Study on assessing the contribution of the framework programmes to the development of human research capacity

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Prepared by: **IDEA Consult**
iFQ
PPMI

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Abstract

This report is prepared by IDEA Consult, PPMI and iFQ for the European Commission, DG Research and Innovation, in order to report on a detailed and robust assessment of the contribution of the Framework Programmes (FP) to the development of human research capacity.

Based on the intervention logic of the FPs and corresponding expected outputs, immediate and intermediate outcomes, the impact is measured at three levels: the individual (researcher), the team and the systemic.

The study comprises an assessment of the existing available evidence and the collection of new data and information through the design and implementation of two surveys (one at the individual and one at the team level) and ten case studies.

The outcomes of the project are analysis results, conclusions and recommendations that inform and support decision-making processes in research and technology policy, and particularly in terms of tailoring the EC's funding instruments (Horizon 2020 Programme) in order to reach maximum impact on human research capacity in the future.

Récapitulatif

Ce rapport a été rédigé par IDEA Consult, PPMI et iFQ pour la DG Recherche et innovation de la Commission européenne afin de fournir une évaluation fiable et détaillée de la contribution des Programmes-cadres (PC) au développement de la « capacité de recherche humaine ».

Sur la base de la logique d'intervention des PC et des effets directs, immédiats et intermédiaires attendus, l'impact est mesuré à trois niveaux : au niveau de l'individu (chercheur), au niveau de l'équipe et au niveau systémique (système dans son ensemble).

L'évaluation se base sur les données et informations existantes disponibles ainsi que sur une compilation de nouvelles données et informations dérivées de la réalisation de deux enquêtes (l'une au niveau de l'individu et l'autre au niveau de l'équipe de recherche) et de dix études de cas.

Le projet débouche sur des résultats, des conclusions et des recommandations qui éclaireront et faciliteront les procédures décisionnelles relatives aux politiques liées à la recherche et aux technologies, et plus particulièrement l'adaptation des instruments de financement de la CE (tels que le programme Horizon 2020) afin d'en optimiser l'impact sur la capacité de recherche humaine pour l'avenir.

0. Executive summary

0.1. About the evaluation study

This report is prepared by IDEA Consult, PPMI and iFQ for the European Commission, DG Research and Innovation, in order to provide a detailed and robust assessment of the contribution of the Framework Programmes (FP) to the development of Human Research Capacity (HRC) in Europe and beyond.

The designed evaluation frame builds on the intervention logic (i.e. the set of assumptions regarding the expected impact of the FP) including the consideration of relevant expected outputs, immediate outcomes and intermediate outcomes as a result of FP participation. The impact is measured at three levels: the individual (researcher), team and systemic, and thereby provides unique insights in team dynamics which have not been the subject of detailed research from this perspective before.

The study comprises an assessment of the existing available evidence and the collection of new data and information through the design and implementation of two surveys and ten case studies.

- The first survey focuses on individual researchers working in Higher Education Institutes in Europe (EU27, Norway and Switzerland) and provides evidence on impacts at the individual level, in particular on skills, expertise and careers. The survey is not restricted to FP participants only and has therefore also collected data for the counterfactual analysis, i.e. the comparison with non-FP participants in terms of impact on HRC.
- The second survey is a team-level survey of FP participants on the basis of the information available in CORDA and provides a representative picture of the population of institutions that have participated in FP7. This survey includes both academic and non-academic actors and focuses on the impact of FP participation at team level, in particular on the organisation, recruitment, leverage and sustainability of job creation.
- In addition to the two large-scale surveys, ten case studies (i.e. individual projects) were implemented. In-depth interviews with project participants were conducted in order to study all aspects of the impact of FP participation on HRC in Europe, within its context, and to enable detailed exploration of the nuances and mechanisms behind these impacts. The cases focus strongly on projects in the non-academic sector.

The combination of these methodological tools and their tailored implementation results in accurate and policy-relevant information. In the interpretation of the results, it is important to keep in mind the specific characteristics of the different datasets with respect to statistical significance and robustness. The surveys have collected representative data at the individual level (with respect to gender, region and field of science) and at the team level (with respect to programme type, organisation type, region and period). This means, for instance, that data accurately reflect the research and team populations for European regions but that we cannot provide detailed cross-country analysis or indicators. The main findings are also based on a counterfactual analysis and on inferential statistical analysis, in order to increase the robustness and attribution of the measured effects.

The final results of the evaluation have been presented to, and validated by, a panel of external experts in a roundtable discussion that took place in Brussels in September

2014. The evaluation study, the first in its kind, sheds light on the impact of FP participation on 'human research capacity'. The conclusions and recommendations inform and support decision-making in research and technology policy and, more specifically, tailoring the EC's research and innovation programmes and instruments (like the Horizon 2020 Programme) to reach maximum impact on human research capacity in the future, and as such contribute to the realisation of the ERA and Europe 2020 objectives. The evaluation study ran from October 2013 to October 2014.

0.2. Key evaluation questions and key results

The entire evaluation is driven by **seven key evaluation questions**. In this section, we present the main findings per evaluation question. In the next section (section 0.3), we synthesise the broader outcomes and conclusions of the study, beyond the evaluation questions or levels of analysis.

EQ1: To what extent do the project participants think that the FP has contributed to increasing their **skills and expertise**? May include project management, international networking within the research community, and ability to work in an open innovation context (links with industry).

EQ2: Can we identify whether the participation in FP projects has had a positive impact on the **careers** of project participants? This may be evaluated through different categories depending on the status and category of expertise, for instance:

a. Senior/permanent positions: promotion effect/increased visibility/increased responsibility within their organisation, etc...

b. Temporary positions: has the FP led to job creation, for example transforming a post-doc or a short-term contract into a permanent position within the same organisation? Has it enabled the temporary staff to get connections and eventually a permanent position in another organisation/partner?

EQ3: Has the FP led to an increase in the **ratio fixed-term/open-ended contracts** (i.e. a relative increase of short-term contracts)?

EQ4: What is the impact of openness of **recruitment practices** induced by FP?

EQ5: What is the impact of FP on research **teams (their composition and size)** and on the **organisation**, including management of financial and human resources, impact on the institution's strategic research agenda (alignment with FP topics?), ability to attract other types of funding (FP as leverage to access to other funding sources), etc.?

EQ6: To what extent has the FP contributed to brain circulation, by attracting researchers from **outside EU27**?

EQ7: Can we identify to what extent the FP has contributed to **job creation** (direct: recruitments to carry out the project and indirect: after the completion of the project), and possibly measure it?

EQ1: Skills and expertise benefit from FP participation

The evaluation results show that training in and development of individual skills and expertise clearly benefit from FP participation. Researchers that participate in FPs strengthen almost all skills and capacities, although this does depend on the career stage of the researcher concerned. The share of respondents who assign the development of networking, leadership and negotiation skills as well as skills regarding the use of science in policy-related contexts to FP-related employment episodes is particularly high (between 64% and 76%) and these skills are moreover considered the more relevant for career development. Next to this, FP participation also contributes to strengthening researchers' autonomy and independence. Between 58% and 71% of FP participants were able to fulfil their tasks without supervision for the first time during FP-related employment episodes. As such, this process enabled them to become more autonomous through empowerment and increased levels of self-esteem. Finally, there is also evidence that FP participation further enhances the mid to long-term international mobility of the researchers involved (39% long term mobility among FP participants compared to 26% among non-participants).

EQ2: No career effects in the short run, but higher autonomy and important skills for career development in the long run

Why do researchers participate in FP projects? Firstly, because of reasons relating to content, i.e. the attractiveness and relevance of the research to be carried out; secondly, because of the international orientation of the programme and the exposure of the researcher to the international context. There is no evidence pointing to FP participation as a 'career catalyser': FP participation does not lead to 'faster' career development. While 45% of early career researchers (R1) with FP-project involvement remain on this career stage for more than 5 years, this applies to only 24% of the researchers not involved in FP projects. In general, the impact of FP participation on career development or progression is rather moderate in the short term. On the other hand, the acquisition of important skills for further career development and increased autonomy in terms of carrying out tasks are effects of FP participation that result in positive outcomes on researchers' careers in the longer run. Overall, almost half of the researchers perceive positive effects of FP participation on their research career. Around one quarter expect that FP participation will contribute to acquiring a new position in academia, and 17% into another sector.

EQ3: Slightly increased use of fixed-term contracts but no long-term impact

The ratio between fixed-term and open-ended contracts is a relevant proxy indicator of the job security and longer career perspectives of a researcher, albeit it is not the only one. FP funding has contributed to a small overall change in the ratio of permanent (+20%) and fixed-term (+27%) contracts and a slight overall shift to the more widespread use of fixed-term contracts in the participating research teams. The reported change in the mix of contract types used varies in intensity across the different types of FP beneficiaries. Although FP funding contributed to an increased use of fixed-term contracts, there was generally no long-term impact at the organisation level. Aside from the issue of job security, in the long term FP participation translates into formal advancement and better working conditions for the researchers that have been involved in FP activities. For instance, the highest share of researchers employed under permanent contracts was found among the participants of FP6 and FP7 (77% versus 55%).

EQ4: Mixed structuring effect on recruitment practices, uneven across organisations

Openness of recruitment practices is an important pillar of the ERA objectives and the associated European Charter and Code for Researchers. FPs had a mixed structuring effect on HR management in the participating organisations (about two-thirds of the teams), with a positive but weak influence on gender mainstreaming (46%). On the other hand, FP participation contributes to some extent to more transparent and merit-based recruitment of researchers (between 30 and 40% of the beneficiaries), particularly in the EU-12 and less technologically-advanced countries. The impact of FPs on HRM was uneven across the participating organisations, with less influence on private research companies and SMEs, who are also less bound by e.g. the principles of the Code and the Charter. It is also demonstrated that effective collaboration and transfer of knowledge contributes to the spread of good practices in HR management.

EQ5: Significant impact on team size and composition (gender, nationality), as well as on the organisation and importantly, its capacity to leverage and attract additional funding

FP participation has a significant impact on the size of the beneficiary research teams, in particular by increasing the number of researchers employed by 1.3 on average per team (see also below). A large part (43%) of those additionally hired researchers stayed in the beneficiary research teams (sustainability). FP participation also has a positive impact on the composition of beneficiary research teams, particularly by increasing the share of women and international researchers among them. Participation helped the beneficiaries to strengthen their strategic orientation towards EU priorities (68%). Next to size and composition impact, teams also experience a significant leverage effect when it comes to attracting additional funding, particularly at EU level (83%, and 72% at national/regional level).

EQ6: Attractiveness for non-EU27 cooperation, but no long-term effect

It has been shown that FP participation helps the Higher Education Institutions to attract non-EU researchers to Europe (8% of participating researchers come from outside the EU), particularly through the Ideas and People programmes, but the magnitude is limited and the effect is not lasting (often confined to the duration of the project). Non-EU institutions are heavily involved in FPs (14% of participating institutions), thus facilitating extra-EU brain circulation and knowledge transfer; nevertheless the real impact on longer-term extra-EU mobility seems to be limited. Finally, the FPs do contribute to a higher level of interconnectivity between research organisations and researchers, between different subsystems of the economy and society.

EQ7: Direct job creation of 61,000 additional research positions

This evaluation has shown that it is possible to measure the employment effects of FP participation. Nevertheless, the results have to be interpreted with care due to a number of uncertainties. FP7 projects have led to the hiring of 142,000 researchers (headcount and not FTEs) and an estimated direct new job creation of at least 61,000, the majority of which can be situated under the Cooperation programme. Next to direct job creation, indirect job creation is significant but impossible to estimate within the context of this study, as it takes place after the end of the FP project. Next to job creation, there is also ample evidence that FPs contribute to maintaining existing levels of researcher employment in Europe. Finally, regional and institutional attractiveness are positively influenced by FP participation and the overall FP participation 'track record'; it leads to increased 'recognition' of researchers, institutions and regions.

0.3. Broader results and conclusions

The underlying evaluation study has led to a truly rich body of data and information relevant to policy makers on different levels. Next to specific evidence used to answer the evaluation questions, several other insights have been obtained. We present these insights below.

✓*FP participation leads to several positive effects with respect to human research capacity development.*

The figure below shows the main positive impacts identified in different parts of the study. It will be important to be aware of these positive effects and continue to facilitate and pursue them.

✓*Internationalisation possibilities and state-of-the-art research are the distinguishing features that make FP attractive to researchers.*

✓*Internationalisation is the main impact realised at team and individual level.*

Team leaders find international cooperation an important motive to participate in FPs, along with the opportunity to deepen or broaden the knowledge of the team on the research topic. Similarly, individual researchers consider international cooperation and interesting research content to be the most important factor here. At team level, participation results in increased recognition and attractiveness of a team in universities or HEI. This effect of international cooperation is further reflected in the high share of researchers indicating that expansion of their international networks is a strong effect of participation (almost 90%) and in the higher rate of long-term international mobility among FP participants (39%) compared to the non-FP researchers (26%). Short international mobility does not seem to be affected.

✓*The main career effect is not formal career progression and promotion but recognition, responsibility and increased self-dependency and autonomy.*

FP participation is recognised in the academic research environment and leads to strong networking and organisation skills in the participating/coordinating researchers. Formal advancement from one career stage to another is not observed during or immediately after the participation in an FP project. The intermediate impact is, however, considered positive, via the recognition process and by acquiring skills that are relevant for future research, networking and attracting additional funding. For later career stage researchers, who are already in a stable position, the longer-term funding provided by FP projects enables them to build a (temporary or sustained) research team and to explore in-depth the research topic of the project.

✓*The realisation of the impact of FP participation on the development of human research capacity is higher for the first participation and is facilitated through successful cooperation and awareness/inclusion in the team's objectives of the project.*

When a team or individual researcher participates for the first time, the impacts are more pronounced. This is particularly the case for acquiring HR, administrative and management practices and for networking effects. Also at the individual level, a researcher acquires most new skills in these fields during their first participation. In this sense, this observation relates directly to effects for early stage researchers. At organisational level, first participation also leads to the strongest effect on strengthening the strategic orientation of the organisation towards EU priorities.

✓*Academic and industrial partners take a different strategic and operational approach in terms of team development and sustainable employment.*

Academia and industry each have their own objectives and motivations when applying for FP funding and expectations in terms of outcomes. In academia, the main employment effect is the hiring and training of young researchers and the stability offered to already employed senior researchers. In industry, FP project work is carried out by the existing pool of employees. When researchers are hired in industry to participate in an FP project, they are likely to stay after the project has ended.

✓*Indications of improved gender balance in FP teams.*

Women researchers are well represented in FP projects, particularly when compared to the total and even in disciplines or sectors that have traditionally low shares of women. In industry, a lower share of women is hired than in universities/HEI (36% compared to 46%). In terms of responsibilities and position, female researchers (slightly) less often exercise the role of project coordinator (20% versus 26%). Female researchers see themselves less often as carrying out tasks independently, than do male researchers (52% under supervision versus 44%).

✓*The Specific Programmes each show a different pattern in terms of team development and employment sustainment.*

In terms of hiring new researchers (job creation), the Ideas and People Specific Programmes hire a higher number of researchers on the project but less stay after completion of the project. In the Cooperation and Capacities Specific Programmes, the direct job creation is smaller but sustained more often in the intermediate/long run. In terms of internationalisation, the Ideas and People Specific Programmes again hire more non-EU researchers compared to the Cooperation and Capacities Specific Programmes, but on the other hand participants in Ideas projects find international mobility and cooperation less important than those in other types of projects.

0.4. Specific recommendations

R1.Consider the introduction of an FP-related label reflecting the impact and importance of FP-participation on a researcher's skills and career path

FP-participation has a positive impact on different aspects of a researcher's career. However, PhD candidates suggest that the acquired organisation, networking and management skills are not as recognised as are the more traditional scientific achievements (like publication output). FP-participation should be recognised by current and future employers. This can be made possible through the introduction of an FP-related label reflecting the impact on and importance of FP participation for the skill-base and the potential career path of researchers.

R2. Stimulate but also require beneficiaries to introduce formalised training schemes

Training for skills and career development is of enormous importance to researchers as it may increase their employability both inside and outside academia. Specific attention should be given to the so-called commercial/entrepreneurial skills to which FP currently has a less pronounced effect. Facilitating the exchange and the sharing of good practices is an ideal starting point, to be followed by clear requirements in this respect from beneficiaries while allowing for sufficient flexibility in the implementation.

R3. Inform the researchers and stimulate beneficiaries to provide 'opportunity structures'

Measures should be taken to raise awareness about alternative career options and corresponding pre-requisites regarding skills and competencies, and the potential role of FP-type of project involvement in this respect. This is important for early stage but also later stage careers. Researchers need to be supported and enabled to develop a clear career development plan (analogous to the required Career Development Plan under the Marie Sklodowska-Curie programme). Beneficiaries, as employers, should be engaged as well.

R4. Further promote gender equality through work programmes and grant agreements

Although the gender balance has improved in research teams where low shares of female researchers are traditionally found, more action is needed. It is strongly recommended that there is continued promotion of gender equality in the implementation of Horizon 2020 through greater awareness of the gender dimension and its integration into work programmes and grant agreements (through specific targets and their monitoring). Particular attention should be paid to the scientific disciplines of Engineering, Education and Sciences.

R5. Continue supporting the implementation of the Charter and the Code through various instruments and on various levels.

The European Commission should continue supporting the implementation of the Charter and the Code through various instruments (e.g. the Human Resources Strategy for Research, the EURAXESS Jobs portal) and expect the application of these guidelines and principles by all the funded participants, especially universities and HEIs. The Model Grant Agreement under H2020, which gives an obligation to the beneficiaries in this respect, allows for strong monitoring and intervention when needed.

R6. Cooperate with Member States to eliminate any legal barriers preventing the full implementation of the Charter and the Code

To maximise the impact of EU funding on open recruitment and other HR practices, in the context of the European Research Area, the European Commission should cooperate closely with the Member States in order to better align their legislation and standards with the principles of the Charter and Code (as also underlined in the 2014 ERA Progress Report). Legal barriers to the application of open, transparent and merit-based recruitment of researchers, and the development of an enabling framework for the implementation of the HR Strategy for Researchers need to be removed.

R7. Keep on supporting the participation of industry, SMEs in particular, in H2020 and future programmes

The staff retention rate (i.e. share of researchers hired for a specific FP project that remain employed after the end of the project) among private industry organisations and SMEs is higher than in the HEI sector. In order to help increase the use of open-ended contracts and maximise the sustainable impact of FP funding on team size, the European Commission should continue supporting the industry dimension, encouraging SME participation in the Horizon 2020 programme and increasing industrial leadership in research and innovation.

R8. Broadly communicate the findings of this study to the relevant stakeholders

Information is powerful. The underlying study provides systematic and reliable evidence on the impact of FP funding on Europe's research capacity. It also discusses shortcomings and conditions needed in order to maximise this impact. Communicating the study results broadly (to the 'public' e.g. through Euraxess, but also to the policy-making community through e.g. ERAC) provides an excellent opportunity to further strengthen on-going discussions on research careers and working conditions.

R9. Monitor, assess stringently, and intervene where needed

The European Commission should continue monitoring and assessing changes in e.g. the balance between permanent/fixed-term contracts in the teams that actively participate in EU-funded projects, as one of the possible indicators of sustained and stable employment conditions. Not only is the contractual situation is important in this respect, but attention should also be paid to the broader framework in which researchers operate and in particular the relationship between researcher and employer. These aspects should be more closely monitored and better reflected in interim and final project assessment reports.

0.5. Recommendations with respect to future monitoring

Monitoring of particular aspects of the impact of FPs on human research capacity should take place on two levels.

The first level concerns the implementation of the conditions required to obtain a maximum impact of H2020 and other European funding programmes on human research capacity. On an institutional level, this comes down to monitoring progress with respect to the implementation of the Charter and the Code, in light of the implementation of the HR strategy for researchers. Monitoring of the implementation of the Charter and the Code by institutions and Member States is already on-going (e.g. through the EMM, or **ERA Monitoring Mechanism**), hence synergies can be developed. As the current H2020 the Model Grant Agreement puts an obligation on the grant beneficiary to make every effort to implement the European Charter for Researchers and Code of Conduct for the Recruitment of Researchers, targeted monitoring of implementation is possible and advisable.

The second level concerns the frequent monitoring of the effects/impact of H2020 funding on the specific dimensions of human research capacity. A number of steps need to be taken here.

Firstly, it is important to **harmonise concepts and definitions**. Several ad-hoc studies have touched on the issue of research careers, working conditions and skill build-up (like the MORE studies, or the Researchers' Report study, or even the CDH project managed by the OECD). What is urgently needed is the **alignment of concepts and definitions** in order to have a common base that allows comparability and integration of data.

Secondly, **synergies with existing or to be developed data collection efforts need to be developed**. If, in the near future, new studies on researchers are launched, it will be very important to coordinate among different sub-areas of policy making relevant to researchers.

Thirdly, consideration should be given to setting up an integrated **pan-EU career tracking system departing from FP participation.** Instead of targeting different groups of researchers over time, it makes a lot of sense to set up an EU-wide career tracking system. Career tracking is about initiatives that follow up researchers' careers over a certain time period to understand their career pathways.

Fourthly, it is important to **distinguish between 'need to know' and 'nice to know'.** Regardless of how selected information will be collected, it is important to distinguish between primary and secondary indicators. On the basis of the work carried out in this study a series of key indicators is proposed in the full report to make this monitoring possible.

0. Résumé

0.1. À propos de l'étude d'évaluation

Ce rapport a été rédigé par IDEA Consult, PPMI et iFQ pour la DG Recherche et innovation de la Commission européenne afin de fournir une évaluation fiable et détaillée de la contribution des Programmes-cadres (PC) au développement de la capacité de recherche humaine (CRH), au sein du territoire européen et au-delà.

Le cadre d'évaluation mis au point repose sur la logique d'intervention des Programmes-cadres (à savoir l'ensemble des hypothèses concernant leurs impacts attendus) et prend en compte les résultats directs et les effets immédiats et intermédiaires attendus et découlant de la participation à un PC. L'impact est mesuré à trois niveaux : au niveau de l'individu (chercheur), au niveau de l'équipe et au niveau systémique (système dans son ensemble). Il offre ainsi des pistes de réflexion uniques sur la dynamique de l'équipe, laquelle n'avait pas encore fait l'objet d'une recherche détaillée dans ce cadre.

