, research institutes, private research foundations, companies, public sector organisations, charities, NGOs and arts and cultural sector organisations.

interested in ISM could benefit from having access to advisory support and guidance. A further possibility is that a computer-driven matching service could help to match researchers seeking a mobility experience with those offering intersectoral researcher mobility opportunities.

A further key finding was the **lack of joint cooperation, networking or partnership working** between the managers of ISM schemes. Being part of a more formalised partnership structure to link ISM scheme managers with one another could bring various potential benefits, such as facilitating networking, sharing good practices, exchanging experiences between scheme managers and sharing benchmarking data on the outcomes of ISM schemes to facilitate evaluation and monitoring.

The absence of sufficient cooperation, networking and partnership working could be addressed by setting up a new programming action (either as a separate initiative or within an existing programme such as the MSCA within Horizon 2020). The purpose of funding such an initiative would be to strengthen inter-scheme partnership working, so that rather than operating their scheme in isolation, they could engage in partnership working and be part of a wider network of ISM schemes.

A new action could be supported either through the creation of a new standalone funding scheme with a separate branding identity or by creating a new sub-action within the MSCA. This could be called "The Intersectoral Mobility Partnerships scheme" or similar. More specifically, its purpose would be to:

- Ensure that there is a **common support structure** in place across the EU-28 and a **helpdesk** specifically focused on intersectoral mobility available in all EU countries.
- Promote **strengthened partnership working, cooperation and the exchange and sharing of good practices as well as benchmarking and monitoring information and data** between ISM scheme managers so as to foster research talents.
- Ensure that **preparatory training** is provided to researchers prior to them taking part in ISM so as to strengthen the impact of such schemes. Such training should consist of the provision of advice and support relating to professional career development and ensure that researchers' horizons are opened to academic and non-academic career development opportunities (*see Case Study 5 – Preparing for ISM and Vitae's researcher development framework*).
- Provide a **consistent approach to delivering formalised skills and training modules for researchers participating in ISM schemes during their mobility experience** (e.g. on entrepreneurship, effective management practices, and softer skills such as communication skills and team working). This would need to be tailored according to the four research career stages (R1 – R4).
- Promote **economies of scale across dedicated ISM schemes** since many ISM schemes are small-scale, and are not presently able to deliver formal skills and training, such services could be procured jointly across a number of ISM schemes to reduce costs, to ensure that formal training is available and to ensure consistency in its delivery.
- Spread good practices in undertaking **monitoring and evaluation** of the outcomes of ISM schemes, and facilitate scheme evaluation through the pooling of resources at national level (to overcome the problem of the over-fragmentation of small-scale schemes which makes it more difficult to evaluate the effectiveness and impacts of schemes).
- Use **EU funding as a mechanism to drive changes in behaviour**. Training could be provided for ISM scheme managers to encourage them to embrace a culture of systematic monitoring and evaluation, using common benchmarks to compare with performance (including costs and benefits) of different types of schemes across Europe. The importance of strengthening monitoring of the performance of ISM schemes could also be promoted by the European Commission through the proposed sub-action to strengthen partnership working between schemes. In addition, national authorities responsible for higher education and research could be encouraged to engage in evaluation and monitoring of ISM more systematically in their national reporting and M&E framework, both in terms of reporting back to the Commission (e.g. the European Semester Reports) and in monitoring the implementation of national strategies on researcher mobility (including the intersectoral dimension) which we advocate in our recommendations that they should draw up.
- **Support for an action that promotes closer cooperation and partnership working could also be used as a means of promoting stronger interested in lower capacity R&I countries** to engage in ISM by sharing good practice examples of how to promote a culture of industry-academic cooperation more effectively. The evidence from the study suggests that in many countries, such cooperation when Structural Funds funding-led may

be superficial and lack sustainability. Therefore, stakeholders from countries with longstanding experience of how to promote sustainable forms of cooperation between academia and other sectors could be invited to make presentations to raise the bar across all countries in terms of ensuring that cooperation benefits all stakeholders.

An overriding objective of funding a new action or initiative to promote stronger cooperation and partnership working between ISM scheme managers, policy makers and other key stakeholders interested in ISM would be to strengthen **the policy importance attached to intersectoral mobility** across the EU-28 by ensuring that all Member States give greater attention to this issue and its potential contribution to the growth and jobs agenda.

The target groups in terms of participation in the partnership working action would be:

- **Individual current and prospective scheme managers** already involved in managing existing ISM schemes or considering setting up new ISM schemes in the near future;
- **Policy makers and wider stakeholders** interested in, or already engaged in intersectoral cooperation interested in learning from good practices and the exchange of experiences

In addition, through the national helpdesk facility, the target group will include the above two target groups, but also individual researchers who may have questions about taking part in ISM, for instance in relation to working conditions, advice on ensuring that their experience during an intersectoral mobility period counts, etc.

RQ22 - What role could the EURAXESS network play in relation to possible new EU support structure?

Regarding how such a support structure would be managed, the Euraxess network already has a structure in place at national level across the EU-28 and in Horizon 2020 associate countries, as well as in some third countries. Euraxess could therefore play a stronger role in providing guidance, advice and support to interested researchers and wider stakeholders.

Whilst EURAXESS already plays an important role in matching researchers looking for international mobility opportunities, it could be given a more dedicated remit to promote ISM and to provide a national support structure for existing ISM schemes, to ensure partnership working and improved networking between schemes, which are presently highly fragmented. In addition, since many countries do not have any national funding or support structures in place, Euraxess could ensure that the existing Euraxess contact points set up in each EU Member State and internationally in key EU partner countries (e.g. the US, China, India etc.) are adapted to provide support specifically on intersectoral mobility. Since many countries lack either national funding or support mechanisms to support them in setting up new, or implementing existing smaller-scale ISM schemes, this role would add value.

A risk associated with Option 2 in general is that there may be confusion among stakeholders between a new scheme and existing EU schemes, given that there are several different schemes already supporting intersectoral mobility for instance through the MSCA's ITN, IF and RISE schemes, the MSCA COFUND which supports regional, national and international intersectoral mobility schemes, the SME Associate Scheme and the EIT's Masters and PhD schemes. However, this could be mitigated by giving the new scheme a distinctive branding relating to intersectoral mobility.

Option 2.6 – Streamline the MSCA by folding in the cross-sectoral aspects into a new umbrella EU scheme dedicated to intersectoral mobility along with the SME Associate Scheme.

A further possibility – but one which would be controversial given that the MSCA has been successfully operating for 20 years and has evolved over time through organic changes – would be to radically restructure the existing programming architecture for EU researcher mobility programmes in planning for FP9 and the new financial perspective beyond 2020. Currently, the MSCA consists of four sub-actions, 1) Innovative Training Networks (ITN) Innovative doctoral-level training providing a range of skills in order to maximise employability, 2) Individual Fellowships (IF), Support for experienced researchers undertaking mobility between countries, and also to the non-academic sector, 3) Research and Innovation Staff Exchange (RISE) International and intersectoral collaboration through the exchange of research and innovation staff, and 4) Co-funding of regional, national and international programmes (COFUND) Co-financing high-quality fellowship or doctoral programmes with transnational mobility. Two of the four promote ISM directly and the two allow scope for ISM but are mainly focused on academia-to-academia international mobility. One possibility to strengthen the visibility of ISM would be to separate out the ISM components and to restructure the MSCA so that a new dedicated ISM programme

contains a number of new and existing sub-actions within an umbrella programme. This could involve, for instance, the following steps:

- A new dedicated ISM scheme incorporating Options 2.1, 2.2 and 2.3 as sub-actions, could be brought under the new umbrella programme focusing on intersectoral mobility.
- In addition, existing schemes that promote ISM already in operation could be brought under the same umbrella through a streamlining process. In particular:
 - The international researcher mobility sub-actions involving academia-to-academia mobility would remain within a streamlined MSCA.
 - The cross-sectoral parts of the MSCA, namely the ITN (including the European Industrial Doctorates and European Joint Doctorates) would be moved over to a new suite of sub-actions focusing on intersectoral mobility.
 - The MSCA COFUND could also be rolled into the new umbrella programme, since it provides support for regional, national and international ISM schemes, with a particular focus on innovation. Consideration could also be given to reforming how it currently operates in FP9, for example by incorporating dedicated sub-actions on ISM to the public and third sectors (i.e. Option 2.3 could be merged with the MSCA COFUND).
 - The SME Associate Scheme could also be rolled into the same programme to promote intersectoral mobility whilst still retaining its branding, since it would remain a sub-action within the umbrella.

An advantage of this approach is that without radical change, there is a risk that the cross-sectoral dimension continues to have low visibility within the MSCA. Under such a scenario, there is a risk that intersectoral mobility does not become more common as a mechanism for making doctoral and post-doctoral researchers more employable and better able to undertake research on a cross-sectoral basis. Currently, only researchers willing to be both internationally and intersectorally mobile will benefit from the MSCA, and arguably, rolling all the different schemes across the Commission into a single new dedicated programme focusing on ISM could have a major impact on heightening attention to the issue at all levels – among researchers, research actors, industry, policy makers, etc.

A disadvantage of the approach outlined in Option 2.6 is that there may be stakeholder opposition from those already taking part in the MSCA, in that the MSCA are well-known. There may also be concerns about undermining the coherence of having the major researcher mobility actions together in a single programme rather than a separate programme since the suite of four existing MSCA described above have been designed to integrate both international and intersectoral mobility (although the latter has had less visible prominence as an explicit feature and objective of the MSCA).

A further possible alternative to separating international from intersectoral mobility into two programmes could be to retain a single programme but to incorporate some of the gaps identified into new MSCA sub-actions. Under this approach, it may still be possible to encourage applications that support intersectoral mobility, as explained under Option 1 by mainstreaming.

Overall, in our view, although radical, such an option should be given serious consideration as a means of heightening attention to intersectoral mobility and being able to make EU support for researcher mobility less academia-driven.

4.1.3.2.4. Managerial aspects of Option 2 - possible new EU schemes to support ISM

Issues relating to how a possible new EU scheme should be managed and structured are now considered. Of course, the detailed management and implementation arrangements would depend on the precise configuration of the new scheme, and which sub-options, if any within Option 2 are adopted.

The role of the European Commission and the Euraxess network respectively if a new EU scheme dedicated to ISM were to be set up are now considered. Under Option 2, an EU co-funding scheme to support existing and new dedicated ISM schemes through FP9 would be set up. However, there are different alternatives as to how this might be structured, notably in relation to whether it should be managed at an EU level, or on a decentralised basis. The relative advantages and disadvantages of these two respective approaches are now summarised.

Most HEIs are already used to applying to take part in EU researcher mobility schemes by direct application through the MSCA, in response to annual Calls for Proposals⁹⁵. The setting up of a top-up funding scheme for national and regional ISM schemes could therefore **feasibly operate if it were managed at an EU level directly**. This would arguably be less administratively complex than setting up entirely new national structures, although a network of national contact points would still need to be put in place to deal with enquiries (as is already the case for the different thematic priorities within Horizon 2020).