L'évaluation se base sur les données et informations disponibles ainsi que sur une compilation de nouvelles données et informations dérivées de la réalisation de deux enquêtes (l'une au niveau de l'individu et l'autre au niveau de l'équipe de recherche) et de dix études de cas.

- La première enquête, qui porte sur les chercheurs travaillant au sein d'instituts d'enseignement supérieur en Europe (UE-27 + Norvège et Suisse), permet d'en savoir plus sur les conséquences au niveau individuel, notamment sur les compétences, l'expertise et les carrières. Cette enquête ne se limite pas aux seuls participants d'un PC. En effet, des données relatives à des non-participants ont également été recueillies afin d'effectuer une analyse contrefactuelle et d'identifier l'impact de la participation à un PC sur la CRH.
- La seconde enquête, qui porte sur les équipes de recherche, a été menée auprès de participants aux PC sur la base des informations disponibles dans CORDA. Cette enquête vise à donner une image représentative de la population des institutions qui ont participé au 7^{e} PC. L'enquête a été adressée à des acteurs tant universitaires que non universitaires et s'intéresse à l'impact d'une participation à un PC au niveau de l'équipe, notamment sur l'organisation, le recrutement, la capacité d'attirer des financements ultérieurs et la durabilité dans la création d'emplois.
- Outre ces deux enquêtes à grande échelle, dix études de cas (qui portent sur des projets individuels) ont également été réalisées. Dans ce contexte, des entretiens approfondis ont été menés avec des participants au projet afin d'étudier tous les aspects de l'impact d'une participation à un PC sur la capacité de recherche humaine en Europe et d'analyser de plus près les nuances et mécanismes à l'origine d'un tel impact. Les cas analysés portent en grande partie sur des projets au sein du secteur non universitaire.

L'association de ces différents outils méthodologiques permet de fournir des informations précises et pertinentes pour la prise de décisions politiques.

En ce qui concerne l'interprétation des résultats, il est important de garder à l'esprit les caractéristiques spécifiques des différents ensembles de données, en matière de signification et de fiabilité statistiques. Les enquêtes permettent de collecter des données représentatives aux niveaux de l'individu (en tenant compte du sexe, de la région et du domaine scientifique) et de l'équipe (en tenant compte du genre de programme, du type d'organisme, de la région et de la période). Les données reflètent donc avec précision la

population de chercheurs et le type d'équipes au sein des régions européennes, mais ne permettent pas de fournir des analyses ou des indicateurs à l'échelle transnationale. Les principales conclusions se basent par ailleurs sur une analyse contrefactuelle et une analyse statistique déductive afin d'améliorer la fiabilité et la spécificité des effets mesurés.

Les résultats finaux de l'évaluation ont été présentés à un groupe d'experts externes, qui les a validés, lors d'une table ronde organisée à Bruxelles en septembre 2014. L'étude d'évaluation, qui est la première de ce genre, met en avant l'impact de la participation à un PC sur la « capacité de recherche humaine ». Les conclusions et recommandations éclaireront et faciliteront la prise de décisions dans le cadre de la politique liée à la recherche et aux technologies, et plus particulièrement l'adaptation des programmes et instruments de recherche et d'innovation de la CE (tels que le programme Horizon 2020) afin d'en optimiser l'impact sur la capacité de recherche humaine pour l'avenir et ainsi contribuer à la réalisation des objectifs de l'EER et de la stratégie UE2020. L'étude d'évaluation a été menée d'octobre 2013 à octobre 2014.

0.2. Questions d'évaluation et principaux résultats

L'ensemble de l'évaluation repose sur **sept grandes questions d'évaluation**. Dans cette section, nous présentons les principales conclusions par question d'évaluation. La prochaine section (section 0.3) résume quant à elle les résultats et conclusions de l'étude au sens large, quels que soient la question ou le niveau d'analyse.

QE1 : Dans quelle mesure les participants au projet pensent-ils que le PC contribue à améliorer **leurs compétences et leur expertise** ? Les compétences et expertise considérées sont, entre autres, les suivantes : la gestion de projet, le réseautage à l'échelle internationale au sein de la communauté de recherche ou encore la capacité à travailler dans un contexte d'innovation ouvert (liens avec le secteur).

QE2 : Pouvons-nous identifier si la participation à un PC a un impact positif sur la **carrière** des participants ? Ce point peut être évalué de différentes manières selon le statut et la catégorie d'expertise :

c. En ce qui concerne les postes fixes/fonctions supérieures : effet de promotion / amélioration de la visibilité / renforcement des responsabilités au sein de l'organisme, etc.

d. En ce qui concerne les postes temporaires : le PC contribue-t-il à la création d'emplois, par exemple en transformant un contrat postdoctoral ou CDD en contrat à durée indéterminée au sein du même organisme ? Permet-il au personnel temporaire de se créer des contacts et, en fin de compte, de décrocher un poste fixe auprès d'un autre organisme/partenaire ?

QE3 : Le PC entraîne-t-il une augmentation du **rapport entre CDD et CDI** (c.-à-d. une augmentation relative des contrats de courte durée) ?

QE4 : Quel est l'impact des **pratiques de recrutement** ouvertes induites par le PC ?

QE5 : Quel est l'impact du PC sur les **équipes** de recherche (**taille et composition**) et sur l'organisation de l'**institut**, en ce compris la gestion des ressources humaines et financières, l'impact sur le programme de recherche stratégique (alignement sur les thèmes du PC ?) ou encore la capacité à attirer d'autres sources de financement (PC en tant que levier pour accéder à d'autres ressources) ?

QE6 : Dans quelle mesure le PC contribue-t-il à la circulation des cerveaux, en attirant des chercheurs venant d'un pays **extérieur à l'UE-27** ?

QE7 : Pouvons-nous identifier dans quelle mesure le PC contribue-t-il à la **création d'emplois** (directe : engagements liés à la mise en œuvre du projet – indirecte : au terme du projet) et identifier les moyens de chiffrer cette création d'emplois ?

QE1 : Effet positif de la participation à un PC sur les compétences et l'expertise

Les résultats de l'évaluation montrent que la participation à un PC exerce une influence clairement positive sur la formation et l'acquisition de compétences et d'une expertise individuelles. Les chercheurs participant à un PC améliorent la plupart de leurs compétences et aptitudes, même si cela dépend du niveau de carrière du chercheur concerné. Une proportion particulièrement élevée de répondants (entre 64% et 76%) associent à une période d'engagement dans le cadre d'un PC l'acquisition de compétences de réseautage, de leadership et de négociation ainsi que de compétences liées à l'utilisation des sciences dans le contexte d'initiatives politiques. Ces compétences sont dans le même temps considérées comme les plus pertinentes en matière d'évolution de carrière. Parallèlement, la participation à un PC contribue également à renforcer l'autonomie et l'indépendance des chercheurs. Entre 58% et 71% des participants à un PC ont pu, durant la période d'engagement dans le cadre d'un PC, réaliser pour la première fois leurs tâches sans supervision. À cet égard, les PC les aident à améliorer leur autonomie grâce à une plus grande responsabilisation et à un renforcement de leur estime d'eux-mêmes. Enfin, certains éléments indiquent également qu'une participation à un PC renforce la mobilité internationale des chercheurs impliqués à moyen voire long terme (39 % des participants indiquent un renforcement de la mobilité à long terme contre 26 % parmi les non-participants).

QE2 : Aucun effet sur la carrière à court terme, mais amélioration de l'autonomie et des compétences importantes pour l'évolution de carrière à long terme

Pourquoi les chercheurs participent-ils aux projets d'un PC ? Tout d'abord, pour des raisons de contenu, telles que l'attractivité et la pertinence de la recherche à réaliser. Ensuite, en raison de l'orientation internationale du programme, qui permet au chercheur de se faire connaître d'un public bien plus vaste. Toutefois, aucun indicateur ne laisse supposer que la participation à un PC est un « catalyseur de carrière » : elle n'accélère pas l'évolution de carrière. Alors que 45 % des chercheurs en début de carrière (R1) ayant participé à un projet dans le cadre d'un PC restent à leur niveau de carrière durant plus de 5 ans, cette situation ne s'applique qu'à 24 % des chercheurs n'y ayant jamais participé. En général, l'impact d'une participation à un PC sur l'évolution ou l'avancement de carrière est plutôt modéré à court terme. Toutefois, une participation à un PC entraîne l'acquisition de compétences importantes pour l'évolution de carrière ultérieure et d'une plus grande autonomie dans la réalisation des tâches, ce qui exerce une influence positive sur la carrière à plus long terme. Globalement, près de la moitié des chercheurs considèrent que leur participation à un PC a eu un effet positif sur leur carrière scientifique, tandis que près d'un quart s'attendent à ce que cette participation les aide à décrocher un nouveau poste dans le monde universitaire et 17 % dans un autre secteur.

QE3 : Recours légèrement plus important à des contrats à durée déterminée, mais aucun impact à long terme

Le rapport entre CDD et CDI est un indicateur connexe pertinent en ce qui concerne la sécurité d'emploi et les perspectives de carrière à plus long terme des chercheurs, même si ce n'est pas le seul. Le financement accompagnant un PC contribue à une légère évolution globale du rapport entre CDI (+ 20 %) et CDD (+ 27 %) et à un léger glissement global vers l'usage plus répandu des CDD au sein des équipes de recherche participantes. L'ampleur du changement rapporté en termes de types de contrats utilisés varie en fonction des différentes sortes de bénéficiaires du PC. Si le financement du PC contribue à un recours plus important aux CDD, aucun impact à long terme n'est toutefois observé au niveau de l'organisme. Outre cet élément lié à la sécurité de

l'emploi, la participation à un PC se traduit à long terme par une promotion officielle et par une amélioration des conditions de travail pour les chercheurs impliqués dans les activités d'un PC. À titre d'exemple, la proportion de contrats à durée indéterminée est plus élevée chez les participants au 6e et 7e PC que chez les non-participants (77 % contre 55 %).

QE4 : Effet structurant mixte sur les pratiques de recrutement et différent d'un organisme à l'autre

Les pratiques de recrutement ouvertes sont un pilier important parmi les objectifs de l'EER, mais aussi de la Charte européenne du chercheur et du Code de bonne conduite en matière de recrutement des chercheurs qui en découlent. Les PC ont un effet structurant mixte sur la gestion des ressources humaines au sein des organismes participants (environ deux tiers des équipes), avec une influence positive, mais limitée, sur l'équilibre hommes-femmes (46 % des bénéficiaires). Parallèlement, la participation à un PC contribue dans une certaine mesure à améliorer la transparence et la prise en compte du mérite dans le recrutement des chercheurs (30 % à 40 % des bénéficiaires), en particulier au sein de l'UE-12 et des pays technologiquement moins avancés. L'impact des PC sur la GRH est aussi différent d'un organisme participant à l'autre, avec une influence plus limitée sur les entreprises de recherche privées et les PME, qui doivent également se plier à moins de contraintes, telles que les principes du Code et de la Charte. Par ailleurs, il est démontré qu'une collaboration et un transfert de connaissances efficaces contribuent à la diffusion des bonnes pratiques en matière de gestion des ressources humaines.

QE5 : Impact significatif sur la taille et la composition (sexe, nationalité) des équipes, ainsi que sur son organisation et sa capacité à attirer de nouveaux financements (effet de levier)

La participation à un PC joue un rôle important sur la taille des équipes de recherche bénéficiaires, en particulier en augmentant le nombre de chercheurs employés de 1,3 par équipe (voir plus loin). Une grande partie (43 %) de ces chercheurs supplémentaires restent ensuite au sein des équipes de recherche bénéficiaires (durabilité). La participation à un PC a également un effet positif sur la composition des équipes de recherche bénéficiaires, principalement en augmentant la part de femmes et de chercheurs internationaux en leur sein. La participation aide les bénéficiaires à renforcer leur orientation stratégique vis-à-vis des priorités de l'UE (68 %). Enfin, les équipes bénéficient également d'un important effet de levier leur permettant de s'attirer de nouveaux financements, en particulier à l'échelle de l'UE (83 %, contre 72 % à l'échelle nationale/régionale).

QE6 : Effet positif sur la capacité d'attraction de coopérations hors UE-27, mais aucun effet à long terme

Il a été démontré que la participation à un PC aide les instituts d'enseignement supérieur à attirer des chercheurs non européens au sein de l'UE (8 % des chercheurs participants viennent de l'extérieur de l'UE), en particulier grâce aux programmes « Idées » et « Personnes », mais l'ampleur est limitée et l'effet n'est pas durable (ne dépassant souvent pas la durée du projet). De nombreux instituts non européens sont impliqués dans un PC (14 % des instituts participants), facilitant ainsi la circulation des cerveaux et le transfert des connaissances depuis l'extérieur de l'UE. Toutefois, l'impact réel sur la mobilité extraeuropéenne à plus long terme semble limité. Enfin, les PC contribuent à un niveau d'interconnectivité plus important entre les organismes de recherche et les chercheurs et entre différents sous-systèmes de l'économie et de la société.

QE7 : Création directe de 61 000 postes supplémentaires en recherche

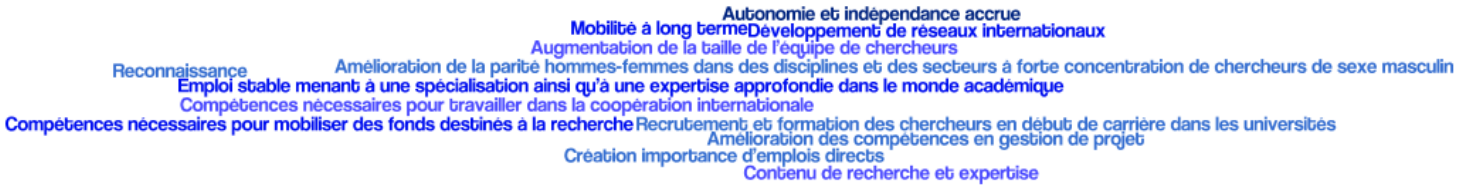
Cette évaluation montre qu'il est possible de mesurer les effets de la participation à un PC sur l'emploi. Il n'en reste pas moins que les résultats doivent être interprétés avec prudence en raison d'une série d'incertitudes. Les projets du 7e PC ont donné lieu à l'engagement de 142 000 chercheurs (en nombres réels et non en ETP) et à une création directe de nouveaux emplois estimée à au moins 61 000, dont une majorité peut être rattachée au programme « Coopération ». Parallèlement à cette création directe d'emplois, la création indirecte est significative, mais impossible à estimer dans le cadre de cette étude, dans la mesure où elle a lieu à l'issue du projet. Outre la création d'emplois en elle-même, un grand nombre d'éléments indiquent que les PC contribuent à maintenir le niveau d'emploi existant des chercheurs au sein de l'UE. Enfin, l'attractivité régionale et institutionnelle est positivement influencée par la participation à un PC. Cette participation entraîne une plus grande « reconnaissance » des chercheurs, instituts et régions.

0.3. Résultats et conclusions au sens large

L'étude sous-tendant l'évaluation a permis de recueillir de nombreuses données et informations intéressantes pour les décideurs politiques. En plus des éléments spécifiques ayant étayé la réponse aux questions d'évaluation, l'initiative a fourni plusieurs autres pistes de réflexion, que nous vous présentons ci-dessous.

✓*La participation à un PC génère plusieurs effets positifs liés au développement de la capacité de recherche humaine.*

L'illustration ci-dessous résume les principaux impacts positifs identifiés dans différentes parties de l'étude. Il est important de tenir compte de ces impacts et de continuer à les encourager et à les rechercher.



✓*Les possibilités d'internationalisation et la recherche de pointe sont les caractéristiques distinctives qui rendent les PC attrayants aux yeux des chercheurs.*

✓*L'internationalisation est l'impact le plus important aux niveaux de l'équipe et de l'individu.*

Les directeurs d'équipe estiment que la coopération internationale est une motivation importante à participer à un PC, en plus de la capacité à approfondir ou élargir les connaissances de l'équipe dans le domaine de recherche. Dans le même ordre d'idées, les chercheurs considèrent que les facteurs les plus importants sont la coopération internationale et le contenu sur lequel porte la recherche, lequel doit éveiller leur intérêt. Au niveau de l'équipe, la participation donne lieu à une plus grande reconnaissance et une plus grande attractivité au sein des universités ou des instituts d'enseignement supérieur. Cet effet de la coopération internationale se reflète également dans la grande proportion de chercheurs (près de 90 %) mentionnant l'expansion des réseaux internationaux parmi les effets importants de leur participation et dans le taux de mobilité

international à long terme, qui est plus important chez les participants à un PC (39 %) que chez les autres chercheurs. La mobilité internationale à court terme ne semble pas influencée.

✓*Le principal effet sur la carrière n'est pas un avancement ou une promotion officiels, mais une reconnaissance, une responsabilisation et une augmentation de l'autodépendance et de l'autonomie.*

La participation à un PC bénéficie d'une bonne reconnaissance dans le milieu de la recherche universitaire et mène à supposer que les chercheurs/chefs de projet participants disposent d'un réseau et de compétences organisationnelles importants. Aucune progression de carrière officielle n'est toutefois observée pendant la durée ou à l'issue immédiate de la participation au PC. L'impact intermédiaire est néanmoins considéré comme positif grâce à l'acquisition d'une reconnaissance et de compétences qui pourront s'avérer utiles ultérieurement, dans le cadre des prochaines recherches, de la création d'un réseau ou dans le cadre des démarches nécessaires à l'obtention de financements supplémentaires. En ce qui concerne les chercheurs plus avancés dans leur carrière, qui occupent déjà un poste stable, le financement à plus long terme fourni par le PC pour leur projet leur permet de constituer une équipe de recherche (temporaire ou fixe) et d'explorer en profondeur le thème de recherche du projet.

✓*L'impact d'une participation à un PC sur le développement de la capacité de recherche humaine est plus important lors d'une première participation et est facilité par une coopération fructueuse et par son intégration dans les objectifs de l'équipe.*

Lorsqu'une équipe ou un chercheur individuel participe pour la première fois à un PC, les impacts sont plus prononcés. Ce constat s'applique particulièrement à l'acquisition de compétences en matière de RH, d'administration et de gestion et aux effets du réseautage. Au niveau individuel également, un chercheur acquerra davantage de nouvelles compétences dans ces domaines au cours de sa première participation. À cet égard, cette observation s'applique directement aux effets engendrés pour les chercheurs en début de carrière. Au niveau de l'organisme, une première participation aura elle aussi l'effet le plus important sur le renforcement de l'orientation stratégique vis-à-vis des priorités européennes.

✓*Les partenaires universitaires et industriels adoptent une approche stratégique et opérationnelle différente en ce qui concerne la constitution de l'équipe et la durabilité de l'emploi.*

Le monde universitaire et le secteur industriel ont chacun leurs propres objectifs, motivations à demander un financement dans le cadre d'un PC et attentes en termes de résultats. Au sein des entités universitaires, le principal effet sur l'emploi est le recrutement et la formation de jeunes chercheurs et la stabilité offerte aux chercheurs plus expérimentés déjà en poste. Dans l'industrie, le travail lié au projet du PC est de préférence effectué par les effectifs existants. Lorsque

des chercheurs sont engagés pour prendre part à un tel projet, ils conservent généralement leur poste au terme du projet.

✓*Les indicateurs font état d'un meilleur équilibre hommes-femmes au sein des équipes participant à un PC.*

Les chercheuses sont bien représentées dans les projets d'un PC, en particulier quand on compare la situation à celle de l'ensemble de leurs pairs, et ce, même dans les disciplines ou secteurs traditionnellement plus masculins. Dans l'industrie, les femmes sont moins nombreuses à être engagées que dans les universités/IES (36 % contre 46 %). En termes de postes et de responsabilités, les chercheuses endossent (un peu) moins souvent le rôle de chef de projet (20 % contre 26 %). Les chercheuses se voient aussi moins souvent réaliser des tâches de manière autonome que leurs homologues masculins (52% des chercheuses sont supervisées contre 44 % pour les chercheurs)

✓*Les programmes spécifiques suivent chacun un schéma différent en termes de constitution d'équipe et de durabilité de l'emploi.*

En ce qui concerne l'engagement de nouveaux chercheurs (création d'emploi), les programmes spécifiques « Idées » et « Personnes » suscitent le recrutement d'un plus grand nombre de chercheurs pour le projet, mais ces derniers sont moins nombreux à rester en poste à son terme. Dans le cadre des programmes spécifiques « Coopération » et « Capacités », la création directe d'emploi est plus limitée, mais se poursuit plus souvent à moyen voire long terme. En termes d'internationalisation, les programmes « Idées » et « Personnes » engagent là encore un nombre plus important de chercheurs non européens par rapport aux programmes « Coopération » et « Capacités », mais les participants aux projets du programme « Idées » considèrent la mobilité et la coopération internationales comme moins importantes que leurs homologues recrutés pour d'autres types de projets.

0.4. Recommandations spécifiques

R1.Envisager l'introduction d'un label certifiant la participation à un PC afin d'en refléter l'importance et d'en montrer l'impact sur les compétences et le plan de carrière des chercheurs

La participation à un PC a un effet positif sur différents aspects de la carrière d'un chercheur. Toutefois, les candidats doctorants laissent entendre que les compétences acquises en matière d'organisation, de réseautage et de gestion ne sont pas aussi reconnues que les réalisations scientifiques classiques (telles que les publications). Il conviendrait dès lors de faire en sorte que la participation à un PC soit reconnue par les employeurs actuels et ultérieurs. Une possibilité serait de lancer un label certifiant la participation à un PC afin d'en refléter l'importance et d'en montrer l'impact sur les compétences et le plan de carrière potentiel des chercheurs.

R2. Soutenir et imposer aux bénéficiaires l'introduction de programmes de formation officiels

La formation en vue de l'acquisition de compétences et d'une évolution de carrière est extrêmement importante pour les chercheurs, dans la mesure où elle peut augmenter leur employabilité tant au sein du monde universitaire qu'en dehors. Une attention spécifique devrait être accordée aux compétences « commerciales » et « entrepreneuriales » sur lesquelles les PC ont actuellement un effet moins marqué. La facilitation des échanges et le partage des bonnes pratiques sont un bon début, mais ils doivent être accompagnés d'exigences claires pour les bénéficiaires, tout en laissant suffisamment de place à la flexibilité au moment de la mise en œuvre.

R3. Informer les chercheurs et encourager les bénéficiaires à proposer des informations structurées sur les différents cheminements professionnels potentiels pour les chercheurs

Des mesures devraient être prises pour faire connaître les options de carrière « alternatives » et les prérequis correspondants en matière d'aptitudes et compétences, ainsi que le rôle potentiel de la participation à un projet de type PC dans cette optique. Ce point est important à la fois pour les chercheurs en début de carrière et pour ceux plus expérimentés. Les chercheurs ont besoin d'un soutien et des moyens nécessaires pour définir un plan d'évolution de carrière clair (comparable à celui imposé dans le cadre du programme Marie Sklodowska-Curie). Par ailleurs, les bénéficiaires tels que les employeurs devraient également être impliqués.

R4. Continuer de promouvoir l'équilibre hommes-femmes par l'intermédiaire de programmes de travail et de conventions de subvention

Si l'équilibre hommes-femmes s'améliore au sein des équipes de recherche, où les chercheuses sont traditionnellement moins représentées, il convient d'aller encore plus loin dans ce sens. Il est fortement recommandé de continuer à promouvoir l'équilibre hommes-femmes dans la mise en œuvre du programme Horizon 2020, grâce à la création d'une plus grande conscience de cette dimension et de son intégration dans les programmes de travail et les conventions de subvention (en passant par l'établissement d'objectifs spécifiques et leur suivi). Une attention particulière devrait être accordée aux disciplines que sont l'ingénierie, l'enseignement et les sciences.

R5. Continuer de soutenir l'application de la Charte et du Code à divers niveaux grâce à différents instruments

La Commission européenne devrait continuer à soutenir la mise en œuvre de la Charte et du Code par l'intermédiaire de divers instruments (tels que la Stratégie de gestion des ressources humaines en recherche ou la section réservée aux emplois sur le portail EURAXESS) et attendre de tous les participants subventionnés, et tout particulièrement des universités et IES, qu'ils appliquent ces principes et directives. À titre d'exemple, la convention de subvention type (Model Grant Agreement) dans le cadre du programme H2020, qui établit une obligation en la matière pour les participants, permet d'assurer un suivi fiable et d'intervenir si nécessaire.

R6. Coopérer avec les États membres pour lever toutes les barrières juridiques empêchant la pleine application de la Charte et du Code

Afin d'optimiser l'impact du financement européen sur les pratiques de recrutement ouvert et les autres pratiques en matière de RH dans le contexte de l'Espace européen de la recherche, la Commission européenne devrait travailler en étroite coopération avec les États membres afin de mieux faire correspondre leur législation et leurs normes avec les principes de la Charte et du Code (tel qu'également souligné dans le rapport d'avancement 2014 de l'EER). Pour ce faire, les obstacles juridiques à l'application d'un recrutement ouvert, transparent et basé sur le mérite pour les chercheurs ainsi que les obstacles à la mise en place d'un cadre habilitant pour la mise en œuvre de la Stratégie de gestion des ressources humaines en recherche doivent être levés.

R7. Continuer de soutenir la participation de l'industrie, et en particulier des PME, dans le cadre d'H2020 et des programmes à venir

Le taux de rétention de personnel (c.-à-d. la part de chercheurs engagés pour un projet spécifique du PC qui restent en poste à l'issue du projet) au sein des entreprises et PME du secteur privé est plus élevé que celui du secteur des IES. Afin de contribuer à augmenter le recours aux CDI et d'optimiser l'impact durable du financement des PC sur la taille des équipes, la Commission européenne devrait continuer à soutenir le volet s'adressant à l'industrie en encourageant la participation des PME au programme Horizon 2020 et en renforçant le leadership industriel en matière de recherche et d'innovation.

R8. Diffuser largement les résultats de cette étude auprès de l'ensemble des parties prenantes pertinentes

Les informations sont précieuses. L'étude sous-jacente fournit des indications fiables et systématiques sur l'impact du financement des PC sur la capacité de recherche européenne. Elle aborde aussi les manquements et les conditions nécessaires pour optimiser cet impact. La diffusion des résultats de l'étude à grande échelle (à l'intention du « grand public », p. ex. via Euraxess, mais aussi par l'intermédiaire de la communauté de décideurs politiques, notamment via l'ERAC) fournit une excellente occasion de relancer les discussions en cours à propos des carrières et des conditions de travail dans le domaine de la recherche.

R9. Assurer un suivi et une évaluation stricte, et intervenir si nécessaire

La Commission européenne devrait continuer de suivre et d'évaluer les changements, p. ex. en ce qui concerne l'équilibre entre CDD et CDI au sein des équipes qui participent activement à un projet financé par l'UE, comme l'une des indications possibles de la durabilité et de la stabilité des conditions d'emploi. À cet égard, il convient non seulement de tenir compte de la situation contractuelle, mais aussi du cadre plus vaste dans lequel les chercheurs opèrent et, en particulier, de la relation entre le chercheur et l'employeur. Ces aspects devraient être suivis de plus près et être mieux reflétés dans les rapports d'évaluation intermédiaire et final du projet.

0.5. Recommandations concernant le suivi ultérieur

Le suivi de l'impact du PC sur la capacité de recherche humaine devrait s'organiser à deux niveaux.

Le premier porte sur l'application des conditions requises pour optimiser l'impact d'H2020 et d'autres programmes financés par l'UE sur la capacité de recherche humaine. À l'échelle institutionnelle, cela revient à suivre les progrès liés à l'application de la Charte et du Code, à la lumière de la mise en œuvre de la stratégie de GRH en recherche. Par ailleurs, les institutions et les États membres suivent déjà ce point (p. ex. par l'intermédiaire de l'EEM : **mécanisme de suivi de l'EER**), ce qui devrait favoriser les synergies. Dans la mesure où la convention de subvention type du programme H2020 impose l'obligation aux bénéficiaires de tout mettre en œuvre pour appliquer la Charte européenne du chercheur et le Code de bonne conduite en matière de recrutement des chercheurs, un suivi ciblé de leur respect est possible et recommandé.

Le second niveau porte sur le suivi fréquent des effets/impacts du financement H2020 sur les dimensions spécifiques de la capacité de recherche humaine. Pour ce faire, plusieurs mesures sont nécessaires.

La première et la plus importante consiste à **harmoniser les concepts et les définitions**. Plusieurs études ad hoc s'intéressent à la question des carrières, des conditions de travail et de l'acquisition des compétences dans le domaine de la recherche (telles que les études MORE, le Rapport sur la situation des chercheurs et le projet sur les carrières des titulaires de doctorats coordonné par l'OCDE). Le plus urgent consiste à **faire correspondre les concepts et les définitions** afin de disposer d'un socle commun qui permette la comparaison et l'intégration de données.

Ensuite, il conviendra de **mettre en place des synergies avec les initiatives de collecte de données existantes ou à mettre sur pied**. Si de nouvelles études relatives aux chercheurs venaient à être lancées dans un avenir proche, il serait essentiel de veiller à la coordination entre les différents sous-niveaux décisionnels relatifs aux chercheurs.

Troisièmement, il conviendrait d'envisager la mise en place d'un **système paneuropéen intégré pour le suivi des carrières qui serait dérivé de la participation à un PC**. La création d'un tel système serait en effet plus sensée que le ciblage de différents groupes de chercheurs au fil du temps. Le suivi de carrière consisterait à mettre en place des initiatives qui s'intéresseraient à la carrière des chercheurs sur une période de temps donnée afin de comprendre leur plan de carrière.

Enfin, il convient de faire la **distinction entre ce qu'il est « nécessaire » et ce qu'il est « utile » de savoir**. Indépendamment de la manière dont les informations sélectionnées seront recueillies, il est important de distinguer les indicateurs primaires et secondaires. Sur la base du travail réalisé dans cette étude, une série d'indicateurs clés sont proposés dans la version complète du rapport afin de permettre ce suivi.

1. Introduction

This draft final report aims to give a full overview of the results of the data collection, analysis and synthesis. It provides a description of the implementation of the survey and interviews, of the collected data and calculated indicators, and a draft set of conclusions and recommendations.

The draft report be used as the basis for the next steps of the project: the US-EU comparison note; the round table with an external and international panel of experts, based on this additional information; and the finalisation of conclusions and recommendations for the final report.

As background to the analysis and findings, the remainder of this introductory section gives a brief overview of the policy context and objectives of the study, as well as its concrete scope and methodological approach.

1.1. Policy context

1.1.1. The realisation of the European Research Area

Where this project aims to find out more about the impact of FP participation on the development of human research capacity, this type of impact has not been the focus of previous studies and has been only partially or indirectly measured before. However, building human research capacity is recognised as a cornerstone for achieving the high-level EU goals of realising a knowledge economy to foster sustainable growth, jobs, competitiveness and welfare in Europe.

With the **EU2020 Strategy** overarching all EU objectives and actions, attention has shifted specifically to building strong human capital in Europe. The underlying vision is to turn Europe's socio-economic development in a direction that can deliver high levels of employment, productivity and social cohesion.

A cornerstone to achieve this is the creation of a **European Research Area (ERA)**, an internal market for research where researchers, technology and knowledge circulate freely, effective European level co-ordination of national and regional research activities, programmes and policies and initiatives are implemented and funded at European level. ERA aims for a single labour market with attractive working conditions for both men and women and seeks to abolish financial or administrative obstacles to trans-national mobility. Moreover, the full opening of academic research positions and national research programmes across Europe, with a strong drive to recruit researchers internationally, and easy movement between disciplines and between the public and private sectors, should also become a reality.

In this respect, the **Innovation Union Flagship**, one of the seven flagships announced in the Europe 2020 Strategy[1][2], called to complete the ERA by 2014 and develop supporting measures to remove obstacles to mobility and cross-border co-operation[3].

[1] European Commission, "EUROPE 2020 A strategy for smart, sustainable and inclusive growth", Brussels, 3.3.2010, COM(2010); adopted by the European Council in European Council Conclusions 17 June 2010

[2] European Commission, "EUROPE 2020 A strategy for smart, sustainable and inclusive growth", Brussels, 3.3.2010, COM(2010).

[3] Endorsed by the European Council meeting of 4 February 2011: European Council 4 February 2011 Conclusions, Brussels, 8 March 2011, http://www.consilium.europa.eu/uedocs/cms_data/docs/pressdata/en/ec/119175.pdf.

The EC Communication of July 17, 2012 proposes the new ERA framework which broadly outlines the strategy necessary in order to realise the ERA by 2014. The **ERA priorities** that are brought forward focus on:

- More effective national research systems;
- Optimal transnational cooperation and competition (common research agendas, Europe-wide open competition and infrastructure for key research);
- An open labour market for researchers (removal of barriers to research mobility, training and attractive careers);
- Gender equality and gender mainstreaming in research; and
- Optimal circulation, access to and transfer of scientific knowledge including through digital means.

The European Commission has indicated that the **Framework Programmes** are one of the principal instruments at EU level necessary to turn the ERA into a reality, together with the Marie Curie Action; the adoption and implementation of the European Charter for Researchers, and the Code of Conduct for the Recruitment of Researchers; the 'scientific visa' package; and the integrated European Researcher Partnership.

1.1.2. The Framework Programmes and Horizon 2020

The Framework Programmes are the main instrument for providing research funding in Europe and the key pillar for supporting the creation of the ERA in line with the EU2020 strategy and are implemented through the Innovation Union Flagship Initiative. The Framework Programmes serve two main strategic objectives: strengthening the scientific and technological basis of industry and encouraging its international competitiveness while promoting research activities in support of other EU policies.

The Framework Programmes have been implemented since 1984, each covering a period of five years. The 6th and particularly the 7th Framework programme are the focus of this study. The 6th Framework Programme was operational from January 1, 2003, and followed by the 7th Framework Programme which, for the first time, ran for seven years instead of five (2007-2013). It is followed by 'Horizon 2020' which will run until 2020.

The **Sixth Framework Programme**[4] was implemented in the aftermath of the Lisbon Summit in March 2000 and in the context of making a "better use of European research efforts through the creation of an internal market for science and technology - a 'European Research Area' (ERA)". In contrast to previous FPs that were divided into several 'vertical' Programmes around research topics and 'horizontal' Programmes that cut across research areas, FP6 contained just two specific Programmes. While the first Programme aimed at integrating and strengthening the ERA, the second Programme sought to structure the ERA.

FP6 provided a number of traditional instruments that were similar to the instruments implemented in FP5, namely Specific Targeted Research, Specific Support Actions and Coordination Actions. Additionally, two new instruments were implemented as a response to identified needs within the research community of EU: Integrated Projects and Networks of Excellence.

Like FP6, the **Seventh Framework Programme** (FP7)[5] continued to be a key pillar for the European Research Area (ERA). The emphasis of FP7 is on **research themes** rather than instruments and in this, FP7 shows strong elements of continuity with FP6. The

4 http://cordis.europa.eu/fp6/sitemap.htm

5 http://cordis.europa.eu/fp7/home_en.html

themes corresponded to major fields in the progress of knowledge and technology, where research was to be supported and strengthened to address diverse European challenges. Still, the central aim was to create sustainable development.

FP7 was built on four objectives and corresponding **specific programmes**: Cooperation, Ideas, People and Capacities. These programmes worked together to stimulate the construction of European poles of (scientific) excellence.

- The **Cooperation** Programme aimed to stimulate transnational cooperation between universities, industry, research centres and public authorities. The goal was to gain and consolidate leadership in key research areas. The programme covered distinct research themes (cf. infra) that were operationally autonomous but complementary in terms of implementation.
- The **Ideas** Programme intended to develop research excellence by promoting competition and risk-taking. To this end, the Commission established the new European Research Council (ERC) to support the most innovative research projects. Within this new structure, an independent Scientific Council identifies priorities and scientific strategies. Still, the ERC supports investigator-driven projects rather than being led by political priorities to ensure that resources are invested into new areas of research. Communicating research results was at the centre of this programme.
- Since an important competitive advantage in science and technology is the quantity and quality of its human resources, the **People** Programme was dedicated to human resources in research. It sought to improve the career prospects of researchers in Europe and attract more high-quality early stage researchers. The aim was to realise researchers' full potential by encouraging training and mobility. In this way, the programme strengthened the "Marie Curie" actions, which have been offering mobility and training opportunities to European researchers for several years.
- The **Capacities** Programme aimed to provide researchers with tools that enable them to improve the quality and competitiveness of European research. It involved investments in research infrastructure in the less successful regions, in the creation of regional research-driven clusters and in research for the benefit of SMEs.

Following the Euratom Treaty, the European Commission continued to support civil nuclear research through a separate FP7 (2007-2011). FP7 Euratom was organised around two specific programmes corresponding to the *indirect actions* on fusion energy research and nuclear fission and radiation protection, and the *direct research activities* by the Joint Research Centre (JRC).

The overall **budget** for FP7 is € 50.5 billion for the period 2007-2013. This represents a substantial increase compared with FP6 (63% at 2007 prices), a reflection of the high priority given to research in Europe. FP7 allocates € 32.413 billion to the Cooperation programme, € 7.513 billion to the Ideas programme, € 4.75 billion to the People programme, € 4.097 billion to the Capacities programme and € 1.751 billion to the JRC. For nuclear research and training activities carried out under the EURATOM treaty 2751 million were foreseen for 2007-2011.

Following FP6 and FP7, the Eighth Framework Programme was initiated in 2014 and called "**Horizon 2020**". The focus now shifts towards a market-driven approach where valorisation of research and knowledge transfer is crucial. Societal challenges will be tackled by helping to bridge the gap between research and the market, by supporting the creation of partnerships with the private sector and stimulating international cooperation.

1.2. Objectives

The present study aims to assess the contribution of the Framework Programmes to the development of human research capacity.

The **key objectives** indicated in the Terms of Reference for this study are two-fold:

1. To provide detailed and robust assessment of the contribution of the FP to the development of human research capacity;
2. To lay the basis for future work related to analysing the impact of FP on the skills, expertise and career paths of participants.

In order to do so, four **operational objectives** are identified:

1. To assess existing available evidence on the contribution of the Framework Programme to the development of human research capacity;
2. To collect new data and information through the design and implementation of a sampling approach for the surveys, interviews, and case studies;
3. To analyse the collected information and draw policy-relevant conclusions; and
4. To translate the results into a basis for future monitoring and analysis purposes.

The results of the study should allow the European Commission to further understand the socio-economic impacts, effectiveness and efficiency of the Framework Programmes (in particular FP7) with respect to intangible assets such as skills and expertise of researchers - and to support the design of new programmes.

These objectives of the proposed study are translated into 7 **key evaluation questions** in the Terms of Reference:

1. To what extent do the project participants think that the FP has contributed to increasing their skills and expertise? May include project management, international networking within the research community, and ability to work in an open innovation context (links with industry).
2. Can we identify whether the participation in FP projects has had a positive impact on the careers of project participants? This may be evaluated through different categories depending on the status and category of expertise, for instance:
   a. Senior/permanent positions: promotion effect/ increased visibility/increased responsibility within their organisation, etc...
   b. Temporary positions: has the FP led to job creation, for example transforming a post-doc or a short-term contract into a permanent position within the same organisation? Has it enabled the temporary staff to get connections and eventually a permanent position in another organisation/partner?
3. Has the FP led to an increase in the ratio fixed-term/open-ended contracts (i.e. a relative increase of short-term contracts)?
4. What is the impact of openness of recruitment practices induced by FP?
5. What is the impact of FP on research teams (their composition and size) and on the organisation, including management of financial and human resources, impact on the institution's strategic research agenda (alignment with FP topics?), ability to attract other types of funding (FP as leverage to access to other funding sources), etc.?

6. To what extent has the FP contributed to brain circulation, by attracting researchers from outside EU27[6]?
7. Can we identify to what extent the FP has contributed to job creation (direct: recruitments to carry out the project and indirect: after the completion of the project), and possibly measure it?

In the development of the conceptual framework, we further elaborate on these evaluation questions (cf. chapter 2).

1.3. Scope

The scope of the study was initiated in the proposal and further refined during the kick-off meeting with the Client. In sum, from the perspective of the impact of FP6/FP7 on human research capacity, we focus on the following aspects:

- Relevant outputs, immediate and intermediate outcomes of FP6 and FP7;
- A three level approach to investigate the role of FP in the development of human research capacity: at the individual, team and systemic level;
- In the individual survey:
  - Focus on researchers in HEIs;
  - In 27 EU countries + Norway and Switzerland;
- In the team level survey:
  - Teams in FP7 and FP6 participating institutions in EU27, in the FP7 eCORDA database;
  - Including non-academic actors;
- In the case studies:
  - Projects in FP6/FP7, focusing on non-academic applicants;
  - Mainly selected from the capacities and cooperation programmes (or equivalent in FP6);
  - Including non-academic actors.

For each of the applied methodologies, the scope is further elaborated in the detailed sections in Annex 1.

For further reference during the analysis, we highlight a number of aspects that determine the scope and interpretation of the results (elaborated in section 1.4 of Annex 1):

- The samples for team and individual level survey are constructed in order to collect **representative data** in the pre-defined strata. When taking these strata into account in weighting, we obtain representative information for the population. However, careful interpretation is advised. For example, the geographical dimension is reflected in the regions, but within one stratum/region, the countries are not necessarily represented in a fully proportionate manner. For example, in the individual level data small countries seem overrepresented compared to larger countries in the EU15 region. Conclusions should therefore be focused on the regional level, rather than the national level. **The data do not allow for detailed cross-country analysis.** A similar observation is made in the team level survey with respect to overrepresentation of the private organisations (including SMEs) within the stratum.
- In the individual level survey, **analysis** both **at the level of the researcher and at the level of the employment episodes** (cf. curricula approach) are possible

[6] We limit the scope to EU27 instead of EU28, to reflect the relevant basis at the time of implementation of FP6 and FP7.

and will be presented in the analysis section. Attention is paid to the distinction where relevant.

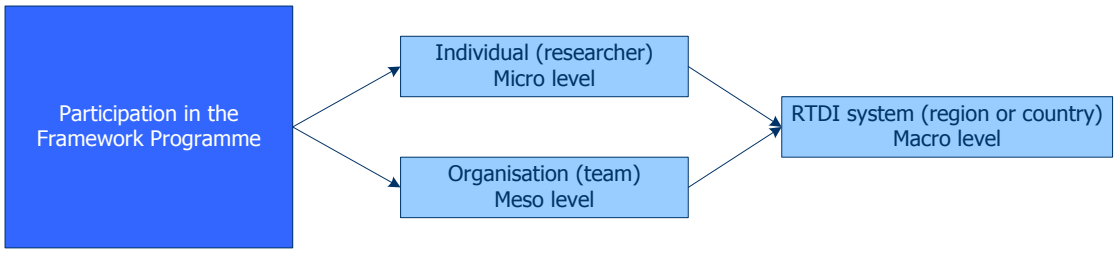
- As indicated in the sections on sampling and implementation of the surveys in Annex 1, it was not possible to calculate one single weight for the different dimensions of the stratification. The main reason for this was the materialisation of ex post changes to the frame based on survey information, due to incorrect information in the original frame extracted from the eCORDA database. The ex post changes lead to situations where more responses are collected per stratum than the estimated population; which does not allow for calculation of weights on these strata separately. Therefore, the research team - in cooperation with the European Commission - has selected **one standard weighting approach** for each survey. The **individual level survey** information presented in the chapter 3, is thus interpreted as **representative for the population in terms of fields of science and region**; the **team level survey in terms of organisation type and region**. The other dimensions are systematically analysed as sub-indicators.