A potential disadvantage of setting up a new scheme at EU level without national implementation structures in place is that this could limit the scope for the scheme to reflect the needs of researchers and participants in ISM schemes from different sectors which tend to emerge 'bottom-up'. Moreover, given that many ISM schemes and mobility experiences take place *within* countries, often at a regional or local level and in existing research-industry clusters, individual ISM scheme managers could miss out on the potential benefits of networking, sharing their experiences and benchmarking their performance with other schemes operating at national level. However, the proposed sub-option 2.5 to establish support mechanisms (including activities to strengthen cooperation and partnership working between schemes) could help to overcome this problem.

An alternative to operating a new EU scheme at EU level could instead involve **setting up a nationally-managed, decentralised training scheme operated under shared management**. This could be organised in each participant country on a national or regional basis with institutional applicants applying to a national implementation agency for training grants for researchers participating in smaller-scale formal schemes (in a similar way to how ESF grants are managed). A national R&D&I funding agency could be allocated responsibility for setting up a joint EU-national financed scheme to which stakeholders interested in participating in ISM – especially universities, research institutes and companies but also public sector and third sector organisations - could apply.

In countries where such a body does not exist, a new body could be set up for this purpose, possibly through the national network of Euraxess National Contact Points. A further advantage of a national implementation approach with a centralised body responsible for overseeing the implementation of a new programme, is that problems relating to the over-fragmentation and lack of critical mass of many national ISM schemes could be overcome by ensuring that EU co-financed top-up funding is available. This would encourage Member States not investing in ISM at all presently (and/ or those investing insufficiently) to do so from FP9 onwards through the financial incentive of EU co-funding.

Whilst all EU countries would be eligible to take part, participation could be made optional and contingent upon whether a particular EU-MS or FP-associated country agrees to contribute to a national co-financing scheme. This approach would be similar to how ERANETs are organised and funded, whereby if particular EU-MS are interested in being involved in a thematic ERANET, they must make a national co-funding contribution as a pre-condition for gaining access to EU top-up funding.

An advantage of this approach is that it would more closely reflect the reality in terms of how most intersectoral mobility takes place. Informal mobility but also many formal schemes takes place either locally, regionally or nationally, rather than on a transnational basis (with the exception of the EU funding schemes). Putting in place a national umbrella structure to which individual HEIs could apply would make it administratively less burdensome to participate in ISM, since potential applicants could simply apply for an existing scheme rather than having to set up their own scheme from scratch.

This option would partly address the problem of the lack of sufficient national funding available dedicated to ISM. Since setting up such a scheme is resource-intensive for individual institutions, having access to an umbrella scheme operating at national level (co-financed by the EU) to which they can apply would encourage more HEIs to engage in intersectoral mobility schemes since they would not have to set up their own scheme. Indeed, this model has been adopted in some countries already. In Switzerland, for instance, the Swiss Science Foundation manages a number of researcher mobility schemes, which as noted earlier were recently opened up to allow scope for intersectoral mobility and individual HEIs can apply to participate in these national schemes. The same is true in Ireland, where the Irish Research Council manages a number of schemes, and then engages with the Research Offices of universities in order to promote the benefits of participating in individual ISM schemes.

⁹⁵ http://ec.europa.eu/research/participants/data/ref/h2020/other/guides_for_applicants/h2020-guide-appl-msca-itn_en.pdf

It will be important to retain flexibility in the structuring of national implementation arrangements to allow Member States to set up structures in their country that reflects the prevailing governance structure i.e. some countries may prefer to establish a more centralised structure at national level or put in place a less centralised structure with implementation bodies at the regional level.

A national approach to implementing a decentralised EU scheme would help to encourage Member States to put in place appropriate support structures, skills and training courses for industrial and academic researchers. There are also potentially further benefits from having national structures set up and operating in each Member State which were referred to under sub-Option 2.5 relating to support structures), such as: ensuring that individual HEIs can obtain advisory support and guidance on setting up a scheme, and having a common approach to monitoring and evaluation of ISM schemes and the outcomes achieved through intersectoral mobility schemes.

4.1.4.3. Option 3 – Sub-action to provide preparatory training and professional career development, skills and training support to intersectorally mobile researchers.

A further Option could be to set up an EU-managed funding scheme dedicated to skills and training, as well as to enhancing the professional career development of doctoral and post-doctoral researchers. Enhancing the employability of researchers through transferable skills acquisition was identified in the interview programme as an important issue. In the past 10 years, increasing the number of doctoral and post-doctoral researchers has become a more important policy priority at EU and national levels. The increase in the numbers of researchers means that they must necessarily be given the opportunity to broaden their skills set so that they can more easily make the transition to undertaking research in another sector, either temporarily as part of a mobility scheme, or permanently by accepting a job in another sector.

There could be two strands to the types of activities supported under such a scheme:

- 1. Providing preparatory training and professional career development advice** *prior to* participants taking part in an ISM experience.
- 2. Strengthening the employability of researchers through formal training and skills development** *during* their ISM experience.

Such a scheme could draw inspiration from existing organisations and agencies working on improving opportunities for the professional career development of researchers such as Vitae and Association Bernard Gregory/ L'Intelli'agence in France (see case study 5 on preparing for ISM). Such a scheme could provide different types of skills and training support for intersectorally-mobile researchers, such as:

- **Preparatory training** to equip mobile researchers with information about the specific needs of other sectors (differentiated by sector e.g. industry, the public sector, private sector).
- **General skills training** to prepare researchers not currently engaged in ISM for a career switch outside academia.
- **Specific types of training courses** to strengthen skills development in areas beneficial to making the transition to working in other sectors, such as:
 - Entrepreneurship training
 - The commercialisation of research results and IPR management and exploitation
 - Managerial and negotiation skills

This could go ahead as a standalone initiative, for example, if it were determined that there is already sufficient support for ISM schemes through existing EU programmes (see Option 0 no action and Option 1 – mainstreaming ISM). However, if a new EU scheme were to go ahead (see Option 2 and sub-options, and Option 3), then there could be strong value added in developing a common approach across the EU in which researchers benefit from preparatory training at the beginning of a doctorate to prepare them for either an intersectoral mobility experience or more generally open their horizons to working in another sector, which is necessary since only an estimated 25-30% of doctoral researchers end up with full-time academic jobs.

Regarding the proposition of supporting training during intersectoral mobility experiences, many ISM schemes do not provide generic training for researchers, or more specific training relevant to the sector they are working in. This is either because they do not have training know-how internally and / or may not have the resources to contract-in such expertise. In the case of academia-to-industry schemes, there can sometimes be an assumption that researchers from academia undertaking a placement, internship or a Fellowship as an industrial researcher will be

provided with training on the job. However, without formal training support, this may be insufficient by itself to equip researchers with the necessary skills they need to ensure that they are able to work in other sectors effectively.

Review of existing provision at EU and national levels to justify intervention under Option 3.

Before considering the introduction of a new training initiative, however, it is important to **review existing provision at EU and national levels.**

There is currently an **absence of EU funding support for preparatory training.** Yet there are many benefits of such training, such as ensuring that early-stage researchers give consideration to taking part in ISM as early on in their careers as possible (irrespective of whether through a formal scheme or informally). The benefits are spelt out in full in case study 5 on preparatory training.

The picture in terms of ensuring that any new scheme avoids duplication with existing EU provision for training and skills development more broadly is more nuanced and care therefore needs to be taken to **avoid overlap and duplication.** The executive summary of the *Ex-post evaluation* and the *H2020 Interim Evaluation of the Marie Skłodowska-Curie Actions* pointed out that *"the majority of current EU doctoral candidates will not take up an academic career, and the need to develop the skills they require to be employed in non-academic sectors has become a major concern. There is a need to broaden their skill base and provide them with interdisciplinary and transferable skills"*.

The Innovative Training Networks (ITN) within the MSCA already support the career development and training of researchers by bringing universities, research centres and companies together from different countries globally to train doctoral researchers. The ITN involves interdisciplinary and intersectoral networks of universities, research institutes and companies based in different countries. However, the **ITN scheme sponsors PhD research itself and not the bursaries.** There is therefore a gap in relation to ensuring that such training should be accessible to any PhD or Postdoc researcher, regardless of how their research is being funded. Therefore, under Option 3, the training component only would be sponsored rather than the full PhD.

A possible further gap in provision through the MSCA's ITN is that it is organised on an international basis, whereas the research has shown that formal intersectoral mobility involves local exchanges of doctoral researchers between sectors, who would be ineligible for training support under the MSCA. Although, the MSCA are open to researchers and innovation staff at all career stages, there is a focus on early-stage researchers, and to a limited extent mid-career researchers. A gap in provision is arguably the lack of sufficient training for later-stage researchers at the R3 and R4 level at national level in non-EU funded schemes. The potential benefits for experienced researchers in receiving training was identified as a benefit for example in case study 4 on R3 and R4 researchers in the Royal Society's Industrial Fellowships Programme.

Overall, EU intervention for preparatory training can be justified, since there is currently a lack of EU support. However, there are still gaps in training provision especially for smaller-scale national schemes presently ineligible for EU support, since the MSCA only provides training for doctoral researchers undertaking international mobility and being awarded a bursary, which represents a small percentage of the total of EU doctoral-level researchers.

Option 3 is also compatible with the recommendations made in the *Interim evaluation of the MSCA in Horizon 2020*⁹⁶, which suggested the need for a stronger emphasis on skills and training of researchers. Although the authors recognise that the MSCA plays an important role in tackling the need to strengthen the focus in researcher mobility programmes on transferable skills for employability, it would be useful to strengthen support for such training at the national level, without requiring an international partnership structure or participation in international mobility. This would avoid the problem that the MSCA benefits excellent researchers⁹⁷ but only a small percentage of the overall population of doctoral researchers.

However, in order for a new EU scheme with a strong national dimension to receive the go-ahead, there would need to be a clear EU value added. There is a question mark as to whether if there

⁹⁶ FP7 ex post and H2020 interim evaluation of Marie Skłodowska-Curie actions (MSCA)

⁹⁷ According to the Guidance for Applicants for the 2018 MSCA call (see weblink below), 25,000 doctoral candidates are expected to benefit in 2014-2020.

were no international mobility dimension, and only an intersectoral focus, could the provision of top-up funding be perceived as an EU subsidy to top-up funding for national doctoral schemes, which is a Member State responsibility. Balanced against this argument, since the lack of national funding and other incentives in many EU-MS to strengthen ISM could be seen as an argument in favour of EU intervention to serve as a funding incentive to persuade more Member States to make national funding available to support dedicated ISM schemes.

4.1.4.4. Option 4 – Expand the scale and scope of the SME Associate Pilot scheme

A further option, Option 6, could be to scale up the new SME Associate scheme.

The SME Associate Scheme presently focuses on industry only. One option could therefore be to expand the scheme to include ISM schemes that facilitate mobility to the public sector and third sector respectively. In our view, this is a viable alternative option to setting up a new scheme to address the identified gaps). However, there is presently insufficient evidence regarding the scheme's effectiveness and impact given that the scheme is still at the pilot stage and although an evaluation has been commissioned by EASME, this commenced in January 2018. Scaling the new scheme up before its effectiveness can be adequately assessed carries the risk that if the scheme were to be significantly expanded, there is a lack of rigorous evaluative evidence to justify this presently (although there should be evidence available once the evaluation has been completed by mid-2018 which could then help to inform discussions across the Commission services regarding the optimal programming architecture in FP9).

If the SME Associate Scheme were to be identified as a potential means of expanding EU funding support for intersectoral mobility in FP9, then the features of the current pilot would need to be reviewed and ideally made more flexible. Presently, SMEs can only receive funding for a post-doctoral researcher for a period of 12 months. The viability of a number of different alternative sub-options with regard to how the scheme operates (drawing on the lessons from this study) should be considered such as:

- Allowing greater flexibility in scheme duration e.g. shorter 3-6 months placements, or conversely longer placements and full PhDs, rather than confining the scheme to 12 months;
- Opening up the scheme to doctoral (and possibly also Masters students) not only post-doctoral researchers;
- Streamlining the scheme to allow for variants on the current model of undertaking a 12 month placement in an enterprise in another EU country, such as: spending 6-9 months in an enterprise in the researchers' own country and 3-6 months on an international mobility placement.
- Avoiding confining the scheme to academia-to-industry mobility by expanding the scope to allow all types of intersectoral mobility across academia, the public sector (including government) and the third sector.

RQ21.1 – If a new EU funding scheme were to go ahead, how could it be ensured that possible duplication and overlap with existing EU funding schemes be avoided?

In considering the options presented above under the options analysis (RQ21), it was made clear that any new EU- funding scheme would have to be **sufficiently differentiated from existing dedicated EU funding schemes**, namely the MSCA ITN, the MSCA COFUND, the SME Associate Scheme and the EIT KIC Masters and Doctoral Programmes. In addition, any new scheme would need to take into account existing EU funding for wider researcher mobility schemes, such as the MSCA IF and RISE sub-actions, which allow scope for academia-to-academia but also academia to non-academia schemes.

The first step in avoiding duplication and overlap between EU funding schemes was to undertake a detailed mapping exercise of all EU funding measures which promote intersectoral mobility. This has been achieved through this study (see RQ4, which summarises the major EU schemes to promote researcher mobility and RQ7, which analyses funding available through these schemes).

The second step will be for EU decision makers responsible for these different programmes to discuss existing schemes in the context of planning for the new Multiannual Financial Framework (MFF) e.g. the use of EU funding to support intersectoral mobility in FP9. Due consideration will be needed as to how to give intersectoral mobility greater prominence. In order to avoid duplication, this could include consideration of the following:

- Mainstreaming intersectoral mobility into all EU programmes with scope to foster researcher mobility so that intersectoral becomes as important a priority as international mobility.
- Setting up a new scheme but with sub-actions supported within the scheme that only address gaps in existing provision (as detailed in RQ21, which identifies the main gaps).

RQ21.2 – Is there an alternative to setting up a new EU scheme, such as expanding the scope of existing EU schemes?

As already explained under the analysis of options presented in RQ21 above, whilst a dedicated new scheme could help to address gaps in existing provision, there are risks associated with going ahead with an entirely new funding scheme, such as:

- Failing to gain sufficient critical mass and visibility for a new scheme, given that there are already a number of existing schemes, some of which are well-known (e.g. MSCA’s ITN).
- Regarding (relatively) new schemes, especially the SME Associate pilot Scheme but also the EIT KIC’s Masters and PhD programmes, there has been insufficient time to fully assess the impacts of new schemes and it is therefore difficult to assess the feasibility of significantly scaling up these schemes (as opposed to setting up a new scheme, which may confuse stakeholders interested in ISM).

Expanding the scope of existing EU schemes could also be feasible. For instance, the existing MSCA could be overhauled and gaps identified and presented under Option 2 could instead be integrated under a reformed MSCA in the new MFF post-2020. Changes could also be made to the SME Associate Scheme (described in Option 4 above), such as opening up participation to the public sector and the third sector, providing greater flexibility on the duration of international mobility, allowing a combination of domestic and international mobility, with the latter being a shorter part of the overall intersectoral mobility period.

4.1.4. EU intervention through a non-funding scheme

RQ23 - Is there a need for further EU intervention of a non-funding nature to support and strengthen intersectoral mobility in Europe?

A further consideration is what more could be done beyond funding to improve awareness of the benefits of ISM, to heighten its visibility and to increase participation levels. The gap analysis suggests that there are a number of areas where EU intervention may be helpful, such as:

a. Need for clear definition of ISM

The survey response and the interviews being held highlighted a crucial semantic problem in implementing intersectoral mobility and on reporting on the outcomes of ISM, both through formal schemes and informal mobility. Many stakeholders – except those familiar with MSCA – appeared to be unfamiliar with the term itself and were thus only able to respond to interview questions when the interviewer probed more deeply using alternative keywords. Terminology such as internships, mentoring schemes, joint PhD supervision, incubators and spin-off companies, often triggered more responses than the general and sometimes misunderstood term “intersectoral mobility”. This conceptual difficulty not only hampered the inventory of schemes, but will also continue to pose difficulties in promoting new schemes, monitoring impact and evaluating long-term outcomes. The European Commission can play a key role in promoting a common understanding of the concept across academic institutions, industry, governments and other sectors of employment. This will facilitate ISM implementation and evaluation and will help to disentangle the role of ISM in the context of broader university-business collaboration.

b. Need for EU-level monitoring and impact evaluation

Current monitoring systems for intersectoral mobility schemes tend to focus on macro-level indicators. This is useful in countries/institutions/schemes where ISM is formalised and large-scale, so that indicators bear a certain relevance. Nevertheless, these indicators are limited in the sense that they cannot disentangle ISM from other forms of intersectoral collaboration or knowledge-exchange. The most commonly used indicators at macro-level are:

- number of researchers
- number of PhD graduates
- number of PhD graduates working outside academia (usually linked to particular ISM-schemes)

- number of patents (usually linked to particular ISM-schemes)

While useful for macro-level monitoring, these types of indicators will do little more than suggest a certain correlation between the prevalence of ISM schemes and general R&D intensity. The actual contribution of ISM, as opposed to general collaborations between universities and the non-academic sector, will remain unknown. On the basis of a solid and widely-accepted definition of ISM, an exploratory set of indicators could be developed with the support of relevant stakeholders. The indicators could, for example, be inspired by the typology developed in 2.1.

In order to gain a better understanding, however, of broader employability outcomes of ISM experiences for the individual researcher, of R&D outcomes for the industry partner, of the level of (service) innovation in public sector/health sector / NGO's, and of the benefits for academic institutions, a broader approach will be necessary. The current desk research and interviews highlighted a striking lack of impact assessments, despite the fact that individual researchers reported very positive personal outcomes and employability of their own intersectoral mobility experience. A follow-up study could focus in more detail on developing an impact evaluation framework which takes into account the researcher's learning experiences and behavioural changes, the institutional benefits, the non-academic partner's benefits and the relation between ISM and other forms of collaboration. By developing international standards and measuring the distance between expected and realised outcomes, the most effective schemes in terms of duration, target group, discipline, level of co-funding, etc. can be more easily recognised. In addition, the most suitable form of ISM-scheme intervention can be tailor-made by taking into account national differences in the R&D fabric.

c. Training and development of researchers as preparation for ISM

The EC has already defined a useful and internationally recognised framework for doctoral education, the Innovative Doctoral Training Principles. These principles include the provision of intersectoral mobility experiences for early-stage researchers. There is some indication that these principles have become widespread across many academic institutions, but their implementation is voluntary. As yet, there is no evidence confirming that these principles have been widely, fully or thoroughly adopted.

More could be done to ensure that all researchers in Europe – not only those funded through existing MSCA schemes – enjoy the benefits of adequate training and development facilities so that they are better prepared for a wide range of (research) careers. Entrepreneurship skills, broader employability skills and exposure to other sectors of the labour market than just academia, should become the standard in all PhD and postdoctoral level programmes, including those outside ISM-focused schemes. The national ERA roadmaps may be a suitable tool to advance a tailor-made approach across all member states but since adequate training requires additional resources, EU-level funding for widespread skills training initiatives could accelerate this development.

d. Guidelines for mainstreaming ISM in all research schemes

While the recommendation above focuses on training and development in general, there is also a case to be made to mainstream ISM in all research funding schemes. As long as ISM remains the attribute of discipline-specific, sector-specific or funding-specific R1 or R2 funding schemes, ISM risks being regarded as a tailor-made experience for PhDs in applied research, a nice-to-have bonus for STEM-disciplines only, or a privilege only open to those successfully applying to the MSCA, which also requires international mobility, which may not be realistic for all doctoral researchers. The potential benefits of ISM for fundamental research, for non-STEM disciplines or for other target groups of researchers will remain unacknowledged.

In order to promote such mainstreaming, an EU-level checklist for ISM-compatibility in funding schemes, based on a widely accepted definition of ISM, could be a useful tool. On the basis of such a checklist, funding agencies and institutions could evaluate their own practices and regulations and, of necessary, remove the barriers currently preventing ISM experiences within their current schemes (such as, for example, IP regulations, bursary regulations, etc.).

The development envisaged by this approach can be easily compared with the promotion of international mobility as part of a researcher's career: 30 years ago this was not widely practiced, but many excellent researchers established international networks or chose to move to the best possible research environment for their area of expertise. Once the benefits were made tangible (networking, collaboration, intercultural experience, higher productivity) mobile researchers received better recognition of their mobility experience, which in turn increased the support measures for new generations of researchers developing their careers. A similar development of appreciation for intersectoral mobility experiences within the academic environment could trigger more support measures, more sustainable schemes & more "mainstreaming" of ISM in a research

career. In addition, ISM may have a potential advantage over international mobility as a means to combat brain drain. By opening up rewarding & lucrative career opportunities to researchers outside academia, ISM may be a more attractive form of researcher mobility benefiting not only the researcher's career but also the innovation level of their area of operation.

4.1.4.1. RQ23.2 - Is there a role for the European Commission in supporting intersectoral mobility?

In examining the European Commission's possible future enhanced role in supporting intersectoral mobility, there is a need to consider and analyse what type of EU intervention is required, and what form this might take. In particular, it is necessary to assess whether further supplementary funding schemes are needed, non-funding measures or both.