1.4. Approach

1.4.1. Multi-level and multi-dimensional definitions of human research capacity

Our study-approach builds on two main concepts and several methodological starting points. The first concept is the **multi-level approach** on which we base all data collection and analysis on 3 levels: the individual, team-level and systemic levels (as depicted in *Figure 1*). All three levels are acknowledged important levels for research capacity building in the literature. E.g. the team level is an important level for knowledge creation in the organisation literature[7]. The levels of impacts are interrelated and there are spill-overs between them, which is important to take into account in the data collection strategy and also in the subsequent analysis.

Figure 1: Overview of types of impact of FP participation (different levels)



Source: The authors.

The multiple levels are reflected in all steps of the study, and determine in particular the perspective we take on human research capacity. The '**definition' of human research capacity** is considered a multidimensional concept: it integrates the three levels as well as a multiplicity of dimensions concerning both quality and quantity of human research capacity. This is further elaborated in the description of the conceptual framework, in section 2.1.

[7] According to Cooke, J. (2005), "A framework to evaluate research capacity building in health care", BMC Family Practice, 6(44). www.biomedcentral.com/1471-2296/6/44

1.4.2. Methodological approach based on the 'intervention logic'

Our methodological approach that corresponds with these multilevel and multidimensional concepts has 4 key features:

1. Intervention logic is the basis for the evaluation and is defined on each of the 3 levels and for the different dimensions of human research capacity (cf. section 2.2).
2. We build on existing methods such as IMPAFEL[8], designed in 1999, based on the Marie Curie Actions, that measure career progression as consisting of employment success, employment location, job profile and level of responsibility. Since its inception, the methodology sought a balance between commercial and social impacts in order to capture all scientific fields and types of organisations. It was updated in subsequent impact assessments of FP4 to FP7 and the recent Marie Curie host-driven actions interim evaluation. The last update added focus on organisation and system-level impact, mechanisms of impact and standard scales used in social sciences to allow for benchmarking.
3. We build on existing typologies of skills, expertise and careers, notably the work that has been carried out in the context of the MORE1 and MORE2 studies[9] (both led by IDEA Consult) and on the typology of transferable skills developed by the OECD[10] and the typology of career stages developed by LERU and taken up by the European Commission[11].
4. There are three methods of data collection, each targeting specific levels and dimensions. After completion of the evaluation frame based on the intervention logic, the IMPAFEL inspired methodology and the existing typologies, the necessary evidence was collected through desk research, surveys and case studies. Thus, multiple sources of data will add important depth and perspective to the findings. Even though each data collection method takes into account spillovers and opportunities of all 3 levels, they each target one of the levels more specifically.

1.4.3. Work plan

The study approach was structured in a work plan in four phases, as presented in

Figure 2. After the kick-off phase, the definition of the approach was refined through discussion with the EC at the kick-off meeting, desk research and exploratory interviews. The refined approach was then implemented and the data were collected in surveys and cases studies. The collected information was subsequently processed, analysed, synthesised and reported in the draft final report. This draft report will be discussed at a round table where the conclusions of the study are discussed and/or validated. The discussion will allow us to further refine and complete the final report.

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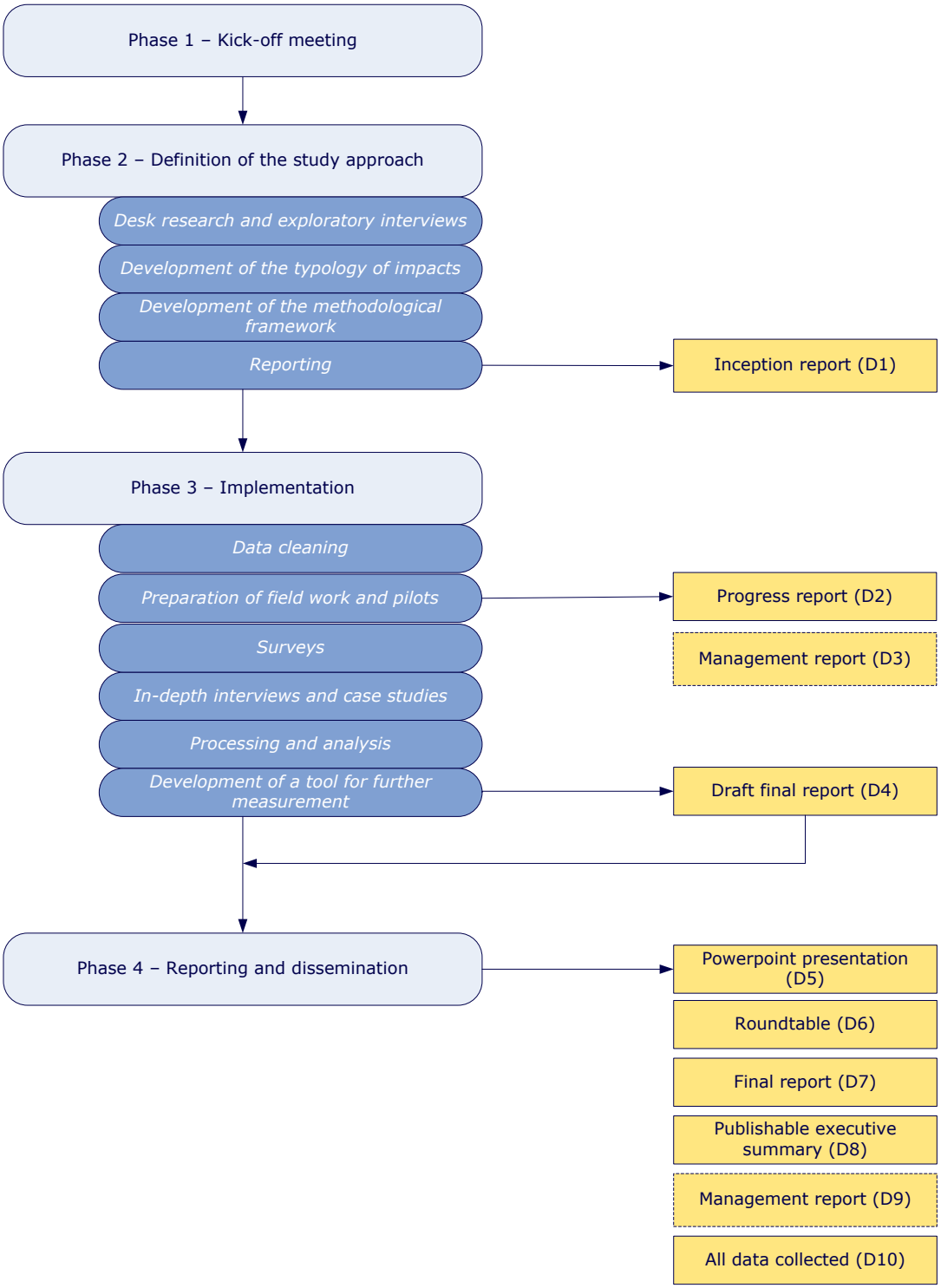
[8] European Commission, DG Research, *A Methodology for Assessing the Impact of the Marie Curie Fellowships. Volume Three: Annexes*, 1999.

[9] MORE study final report: http://ec.europa.eu/euraxess/pdf/research_policies/MORE_final_report_final_version.pdf
MORE2 study final report: http://ec.europa.eu/euraxess/pdf/research_policies/more2/Final%20report.pdf

[10] OECD (2012), *Transferable Skills Training for Researchers: Supporting Career Development and Research*, OECD Publishing, see p. 20.

[11] European Commission (2011), Towards a European Framework for Research Careers. Brussels, p.2.

Figure 2: Detailed approach and deliverables



Source: The authors.

1.5. Guide to the reader

After this introductory chapter, the guidelines are set for the remainder of the report:

Chapter two summarises the results of the conceptual framework development. It describes the definition of human research capacity, the intervention logic from the perspective of human research capacity and the link with the evaluation questions and translation of all concepts into indicators.

In **Chapter three**, we analyse in detail the data collected from three sources (desk research, surveys and case studies). We structure the analysis according to the seven main evaluation questions and according to the respective sources of information.

Chapter four triangulates and synthesises the outcomes of the analysis across the different sources to formulate an answer to each of the seven evaluation questions.

In **Chapter five** we present conclusions and reflections that are drawn across levels and across evaluation questions and that will lead, together with the direct answers to the evaluation questions, to evidence-based recommendations in **Chapter six**. The recommendations are formulated at different levels: the implementation and design of EU funding programmes, the broader and relevant EU R&D and innovation framework conditions and the future monitoring of impact of FPs on human research capacity.

In the Annexes to this report, we provide more detail on the practical implementation phase (**Annex 1**). We describe the data collection process through the various information channels and give an overview of the collected data and its possibilities in terms of analysis. **Annex 2** presents the survey questionnaires, and **Annex 3** the resulting data.

In **Annex 4** reports in detail on the methodology of the counterfactual analysis.

Annex 5 gives an overview of all references made to previous studies and articles.

Annex 6 is the management report on the final stages of the study.

Finally, **Annex 7 and 8** present respectively the essay comparing the EU and US perspectives, which served as input to the round table discussion, and the summarised findings from this meeting of experts.

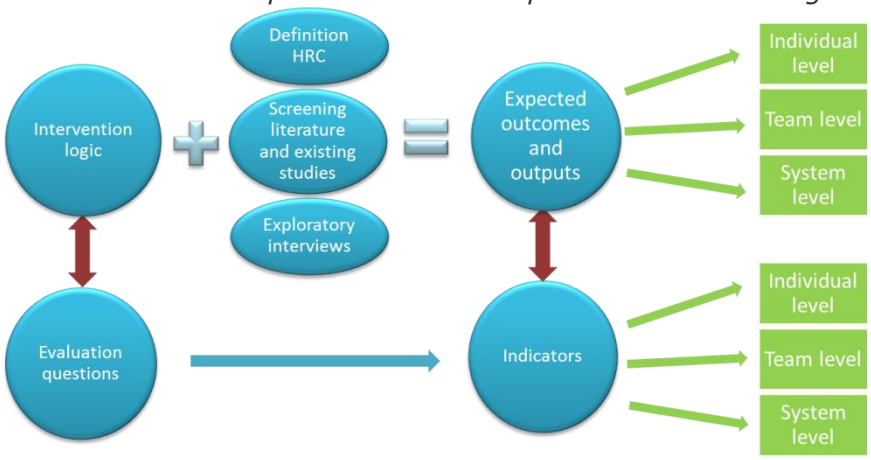
2. Conceptual Framework: Evaluation methods and questions

The conceptual framework is built as follows. First, an intervention logic from the human research capacity (HRC) perspective is developed, based on the objectives of the FP6 and FP7 that relate to HRC. Together with the results of the desk research on the definition of HRC and the potential impacts and the results of the exploratory interviews, a list of expected outcomes and outputs is derived at each level of analysis.

In a parallel process, the evaluation questions of the Terms of Reference are structured and detailed, in line with the intervention logic on HRC. Based on this process, indicators are defined that reflect the expected outcomes and outputs and correspond to the data needed to answer the detailed evaluation questions. Indicators are also defined at each level of analysis.

The process is summarised in Figure 3.

Figure 3: Process of the development of the conceptual and methodological framework



Source: The authors.

In the following sections, we describe the outcomes of this process in terms of definition of HRC, intervention logic and the resulting evaluation questions and indicators framework.

2.1. Definition of Human Research Capacity

As indicated in section 1.4.1, our approach is built on a multi-level perspective. Therefore, the definition of human research capacity should also reflect this. The definition on which all further methods and analysis build, was based on the multiplicity of dimensions mentioned in the Terms of Reference at each of the defined levels. The different levels are furthermore interrelated. The definition was completed through desk research.

At the system and organisation level, research capacity relates to both quantity and quality of research. It refers to the increasing need for greater numbers of researchers to enhance the knowledge based economy of Europe and its competitiveness, as well as the excellence of research and the creation of cutting-edge knowledge to tackle the most

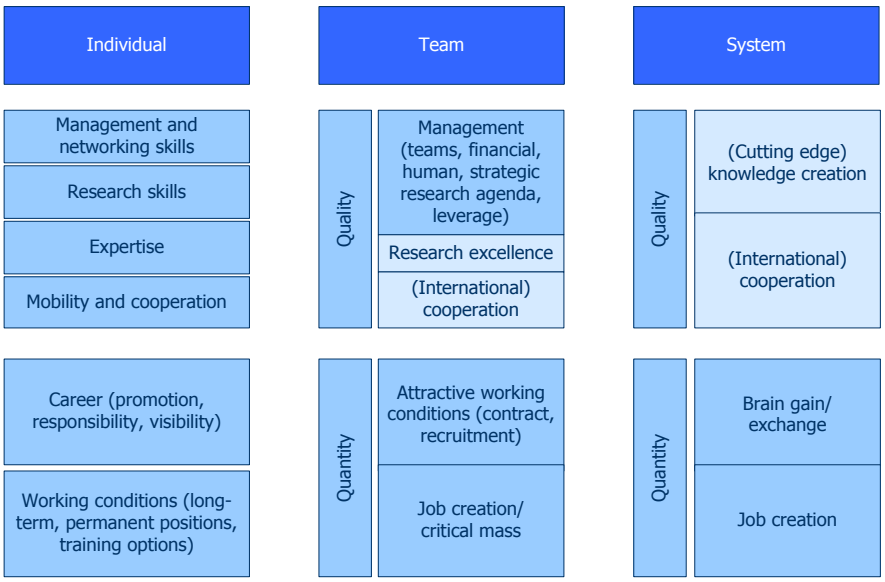
important societal challenges ahead. Excellence in research and the policy context of the research profession in turn determine the attractiveness of the research environment to incentivise non-EU researchers to work in the EU or EU researchers to return to the EU after their stay abroad (brain gain, brain exchange[12]).

At the level of the researchers, human research capacity refers to skills and competences, as well as to the international and inter-sectoral mobility and collaboration of the researchers.

A similar approach is taken in Cooke (2005), based on Trostle (1992)[13] who describes research capacity building as a "process of individual and institutional development which leads to higher levels of skills and greater ability to perform useful research". In his Debate Article, Cooke goes onto argue that research capacity building in the health care sector refers to development of skills, confidence, linkages and partnerships, research close to practice in health, appropriate dissemination and infrastructure and sustainability and continuity. It is also recognised that effects take place at the individual, team, organisation and supra-organisation level. Monitoring research capacity building is therefore said to include both process and outcome measures.

The final definition as used throughout this project is represented in Figure 4. The darker boxes are explicitly covered in the 7 key evaluation questions, the lighter boxes only implicitly. The boxes are interrelated between and within the levels. For example, individual expertise development is related to the creation of knowledge and excellence at team and systemic level. Within the individual level, skills development is related to career path, cooperation and leveraging effects to obtain other funding.

Figure 4: Definition of human research capacity at 3 levels of analysis



Source: The authors.

[12] A narrow definition of brain gain will be applied in this study, in compliance with the definition in the Terms of Reference and introduced in Evaluation Question 6. Although other aspects such as the exchange of knowledge and international cooperation are taken into account, the definition of brain gain as attracting non-EU researchers to Europe will prevail in the analysis.

[13] Cooke, J. (2005), "A framework to evaluate research capacity building in health care", BMC Family Practice, 6(44). www.biomedcentral.com/1471-2296/6/44.
Trostle, J. (1992), "Research Capacity building and international health: Definitions, evaluations and strategies for success.", *Social Science and Medicine*, 35(11):1321-1324.

2.2. Intervention logic

In order to define the outcomes that can be expected from FP participation, we started from the formal objectives of the FP7 and its specific programmes to build an intervention logic from the perspective of human research capacity building.

FP7 aims to strengthen Europe's scientific and technological base and to support its international competitiveness and EU policies through research cooperation among Member States, with international partners. It aims to contribute to the creation of a European labour market for researchers (ERA).

To this end, four specific programmes are established, each with a specific focus, as outlined in Section 1.1.2. The following table provides an overview.

Table 1: Long-term strategic objectives of FP7 and the Specific Programmes

Long-term strategic objectives of FP7	
FP-level	**Strengthening Europe's scientific and technological base ERA - European Labour market for researchers (wide use and dissemination of knowledge generated by publicly funded research activity)**
Cooperation	• cooperation in thematic areas corresponding to major fields of the progress of knowledge and technology (European social, economic, environmental, public health and industrial challenges that serve the public good and support developing countries)
Capacities	• strengthening of human potential in research and technology • optimising the use and development of research infrastructures • strengthening innovative capacities of SMEs and ability to benefit from research • development of regional research-driven clusters • unlocking research potential in the Union's convergence and outmost regions • better education and training • science-society dialogue
People	• attractiveness of the profession • recognition of the profession • easier access to research opportunities • presence of women in research • researchers' career development • structure research training offer and options
Ideas	• research at the frontier of knowledge • excellence in research
FP-level	**Supporting its international competitiveness and the EU policies, through research cooperation among Member States and with international partners.**
Cooperation	• transnational cooperation at every scale across Europe
Capacities	• coherent development of research policies at national and Community level • horizontal actions and measures in support of international cooperation
People	• researchers' mobility • encourage intersectoral mobility • (international) attractiveness of the research profession in Europe • attractiveness for the 'best' researchers (mobility and career development for the transfer of knowledge between countries and sectors and for ensuring that innovative frontier research in various disciplines benefits from dedicated and competent researchers, as well as financial resources)
Ideas	• raising the profile of European research at international level

Source: Decision No 1982/2006/EC of the European Parliament and of the Council of 18 December 2006

The intervention logic behind FP7 was built from these objectives[14]. For the specific purposes of this study, we took the perspective of human research capacity. The resulting intervention logic is thus not to be interpreted as general and exhaustive in listing expected effects of FP7, but identifies the effects that are expected in terms of building skills, knowledge, research capacity and critical research mass.

To develop this specific intervention logic, we started from the official definition of the specific programmes and overall strategic objectives of FP7[15], as illustrated in the previous table. In order to develop the individual- and organisation-level intervention logics, we removed the thematic content of the various FPs and their lines of objectives and restated them in terms of human research capacity (expected) outputs (concrete and short term), immediate outcomes (short to medium term) and intermediate outcomes (medium to long term).

For each output or outcome, we also indicated the level at which it is expected to have an important effect: individual (I), team (T) or systemic (S) level. This classification allowed us in a next step to link the outputs and outcomes to the key evaluation questions of each level in order to define a balanced and complete set of indicators to answer the evaluation questions. This completed the conceptual development and allowed for the concrete implementation in the different data collection methods in a structured and logical way.

Even though the lines of objectives are presented in a linear manner in the intervention logic, we are aware that many non-linear effects and mechanisms have an influence. This was taken into account in the next steps when elaborating on the evaluation questions, and in the analysis and interpretation of the results.

Intervention logic at FP-level (Table 2)[16] is illustrated in the table below.

[14] The intervention logic was built as an explicit theory of how a set of interventions contributes to a set of specific outcomes through programme activities/outputs and the corresponding mechanisms of influence. This theory-based ("theory of change") approach has been used to explain why, how and under what conditions certain outcomes can be reasonably attributed to the framework programmes.

[15] Decision No 1982/2006/EC of the European Parliament and of the Council of 18 December 2006 concerning the Seventh Framework Programme of the European Community for research, technological development and demonstration activities (2007-2013).

[16] The detailed table at Specific Programme level was also presented in the Inception Report.

Table 2: Intervention logic of FP7 in the perspective of Human Research Capacity

Strategic objectives of the 7th Framework Programme per sub-programme		**Outputs**	**Immediate outcomes (short, mid-term)**	**Intermediate outcomes (mid, long term)**
FP-level	Strengthening Europe's scientific and technological base (Wide use and dissemination of knowledge generated by publicly funded research activity) ERA - European Labour market for researchers Supporting its international competitiveness and the EU policies, through research cooperation among Member States and with international partners.	• Employment of researchers (I,T): ○ Creation of additional research positions ○ Increase in long term/permanent positions/contracts	• Increased number of research positions: critical mass (T,S) • Sustainable positions and career prospects (I,T,S) • Positive changes in recruitment practice (T) • Improved working conditions (I,S)	• Critical mass in research (T,S) • Structural/long-term growth of research "stock" in Europe (S) • Increase in the attractiveness of the research profession and ERA as a destination for researchers (I,S) • Sustainability of knowledge and skills due to continuity in research (I,S)
		• Training and supervision activities (I,T) • New and / or advanced research tools, techniques, models, infrastructure and equipment (I,T)	• New/strengthened research and transferable skills and competencies (including industry-relevant skills) (I)	• Strengthened methodological skills (I,S) • Enhanced employability of researchers (I,S)
		• Research output (I): ○ Development of new cutting-edge knowledge ○ Publications (including study results and reports), highly cited papers ○ Patents or trademarks ○ Conference/workshop papers & proceedings ○ PhDs and other, various formal and non-formal qualifications	• Enhanced body of knowledge (S) • Enhanced visibility and reputation among industry, research and user communities (I,T,S)	• Research excellence (I,T,S) • Enhanced capability to explore new subfields/areas for research (I,S)
		• Mobility of researchers (I,T): ○ to other sectors, ○ fields, ○ institutions and ○ countries • Research collaboration (I,T): ○ Research visits (outgoing and incoming) ○ Co-authored papers ○ Completed international/interdisciplinary research projects ○ Exchange of expertise	• Knowledge exchange, dissemination and outreach (I,T,S) • Higher levels of international mobility (I,T) • New, international and interdisciplinary networks of researchers (I,T, S) • Increased intersectoral and international cooperation (I,T) • Brain circulation (S)	• Sustainable long-term and useful research contacts and networks and enhanced networking capability (I,T,S) • Broad dissemination of knowledge generated by publicly funded research activities (S)
		• Acquiring skills and capability to attract of (third party) funding e.g. individual fellowships / grants but also projects (I,T)	• Enhanced capability to attract additional funding or join other research projects (I,T)	• Leveraging effect to enhance sustainable funding (T,S)

Source: The Authors, based on Decision No 1982/2006/EC of the European Parliament and of the Council of 18 December 2006 and desk research

In this study, **impacts** are defined as the extent to which FPs contributed to the observed changes in researchers' behaviour (especially **outcomes**). To establish links and causalities between FP support and the observed outcomes (i.e. to establish whether **impacts** have occurred), we compare the outcomes of FP participants and non-participants based on **counterfactual design** (applied at the individual level of analysis), as well as test possible links between independent and dependent variables based on **inferential statistics** (individual and research team levels). We were able to attribute many of the outcomes and immediate impacts to participation in FP. In addition, **qualitative methods** (case studies and interviews, to be adopted for all levels of analysis) did not only enhance our understanding of the context and process of human resource capacity, but also produced some evidence on what factors cause this phenomenon and what important contextual factors or **mechanisms of influence** contribute to FP interventions and outcomes (e.g. the development of human resource management practices in the organisation/positive impacts on transparency of the rules and responsibilities for researchers in the participating organisations[17]; the development of research infrastructures that are used for research and development, as well as training of researchers in the organisations involved in FPs[18]; the development and strengthening of transnational, interdisciplinary and inter-sectorial R&D networks, thereby facilitating transfer of knowledge and technology[19;20]; leverage and diversification of R&D funding[21]; influence on research agenda and priorities of the organisations involved[22]). During the qualitative data collection, attention was paid to these mechanisms of influence and the specific attribution to FPs.