In relation to the non-funding role, the EC might play a role in structuring and animating the community of scheme managers involved in facilitating intersectoral mobility. The rationale for this is that the research identified a lack of sufficient critical mass in terms of the size of individual schemes and the absence in most countries of a national strategy or any form of coordination in respect of formal ISM schemes. The EC could therefore play a crucial role in respect of the following:

- **Coordination** – coordinating the exchange of experience, knowledge and data between Member States in respect of ISM.
- **Promoting the exchange of good practices** – although significant good practice has been identified through this study in different countries, there is no mechanism or structure for sharing experiences between those directly involved in intersectoral mobility who could present good practices to other countries to maximise opportunities to share experiences and serve as ISM champions in their own country by promoting ISM to a broader range of stakeholders.
- **Communication and dissemination activities** - Awareness levels among prospective funders, higher education institutions, industry and individual researchers as to how participating in an ISM scheme could deliver benefits is presently low, partly reflecting unfamiliarity with the term and concept, but also the low visibility of existing schemes which tend to be small-scale and fragmented and where oftentimes ISM happens on an ad hoc basis but is not supported systematically and consistently. Awareness-raising could take place in a number of different ways, such as by:
 - **Publicising the good practice case studies produced through this study to relevant stakeholders.** This should include cases relating to different types of mobility (i.e. university-industry collaboration, ISM between academia and the public sector and between academia and the third sector);
 - **Development and dissemination of a good practice manual aimed at ISM scheme managers containing a template setting out the characteristics of an "ideal" intersectoral mobility scheme.** The manual could provide information to prospective new scheme managers regarding good practices in terms of the scheme characteristics at each stage involved i.e. the design and set-up phase, managing and operating a successful scheme and monitoring and evaluation aspects. The manual could provide guidance relating to specific aspects of managing an ISM scheme, such as IPR-sharing arrangements, support structures, supervision, the provision of formalised training and skills for participants in ISM etc.;
- **Development and dissemination of a further practical handbook and guide targeted at industrial and academic researchers to enable them to work together more effectively.**
- **Setting up an EU network of experts on intersectoral mobility to exchange experiences and good practices.** This could in turn help to ensure that ISM is discussed with national-level stakeholders on a more systematic basis since each national expert could serve as an intersectoral mobility ambassador in their respective country.

4.1.4.2. RQ23.3 – Could the EU provide a good practice model scheme structure around which regional, national and international schemes could model themselves?

The EU could provide guidance on different possible structures for setting up dedicated ISM schemes for each type of mobility (e.g. academia-industry, academia-public sector and academia-third sector and vice versa). The EU could communicate and disseminate the results of the five case studies developed through this study, which outline good practice models as to how ISM schemes operate. These stress the importance of customising schemes when adapting them to the national level.

4.1.4.3. RQ23.4 - Do schemes work best when they are developed from the bottom-up, or is there a need for a top-down approach with more EU involvement?

Many of the national ISM schemes developed were found to have been developed on a bottom-up basis. Since a key finding is that ISM schemes need to be developed in a way that responds to identified needs on the ground and to be as flexible as possible, a bottom-up approach can clearly be effective.

However, this does not preclude the possibility of also in parallel having a top-down approach to provide impetus to encourage more stakeholders to consider setting up their own ISM schemes drawing on good practice identified through EU-level studies such as this one with EU funding providing a possible further impetus. The EU already plays a significant role in funding ISM through the various programmes mentioned earlier in the baseline assessment (see the responses to RQ4 relating to existing ISM schemes and RQ6 relating to funding in Sections 2.2.4 and 2.2.7 respectively). However, since existing schemes require an international mobility period they do not represent the best source of inspiration for national stakeholders considering setting up a national scheme. However, the EU could play an important role by communicating and disseminating the good practices identified through the case studies in relation to the characteristics of a successful scheme.

In addition, the EU could provide top-down inspiration basis to relevant stakeholders so as to promote demand for intersectorally-mobile researchers, and enhance the take-up of participation in, and the supply of intersectoral mobility schemes in particular by:

- Promoting the key principles required to create the necessary framework conditions for ISM at EU and national level (see Section 3.1.5).
- Promoting greater awareness of intersectoral mobility and its benefits;
- Disseminating the good practices in the set-up, design and operation and the management of schemes (as identified through the case studies);

It should be emphasised that the approach to the development of the case studies, which highlight the characteristics of successful schemes by type of mobility includes an assessment of the replicability potential of different schemes but emphasises that any scheme will need to be adapted and customised to reflect the specific needs of industry, the public sector, the third sector and academia and furthermore be adapted to the situation on the ground. This means that it would not be feasible or realistic to implement a top-down 'one size-fits-all' approach imposed from the EU level. However, this does not preclude an EU-level scheme which allows flexibility as to how schemes are designed and implemented provided they meet certain quality criteria and incorporate the essential principles of good practices in scheme set-up and design, management, operation, and monitoring and evaluation.

4.2. Recommendations

4.2.1. Introduction

The recommendations build on the study findings and overall conclusions from the baseline assessment and on the findings from the gap analysis and feasibility study. The recommendations are addressed firstly to the EC, secondly to Member State authorities, and thirdly to individual ISM scheme managers. The recommendations take into account the good practices identified through the case studies, and include concrete actions that could be taken to increase ISM (funding and non-funding), as well as 'soft' measures. They also seek to address shortcomings in the current prevailing framework conditions in which ISM can flourish. The recommendations consider the need to build on good practices and to identify the key features of an "ideal" ISM scheme at European level which could then be used as a model and adapted to meet specific needs at national, regional and local levels. Each recommendation is supported by an explanation of the rationale.

4.2.2. Recommendations for action by the European Commission

Recommendation 1: The European Commission should take the lead in strengthening the communication and dissemination of the tangible and intangible benefits of intersectoral mobility, for the economy and society as a whole, and for all stakeholders concerned.

The trickle-down effect will help to convince national policy makers and funding agencies of the merits of investing resources in ISM.

Awareness levels among prospective funders, higher education institutions, industry (especially SMEs) and individual researchers as to how participating in an ISM scheme could deliver benefits are presently low, partly reflecting unfamiliarity with the term and concept, but also the low visibility of existing schemes which tend to be small-scale and fragmented and where ISM often happens on an *ad hoc* basis but is not supported systematically and consistently.

The purpose of the EC playing a stronger role would be to strengthen the visibility of ISM and to raise awareness about the benefits. Communication messages will need to be streamlined so that these convince national policy makers and R&I funding agencies to set up national funding schemes, and to consider redirecting R&D&I resources to intersectoral mobility. The tangible and intangible benefits will need to be communicated effectively to researchers themselves, and to the broad spectrum of different actors that take part in ISM: academia, industry representatives, government and the third sector. Awareness-raising activities might include, *inter alia*:

- **Making data about existing ISM schemes available for benchmarking purposes** through a searchable online database on the EC's website on researcher mobility and / or the Euraxess website. This could be developed using the basic mapping Excel database of some 270+ schemes, which is a part of this study.
- **Publicising the good practice case studies produced in this study to relevant stakeholders** relating to different types of mobility (i.e. university-industry collaboration, ISM between academia and the public sector and between academia and the third sector);
- **Development and dissemination of a good practice handbook aimed at ISM scheme managers containing a template setting out the characteristics of an "ideal" intersectoral mobility scheme** (also see Recommendation 4).
- **Development and dissemination of a practical and guide targeted at industrial and academic researchers to enable them to work together more effectively** (see also Recommendation 4).
- **Commissioning a study to gain a better understanding of the current and potential estimated future economic benefits of ISM across the EU-28.**

Recommendation 2: A holistic and integrated approach to fostering greater participation in intersectoral mobility should be adopted at EU level, thus making the practice and benefits of ISM as widely known as those of international mobility.

The EC has given researcher mobility considerable prominence in EU policy communications (as reflected in various Council conclusions) since 2000. However, this has tended to be understood in the context of *international mobility* to promote the internationalisation of researchers as a means of strengthening transnational collaborative research and promoting scientific excellence within the ERA context. Extending the EU policy importance attached to researcher mobility in general to *intersectoral mobility specifically* could increase the visibility of ISM and have a positive impact in making it more prominent in national R&I policies.

A new policy Communication by the European Commission should highlight the contribution of intersectoral mobility to Europe's innovation ambition. A consistent promotion of the concept throughout the various policy documents related to the Modernisation agenda, the Skills agenda and the Innovation agenda would help to mainstream ISM as a policy priority and would provide the necessary framework for new initiatives, bring together existing support schemes for ISM under a single umbrella, and highlight the untapped potential of ISM for research impact, entrepreneurship initiatives and the knowledge economy as a whole.

This policy focus in its turn would trigger various other, more operational, initiatives:

Recommendation 2.1: Strengthen coherence in European ISM-related funding schemes.

Giving ISM a greater policy focus at EU level could help to ensure that existing EU initiatives spread across various EU programmes are made more cohesive in achieving policy aims relating to ISM (e.g. the MSCA's ITN and COFUND, the SME Associate Pilot Scheme, the EIT Masters and PhD programmes etc.). It would then in future be easier to monitor how far the EU is contributing to strengthening intersectoral mobility across different funding and non-funding initiatives.

Recommendation 2.2: Set appropriate framework conditions to increase formal and informal ISM schemes, making use of ERA roadmaps.

As outlined in Section 2.6.5, certain framework conditions are necessary to foster an enabling environment for intersectoral mobility, such as a culture of openness towards interacting with other sectors, sufficient length of time and experience of sustainable academic-industry cooperation, and

the presence of appropriate support structures and funding incentives. The national ERA roadmaps are the member states' own tools to address such framework conditions, provided the Commission directs the course.

Recommendation 2.3: Coordinate indicator-driven monitoring and long-term impact assessment.

The EC should encourage regular reporting by the Member States on progress made in strengthening participation in ISM, for instance through the annual RIO reports in the European Semester reporting process and in the ERA National Roadmaps, or through similar reporting at national level or funding scheme level on the benefits of ISM in Europe's innovation ambitions. Consistent data on patents generated by PhD or postdoc level researchers, on the share of PhD graduates employed in the private or third sector, or on the number of PhD researchers engaged in ISM experiences, would be of great help in monitoring the prevalence and impact of ISM schemes.

In addition, standardised methods of measuring medium and long-term impact of ISM experiences for individual researchers and other stakeholders would help to develop the efficiency and effectiveness of ISM schemes across the EU. The lack of evaluations and monitoring data on ISM scheme outcomes is still a hindrance to current benchmarking and quality improvement exercises.

Recommendation 2.4: Data on the careers of doctorate holders should be collected more regularly at EU and national levels.

Improved longitudinal statistics on the careers of doctoral and post-doctoral researchers that have participated in ISM are needed in order to strengthen information as to the impact of participation on the employability of researchers.

Recommendation 2.5: Promote the exchange of experiences, knowledge and good practices between ISM schemes; support partnership working, networking and the sharing of benchmarking monitoring data.

Many ISM scheme managers and participants struggle with similar questions such as the ideal co-funding leverage or the best IPR regulations in collaborative ISM schemes. The European Commission should take the initiative to foster ISM-focused networks of experts who share expertise and good practices. It should also boost a culture of curiosity, openness and exchange between academic and non-academic stakeholders, an environment in which ISM thrives, by co-funding networking events, partnership searches etc.

In addition, European-level networks of national experts should help to ensure that ISM is discussed with national-level stakeholders on a more systematic basis since each national expert could serve as an intersectoral mobility ambassador in their respective country. Such an EU-level support framework – underpinned by national support structures could assist institutions and organisations interested in setting up or participating in ISM in future to obtain advice and guidance; as well as institutions and organisations already involved in managing ISM schemes to strengthen the effectiveness of their ISM schemes.

Recommendation 3 - Intersectoral mobility should be mainstreamed in FP9 as a "horizontal" priority, as well as implemented "vertically" through specific funding calls.

Intersectoral mobility ought to become as widespread through FP9 as international has been in the previous framework programmes. FP9 guidelines can support this "horizontally", or broadly, throughout all its funding and co-funding schemes. In addition, ISM ought to be strengthened vertically, or in specific niches, through ISM-targeted calls. A number of different aspects should be considered as part of the development of a possible new EU scheme consisting of different sub-actions. It should be noted that the different recommendations outlined below are not mutually exclusive:

Recommendation 3.1: A new EU funding umbrella programme dedicated to promoting intersectoral mobility should be set up. This should consist of a number of sub-actions such as:

- **Recommendation 3.1.1** - A sub-action introducing Industrial Fellowships for Excellent Researchers.
- **Recommendation 3.1.2** - A sub-action to promote mass participation in ISM offering small grants to researchers to provide intersectoral mobility placements and internships.

- **Recommendation 3.1.3** - A sub-action to promote intersectoral mobility between academia and the public sector and third sectors.
- **Recommendation 3.1.4** - A sub-action to increase ISM opportunities for researchers in non-STEM subject disciplines to undertake mobility experiences.
- **Recommendation 3.1.5** - Setting up a dedicated EU and national level support structure to strengthen support for intersectorally mobile researchers and research, industry, public and third sector actors considering getting involved in setting up, and/ or participating in an ISM scheme.

Recommendation 3.2: If a new umbrella programme focused on ISM were to be set up in FP9, consideration should be given to streamlining existing EU researcher mobility programmes post-2020 (e.g. the MSCA's ITN and the SME Associate Scheme) and moving these under a new umbrella programme, which could be comprised both of pre-existing EU researcher mobility programmes and any sub-actions newly established.

The gap analysis identified a need for a number of new sub-actions to be set up and receive funding support beyond 2020 in the new MFF. In addition, it would be useful from a coherence point of view to incorporate some of the intersectoral mobility focused actions within the MSCA into a new umbrella scheme. Likewise, the SME Associate Scheme could be brought within the framework of the same new umbrella.

Recommendation 3.3: A new EU co-funding scheme should also be set up encouraging the development of new small-scale regional, national and international ISM schemes, and supporting the scaling-up of existing ones.

A possible new scheme could tap into the necessary framework conditions highlighted above and address specific gaps in funding and in the provision of particular types of mobility between sectors, such as: i) support for scaling-up smaller-scale prestigious schemes; ii) funding virtual schemes and schemes designed to encourage the participation of start-ups and SMEs; and iii) dedicated schemes for PhDs to promote mobility between academia the public sector and the third sector.

A key differentiator with the MSCA COFUND is that such a scheme would focus on supporting schemes meeting minimum quality criteria that operate on a smaller scale currently, and which have potential to scale-up. Currently, MSCA COFUND supports only large-scale schemes which include an intersectoral mobility dimension. An alternative would be to reform the MSCA COFUND and to provide support for smaller-scale schemes, not only large-scale, showcasing innovative schemes.

Recommendation 3.4: A new EU funding or co-funding scheme preparing for ISM should address the need for professional development training for researchers to broaden their career horizons to working in other sectors, as well as skills development during their ISM period (with a focus on skills to strengthen employability, digital skills, entrepreneurship and IPR).

Since the largest number of intersectorally mobile researchers are those who leave academia after obtaining the PhD, a particular EU-funded scheme could address entrepreneurial and innovation-driven training provisions for all researchers in all disciplines. A competitive call for a selective bootcamp-format could bring the best business schools to collaborate on a researcher-oriented training programme, promoting interdisciplinary, intersectoral and international mobility amongst the researchers with an entrepreneurial mind-set. Alternatively, international transferable skills programmes (employability skills, digital skills, open science skills) set up in collaboration with non-academic partners would help to embed international and intersectoral mobility within the individual career development of high-achieving researchers.

Schemes such as this will draw attention to the current problem that too much knowledge gets lost and too much time wasted because researchers find it hard to adapt to a non-academic environment when their university appointment ends. Employability skills and an understanding of the sector in which they will most likely establish a career will enhance the quality of this transition so that they can build on their strengths and expertise, tune into labour market demands and address the needs of the knowledge economy more avidly. Such policy focus in FP9 will help to align national-level schemes with these priorities.

Funding training for a wider pool of researchers is clearly differentiated from the MSCA's ITN, which only funds training for those taking part in international mobility having been granted doctoral awards.

Recommendation 3.5: Additional financial allocations (or a reduction of co-financing requirements) to countries prioritised under the “widening participation” agenda in Horizon 2020 or in its follower FP9.

Widening participation targets any under-performing country in terms of FP participation levels. Many EU-13 countries and associated countries are among those targeted as part of this agenda. Since funding challenges were identified as the greatest barrier in EU-13 for ISM, countries eligible for widening participation should be encouraged to make more use of ESIF funding explicitly for the purposes of strengthening intersectoral mobility.

Some form of differentiation through the FPs could incentivise countries with more limited national funding available to engage in ISM more actively. For example, co-financing requirements could perhaps be reduced for countries with GDP below a certain average, perhaps 75% to take part in a new EU funding scheme to foster ISM. Alternatively, a dedicated funding action to promote intersectoral mobility could be reserved only for those countries eligible for widening participation measures, given that such countries may find it more difficult to compete for funding, given lower levels of ISM identified in the baseline situation.

An assessment of the absorption capacity to accommodate an increase in funding for ISM, may be required. Many of the EU13-countries have less research-intensive economies and reduced levels of Business enterprise R&D expenditure (BERD) in the private sector. In such contexts, any ISM-scheme must be designed not only to strengthen the individual PhD and post-doctoral researchers’ potential but also to increase the R&D intensity and to increase labour market demand for highly-skilled researchers.

Recommendation 3.6: Support non-industrial ISM and a higher take-up of ISM in non-STEM subjects.

The availability of intersectoral mobility schemes varies between sectors. Whereas there are already many academia-industry schemes (albeit with scope to increase the number of participant researchers through scaling-up), there was found to be a lack of provision of ISM schemes targeting either the public sector or third sector, despite evidence of the benefits of recruiting highly-talented researchers.

There are also many more schemes aimed at researchers in the STEM subjects than non-STEM. Prioritising non-STEM through a dedicated sub-action could be advantageous since it would open up early-stage researchers’ career horizons with a background in social sciences or the humanities to the possibility of a non-academic career in the third sector or public sector.

Recommendation 3.7: As an alternative to setting up a new EU funding programme with specific sub-actions, the scope of existing ISM schemes (e.g. MSCA, the SME Associate Pilot Scheme) could be expanded in order to address identified gaps in funding provision.

Although a new EU funding scheme could be feasible, expanding the scope of existing EU funded schemes to promote intersectoral mobility, and adjusting these to address identified gaps, could be a viable alternative. It will therefore be necessary that different actors within the EC involved in existing EU programmes that promote researcher mobility in the 2014-2020 period should liaise closely to determine the most appropriate programming architecture for FP9. Mainstreaming and integrating ISM into the appraisal process for R&I projects under FP9, is an additional possibility. For example, additional points could be given to applicants to the MSCA (outside of the ITN which are already ISM-focused) if they incorporate an ISM dimension into their funding application.

Recommendation 4: The European Commission should support the development of good practice guidance documents relating to intersectoral mobility.

The good practice guides should draw on the extensive case study materials produced as part of the current study. Examples of good practices that could be developed either into a single guidance document or into several shorter guides are:

Recommendation 4.1: A Practical Guide to Intersectoral Mobility

The guidance manual should provide information to prospective new scheme managers about good practices and highlight the characteristics of schemes by stage i.e. the design and set-up phase, managing a scheme, operating a successful scheme and monitoring and evaluation aspects. The guide should be updated on a regular basis with new schemes and good practice examples, and could include illustrative examples of the ideal type of ‘researcher’ that is the target for different scheme types.

The manual should provide guidance relating to:

- How to go about designating, setting-up, operating, managing, monitoring and evaluating ISM schemes.
- Specific aspects of managing an ISM scheme, such as IPR-sharing arrangements, support structures, academic and industry supervision arrangements, the provision of formalised training and skills for participants in ISM etc.;
- The tangible and intangible benefits of taking part in intersectoral mobility (highlighting the benefits for individual researchers, the business case for industry, the rationale for participating in ISM for universities etc.).

Recommendation 4.2: A Guide on IPR Issues relating to Intersectoral Mobility

This guide should provide examples of different models of IPR agreements⁹⁸ and licensing agreements to facilitate industry-university collaboration to overcome issues relating to how IPR is shared between different sectors collaborating together on research projects. This could cover IPR-sharing models to facilitate industry-university collaboration, how to deal with background and foreground IPR at the outset of a research project etc.

4.2.3. Recommendations for action by the Member States

A change in research culture can only be effective if the various policy and authority levels strengthen one another. The EU is already active in providing funding support for intersectoral mobility through existing EU programmes⁹⁹, but the Member States have primary competence for their education and research systems.

Recommendation 5: Inspired by the European initiatives described under 2.2.2, national authorities should develop a national (industrial) research strategy that explicitly supports ISM as a mechanism for fostering industrial talents, and for strengthening industrial competitiveness over the longer term. ISM policies should be embedded in a 'higher-level skills needs' strategy and involve not only the industry sector but also the public and third sectors

Putting in place an appropriate policy framework is a necessary pre-requisite to ensure that intersectoral mobility is given the necessary policy and funding attention at national level that it deserves. The national strategy should emphasise the importance of openness of HEIs, industry (including SMEs) and key actors in the R&D&I systems towards a culture of cooperation and research collaboration, linking in with the EU policy framework on open innovation, open data and open science to the world.

The national strategy should pay appropriate attention to overcoming any challenges and obstacles relating to gender equality and family support (such as the lack of a family mobility policy for mobile researchers and the question of the costs involved). The costs would be less significant were more localised ISM opportunities to be made available through national governments funding national schemes rather than over-relying on EU schemes that require an international mobility period.

It may be appropriate to develop both an *industrial research strategy* and a *wider national research strategy* that addresses the important role of PhD and post-doctoral researchers in all non-academic job sectors. Some countries may however already have developed such a strategy within the context of the new Skills Agenda for Europe. In such cases, they should check that they have sufficiently mainstreamed ISM.

⁹⁸ The University Industry Demonstration Partnership (UIDP) model for industry-academic collaboration from the US could serve as inspiration in this regard (see Section 2.3.4 on Intellectual Property Rights). See specific publications such as "Contract Accords for University-industry Sponsored Research agreements" by the UIDP <https://www.uidp.org/publication/contract-accords/?download=422>

⁹⁹ The EU supports ISM through the MSCA's ITN, but also the IF and RISE programmes, the MSCA COFUND scheme to support regional, national and international schemes, the EIT Masters and Doctoral programmes and the new SME Associate Pilot.

Recommendation 6: The Member States should ensure that they put in place the necessary framework conditions conducive to supporting ISM identified through this study.

The general principles that need to be mainstreamed in order to support ISM, have already been outlined above for the EU-level. Several of the following recommendations address more specific aspects of steps that need to be taken at national level.

Recommendation 6.1: The Member States should put in place the necessary funding, incentives (including relocation support for families and tax incentives) as well as institutional arrangements to support the development and implementation of ISM schemes at national level.

The research found a lack of national funding, institutional or support structures in place to support intersectoral mobility in most EU countries. Increasing national funding allocation to ISM would help to strengthen the sustainability of intersectoral mobility, since many (though not all) EU countries are currently over-dependent on EU funding alone. Although there is under-reporting of national expenditure on ISM (since the concept is not well-known), only a small number of countries presently invest sufficiently in ISM, despite its potential contribution to promoting high-quality jobs, more sustainable economic growth and a strengthened scientific, industrial and research base.