2.3. Key evaluation questions and indicators

Finally, the intervention logic was applied in the further development of the evaluation framework, namely in the translation of the defined evaluation questions from the Terms of Reference into sub-questions and indicators. The data collection methods used to find the necessary information and answer each of the questions is also represented in the table below.

This table completed the evaluation framework and fed into the development of the survey and case study questionnaires and into final analysis of the data.

[17] Emilia Primeri and Emanuela Reale, "How Europe Shapes Academic Research: insights from participation in European Union Framework Programmes", *European Journal of Education*, Vol. 47, No. 1, 2012.
[18] Rambøll Management-Matrix-Eureval Consortium, "Community Support for Research Infrastructures in the Sixth Framework Programme: Evaluation of pertinence and impact", 2009.
[19] European Commission, "Assessing the Social and Environmental Impacts of European Research", Report to the European Commission, 2005.
[20] EPEC, "Understanding the Long Term Impact of the Framework Programme", Final Report, 5 December 2011.
[21] Min-Wei Lin and Barry Bozeman, "Researchers' Industry Experience and Productivity in University–Industry Research Centers: A ''Scientific and Technical Human Capital'' Explanation", *Journal of Technology Transfer*, 31, 269–290, 2006.
[22] Min-Wei Lin and Barry Bozeman, "Researchers' Industry Experience and Productivity in University–Industry Research Centers: A ''Scientific and Technical Human Capital'' Explanation", *Journal of Technology Transfer*, 31, 269–290, 2006.

ISSUE/EVALUATION QUESTION	INDICATOR(S)	ANALYTICAL METHODS
1. To what extent the project participants think that the FP has contributed to increasing their skills and expertise? May include project management, international networking within the research community, and ability to work in an open innovation context (links with industry).		
▪ To what extent do the project participants think that the FP has contributed to their overall level of skills and expertise? ▪ To what extent have FP researchers progressed in their career, compared to their non-FP peers? ▪ Have the FP-induced recruitment practices motivated researchers to start or resume a research career, carry out research in Europe or move between sectors?	- Share of researchers who indicate that their current level of skills is attributable to their participation in FP; - Self-estimates on the levels of skills and expertise of FP and non-FP researchers in comparable positions; - All researchers: starting or resuming a research career, moving between sectors; - Third country researchers: carrying out research in Europe.	- Survey of individual researchers - Desk research
▪ To what extent has the expertise of FP researchers impacted their societal prominence and reputation?	▪ Conference participation experience before and after FP; ▪ Contacts with the media before and after FP.	▪ Survey of individual researchers
▪ To what extent has the expertise of FP researchers been commercialised?	▪ Attracting other sources of funding; ▪ Developing patents, spin-offs and new products.	▪ Survey of individual FP and non-FP researchers
2. Can we identify whether the participation in FP projects has had a positive impact on the careers of project participants?		
Researchers who stayed in the same organisation after FP: ▪ Do the researchers believe that, as a consequence of participation in FP, the rules and responsibilities for researchers and their employers have become more transparent? ▪ Have the researchers received a promotion as a consequence of FP? ▪ Have the researchers received more visibility and responsibility within the organisation? ▪ If they had a fellowship or a short-term contract, was it transformed into a permanent position?	▪ Share of FP researchers who report a promotion; ▪ Share of FP researchers who report more visibility and responsibility; ▪ Share of FP researchers in a short-term position who received a permanent position in the same organisation; ▪ Average number of short-term positions preceding the first permanent position for FP and non-FP researchers who had their short-term contract transformed into a permanent one within the organisation.	▪ Survey of individual researchers ▪ Case studies

ISSUE/EVALUATION QUESTION	INDICATOR(S)	ANALYTICAL METHODS
Researchers who moved to another organisation after FP: ▪ Did the researchers move into an organisation within the same network? ▪ Did the researchers move into a position with more responsibility? ▪ Did the researchers move into a position with better contractual conditions? ▪ If the FP position was temporary, how many temporary positions it took to gain a permanent position? ▪ Has the move between organisations entailed an intersectoral move?	▪ Share of FP researchers who moved to another organisation within the same network; ▪ Share of FP researchers who moved into a position with more responsibility; ▪ Share of FP researchers who moved into a position with better contractual conditions; ▪ Average number of short-term positions preceding the first permanent position for FP and non-FP researchers who were offered a permanent position in a new organisation after their last short-term position; ▪ Share of FP and non-FP researchers who moved between sectors.	▪ Survey of individual researchers ▪ Case studies ▪ Interviews ▪ Desk research
▪ Which external factors influenced the impact in this area (regional differences, the size of the team, typical profiles of researchers in the area, etc.)?	▪ Prevalence of external factors as identified in academic literature and earlier evaluations.	▪ Desk research
▪ To what extent attractive contractual conditions were among the motivating factors to participate in FP?	▪ Share of FP researchers who list attractive contractual conditions among the motivators to participate; ▪ Alternative funding mechanisms that non-FP researchers use to fund their research.	▪ Survey of individual researchers
How has FP participation impacted on equal access to research careers of the participating researchers? ▪ Have the individual participants experienced any barriers to their research career before their participation in FP? ▪ In their experience, did their participation in FP change the prevalence of these barriers?	▪ Prevalence of specific barriers (e.g. difficulties in combining a research career with parenthood) among researchers; ▪ Attached importance to these barriers; ▪ Attribution of influence of the participation in FP to the overcoming of these barriers	▪ Surveys ▪ Desk research ▪ Case studies

ISSUE/EVALUATION QUESTION	INDICATOR(S)	ANALYTICAL METHODS
3. Has the FP led to an increase in the ratio fixed-term/open-ended contracts (i.e. a relative increase of short-term contracts)?		
▪ How has participation in FP projects changed the share of researchers on fixed-term/open ended contracts in the participating organisations? What other factors might have influenced the observed changes?	▪ Comparison with other funding mechanisms; ▪ Number of fixed-term and open-ended contracts in participating and non-participating research teams, and the effects that FP funding/other factors had on this ratio	▪ Survey of participating research teams ▪ Desk research ▪ Case studies
4. What is the impact of openness of recruitment practices induced by FP?		
▪ Do participating researchers believe that, as a consequence of participation in FP, the rules and responsibilities for researchers and their employers have become more transparent? ▪ Is there evidence of spill-overs within the networks or into research and innovation policies at the regional or national level?	▪ Evidence of recruitment practices becoming more closely aligned to the principles of the Charter and Code in the participating research teams/organisations ▪ Qualitative insights from interviewees about the changes in transparency ▪ Evidence of spill-over effects within networks; ▪ Evidence of spill-overs into the system level.	▪ Survey of participating research teams ▪ Desk research ▪ Case studies
▪ Has the profile of recruited researchers changed (taking into account gender, age and geographical region)? If so, how? If not, why?	▪ Change in the gender balance/age structure/diversity of nationalities in participating research teams;	▪ Survey of participating research teams ▪ Case studies
5. What is the impact of FP on research teams (their composition and size) and on the organisation, including management of financial and human resources, impact on the institution's strategic research agenda (alignment with FP topics?), ability to attract other types of funding (FP as leverage to access to other funding sources), etc.?		
▪ What is the impact of FP on research teams in terms of their composition and size?	▪ Evidence of structural/long-term growth of number of researchers in participating research teams (including additionally hired researchers from outside of the participating organisations & researchers additionally attracted to the participating research teams from other departments/divisions of the same organisation). ▪ Evidence of research teams becoming more gender balanced, international, interdisciplinary and involving a wider variety of researchers from different sectors/types of organisations	▪ Survey ▪ Desk research ▪ Case studies ▪ Interviews

ISSUE/EVALUATION QUESTION	INDICATOR(S)	ANALYTICAL METHODS
▪ What is the impact of FP on management of financial and human resources?	▪ Evidence of peer learning and sharing of good practice between FP beneficiary organisations with respect to management of financial and human resources ▪ Share of research teams/organisational entities that better aligned their HR policies with top European standards, including the European Code and Charter for Researchers ▪ Share of research teams/organisational entities that improved management of financial resources, including procedural routines, research budgeting, control procedures and compliance with planning, reporting and monitoring requirements. ▪ Evidence of FP projects contributing to the establishment/further strengthening of clearly defined administrative units that ensure effective administration of research projects	▪ Survey ▪ Desk research ▪ Case studies ▪ Interviews
▪ What is the impact of FP on the participating institutions' strategic research agenda?	▪ Evidence of FP projects bringing other areas of research teams'/organisations' research (i.e. other than FP projects themselves) closer to the thematic areas and research topics of FP (& evidence of the results of FP projects being used in other strands of research undertaken by the organisation) ▪ Evidence of research teams/organisational entities that established regular and long-term R&D activities in areas closely related to FP themes and research topics ▪ Evidence of research teams/organisational entities entering into a new enabling technology that was in line with FP priorities	▪ Survey ▪ Case studies ▪ Interviews

ISSUE/EVALUATION QUESTION	INDICATOR(S)	ANALYTICAL METHODS
▪ What is the impact of FP on research teams and on the organisation in terms of ability to attract additional funding?	▪ Evidence of high complementarity between FP and national/regional funding and the resulting strong leverage affects ▪ Evidence of FP funding and the success achieved stimulating private R&D investment (i.e. use of own funds and investments from private R&D funding schemes).	▪ Survey ▪ Case studies ▪ Interviews
▪ What is the impact of FP on the participating institutions' strategic research agenda?	▪ Evidence of FP projects bringing other areas of research teams'/organisations' research (i.e. other than FP projects themselves) closer to the thematic areas and research topics of FP (& evidence of the results of FP projects being used in other strands of research undertaken by the organisation) ▪ Evidence of research teams/organisational entities that established regular and long-term R&D activities in areas closely related to FP themes and research topics ▪ Evidence of research teams/organisational entities entering into a new enabling technology that was in line with FP priorities	▪ Survey ▪ Case studies ▪ Interviews

ISSUE/EVALUATION QUESTION	INDICATOR(S)	ANALYTICAL METHODS
6. To what extent has the FP contributed to brain circulation, by attracting researchers from outside EU27?		
▪ What is the impact of FP on the attractiveness of the EU27 as research environment for non-EU27 researchers? ▪ What is the impact of FP on the transfer of knowledge across regions?	▪ Share of non-EU27 researchers that currently work in the EU27 thanks to FP projects directly ▪ Share of non-EU27 researchers that currently work in the EU27 for reasons indirectly related to FP projects (attractiveness of the institute, of the region, working conditions, leverage effect) ▪ Share on non-EU27 researchers in organisations in relation to the level of FP funding awarded to the organisation ▪ Number of non-EU27 organisations participating in FP projects ▪ Share of EU27 researchers that have returned to the EU27 thanks to FP projects directly ▪ Share of EU27 researchers that have returned to the EU27 for reasons indirectly related to FP projects (attractiveness of the institute, of the region, working conditions, leverage effect) ▪ Share of FP funded projects with international (extra-EU27) collaboration ▪ Share of researchers/organisations that find it easier to attract non-EU27 researchers thanks to FP projects ▪ Share of EU27 researchers that were internationally mobile thanks to FP funding (split up per destination and origin region) ▪ Share of EU27 researchers that were intersectorally mobile thanks to FP funding (split up per destination and origin region) ▪ Aggregation of the perception of effects on networking and exchange of knowledge	▪ Desk research ▪ Interviews ▪ Surveys

ISSUE/EVALUATION QUESTION	INDICATOR(S)	ANALYTICAL METHODS
7. Can we identify to what extent the FP has contributed to job creation (direct: recruitments to carry out the project and indirect: after the completion of the project), and possibly measure it?		
▪ What is the impact of FP on the overall researchers stock in Europe? ▪ What is the impact of FP of the overall level of education (degree of qualification) in Europe? ▪ Does the FP increase the attractiveness of the region? ▪ How is job creation distributed across sectors?	▪ How many researchers have been employed additionally on the FP projects? o In total o On average per project o Per sector ▪ How many researchers have been employed additionally on the FP project and have stayed employed after the project? o In total o On average per project o Per sector ▪ How many researchers have been employed indirectly thanks to an FP project? o In academia (without funding; with other funding sources) o In other sectors ▪ How many researchers have completed their PhD or other academic qualification stages thanks to an FP project? o In academia (without funding; with other funding sources) o In other sectors *Attractiveness will be measured through several of the indicators in other evaluation questions, and in particular under EQ2:* ▪ *Share of FP researchers who list attractive contractual conditions among the motivators to participate;* ▪ *Alternative funding mechanisms that non-FP researchers use to fund their research.*	▪ Desk research ▪ Interviews ▪ Surveys

3. Analysis and results

3.1. Evaluation Question 1: Contribution to individual skills and expertise

Evaluation Question 1 addresses the perceived contribution of FP funding on outputs on the individual level that are linked to the participants' skills and expertise. In order to answer this question we primarily draw on evidence gathered from the survey of individual researchers (see Annex 1 section 1.2.1) as well as the case studies (see Annex 1 section 1.1) carried out.

In the survey, researchers were asked to describe their employment history and to specify the characteristics of different 'employment episodes'.[23] More precisely, for each of the completed (or ongoing) career stages[24], the respondents itemised the different employers (including self-employment) along with the length of employment, the type of contract or position, the type of funding (e.g. FP or institutional funding) or the tasks fulfilled. This exercise allows locating the effects and conditions of FP projects on a researcher's personal and career development.

In addition, we are able not only to compare FP participants with non-FP participants but also to assess possible differences between employment episodes of different kind (e.g. with or without FP project involvement).

Apart from the survey carried out in the context of this study we also draw upon evidence gathered in a study focussing on individuals who successfully applied for ERC starting grants and who are subject to a monitoring regarding the implementation of the respective ERC funding program. Thus, the evidence regarding perceived contributions of this particular line of funding was provided by the MERCI study (Monitoring European Research Council's Implementation of Excellence), which is carried out by iFQ on behalf of the ERC.

3.1.1. Evidence from the individual level survey

Respondents to the individual level survey were asked to assess the extent to which their FP involvement had contributed to their overall level of skills and expertise. More specifically, we asked them to assess during which employment episodes they received the strongest training with regard to a set of defined skills. Employment episodes are further differentiated according to the career stage of the respondent.

[23] Following approaches used in labour market studies, we define "employment episode" as the period in which a respondent in a certain career stage has continuously worked for a certain employer (in this case a research organisation or firm). For instance:

- Huininka, Johannes, Sergi Vidala and Stefanie Kleyb (2014). Border crossings: Research training, knowledge dissemination and the transformation of academic work. *Higher Education*, 49(1-2), 119-13.
- Oberschachtsiek, Dirk and Patrycja Scioch (2011). The outcome of coaching and training for self-employment: A statistical evaluation of non-financial support schemes for unemployment business founders in Germany. *IAB discussion paper*, 16/2011.

[24] In so doing, we refer to the typology outlined and defined in the European Commission Communication (2011) "Towards a European Framework for Research Careers" (access via http://ec.europa.eu/euraxess/pdf/research_policies/Towards_a_European_Framework_for_Research_Careers_final.pdf). The typology differentiates between four types of career stages:

- "R1 First Stage Researcher",
- "R2 Recognised Researcher",
- "R3 Established Researcher",
- "R4 Leading Researcher".

In order to measure the degree of skills acquisition, we refer to the typology of skills developed by a study of the European Science Foundation (ESF) which defines basic transferable skills as capacities "learned in one context (for example research) that are useful in another (for example future employment, whether in research, business etc.)".[25]

As mentioned above (and see Annex 1 section 1.2.1.5), we distinguish between different employment periods in which the respondents either received FP funding or not. This perspective allows us to assess the effects of FP involvement more thoroughly.

Type of activities: *FP participants spend more time on administrative tasks than researchers working on other types of projects.*

To begin, we look at the type of activities the respondents carried out in the different types of employment episodes (either involving or not involving FP engagement). Unsurprisingly, the vast majority of employment episodes contain **research tasks**. In employment periods related to FP activities this share is slightly higher. Almost all (95%) such episodes entail research activities compared to 90% of non-FP related episodes (see Figure 5).

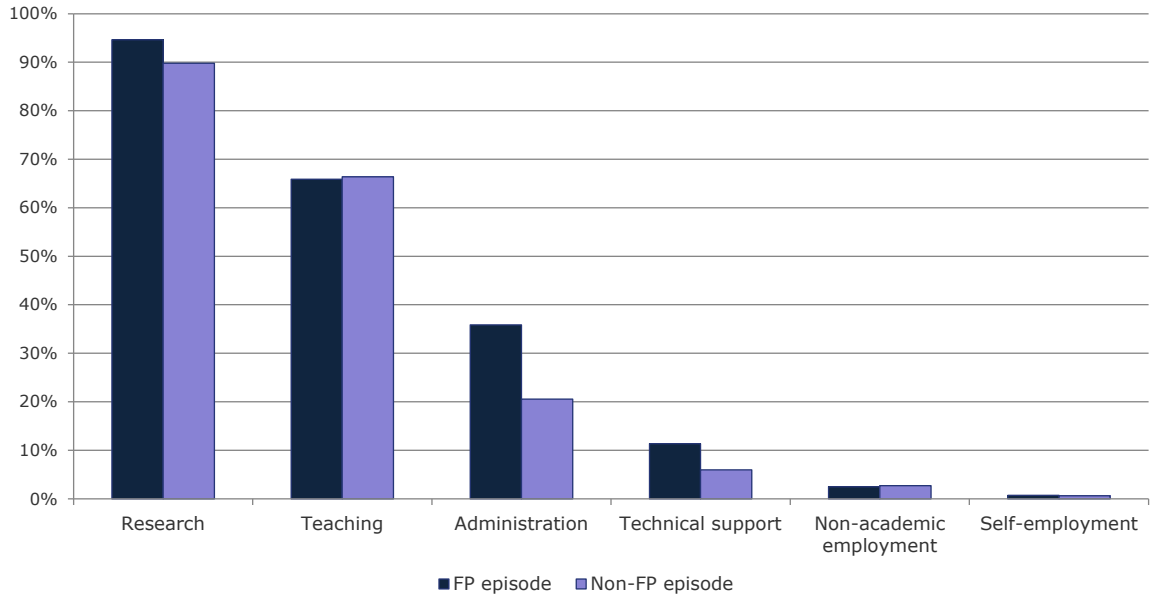
In addition, most of the episodes also contain **teaching obligations**, with almost no difference between FP and non-FP episodes. This differs with respect to the share of episodes that involve administrative tasks. Here, FP episodes seem to be more heavily loaded with **administrative obligations**. Further inferential testing indicates that this difference between the two types of employment episodes is indeed statistically significant.[26]

This finding corresponds to the result that a high share of respondents was faced with administrative-related tasks without supervision (such as e.g. project management and planning) for the first time in employment episodes with FP project involvement (see also below Figure 11) and the positive effects FP involvement had on developing these skills (see below Figure 6).

[25] ESF (European Science Foundation) (2010). *Research Careers in Europe: Landscape and Horizons*, A Report by the ESF Member Organisation Forum on Research Careers, ESF, Strasbourg, see p. 47.

[26] The Pearson's chi-squared test yields a value of 153.42 (p = 0.000 and df = 2), a finding that is further corroborated by the Fisher's exact test.

Figure 5: Share of employment episodes involving types of activities as specified (n=14,799)



Source: Analysis of the individual level survey data.
N: 14,799 total employment episodes, of which 1,137 FP episodes, 12,688 non-FP episodes, and 974 unspecified episodes.

Perception of skills acquisition: *FP projects go together with strong skills training*

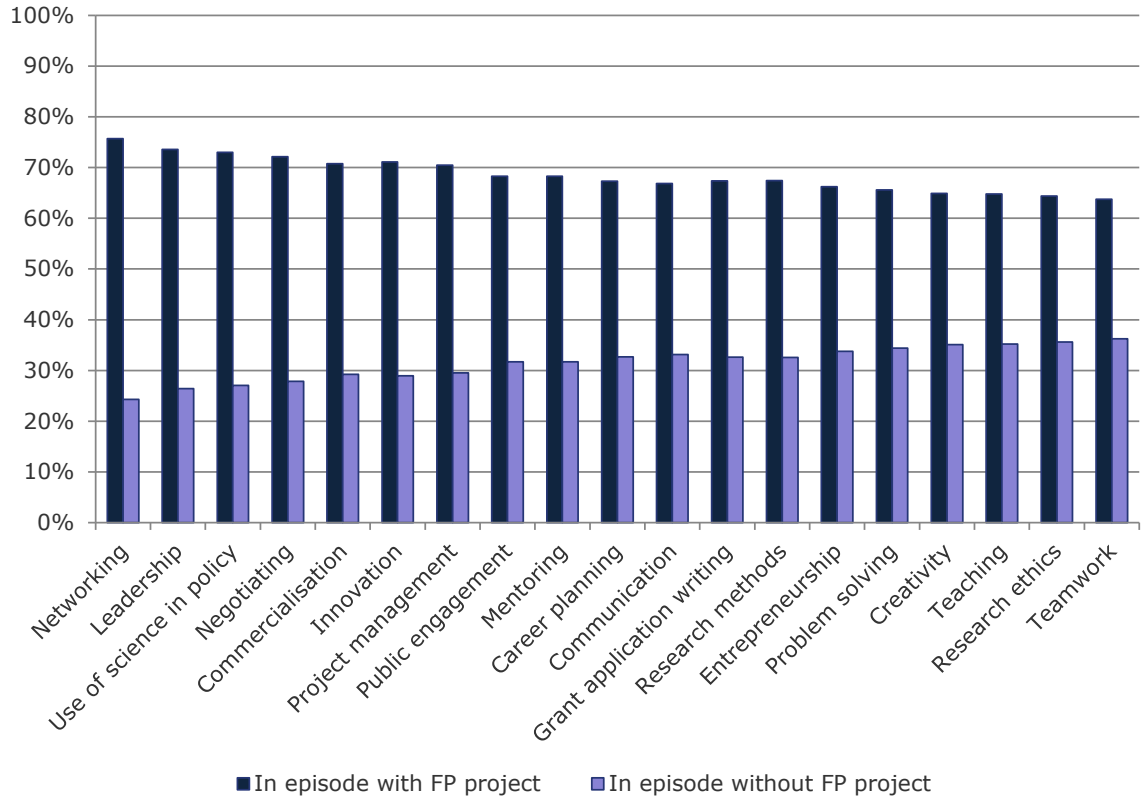
As for the perceived acquisition of skills and capacities (or the outcome of FP projects for the individual researcher) the reported differences between FP and non-FP employment periods are more striking. Respondents were asked to name the employment episode in which they received the strongest training in different research-related tasks. Evidence from the case studies suggests that skills are not only acquired through formal training but rather developed through on-the job-training.