In order to strengthen policy attention to ISM at national level, Member State authorities should designate a national research or innovation promotion agency with responsibility for coordinating ISM schemes at a national level (or if more appropriate at a regional level). Their role would be to strengthen coordination at national level, ensure that intersectoral mobility is mainstreamed into R&I funding schemes and be responsible for monitoring and evaluation at national level.

Recommendation 6.2: The career appraisal systems in individual HEIs should explicitly recognise the value of taking part in intersectoral mobility from a professional career development perspective

Steps need to be taken to ensure that it is easier for former academics to move back to academia following a longer period in industry. Taking part in ISM is only considered positively in the career appraisal systems of a few EU countries due to the lack of formal recognition and accreditation of time spent in industry. Conversely, in many EU countries, there is no scope for formal recognition of mobility experiences as a progression criterion for an academic career. Indeed, there remains a culture in many universities of seeing an intersectoral period of mobility as hampering career development, due to difficulties in demonstrating progress against traditional metrics of academic success, such as the number of publications and scientific impact.

To support appraisal and behavioural changes in HEIs, national bodies responsible for developing career appraisal frameworks and individual HEIs should be much more flexible as to how they judge career progression and explicitly recognise the different tangible and intangible benefits for individual researchers of taking part in a mobility experience such as scientific achievements during the mobility period, stronger networks with the private sector, improved entrepreneurial, communications and management skills, etc.

Recommendation 6.3: National governments and public sector organisations should lead by example and hire more PhD graduates themselves and encourage other sectors to recruit and retain more doctoral and post-doctoral researchers.

Leading by example should have an important demonstration effect and encourage more recruitment of higher-level research skills at the PhD and post-doctoral levels. The recommendation could also be taken up by the EU institutions themselves in parallel.

Recommendation 6.4: The general and specific benefits of intersectoral mobility for different types of stakeholders should be familiar to all.

As already highlighted above under EU-level actions, intersectoral mobility and its benefits need to be better explained. Joint action between the Member States and the Commission is needed in this regard to overcome low levels of awareness about the concept of ISM.

ISM could be usefully conceived as part of a more general model for addressing the human resource needs of innovation, including the need of firms (but equally the public sector and third sector) to develop internal skills and competences as much as 'buy-in' expertise from outside.

Recommendation 6.5: Key stakeholders (policy makers, industry stakeholders, universities, companies) should be involved in designing new ISM schemes, in a dialogue on how ISM can best meet identified needs.

Since many EU and FP-associated countries either do not have a strong tradition of academic-industry cooperation, or few sustainable forms of collaborative research, it is important to bring stakeholders together to engage in dialogue as an essential starting point. Beyond this, there is a need to ensure that new ISM schemes supported through national funding support are demand-led and also take into account the needs of the whole economy. In several countries (e.g. Estonia, Latvia), it was noticeable that there has been an effort to foster intersectoral mobility of researchers as a means of strengthening public-private R&D&I cooperation in sectors prioritised under the Smart Specialisation strategies.

New ISM schemes should be demand-led, and recognise the different motivations of researchers likely to be interested in taking part in intersectoral mobility e.g. those actively seeking a career in another sector, as well as those researchers obliged to make a career switch due to the limited absorption capacity for researchers in universities.

ISM schemes must be designed to meet the needs of both the public sector and service sector, not only those of the manufacturing or high-tech industry. This can be achieved either through a mainstreaming approach (ensuring that the eligibility requirements for existing ISM schemes are opened up so that these sectors can participate) or by putting in place a dedicated funding scheme targeted at these sectors. These have as much to benefit from having high-level researchers coming to work for them to carry out research projects as industry and ISM between academia and these sectors could play an important role in addressing societal challenges, which is a key priority during Horizon 2020 and is likely to remain so in FP9.

Recommendation 7: A stronger culture of monitoring and evaluation of intersectoral mobility schemes operating in each Member State should be promoted and/or included in their country Semester Report / annual RIO report. Lessons learned through different ISM schemes should be integrated into evaluation exercises, with attention for output data as well as qualitative outcomes.

Monitoring and evaluating the implementation of formal ISM schemes needs to be improved, and a culture of M&E systematically embedded from the outset. Nevertheless, it is important to be realistic about what can be achieved in terms of improving M&E at the individual scheme level since many schemes are small-scale with only a few researchers participating per year in an excellence fellowship. Since individual schemes many not have the resources to commission external evaluations or to engage in benchmarking with other ISM schemes, there is an important role for national authorities (or in the case of federalised countries, also regional) to play in commissioning evaluations of ISM schemes at national level.

The indicators currently used to assess the outcomes of ISM are inadequate since they are often either limited solely to basic output indicators (e.g. the number of participant researchers) or are not fit for purpose (e.g. an over-focus on conventional scientific indicators, such as publications and citations). A wider range of quantitative and qualitative metrics are needed to assess the outcomes of participation in ISM. Nevertheless, it is difficult to measure the impact of participation in ISM schemes quantitatively especially for more experienced, later-career stage researchers. Therefore it is appropriate to carry out mini-case studies focusing on individual researchers that have taken part in mobility experiences and to assess what impact participation has had on their career trajectory, salary progression, networks and linkages with other sectors and how sustainable these have been. Imaginative ways of presenting information about the qualitative outcomes on the impacts on individual careers for R3 and R4 researchers should be explored, such as producing mini case studies on individual participants in schemes, video footage of researchers talking about how taking part in an intersectoral mobility placement or internship has benefited them personally and professionally etc.

4.3. Recommendations for managers of individual intersectoral mobility schemes

Managers and coordinators of existing funding schemes should engage in close interaction with their policy makers at national and European level to persuade them of the benefits of taking part

in ISM for researchers participating, regardless of the type of research (basic or applied), the level of researcher (R1-R2-R3-R4) and the field of research. In line with changing national and EU-level policies and in close consultation with relevant stakeholders, a gap analysis of individual funding mechanisms looking at the various framework conditions for ISM should form the basis of the development of further initiatives.

Recommendation 8: Remove any limitations in existing university-level and/ or researcher mobility scheme level regulations currently impeding ISM and develop the appropriate framework conditions for successful ISM schemes.

If ISM is currently not (yet) supported, existing university-level and/ or researcher mobility scheme level regulations could be modified so that ISM could be integrated within existing schemes. Alternatively, new ISM schemes could be developed, whichever intervention proves to be most feasible. In line with recommendation 6.5 at national level, key stakeholders must be involved in the (re-)design of such schemes to ensure maximum benefit and impact. The following sub-recommendations are closely related to the recommendations formulated above at national level but apply in particular to the managers of existing and prospective new schemes.

Recommendation 8.1: In designing ISM schemes between academia and industry, scheme managers should ensure that ISM schemes are sufficiently flexible to adapt to the changing circumstances on the ground during scheme implementation.

One of the key findings in this report is that there is no golden standard for a successful intersectoral mobility scheme in terms of regulation, duration, co-funding or focus. Any of these should be sufficiently flexible to meet the (changing) demands of the stakeholders involved, the innovation context as well as funding challenges.

Recommendation 8.2: A particular effort should be made to ensure that 'less obvious' non-academic partners are equally keen to participate as large R&D-intensive industrial companies. SMEs (and ideally also start-ups), the public sector and the service sector should be equally able to take part in ISM schemes.

In order to welcome a broad range of stakeholders in ISM-related schemes, such stakeholders should be able to participate in the design and set-up of ISM-schemes so that potential barriers to the participation of particular stakeholder types can be fully addressed and the expected benefits for participants be made clear. SMEs, for example, are often more easily committed if a significant virtual mobility component can be integrated so that researchers only spend limited time on-site. The public and third sectors will be more eager to participate if broader social impacts are appreciated to the same extent as indicators signalling economic benefits.

Recommendation 8.3: When designing ISM schemes, the employment and working conditions of academic (and industry) staff should not be unduly affected by undertaking a mobility period.

The research found that many researchers are concerned that they will be adversely affected by taking time out from their core research role during an intersectoral sabbatical period. Broad concerns were identified among academics relating to ensuring that their working conditions and employment status were not adversely affected. Some were worried that it would affect their salary for instance if they were unable to show continuous progression in an academic career without interruptions working in other sectors.

Recommendation 8.4: ISM scheme managers should ensure that adequate resources are put into scheme management, administration, evaluation and monitoring.

Having adequate human and financial resources is crucial for ensuring that quality support is made available through formal ISM schemes to participant researchers, companies and other organisational participants during the scheme's implementation; and that sufficient attention is put into monitoring and evaluation from the outset.

Evaluation mechanisms should take into account the diversity in objectives for ISM-schemes. Taking an example, commercialisation-related indicators such as the income generated through harnessing IP and licensing fees will be relevant to industry-academia ISM schemes but less so in the third sector and public sector. For these sectors, a wider range of qualitative indicators may be relevant, for instance, scheme performance through research projects in solving diverse problems and challenges (societal challenges, internal organisational issues, challenges in respect of external public service delivery, etc.).

Arrangements should also be put in place at the minimum at the level of individual schemes to ensure longitudinal tracking of the destinations of intersectorally-mobile researchers to assess the longer-term impact of their participation in ISM on enhancing their employment prospects. In addition, monitoring activities should seek to measure the impact on salaries, and to assess the impact of working on a cross-sectoral basis during their career and for those doctoral and post-doctoral researchers returning to academia following a mobility experience, the impact on their career progression within academia. Ideally, monitoring arrangements at the level of individual schemes should be supplemented at the national level to aggregate the data collected relating to the outcomes of participation in schemes on individual researchers.

Scheme managers should foster a culture of open data and information exchange. Ideally they can benchmark their own results with other ISM schemes, taking into account different contexts and typologies, and respecting confidentiality agreements linked to IPR issues.

5. EXECUTIVE SUMMARY

This Executive Summary outlines the findings from a *Study on Fostering Industrial Talents in Research at European Level* coordinated by EPRD, together with the Centre for Strategy & Evaluation Services, inova+ and PPMI Group.

5.1. Introduction

5.1.1. Study objectives

The overall study objective is to examine the feasibility of additional EU-level initiatives to increase the participation of academic and industrial researchers in intersectoral mobility ("ISM") in Europe. The specific objectives are to:

- Produce an inventory of existing literature on ISM in Europe and selected third countries;
- Identify up to 10 examples of formal national ISM schemes per country, and examples of mobility between sectors taking place through informal means;
- Identify and analyse the barriers and drivers of the uptake of ISM, including the availability of, and access to support structures, guidance and training and funding mechanisms for researchers;
- Ascertain the level of ISM among researchers in the EU-28 Member States, EFTA/ EEA and candidate countries, and between the EU and third countries;
- Identify five good practice examples of ISM schemes and critically evaluate these, highlighting the strengths and weaknesses and examining the scope for replicability¹⁰⁰;
- Develop recommendations as to what form possible further EU-level interventions to increase the intersectoral mobility of researchers – if deemed necessary – might take.

5.1.2. Definition of intersectoral mobility

ISM refers to all possible bridges between universities, industry, and the public and third sectors. In a narrower sense, ISM is defined as the physical mobility of researchers between one sector (academia) and another¹⁰¹. Researcher mobility may also involve partial mobility (for instance, spending one day per week in an enterprise and four days carrying out PhD research at university) or take place virtually (e.g. co-location, carrying out a collaborative research project within industry, but remaining on-site within academia).

5.1.3. Study scope

The study's **thematic scope** covers the mobility of researchers between **academia** (e.g. universities, other types of higher education institutions and publicly-funded research institutes) **industry** (e.g. SMEs and large firms) the **public sector** (e.g. national government, local authorities, and public institutions) and the **third sector** (NGOs, community organisations, including arts and cultural). The **geographic scope** covers the EU-28, EEA and EFTA countries, the Associated Countries ("AC") participating in Horizon 2020 and international comparator countries such as the **USA, Japan, Canada, South Korea, Australia, Singapore** and the **BRICs (Brazil, Russia, India, and China)**.

5.1.4. Methodology

The methodology required a detailed baseline assessment to map national examples of formal and informal mobility schemes taking place, and a review of existing EU programmatic and funding support for ISM. This led to the development of a gap analysis and responses to the research questions. A feasibility of the scope for further EU intervention to strengthen participation in ISM was then undertaken.

¹⁰⁰ It was agreed with DG RTD that since no individual ISM scheme has all the characteristics of an ideal scheme, the case studies would adopt a cross-comparative approach by type of mobility. This still focuses in on individual dedicated ISM schemes.

¹⁰¹ Definition adapted from Vandeveldt, K.: "Intersectoral Mobility. ERAC Mutual Learning Workshop on Human Resources and Mobility", 2014. https://cdn1.euraxess.org/sites/default/files/policy_library/report-intersectoral-mobility.pdf

The data collection approach consisted of desk and field research, namely: 1) a comprehensive review of previous literature e.g. studies and evaluations relating to ISM 2) an extensive interview programme with >100 stakeholders participating in ISM or involved in scheme design, covering circa 50 countries and 3) three online surveys with i) higher education institutions and research institutes ii) industry and private sector research institutions and iii) individual researchers. The survey response overall was 105¹⁰². Nevertheless, sufficient qualitative data was gathered through the interview programme to address the key research questions.

5.2. Key findings

5.2.1. Key findings – baseline assessment

The purpose of the baseline assessment was to identify what types of national ISM schemes already exist, and to analyse their key characteristics, size and scale. In total, more than 270 different schemes were identified across the EU-28, associated countries and internationally. Two types of schemes were identified, firstly, dedicated ISM schemes where intersectoral mobility is a central feature and secondly, schemes which allow scope for cross-sectoral mobility but this is not the primary focus. Subsequently, having completed the national scheme mapping, to inform the gap analysis, an assessment of existing provision of EU schemes¹⁰³ to facilitate researcher mobility (including ISM) was undertaken. The drivers, challenges and obstacles to participation in ISM were also analysed. On the demand side, the study examined the motivations of researchers in taking part in formal and informal ISM and for different stakeholders participating in and involved in the setting-up, management and implementation of ISM schemes.

5.2.1.1. The demand-side of intersectoral mobility

There is a lack of previous studies to assess the level of demand among industry for PhD and post-doctoral level researchers and a corresponding lack of data. However, based on qualitative assessment, the research found that:

- In countries with a longer-established tradition of industry-academic cooperation, there is evidence of **strong demand for PhD and post-doctoral researchers among industry**, especially for researchers in STEM subjects.
- In the public and third sectors, there is **stronger demand for researchers in non-STEM subjects, social sciences, arts and humanities**.
- There is particular **demand for PhD and doctoral level researchers in specialist skills shortages areas**, such as in the ICT domain, in specific sub-sectors such as programming and cryptography.
- There is a **higher level of awareness among larger firms than SMEs about the benefits of engaging with PhD and post-doctoral researchers through ISM to recruit the best industrial researchers to drive future growth**. Some large firms sponsor ISM schemes and others actively participate in industrial PhD and fellowship schemes.
- **Many SMEs remain unaware about the potential benefits of recruiting PhD and / or post-doctoral researchers**. Although attitudes are changing, a significant percentage of smaller companies view PhDs as being too 'academic', and the research skills acquired as being too theoretical to be applied in industry.
- In some industries, however, **demand for post-doctoral researchers to carry out industrial research projects is relatively limited**. There is rather a need for industry to recruit bright Masters and PhD graduates with transferable skills that help to strengthen their employability to work on company-specific challenges.
- There is, in some countries, a **lack of interest among researchers in developing a career outside of the academic setting**. However, given the increasing supply of doctoral and post-doctoral researchers, there is increased pressure on researchers in academia to open their horizons to a non-academic career.

¹⁰² Other than survey fatigue, one of the reasons for a low response was that the survey was targeted mainly at those that have participated in a formal ISM scheme, which limited the target cohort.

¹⁰³ This covered the Marie Skłodowska-Curie Innovative Training Networks (MSCA ITN), the SME Associate Pilot, and the European Institute of Innovation & Technology (EIT)'s Knowledge and Innovation Communities (KICs), which offer Masters and Doctoral courses and the European Structural & Investment Funds (ESIF).

5.2.1.2. Supply side - prevalence of ISM schemes by sector and geographic coverage

- **There is low awareness and understanding about the term “intersectoral mobility” among many stakeholders.**
- **There are major variations in the number of formal ISM schemes across the EU-28 operating at national level.**
- **The EU is the only financing source for schemes which combine intersectoral and international mobility. Most national schemes are small-scale and only operate domestically.**
- **There are proportionately more ISM schemes targeted at industry than at the public sector and third sector.**

5.2.1.3. Funding of ISM

- **The majority of EU Member States do not have a dedicated national funding system to support formal ISM schemes. There are however a number of significant-scale publicly-financed national funding schemes to support ISM.**
- **A number of different national public and private funding sources have financed the setting up and operation of ISM schemes operating in individual EU and associated countries.**
- **In many EU-13 countries, but also some EU-15 countries (e.g. Germany), the main funding source to promote ISM is through dedicated EU-funded schemes, namely the MSCA's ITN which provides European Industrial Doctorates and European Joint Doctorates, the MSCA COFUND, the EIT KICs and the SME Associate Pilot.**

5.2.1.4. Scheme design, management and implementation

- There were found to be a variety of different approaches to scheme design, such as one-two year Fellowships and three-four year full industrial PhD schemes, as well as internships and placements involving much shorter periods of mobility.
- It is difficult to generalise about scheme design since there are a wide heterogeneity of schemes (reference should be made to the case studies, which show alternative approaches).
- The most effective approach to scheme design and implementation was found to prioritise flexibility over a prescriptive approach.
- Regarding scheme management, good practice suggests the need for a minimum of one dedicated scheme manager with a strong understanding of both industry and academia (or other sectoral) needs, able to monitor scheme implementation and to provide practical, hands-on support to researchers and institutional and company participants.

5.2.1.5. Monitoring and evaluation

- The best schemes undertake periodic reviews and / or evaluations of scheme implementation to assess how effectively schemes are operating (see case studies and section on evaluation practices).
- However, a general problem identified is the lack of systematic evaluation and monitoring and the absence of sufficient attention to indicators from the outset of scheme implementation. This is partly due to the small size and fragmented nature of many schemes.
- Longitudinal assessment of the impacts of participation on researchers and on institutional/ organisational participants would help to strengthen the evidence base attesting to the benefits of ISM.

5.2.1.6. Good practices in intersectoral mobility

A large number of good practices were identified and these are highlighted in detail in the five case studies (see standalone case study report). Examples of good practices are:

- The majority of schemes rely on a combination of **formal and informal skills and training**. Among the benefits for researchers and HEIs of such training were: strengthening transferable skills for employability, and making it easier to make the transition from academia to the non-academic sector.

- Regarding **supervision arrangements**, well-managed schemes ensure that doctoral researchers have both an academic and industry supervisor responsible for monitoring their mobility experience.
- The **co-funding of schemes between the public and private sectors** is an effective practice, since schemes where the private sector has made a contribution towards the costs of recruiting PhD researchers were viewed especially positively in terms of their benefits for researchers and industry participants. Co-funding also tends to ensure buy-in from all parties involved.
- **Evaluation and monitoring** should be built into scheme design from the outset.

5.2.2. Overall conclusions – baseline assessment

Overall, there are **low levels of awareness about the concept of intersectoral mobility**, because the term is not widely used. More should be done to raise awareness among researchers and stakeholders that could potentially benefit from participating in ISM.

Whilst across the countries within scope, there were found to be a high number of schemes dedicated to intersectoral mobility operating at national level, this masks **considerable variation in the provision of formal schemes across the EU-28 and H2020-associated countries**. Accordingly, due to the lack of national investment in such schemes, some countries (especially those eligible for widening participation) are currently over-dependent on EU funding to facilitate researcher mobility. Since EU schemes include a mandatory requirement to take part in international mobility, strengthening participation in ISM through EU schemes as they are currently designed may exacerbate the risk of brain drain in many EU-13, and at least some associated countries.

There are many tangible and intangible benefits of taking part in formal and informal ISM. ISM schemes studied have led to many different benefits within the knowledge triangle ecosystem for researchers, industry and academia, and for the public sector and third sector. The nature and magnitude of benefits varies depending on the stakeholder type:

- **Researchers** - taking part in ISM gain valuable experience through mobility periods, and acquired transferable skills to improve their employability;
- **Industry and SMEs** – access to high-quality top research talents for industrial research purposes, opportunity to strengthen collaborative relationships with universities and research institutes.
- **Public sector** – access to high-quality researchers to solve problems and challenges relating to public service delivery and public policy.
- **Third sector** - access to high-quality researchers to solve problems and challenges relating to national and international NGOs, CVOs etc.

There are a wide variety of **different types of outcomes from ISM**, some of which are measurable. However, many indicators were found to be predominantly outputs rather than results of impacts. Nevertheless, there are some interesting examples of outcomes, such as IPR generated, new revenue streams from licensing arrangements, and positive outcomes for researchers such as enhanced employability prospects and higher salaries.

A further finding was that there would be strong value in having a more holistic EU-level approach to promoting increased participation in ISM to strengthen the coherence of existing EU researcher mobility initiatives, some of which promote such mobility. These different initiatives would benefit from being branded under a common umbrella to heighten awareness about ISM.

5.2.3. Key findings – gap analysis

The purpose of the gap analysis was to ascertain how far there are gaps in the availability of formal ISM schemes by country, and type of mobility by sector. The findings were that:

- **Access to national ISM schemes by researchers is not uniform, since there is geographic unevenness in the number of dedicated national ISM schemes.** There are very few dedicated ISM schemes in EU-13 countries, where industry-academic cooperation is generally less well developed.