From this perspective, the observed differences between FP and non-FP employment episodes are even more remarkable with the majority of FP participants stating that they received their **strongest training** with regard to all mentioned skills **in employment episodes that involved FP projects** (see Figure 6).

The share of respondents who assign the development of **networking** (76%), **leadership** (74%) and **negotiation** (72%) skills as well as skills regarding the use of **science in policy related contexts** (73%) to FP-related employment episodes is particularly high. In this context, training of all skills figures predominantly in the respondents' first FP project (with values ranging between 59 to 71%).[27]

[27] FP participants report that "entrepreneurial" skills were trained specifically during the first FP episode in 59% of the cases. This is true for 71% of the respondents as regards "communication" skills.

Figure 6: Assessment of during what kind of employment episode – with or without FP funding - training received with regard to various skills was strongest

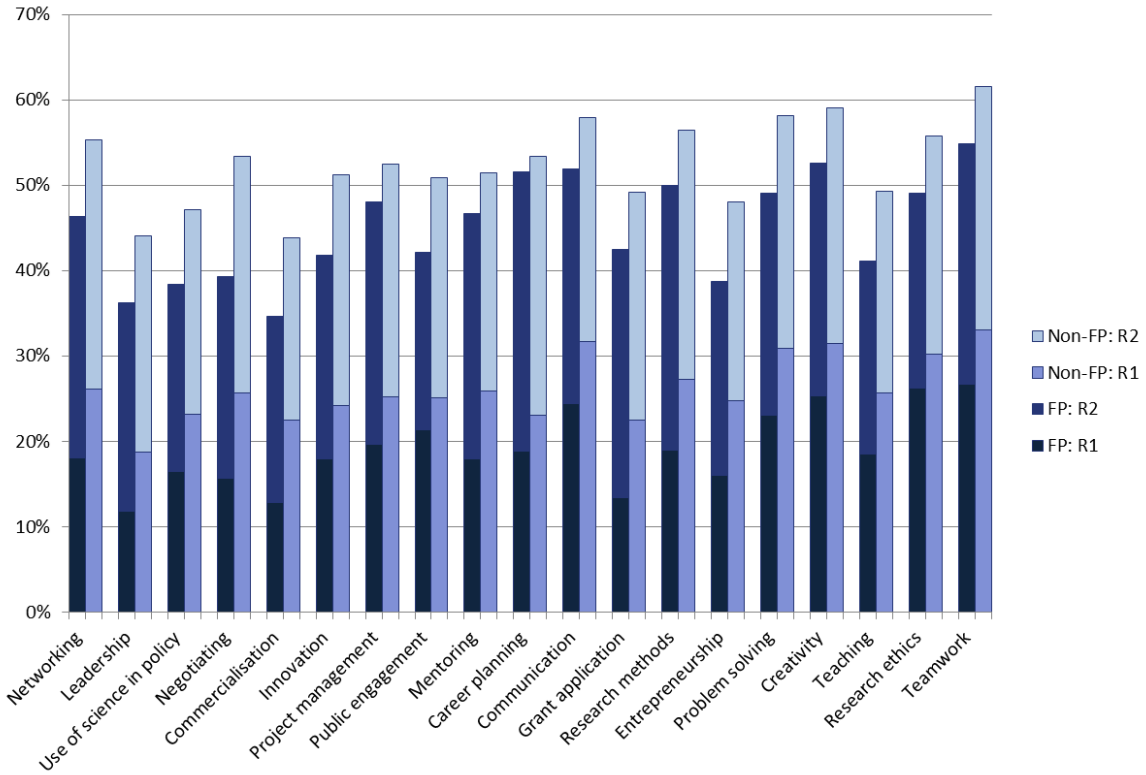


Source: Analysis of the individual level survey data.
N: varies between 850 and 1,856 employment episodes.
Note: The results refer to FP participants only.

Timing of skills acquisition: *FP participants receive strongest training later in their career compared to non-FP participants.*

Interestingly, we observe differences between FP recipients and non-FP recipients as regards the timing of skills acquisition (at different career stages). There is slight evidence in the data that FP recipients receive **strongest training of the skills in later stages** than their non-FP counterparts with regard to a number of different capacities (e.g. "commercialisation", "entrepreneurship" "grant application writing" or "negotiating" etc.). Figure 7 illustrates the share of respondents that, according to their personal perception, received the strongest training in the respective skills and capacities during the first two career stages (i.e. R1 and R2 respectively).

Figure 7: Share of respondents that received the strongest training as "First stage researcher" (R1, left hand side) or "Recognised Researcher" (R2, right hand side)



Source: Analysis of the individual level survey data.
N: varies between 238 and 493 (FP) and 529 and 1,152 (non-FP) respondents
Note: The data exclude respondents that could not tell whether they participated in FP or not as well as responses that could not be matched with the set of specified employment periods.[28]

The findings indicate that less than 50% of FP researchers received strongest training in the listed skills as early-career or recognised researchers (R1 and R2) except for those regarding "career planning", "communication", "research methods", "creativity" and "teamwork" skills, which seem to be less dependent on their degree of seniority. Training in these skills was also associated with FP projects by respondents of the qualitative interviews (see below section 3.1.3) who stressed that "teamwork" and "communication" skills are important for the overall success of co-operation projects.

Inferential statistics suggest that for the majority of skills, **both FP participation and career stage are important for explaining the degree of skills training.**[29] While FP participation has a significant positive effect on all skills and capacities at the 1% level of significance (except for "career planning", where only a 10% level of significance can be reached), the impact of career stage varies over skills and capacities. All other things being equal (i.e. subtracting the effect of FP participation), training becomes more likely later on than during early career stages.[30] With regard to

[28] Non-matching occurs if the respondents have used different codes or names for employment episodes for the responses to different questions, which complicates the matching procedure.

[29] Logistic regression (including survey weights) for explaining whether training of a specific skill has taken place illustrates the importance of both career stage and type of employment episode (i.e. FP vs. non-FP participation).

[30] However, this finding is not significant in all cases (i.e. with regard to all skills and capacities). In some cases the differences between early career stages (R1 and R2) are almost non-existent, whereas the training of other skills is not significantly different for later career stages (R3 and R4).

a number of management skills ("leadership and research management", "negotiating", "networking" and "project management") the model shows a good fit with the likelihood of skills training increasing over all four career stages.[31] Interestingly however, career stage does not play a significant role when it comes to the training of "teamwork" skills. These skills seem to play a crucial role for researchers in general regardless of career stage and the respective type of tasks to be fulfilled. In sum, **while career stage has a differential effect on the training of capacities and skills, FP project participation is positively associated with skill development.**

Relevance of acquired skills: *FP projects have a strong or very strong impact on those skills and capacities that have the highest relevance for the respondents.*

This leads to the question: to what extent had participation in FP funded projects contributed to developing the skills of individual researchers? The results of that assessment are shown in Figure 8. In line with results presented in section 0 on the effects of FP involvement on career paths, the respondents assign particular relevance to FP for the development of "**teamwork**", "**networking**", "**communication**", "**research methods**" "**problem solving**", "**project management**", "**creativity**" and "**leadership**" skills. More than 50% of respondents attribute a very strong or strong effect to FP project participation on the individual development of these skills. Interestingly, these skills and capacities also rank among those that the respondents consider to be the **most important ones for the career development** (see below Figure 9 and Figure 10).

This interpretation is further supported by the MERCI study, which observes a similar focus on select skills (such as "networking" or "leadership"), also with the group of recipients of ERC starting grants (see below section 3.1.2). In sum, among the approved StG applicants, skill development is concentrated on a smaller set of competencies, namely leadership, acquisition of research funding and networking skills, whereas in the reference group a broader set of skills has been mentioned and the picture appears to be much more heterogeneous.

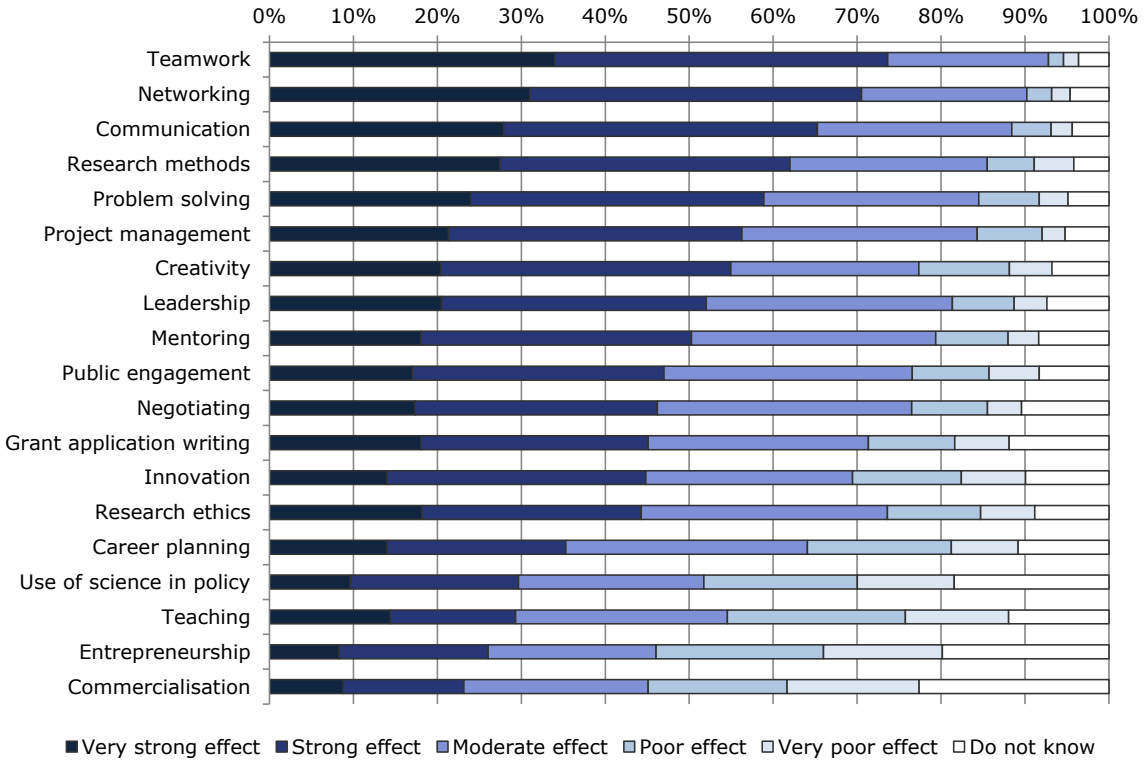
There is reason to assume that FP participation indeed contributes to training in collaboration skills (e.g. "teamwork" or "networking") and their sustainability. This interpretation is underlined by bibliometric studies that find that FP6 participation indeed entails increased (co-)publication activities by researchers from the FP network (see below section 3.1.4). Evaluation of MC actions under FP6 and FP7 confirm the finding that FP participation encourages transnational, intersectoral and interdisciplinary collaboration of researchers.

Some of the "**enterprise skills**" (such as "entrepreneurship", and "commercialisation") but also "use of science in policymaking" or "teaching" are considered skills that **received least training in FP projects** with less than 30% of the respondents specifying a very strong or strong effect. In terms of these skills, respondents also had the most difficulties in assessing the effect as is reflected by the comparably high share of respondents who stated that they are unable to provide such an assessment (12% to 23% respectively).

[31] As concerns "career planning", "grant application writing", "mentoring", "research methods", we observe a good fit of the model with regard to the first three career stages (but there are not any statistically significant differences between R3 and R4).

Career stage does play a role except for the first two career stages (R1 and R2) with respect to "commercialisation", "public engagement", "entrepreneurship", "use of science in policy making", "problem solving", "teaching", "communication", "creativity", and "research ethics".

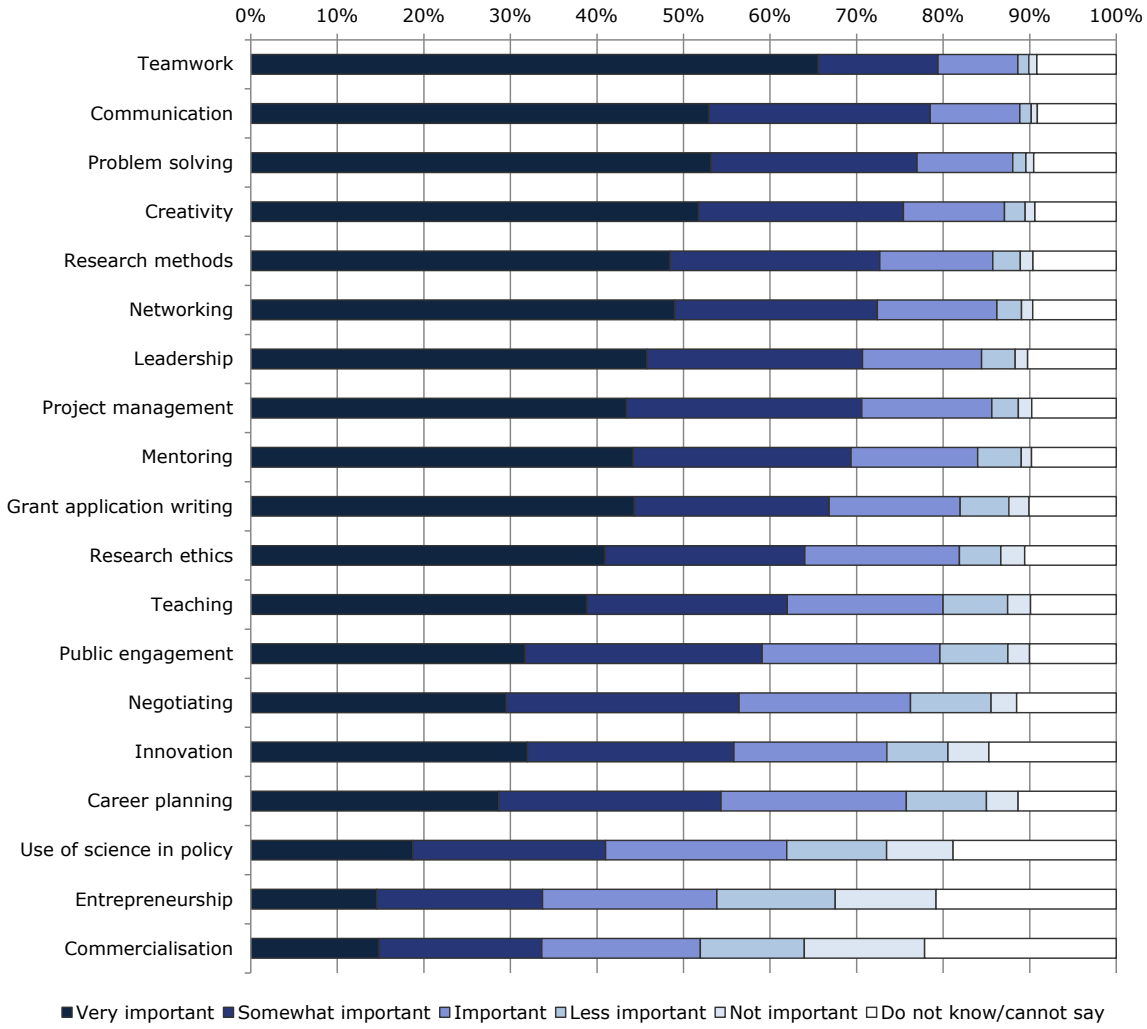
Figure 8: Effect of FP project participation on skill development



Source: Analysis of the individual level survey data.
N: 971 FP projects carried out by 707 FP project participants.
Note: The results refer to FP participants only.

We observe considerable differences with respect to the importance that respondents assign to different skills and capacities. Some of the skills stand out as being particularly **relevant for the development of careers**. Respondents assign particular importance to **"communication", "creativity", "leadership", "problem solving", "project management", "research methods", and "teamwork"** with more than 70% agreeing that these capacities and skills are either very important or somewhat important. This is different for instance as concerns "commercialisation" or "entrepreneurship" that finds similar support by less than 35% of the respondents (see Figure 9). The findings also suggest that the skills that can be categorised as "enterprise skills" (such as "entrepreneurship", "commercialisation" and "innovation") as well as the "use of science in policymaking" are relevant only to a (disciplinary or organisational) subset of the respondents. Around 20% of the respondents specify that they cannot evaluate the importance of these skills for career development. This interpretation is backed by the case study analysis that suggests that these issues are guiding industry-led FP-funded research projects in particular (and less so academia-led projects).

Figure 9: Rating the importance of skills for career development (n=3,682)

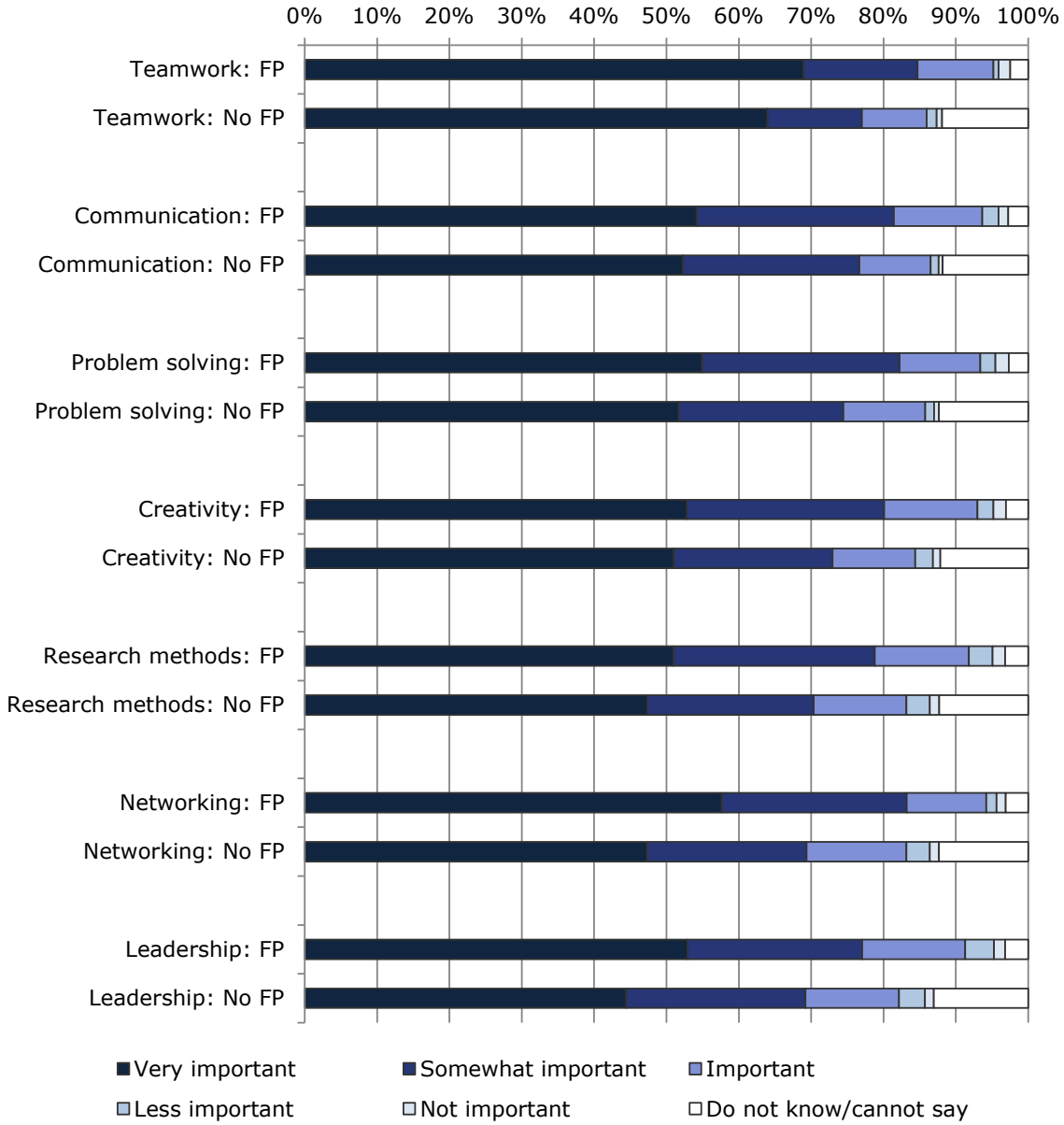


Source: Analysis of the individual level survey data.

If we compare FP participants with non-FP participants as regards the evaluation of the seven skills considered most important (see Figure 9), we find that overall FP participants assign slightly higher importance to all seven skills than their non-FP counterparts (see Figure 10). The divergence differs over skills. Group comparisons show that the slight but measurable differences are statistically significant at a high level except for the issue of "research methods".[32] In other words, FP participants are more likely to assign stronger importance to a number of skills and capacities than their counterparts without FP project experience.