- There was found to be an **absence of appropriate framework conditions** in many EU countries (especially countries eligible for H2020 'widening participation' support). Among the framework conditions necessary for intersectoral to flourish are: a long and well-established culture of intersectoral collaboration, mechanisms to facilitate joint industry-academic cooperation, the availability of R&I tax incentives to recruit doctoral/ post-doctoral researchers.
- Whilst in some countries, ISM schemes between industry and academia are relatively well-developed, there has been **insufficient policy importance attention given to researcher mobility between academia and other sectors**.
- There is a lack of **inter-scheme connectivity** since many schemes are very small in scale and therefore the opportunities for scheme managers to engage in partnership working, information and data exchange about outcomes and the exchange of experiences and good practices is presently being lost. One possibility to overcome this problem could be to provide EU funding to enable scheme managers to cooperate more closely in future.
- There is insufficient attention being given to **preparatory training for researchers** before they undertake intersectoral mobility experiences. Such training could help open their horizons to undertaking a mobility period in another sector and equip them with skills to strengthen their transferable skills. There could also be a need for industry training and to provide general information for participants in schemes from other sectors as to how to best make use of a visiting researcher, how best to use their time and expertise etc.

Overall, the findings from the gap analysis suggest that whilst there are many examples of national formal ISM schemes in some countries, and evidence of good practices in scheme design, management and operation, there is insufficient access for researchers in all countries to take part in ISM through existing national schemes. Very few countries are making national resources available to support ISM, raising question marks as to the sustainability of existing schemes, and making it more difficult to increase overall levels of participation in ISM across the EU. This suggests that there is a rationale for further EU intervention. Possible options in this regard are considered under 2.4 – feasibility study.

5.2.4. Feasibility study and options definition / analysis

The feasibility study considered a number of questions relating to possible further EU intervention in future to strengthen participation in ISM. An options analysis was developed based on the findings from the baseline assessment and gap analysis. The options defined were:

Option 0 – No change.
Option 1 – Mainstreaming intersectoral mobility as a horizontal theme.
Option 2 – Set up a new EU funding umbrella programme dedicated to promoting intersectoral mobility.
Option 2.1 – Sub-action: Industrial Fellowships for Excellent Researchers.
Option 2.2 – Sub-action: Intersectoral mobility placements and internships.
Option 2.3 – Sub-action: Intersectoral mobility between academia and the public sector and third sectors.
Option 2.4 – Sub-action: Intersectoral mobility to increase opportunities for researchers in non-STEM subject disciplines to undertake mobility experiences
Option 2.5 – Set up a dedicated EU and national level support structure
Option 2.6 – Streamline the MSCA by folding in the cross-sectoral aspects into a new umbrella EU scheme dedicated to intersectoral mobility along with the SME Associate Scheme.
Option 3 – Sub-action to provide preparatory training and professional career development, skills and training support to intersectorally mobile researchers
Option 4 – Expand the SME Associate Pilot Scheme

The findings were that no change is not a realistic option, since ISM currently has low visibility within EU programmes. The possibility of mainstreaming ISM more prominently in future programmes is a viable possibility, but under this option consideration would need to be given as to how to address identified gaps (perhaps through the introduction of new sub-actions post-2020). The series of options identified under Option 2 relating to possible new funding measures to complement existing initiatives are potentially viable and since they are not mutually exclusive could be implemented in parallel. Option 2.6 in particular would involve restructuring existing initiatives that support ISM and combining these post-2020 with the proposed new funding sub-actions outlined in Options 2.1, 2.2, 2.3 and 2.4 respectively.

The research identified sufficient grounds to justify a new sub-action to provide preparatory training and professional career development, skills and training support to doctoral researchers. Although something similar exists already through the MSCA ITN, access to training provision is confined to those awarded European doctoral awards under the MSCA and is not open to all researchers. Option 4 – expanding the current focus of the SME Associate Pilot Scheme beyond industry alone to other sectors and making it more flexible so that the emphasis in the mobility period is not on international mobility alone was also found to be viable, although the scheme should not be expanded yet until the evidence base becomes clearer as to its effectiveness (an evaluation of the pilot only commenced in January 2018).

The future role of the European Commission (EC), Euraxess, Member State authorities and individual scheme managers in strengthening the European intersectoral mobility eco-system was considered. The findings were that the EC should play an active role in heightening policy attention to ISM among national authorities, and a strong coordination role in launching and overseeing the implementation of a holistic new EU initiative on intersectoral mobility. This could combine existing researcher mobility initiatives and new funding and non-funding measures to strengthen participation in ISM. The research also found that both the European Commission and Member State authorities should be taking more active steps to ensure that the framework conditions in which ISM can flourish are made more propitious. Therefore, even if a series of new funding measures were to go ahead post-2020, steps need to be taken in the current period to mainstream ISM and to promote the strengthening of the framework conditions in which ISM can flourish at national level. The absence of sufficient access to national support structures merits consideration of expanding the role of Euraxess to provide support for setting up and operating ISM schemes under the overall coordination of the European Commission (Option 2.5).

5.2.5. Recommendations at EU level for The European Commission

Recommendation 1: The European Commission should take the lead in strengthening the communication and dissemination of the tangible and intangible benefits of intersectoral mobility, for the economy and society as a whole, and for all stakeholders concerned.

Recommendation 2: A holistic and integrated approach to fostering greater participation in intersectoral mobility should be adopted at EU level, thus making the practice and benefits of ISM as widely known as those of international mobility.

- **Recommendation 2.1:** Strengthen coherence in European ISM-related funding schemes.
- **Recommendation 2.2:** Set appropriate framework conditions to increase formal and informal ISM schemes, making use of ERA roadmaps.
- **Recommendation 2.3:** Coordinate indicator-driven monitoring and long-term impact assessment.
- **Recommendation 2.4:** Data on the careers of doctorate holders should be collected more regularly at EU and national levels.
- **Recommendation 2.5:** Promote the exchange of experiences, knowledge and good practices between ISM schemes; support partnership working, networking and the sharing of benchmarking monitoring data.

Recommendation 3: Intersectoral mobility should be mainstreamed in FP9 as a “horizontal” priority, as well as implemented “vertically” through specific funding calls.

- **Recommendation 3.1:** A new EU funding umbrella programme dedicated to promoting intersectoral mobility should be set up post-2020, drawing on funding from FP9.
- **Recommendation 3.2:** Consideration should be given to the possibility of streamlining the ISM component within existing EU researcher mobility programmes post-2020 (e.g. the MSCA’s ITN and the SME Associate Scheme) into the same umbrella programme, so as to complement the establishment of new funding sub-actions and other complementary proposed measures (e.g. relating to support structures, which would include stronger EU-

level coordination and improved partnership working between national authorities and between ISM scheme managers).

- **Recommendation 3.3:** A new EU co-funding scheme should also be set up encouraging the development of new small-scale regional, national and international ISM schemes, and supporting the scaling-up of existing ones.
- **Recommendation 3.4:** A new EU funding or co-funding scheme preparing for ISM should address the need for professional development training for researcher to broaden their career horizons to working in other sectors, as well as skills development during their ISM period (with a focus on skills to strengthen employability, digital skills, entrepreneurship and IPR).
- **Recommendation 3.5:** Additional financial allocations (or a reduction of co-financing requirements) to countries prioritised under the “widening participation” agenda in Horizon 2020 or in its follower FP9.
- **Recommendation 3.6:** Support non-industrial ISM and a higher take-up of ISM in non-STEM
- **Recommendation 3.7:** As an alternative to setting up a new EU funding programme with specific sub-actions, the scope of existing ISM schemes (e.g. MSCA, the SME Associate Pilot Scheme) could be expanded in order to address identified gaps in funding provision.

Recommendation 4: The European Commission should support the development of good practice guidance documents relating to intersectoral mobility. Examples of good practices that could be developed either into a single guidance document or into several shorter guides are:

- **Recommendation 4.1:** A Practical Guide to Intersectoral Mobility
- **Recommendation 4.2:** A Guide on IPR Issues relating to Intersectoral Mobility

Recommendation 5: Inspired by the European initiatives described under 2.2.2, national authorities should develop a national (industrial) research strategy that explicitly supports ISM as a mechanism for fostering industrial talents, and for strengthening industrial competitiveness over the longer term. ISM policies should be embedded in a ‘higher-level skills needs’ strategy and involve not only the industry sector but also the public and third sectors.

Recommendation 6: The Member States should ensure that they put in place the necessary framework conditions conducive to supporting ISM identified through this study.

- **Recommendation 6.1:** The Member States should put in place the necessary funding, incentives (including relocation support for families and tax incentives) as well as institutional arrangements to support the development and implementation of ISM schemes at national level.
- **Recommendation 6.2:** The career appraisal systems in individual HEIs should explicitly recognise the value of taking part in intersectoral mobility from a professional career development perspective.
- **Recommendation 6.3:** National governments and public sector organisations should lead by example and hire more PhD graduates themselves and encourage other sectors to recruit and retain more doctoral and post-doctoral researchers.
- **Recommendation 6.4:** The general and specific benefits of intersectoral mobility for different types of stakeholders should be familiar to all.
- **Recommendation 6.5:** Key stakeholders (policy makers, industry stakeholders, universities, companies) should be involved in designing new ISM schemes, in a dialogue on how ISM can best meet identified needs.

Recommendation 7: A stronger culture of monitoring and evaluation of intersectoral mobility schemes operating in each Member State should be promoted and/or included in their country Semester Report / annual RIO report. Lessons learned through different ISM schemes should be integrated into evaluation exercises, with attention for output data as well as qualitative outcomes.

5.2.6. *Recommendations for managers of individual intersectoral mobility schemes*

Recommendation 8: Remove any limitations in existing regulations currently impeding ISM and develop the appropriate framework conditions for successful ISM schemes.

- **Recommendation 8.1:** In designing ISM schemes between academia and industry, scheme managers should ensure that ISM schemes are sufficiently flexible to adapt to the changing circumstances on the ground during scheme implementation.

- **Recommendation 8.2:** A particular effort should be made to ensure that 'less obvious' non-academic partners are equally keen to participate as large R&D-intensive industrial companies. SMEs (and ideally also start-ups), the public sector and the service sector should be equally able to take part in ISM schemes.
- **Recommendation 8.3:** When designing ISM schemes, the employment and working conditions of academic (and industry) staff should not be unduly affected by undertaking a mobility period.
- **Recommendation 8.4:** ISM scheme managers should ensure that adequate resources are put into scheme management and administration, evaluation and monitoring.

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This study was carried out for the European Commission's DG Research and Innovation. The purpose was to examine the feasibility of further EU initiatives to increase the participation of researchers in intersectoral mobility ("ISM") in Europe. The study involved the identification of 270+ national ISM schemes in 50 countries to identify scheme characteristics from their design and set-up through to management, implementation, monitoring and evaluation. Case studies were developed by type of mobility (e.g. academia-industry, academia to the public and third sectors) to identify good practices. The outcomes were a strengthened evidence base about existing national ISM schemes, information about the outcomes of participating in schemes for researchers, industry and other research actors and insights into factors determining their sustainability.

A gap assessment was conducted of existing provision through formal schemes and an assessment of demand to take part in ISM. An options analysis was developed through the feasibility study outlining ways of increasing participation in future. This informed the development of recommendations for the European Commission (stressing the role of the Euraxess network, national authorities and scheme managers). The report advocates the need for a holistic initiative combining existing and new funding/ non-funding measures to strengthen ISM.

Studies and reports