[32] The Kruskal-Wallis equality-of-populations rank test shows that the respondents of the two groups differ in their evaluation and ranking of the importance of skills. In all tests but the one on "research methods" the probabilities have values below 0.001

Figure 10: The importance of skills for career development: Comparing FP and non-FP participants (n = 707 (FP) and n= 2,263 (non-FP) researchers)



Source: Analysis of the individual level survey data.
Note: The data exclude respondents that could not tell whether they participated in FP.

The data reveal respondents' tendency to evaluate those skills and capacities as important for which they – according to their own perception – have received strong or very strong training in during their FP participation (see above Figure 8). With regard to the above listed skills considered most important ("communication", "creativity", "leadership", "networking", "problem solving", "research methods", and "teamwork", see Figure 10), we observe a **strong relation between skill acquisition (in FP projects) and the perceived relevance of skills**. With respect to "communication" skills, the share of respondents (having received strong or very strong training during their FP participation) that rate the capacity as very important or somewhat important amounts to 88%. The picture is similar for "teamwork" (91%), "problem solving" (90%), "creativity" (89%), "research methods" (87%), "leadership" (88%) and "networking" (84%).

***Mobility**: FP participants are more inclined to include long-term stays abroad during their research career, whereas short-term mobility is related to career stage rather than to FP participation.*

As Table 3 illustrates, FP-funded researchers are more mobile than their non-FP counterparts if we look at mid- or long-term stays (lasting more than three months) with 39% of FP researchers having worked abroad during the last ten years. This applies to only 26% of the researchers without FP funding. The picture is similar for more remote mid- or long-term stays that have taken place at least ten years ago – though the differences between the two groups become less pronounced. As for short-term stays abroad, the differences between FP participants and non-FP participants are weaker with shares of 38% (FP participants) and 43% (non-FP participants) having worked abroad for less than three months in their recent career. The findings allow for the following conclusions. First, **FP6 or FP7 participants are more mobile when it comes to mid- or long-term stays abroad** – a finding that is in line with the evaluation of the Marie Curie programme under FP6 and FP7 (see below section 3.1.4). This is especially true during the periods covered by the two FP funding schemes under study (i.e. after 2002). Second, non-FP participants have been slightly more inclined to work abroad for shorter periods during the ten years preceding the survey. This relationship is, however, reversed if we look at periods that are not covered by FP6 or FP7 (more than ten years before the start of the survey).

Table 3: Share of researchers that have worked abroad during their career: Comparing FP and non-FP participants (n=625)

Mobility	FP participants	Non-FP participants
Work abroad for **more** than 3 months (at least once in the last 10 years)	39%	26%
Work abroad for **more** than 3 months (more than 10 years ago)	17%	12%
Work abroad for **under** 3 months (at least once in the last 10 years)	38%	43%
Work abroad for **under** 3 months (more than 10 years ago)	18%	10%

Source: Analysis of one-question survey data.

As with other skills and capacities, the mid- or long-term mobility of researchers seems to be fostered by FP participation (see above). However, if we assess the effect of career stage, "mid- or long-term mobility" is different from the aforementioned set of skills and capacities studied in the individual level survey (see Figure 9). As Table 4 shows, we cannot attribute any effect to career stage on the mid- or long-term mobility of researchers. While 29% of second-stage researchers (R2) have worked abroad for more than three months, this applies to 31% of third-stage (R3) and 30% of the fourth-stage (R4) researchers in the sample.

With regard to "short-term mobility" however (for which the findings do not reveal any positive impact of FP), **career stage seems to play a stronger role**, with researchers increasingly working abroad for less than three months as they move onto more senior research stages.

Table 4: Mobility during FP participation: Comparing researchers on different career stages (n=675)

Mobility	R2	R3	R4
Work abroad for **more** than 3 months at least once in the last 10 years	29%	31%	30%
Work abroad for **under** 3 months at least once in the last 10 years	36%	40%	50%

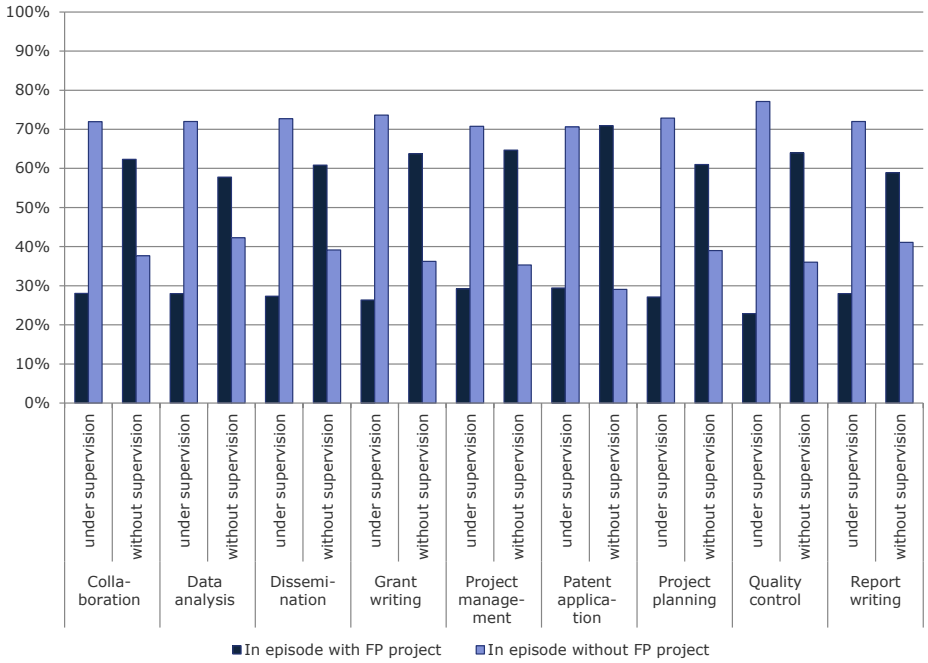
Source: Analysis of one-question survey data.

There are only slight differences between FP and non-FP researchers with regard to the motives for and intensity of short-term mobility. With regard to "conference participation", for instance, 42% of FP researchers indicated that they often participate in conferences (three times a year or more), with 38% of them doing so once or twice a year. With regard to non-participants the share of researchers frequently attending conferences (three times a year or more) amounts to 35%, while roughly half of them (51%) has a moderate conference participation rate (one or two times a year). With regard to other "visits" abroad there are not any visible differences between FP and non-FP participants. Yet again, **as concerns the frequency of participation in "meetings", FP participants are slightly more active** than non-FP researchers. Roughly one third in both groups occasionally attend meetings abroad (i. e. once or twice a year) with shares of 35% (FP participants) and 36% (non-FP participants). While 27% of FP researchers do so often (i.e. at least three times a year), this applies to only 17% of non-FP researchers. This finding can be explained by the necessity to foster intra-project communication in international projects (e.g. through consortium meetings), which is also true for FP projects (cf. case study evidence in sections 3.1.3 and 0).

***Autonomy**: FP projects offer ample room for scientists to carry out research independently and to develop the skills necessary for advancing into more senior research roles.*

In order to further analyse the effects of FP funding on the acquisition of skills and capacities, we now turn to the description of tasks the respondents were responsible for in different employment episodes (either with or without FP project involvement). In this context, the respondents were asked to specify the employment period in which they carried out different tasks for the first time - either under supervision or without supervision. The results are shown in Figure 11. Interestingly, the share of researchers that carried out the specified tasks without supervision is higher for researchers with FP involvement than for those scientists without FP participation. The majority of FP participants who carried out the different tasks independently did so in the context of FP projects. This is the case for all the tasks enquired about and shares are at very similar levels. **FP engagement thus contributes to increasing self-dependency and autonomy of researchers, at least with regard to individual tasks**, which does not necessarily mean that the entire workload is carried out without supervision.

Figure 11: Share of FP participants that carried out the specified task for the first time in FP and non-FP project episodes



Source: Analysis of the individual level survey data.
N: between 850 and 1,856 FP and non-FP employment episodes.

Differentiating by career stage and type of project (FP vs. non-FP employment episodes) yields interesting results that confirm the participants' rating of employment episodes according to their impact on the training of skills and capacities (see above Figure 7).

Inferential statistics show that **for the majority of tasks both FP participation and career stage are important predictors** for the types of tasks fulfilled in the respective employment episodes.[33] First, FP participation has a significant positive effect on all tasks at the 1% level of significance (except for "collaboration under supervision"). This finding suggests that working with others is characteristic of most research projects or contexts – not only those involving FP project involvement. Second, career stage is important for explaining the timing of first-time fulfilment of most of the tasks. As expected, the likelihood of performing different tasks without supervision increases with career stages whereas the opposite applies for tasks carried out under supervision. As has been the case with regard to the training of skills and capacities, the impact of career stage varies over different tasks. We find a good model fit and statistical evidence for the positive impact of FP and the expected effect of career stage for the following tasks: "collaboration" (without supervision), "data analysis" (both under and without supervision), "dissemination of results" (without supervision), "grant application writing" (both under and without supervision), "project management" (both under and without supervision), "patent application writing" (both under and without supervision), "project planning" (both under and without supervision), "quality control" (without supervision), and "report writing" (without supervision).[34]

[33] Logistic regression (including survey weights) for explaining whether the performance of a certain task has taken illustrates the importance of both career stage and type of employment episode (i.e. FP vs. non-FP participation).

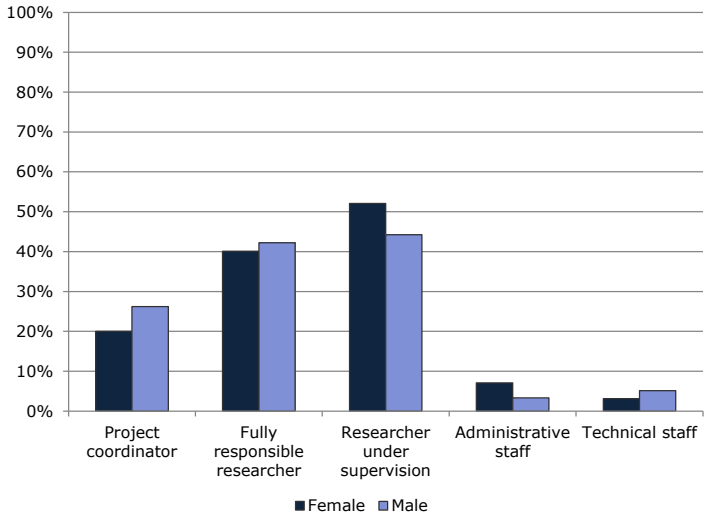
[34] As concerns "collaboration" (under supervision), "dissemination of results" (under supervision), "quality control" (under supervision), and "report writing" (under supervision), we observe a good fit of the

Evidence from the MORE2 HEI survey lends further evidence to the type of collaboration researchers are engaged in. The survey results indicate that – regardless of FP participation – collaboration is strongest with universities or public research institutes (in the respondent's own country, followed by research institutes in other EU countries and subsequently those in non-EU countries). Collaboration with the non-academic sector in the researchers' own countries ranks fourth, followed by collaboration with private industry. **The share of FP participants engaged in collaboration (of any kind) is higher than the share of non-FP researchers**. The "gap" is particularly visible with regard to collaboration with universities or research institutes **in other EU countries**. While 88% of FP participants are involved in this type of collaboration, this applies to 72% of non-FP researchers only.

***Autonomy with respect to gender**: Female researchers perceive themselves more frequently as a researcher under supervision than their male counterparts*

Carrying out individual tasks without supervision does not necessarily mean that a researcher within an FP project is fully responsible or in charge of the entire project. Respondents who state that they carried out tasks independently might also act as researchers under supervision. With regard to roles undertaken by individual researchers in FP projects the distribution among respondents is as presented in Figure 12. Most respondents perceive themselves as **researchers under supervision**. The illustration also suggests that this share is **slightly higher among female researchers**, while the specific position of the project coordinator is to a slightly higher degree undertaken by male researchers. Fully responsible researchers are slightly more often male than female.

Figure 12: Role taken by individual researcher within FP projects (n=444 (female) and n=674 (male))



Source: Analysis of the individual level survey data.
Note: 444 FP projects reported by female researchers and 674 FP projects reported by male researchers.

model with regard to the first three career stages (but there are not any statistically significant differences between R3 and R4).

3.1.2. Evidence from the ERC starting grants programme

As stated in the introductory paragraph of this chapter, aside from the findings from the survey of individual researchers, we can draw upon empirical evidence gathered by the MERCI study, which is carried out by iFQ (cf. box below). In the following box, the study is described in more detail and the following paragraphs outline the analysis and results of this study with respect to the individual career development and competences, as far as they relate to this study. The analysis confirms the findings that programme funding leads to a different kind of competence development, with focus on the management and networking skills and the acquisition of new funding.

MERCI study – Evaluation of the ERC's Starting Grants Programme

MERCI evaluates the ERC's "Starting Grants" (StG) programme[35] – a funding scheme for up-and-coming post-docs to build up or consolidate a research group at a host institution in the EU – by focusing on the programme's effects on the individual career development of young researchers.

The evaluation of the ERC programme's effects on the career development of researchers requires a comprehensive gathering of individual and aggregate data and their changes over time. In order to answer the question as to whether the StG programme has a positive effect on career development, iFQ chose a longitudinal and comparative design with several cohorts of approved and rejected StG applicants. Therefore, one building block of the MERCI study is a panel approach consisting of two waves of standardised online surveys:

1) The first panel wave is conducted at the beginning of the StG funding (respectively one year after the application for rejected applicants), the second wave is conducted 2.5 years later, and, thus in the last part of the StG funding period. A short intermediate survey runs between the first and the second wave.[36]

2) The second wave survey provides information on skills and competences developed during the StG funding period (respectively since the StG application), on the perceived influence of the ERC funding scheme on the career development and the (anticipated) sustainability of the StG funding, the satisfaction with the ERC grant management, the subjective assessment of the status at the institution, third party funding activities, experiences of international mobility and the career aspiration.

In the following, we aim to present results of two second wave survey questions tackling the perception of the acquisition of skills and competences during the last few years.

Self-selection: Self-perception points to a higher level of competences among StG applicants.

Taking into account that the target group of post-docs addressed by the StG programme is enormously broad (researchers of any nationality with 2-12 years of experience since completion of their PhD no matter what position they fill, meaning that even professors are eligible to apply[37]), and that country specifics in terms of national research systems/positions need to be considered, the ascription of developed

[35] See the ERC website for information on the "Starting Grants": http://erc.europa.eu/starting-grants.

[36] For further information on the concept of the MERCI study cf: http://www.research-information.de/Projekte/Merci/projekte_merci_lang.asp.

[37] Already at the time of the StG application roughly every fifth of the approved and rejected StG applicants holds a full or associate professorship in the MERCI panel. Since 2013, the ERC differentiates between the "Starting Grant" programme addressing post-docs with 2-7 years of experience since completion of their PhD (or equivalent degree) and the "Consolidator Grant" programme with over 7 and up to 12 years of experience since completion of PhD (or equivalent degree). Since MERCI deals with the StG 2009-2011 cohorts, this differentiation does not play a role for this study context.

skills and competencies is confounded by many contextual factors. To get a proxy for perceived developments of individual skills independently of the career stage and the position the respondent currently holds, the approved and rejected StG applicants were asked to rank their own level of competence compared to colleagues at the same career level on a seven-point Likert Scale ranging from "very low" (1) to "very high" (7). The competences listed in the corresponding item battery strongly resemble the ones used in the "Study on assessing the contribution of the framework programmes to the development of human research capacity", with some minor changes.[38]

For the subsequent analysis of competence development we can draw on the answers of a maximum of 372 rejected StG applicants and 141 approved ones.[39] Table 5 lists the means and standard deviations for the perceived level of competence. A value of 4 here denotes a level of competence which is deemed comparable to colleagues on the same career level, whereas values above 4 indicate a higher level compared to colleagues. In general, **approved as well as rejected StG applicants consider their own level of competence higher** than that of colleagues on the same career level with the exception of "Commercialisation, patenting and knowledge transfer" and "Scientific consultancy". Given that the StG programme primarily aims at enabling ground-breaking and thus rather basic research, these findings are not really surprising.

The respondents' overall tendency to rate their own competencies as "above average" is striking, but points to strong levels of self-selection among the applicants, meaning that the StG programme attracts primarily those researchers which – at least in their own perception – perform very strongly especially with regard to genuine research-related skills. Due to the fact that both approved as well as rejected applicants perceive their abilities to carry out research independently as very strong compared to colleagues at the same career level, it is questionable as to whether strong research skills are here a precondition for the application than an outcome of the programme. The same applies to publication and presentational skills as well as the acquisition of research funding. Despite the fact that the StG programme targets early career researchers, these researchers had already achieved a substantial level of genuine research-related skills. So, it is more revealing to explicitly approach the differences between both groups in order to offer insights into skill development which is triggered by the Starting Grant programme.

<u>Improvement of management, acquisition of funding and networking skills among the Starting Grantees.</u>

The strongest differences in the current level of competence between Starting Grantees and the reference group of rejected applicants are apparent for the acquisition of research funding, personnel management, networking, and project management skills; with the Starting Grantees scoring significantly higher. The findings here might suggest that – whereas scientific independence has been achieved

[38] The following competences were listed: Leadership qualities; Methodological skills; Conducting research independently; Publication of research results; Presentation of research results; Acquisition of research funding; Personnel management; Teaching skills; Negotiation skills; Networking skills; Project and time management skills; Commercialisation, patenting and knowledge transfer; Communication/dialogue with non-scientific audiences and Scientific consultancy (e.g. for policy making).

[39] The number of valid answers for each item ranges between 373 and 278 for the rejected applicants and between 141 and 98. In this case, the number of valid answers apparently reflects the relevance of the specific skills respectively their centrality. "Commercialisation, patenting and knowledge transfer" and "Scientific consultancy" show by far the highest number of missing values among all items for this question.

before – **especially skills which are related to managing research groups and allocating resources are acquired among the Starting Grantees**.

Table 5: Mean level and standard deviation of competence for approved and rejected Starting Grant applicants

	Rejected StG applicants			Approved StG applicants		
	Mean	SD	N	Mean	SD	N
Leadership qualities	5.13	1.04	365	5.52	1.08	140
Methodological skills	5.20	1.02	370	5.25	0.99	139
Conducting research independently	5.67	1.09	373	5.99	0.89	141
Publication of research results	5.27	1.18	372	5.52	1.07	139
Presentation of research results	5.32	1.10	372	5.74	0.92	140
Acquisition of research funding	4.44	1.37	367	5.78	1.01	139
Personnel management	4.70	1.14	357	5.24	1.04	138
Teaching skills	4.98	1.15	355	4.80	1.36	133
Negotiation skills	4.19	1.25	338	4.54	1.27	138
Networking skills	4.49	1.39	366	4.91	1.24	139
Project and time management skills	4.60	1.17	367	5.02	1.14	138
Commercialisation, patenting and knowledge transfer	3.51	1.38	299	3.71	1.47	99
Communication / dialogue with non-scientific audiences	4.50	1.48	346	4.57	1.36	129
Science consultancy (e.g. for policy making)	3.93	1.43	278	4.19	1.38	98

Source: Analysis of the MERCI survey date (2nd wave).

Beyond the status quo, the MERCI respondents were asked to select from the above-mentioned set of competencies the three which had been developed most strongly during the StG funding period respectively, as for the rejected applicants, during the last three years.

In sum, among the approved StG applicants, skill development is concentrated on a smaller set of competencies, namely leadership, acquisition of research funding and networking skills, whereas in the reference group a broader set of skills has been mentioned and the picture appears much more heterogeneous. Table 6 provides an overview about the competences for which the MERCI respondents experienced the strongest development (distribution in percentage).

Table 6: Percentage of approved and rejected Starting Grant applicants who perceived the strongest development in the following competences (up to three answers were possible).

	Rejected StG applicants in % of respondents	Approved StG Applicants in% of respondents	Total in % of respondents	Total (number of responses)
Leadership qualities	57	70	61	306
Methodological skills	21	18	20	101
Conducting research independently	38	27	35	175
Publication of research results	13	14	13	67
Presentation of research results	31	26	29	145
Acquisition of research funding	27	49	33	168
Personnel management	29	2	22	109
Teaching skills	5	6	6	28
Negotiation skills	17	11	15	77
Networking skills	16	38	22	113
Project and time management skills	20	23	21	105
Commercialisation, patenting and knowledge transfer	5	3	5	23
Communication / dialogue with non-scientific audiences	7	6	6	32
Science consultancy (e.g. for policy making)	4	3	4	20
N (cases)	368	138	506	

Source: Analysis of the MERCI survey date (2nd wave).
Note: MERCI respondents were requested to select those three competencies for which they experienced the strongest improvement.

In line with the focus of the StG-program, an overwhelming majority (70%) of the StG recipients mentioned leadership qualities, but in the reference group 57% of the respondents also observed strong development in this competence. In contrast, the ability to conduct research independently was mentioned far less frequently (StG recipients: 27%, reference group: 38%). This finding corroborates what has been suggested above: researchers who apply for the StG - among them a substantial proportion of people who already hold a full or associate professorship - achieved a high level of scientific independence even prior to their application; ensuing progress in skill development is rather experienced in the sphere of leadership. Interestingly, more than a quarter of the rejected applicants mentioned personnel management as a field in which they experienced the strongest improvement, whereas this skill went almost unmentioned by the approved StG applicants.

3.1.3. Case study evidence

FP projects have positive effects on **expertise development**.

Case study evidence seems to confirm the findings from the individual level survey. Generally, interviewees perceived the contribution of their participation in an FP project on skill development as positive. Positive effects were felt in terms of improving the knowledge/developing expertise in a specific research area and positive

effects regarding research-specific skills were reported repeatedly (see cases 1, 2, 3, 4, 5, 9). More specifically, in some project contexts widening the focus of research by interdisciplinary research activities was described as positive and/ or career boosting (see cases 4, 8) However, there are also cases where the effects seem to be rather limited and no significant contributions to skill development were acknowledged especially with regard to research-specific skills (cf. in particular case 6). Still, effects with regard to networking and management/administration skills were also noted in case 6.

FP projects have positive effects on **(international) networking**, teamwork and language skills.

There is no doubt that participating in an FP project opens opportunities to enter national and international networks. This enables young researchers in particular to interact with leading researchers in the scientific field. Basically, it seems that the participation in FP projects contributes to developing particular networking skills which include team working skills, especially in international contexts and, (intercultural) communication skills across the board - a finding that is confirmed by the individual level survey. Not least, language skills can be improved by working in a FP project: on the one hand, by constantly communicating in English, researchers may significantly progress their English. And on the other hand, researchers coming from outside the EU may significantly progress their knowledge of a foreign language and/or their English language skills. This is also reflected in the strong mobility of FP participants (see section 3.1.1).

Differences between career stages/levels of seniority: Young researchers associate the acquisition of technical and scientific skills with FP. Project coordinators benefit in terms of increased project-management skills.

While experienced researchers seem to have difficulties in actually attributing potential effects to a specific FP engagement, younger researchers (cases 2, 4, 8), especially PhD candidates involved in FP projects, reported positive effects on skill development, also with regard to the scientific and technical skills that they acquired in the context of the FP project. This finding is in line with comparable studies analysing the impact of FP (see below section 3.1.4). Evidence also points to the fact that the specific project role/position an individual researcher influences the effects on skill development (cases 1, 2, 3, 4, 5, 7, 8, 10). Thus, the amount and types of actual benefits depend on the level of seniority of the participating researcher. For example, management and leadership skills, which are reported frequently as benefitting from FP participation (cases 1, 2, 5, 6, 8, 10) are, not surprisingly, affected more if a person is actually involved in respective tasks. First and foremost, this applies to the project coordinator and the project leaders at the organisations/universities involved in the FP project. Moreover, FP project coordinators stated that they also acquired skills regarding how to strategically interact with stakeholders, in particular the EC. Benefits were also attributed to the interaction with a project management company (e.g. cases 2, 5).

There is sporadic evidence of positive effects on the development of skills which are particularly relevant in industrial R&D contexts; however, this strongly depends on the actual context of the individuals and their exposure to industry or the intensity of collaboration with industrial partners (case 2).

In terms of skills regarding commercialisation, the picture is rather scattered; e.g. in case 1 successful commercialisation of project results have been reported by one company while others participating in the same project did not get that far in the

context of the actual project but were able to continue working on commercialisation of the product after the project ended, which lead to either prototype development (case 8) or launch of a product (case 3).

3.1.4. Evidence from desk research

To date there is little empirical evidence with regard to the effects of participation in EU-funded research activities on individual skills, expertise and researcher careers. EPEC (2011) in its report "Understanding the Long Term Impact of the Framework Programme"[40] explicitly mentioned that so far little effort has been undertaken to investigate "wider effects of the programmes" (EPEC, 2011, p. 1). Also among the issues mentioned is capability-building, which comes close to the issues that we are dealing with in the present study. The study also highlights that investigating the "longer term impacts of the Framework Programmes in the area of mobility and individual careers" (EPEC, 2011, p. 85) is of interest for future studies. In the same study, a move "to a human capital approach to complement the existing focus on 'research impacts'" is asked for as this "is notably important in relation to exploring the role of the FP in developing and sustaining Knowledge Value Collectives" (EPEC, 2011, p. 86). Most of the studies so far rather address countries, organisations or projects when it comes to assessing the impacts of FP.

FP participation has a positive impact on publication and co-publication records of researchers.

There are bibliometric studies analysing potential effects of FP involvement on researcher's productivity and impact. In the study "Bibliometric Profiling of Framework Programme participants" (Technopolis, 2009, p. 9) lead scientists[41] who participated in FP6 were found to perform better than non-participants in terms of publication and impact received (measured in terms of citations received). Also a bibliometric study carried out by AVEDAS (2009) concluded that "FP6 projects have led to increased co-publication activity between project partners; these co-publications have a significantly higher impact (as measured by citation performance) on the scientific field than the world-average (up to twice as great)" (cited from EPEC 2011, p. 27).

More generally, meaning without linking productivity gain to FP activities but still studying effects of funding, Lee and Bozeman (2005) studied the impact of collaboration on research productivity based on 443 scientists affiliated with university research centres in the USA. They used both full count measures (each publication is equally attributed to each of the co-authors) and fractional count measures (each publication is attributed to each co-authors as a fraction 1/n with n being the number of co-authors). While they found that that collaboration is positively and significantly related to research productivity if full count measures are used, their results also suggest that there is no significant relationship based on fractional counts (Lee & Bozemann, 2005, p. 692). According to Lee and Bozemann, it is rather the funding provided that leads to increased productivity. Still, they do not conclude that there are no gains from collaboration. They argue that "collaboration may be the key element in S&T human capital development, and the implications of collaboration for career development are likely to be quite different than for discrete measures of individual publishing productivity" (Lee & Bozeman, 2005, p. 695). Defazio et al. (2009), who also looked into the relationship between funding, collaboration and productivity but only took into account FP4 and FP5 related actions, also found a positive impact of

[40] See EPEC (2011)

[41] See EPEC, 2009, p. 8-9 for methodology and definition.

funding on productivity, primarily in the post-funding period, while the overall impact of collaboration within the funded networks seems to be rather weak (Defazio et al., 2009, p. 303f.).

Another study on "Impacts of the Framework Programme in Sweden" (Vinnova 2008), covering Swedish participation in FP3 to FP6, which also comprises a bibliometric analysis (Fröberg& Karlsson, 2008, p. 256)[42], states that "from the results we can conclude that no apparent effects from frame programme participation are found on the bibliometric measures. The group of EU-researchers can, however, be described as being more successful in terms of both citation rates and number of collaborations, even before participating in EU-financed projects. This suggests that one pre-requisite for being successful when applying for EU-funding is to already be an established researcher. Another conclusion is that the general trend towards an increased internationalisation of science has the effect that the differences between the two groups have decreased over time." Moreover, the EPEC study (2011, p. 78) states that "at the level of individuals, in three out of four fields analysed, FP participants were strongly represented among the most productive researchers in the world". Here, however, no conclusion can be drawn as to whether achieving this position was due to being involved in FP activities or whether individuals were able to participate in these because of their strong performance.

FP participation has favourable effects on the researchers' networks.

From the study on Swedish FP participation (Vinnova, 2008, Summary) there is also evidence that participation in FPs contributes to expand the size and scope of researchers' networks. Researchers become part of more international 'invisible colleges' and thus are also more closely linked to researchers who are considered to be leading in their fields. From the Swedish universities it is reported that due to the fact that PhD students often carry out the actual research in these projects, they "play an important role in doctoral education and also expose those doctorands to the international partnerships of the FPs, with beneficial effects on their educational, research and career prospects" (Vinnova, 2008, Summary).

A study on the effects of FP participation in the UK (Technopolis 2010) finds that networking opportunities given in the FP context is an important motive for participation, with access to funds being roughly equally important. According to the study, FP participation's biggest impact regards "international relationships and improved knowledge of a given field" (Technopolis, 2010, p. 92-93). Findings also list increased international scientific reputation as a positive impact. However, according to the study, benefits for researchers' careers are considered to be rather moderate (Technopolis, 2010, p. 92). Only respondents from Higher Education Institutions mention newly trained/qualified personnel among the top 5 benefits from FP participation while for Industry and Research Institutes this aspect did not rate as high (Technopolis, 2010, p. 67). Interviews among stakeholders revealed that they are hardly able to judge the impact of FP participation on skill and capacity development beyond improved collaboration and communication skills as well as administrative skills (Technopolis, 2010, p. 92).

[42] See Fröberg, J. & Karlsson, S. (2008) Possible effects of Swedish participation in EU frame programmes 3-6 on bibliometric measures. In: Vinnova (2008) *Impacts of the Framework Programme in Sweden*, p. 256-292

FP participation has favourable effects on research collaboration and mobility.

The Marie Skłodowska-Curie Actions specifically support researcher career development and training. MSCA provide grants to researchers at all career stages and encourage transnational, intersectoral and interdisciplinary mobility. In the past, assessments of the MCSA have been carried out regularly, e.g. 2010 focusing on activities in the context of FP6 and 2013 on FP7-related activities. The evaluation of FP6 MSCA found a generally positive perception among the MSCA Fellows regarding skill development and career development. The results are also in line with other findings in that they confirmed that developing new networks was among the most significant outcomes and that various forms of collaboration – international, interdisciplinary, intersectoral – benefitted from the programme (The Evaluation Partnership, 2010, p. 26).

This also leads to the development of respective skills such as gaining international experience and interdisciplinary research skills. The majority of survey respondents agree that their fellowship contributed significantly to their development of research skills as well as complementary skills (The Evaluation Partnership, 2010, p. 27-28). Also the interim evaluation of the FP7-related MSCA (PPMI 2013) confirms the overall positive effects of the programme. Besides the positive effects reported regarding the further development of research skills, fellows also benefitted with respect to the acquisition of soft skills. Skills relevant to industry were rather developed in the context of schemes particularly focusing on academia-industry interaction such as the IAPP scheme (Industry Academia Partnership and Pathways). Generally MSCA Fellows are very satisfied with the training and subsequently the development of their skills, especially the acquired research skills (PPMI, 2013, p. 59).

3.2. Evaluation Question 2: Contribution to individual career paths

3.2.1. Evidence from the individual level survey

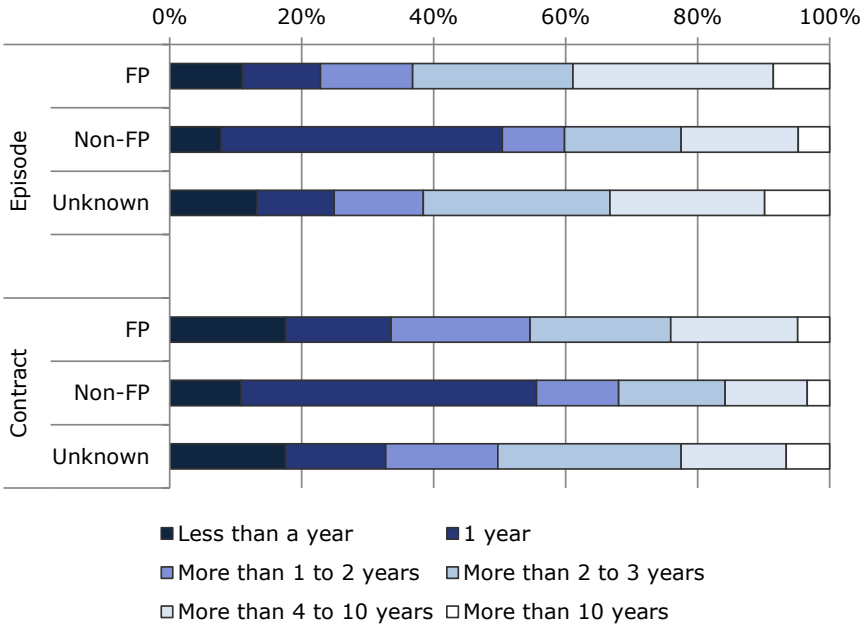
Length of employment episodes and contracts: FP projects offer longer-term career perspectives for researchers at all career stages.

In order to shed light on the short-term career implications of FP participation, we will first look at the length of episodes of different type (according to whether they involve FP funding for the respondents or not). In addition, we compare the average length of contracts respondents have held during different employment periods (according to whether these periods involve FP funding or not).

Figure 13 illustrates the average length of employment episodes and contracts according to whether or not they coincide with FP participation. Interestingly, **short-term contracts are more common in non-FP employment episodes** than in employment episodes that involve FP participation.

The length of employment episodes (i.e. the duration during which a researcher stays with one and the same organisation or employer) is equal or less than a year in 51% of all the employment periods that do not involve FP participation. This is true for only 23% of episodes that include FP involvement. Similarly, the **share of mid- and long-term episodes is higher for employment episodes with FP participation**. In 30% of the cases with FP involvement, employment episodes have a length of 4 to 10 years. This applies to 18% of the non-FP employment episodes. These patterns are also reflected in the distribution of employment contracts and their respective length.

Figure 13: Average length of employment episodes and contracts (n=11,277)



Source: Analysis of the individual level survey data.
Note: 11,277 completed employment episodes (i.e. that are not ongoing any more).

The differences in the length of employment episodes or contracts might also be explained by underlying differences with regard to the "typical" length of research projects. Further, the findings suggest that a number of researchers working on or

managing FP projects are not necessarily financed from these projects (e.g. professors or researchers with institutional funding). This is reflected in the share of permanent contracts for researchers working in FP projects and those in employment episodes without FP projects. While 47% of the FP researchers hold permanent employment contracts, this applies to only 39% of the researchers in employment episodes without FP involvement.

In sum, FP-funded projects with a comparatively high funding seem to allow for longer contracts and less fluctuation in employment.

Length of career stages: FP participants take longer to move from one career stage to the next than non-FP researchers.

In order to find out whether FP participation works as a catalyst for career progress (i.e. to assess the outcomes of FP projects on individual researchers' career development) or, rather, leaves more room for career development, it is worth comparing the time during which respondents stayed on a particular career stage according to whether they were involved in FP projects in that particular career stage or not.

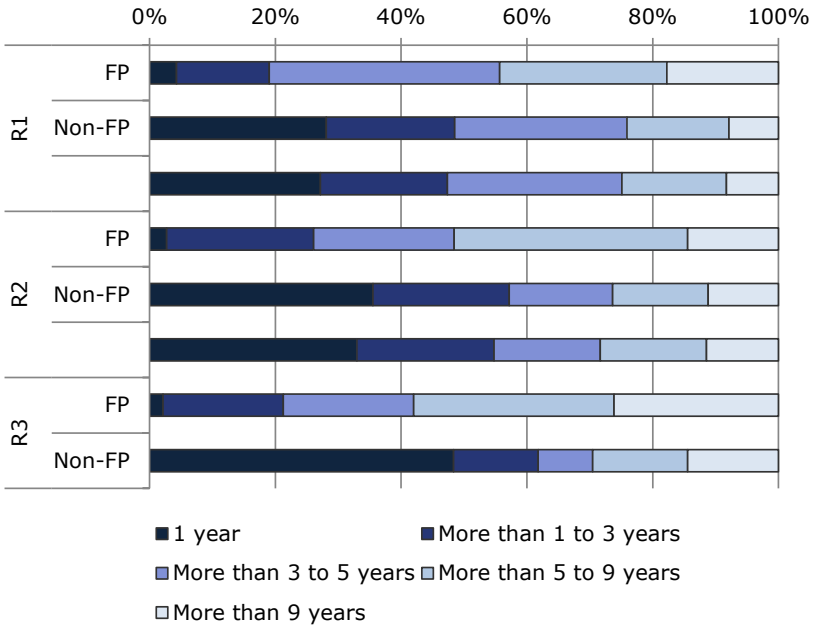
Figure 14 illustrates the findings for the career stages that have been completed (i.e. excluding career stages for which the respondents' employment episodes are ongoing). Altogether, **FP participants seem to prevail for a longer time on a particular career stage than their non-FP counterparts**. The share of respondents that completed the first career stage (R1) in less than three years amounts to 29% in case of FP participation and 48% in case the respondents did not participate in FP projects during that career stage. With regard to the second (R2) and third (R3) career stage the differences are even more striking with shares of 26% vs. 58% (FP vs. non-FP participation) in R2 and 21% vs. 61% in R3. Similarly, it is more common for FP participants than for non-FP participants to stay more than 5 years on a certain career stage.[43] Moreover, differences in the average length are also manifest over career stages regardless of type (i.e. with or without FP funding), meaning that researchers tend to require more time to move from one career stage to the next with increasing seniority.[44] These findings are in line with the findings of the counterfactual analysis (see section 1.3 of Annex 1) that suggests that FP participants do not have a higher likelihood of experiencing changes in career stages than researchers without FP-project experience.

If we compare the average length of the different career stages (R1 to R3) according to the respondents' field of science, the differences are less pronounced, with 44% (of the respondents belonging to agricultural sciences) to 61% (of the respondents belonging to the group of health and welfare) staying less than three years on one career stage. Also, the findings do not suggest significant differences between female and male researchers.

[43] The Kruskal-Wallis equality-of-populations rank test shows that the respondents of the two groups (FP participation vs. no FP participation in different career stages) systematically differ in the time needed to complete the particular career stage with FP participants staying significantly longer on career stages with a probability value below 0.0001.

[44] The Kruskal-Wallis equality-of-populations rank test shows that there is gradual increase in the duration of career stages (R4 vs. R3 vs. R2 vs. R2). These differences are confirmed with a probability value below 0.0001.

Figure 14: Average length of career stages (n=381 (FP) and n=6,445 (non-FP))



Source: Analysis of the individual level survey data.
Note: 381 completed career stages with FP participation, 6,445 completed career stages without FP participation.

Academic qualifications: FP projects have a positive impact on both researchers' academic networks and their academic qualifications.

Respondents were asked to estimate the impact of their participation in FP-funded projects along various dimensions (see Figure 15) among which included items addressing career paths.

More than two thirds of the FP participants stated that they definitely received their strongest training in career-planning skills in an FP-project context (see Figure 6), and the evaluation of the extent to which FP participation has an impact on actual career developments is in line with this finding (despite the aforementioned longer time needed to actually move to the next career stage): 48% of the researchers perceive that their FP participation has had or might have a strong or very strong effect on moving to a more senior researcher position. Another 25% attribute at least moderate effects to the FP participation. More specifically, 45% of the researchers state that participation in FP-funded projects had or might have a strong or very strong effect on becoming a leading researcher (R4), another 29% attribute at least moderate effects to FP participation. Related to this result, 48% of the researchers state that participation in FP-funded projects had or might have a strong or very strong effect on becoming an established researcher (R3), another 22% attribute at least moderate effects to the FP participation.

With regard to managerial positions, the expected effects of FP participation are lower, with 38% of researchers stating that the participation in FP-funded projects has had or might have a strong or very strong effect on moving to a more senior managerial role. Another 29% attribute at least a moderate effect to FP participation. These findings suggest that it is useful to distinguish between short-term and long-term impacts of FP participation on career development.

The expected effects of FP participation on obtaining a PhD are very moderate. Approximately one third of the respondents is rather unsure about this and thus answered "I don't know". Less than one third (30%) of the researchers relate this degree to participation in FP-funded projects by confirming that the project has had or might have a strong or very strong effect on obtaining a PhD. Another 12% attribute at least moderate effects to FP participation. However, the findings are different for those scientists that participated in an FP project as first stage researchers (R1) and for whom this rating is more tangible than for researchers that gained FP-project experience at a later career stage. 61% of this group of FP researchers agree that the project has had or might have strongly or very strongly contributed to their obtaining a PhD. While 13% confirm at least a moderate effect of FP participation, the share of respondents that are not able to judge the importance of FP projects for obtaining a PhD only amounts to 14% of the respondents.

Notwithstanding the perceived positive mid-term impacts of FP participation on career development, the data do not provide evidence of FP project participation functioning as a particular catalyser for the immediate or short-term career development (see above, Figure 14 on the average length of career stages).[45] While, on average, in 37% of the cases of FP participation (i.e. employment episodes with FP involvement), participants experienced subsequent promotion to the next career stage during their subsequent employment episode, this applies to 54% of the employment episodes without FP involvement. In general, promotion is more likely for early career stages regardless of FP participation.

Table 7: Share of individual researchers that have experienced changes in career stage after employment episodes with or without FP involvement (n=866 (FP) and n=12,170 (non-FP))

	From R1 to R2	From R2 to R3	From R3 to R4	Any change
Participation in FP in preceding employment episode	42%	39%	30%	37%
No participation in FP in preceding employment episode	63%	55%	36%	54%

Source: Analysis of the individual level survey data.
Notes:

- 886 employment episodes with FP participation on the first three career stages (R1, R2, R3); 12,170 employment episodes without FP participation on the first three career stages (R1, R2, R3).
- The second column ("From R1 to R2") refers to the share of employment episodes for R1 that entailed promotion to a higher career stage; the third column ("From R2 to R3") refers to the share of employment episodes for R2; the forth column ("From R3 to R4") refers to the share of employment episodes for R3.

No clear direction of impact on **contractual conditions** in total (during and following participation).

With regard to the changes in contractual conditions for different types of researchers (i.e. FP participants vs. non-FP participants), the data allow for similar conclusions. The findings suggest that **changes in employment contracts occur in all directions**. While 28% of the FP participants with fixed-term contracts, grants or combinations of permanent and fixed-term contracts move to a permanent contract in the subsequent employment episode, 25% of FP participants experience changes in the other direction (i.e. from permanent contracts during employment episodes with

[45] This assessment is based on the respondent's affiliation to career stages during and in the employment episode directly following FP participation.

FP to fixed-term contracts, grants or combinations of permanent and fixed-term contracts in the subsequent employment period).

These contractual differences *following* FP and non-FP employment episodes are, however, countered by the different shares of permanent contracts *during* FP and non-FP employment episodes. As specified above, 47% of the FP researchers hold permanent employment contracts, while this is true for only 39% of the researchers in employment periods without FP involvement.

As for non-FP employment episodes, 31% of the cases indicate a move from employment episodes with fixed-term contracts (including grants, combinations of permanent and fixed-term contracts) to permanent contracts. In only 14% of cases do the contractual conditions move in the opposite direction.[46]

Career development outside organisation: Participation in FP projects has a moderate impact on researchers' international (beyond the EU), intersectoral and interdisciplinary mobility.

Career development might also manifest itself in acquiring a new position at another organisation. Thus, we also asked researchers to estimate the effects of their FP participation on securing a position at either **a national or an international (within or outside the EU) university**. Again, expectations are rather moderate. 23% of the researchers state that participation in a FP has had or might have a strong or very strong effect on moving to a prestigious non-EU university. Another 18% say it had a moderate effect. Slightly higher are the expected effects in terms of moving to a prestigious EU university, with 29% of researchers stating that their FP participation has had or might have a strong or very strong effect on this. Another 19% say it has a moderate effect. The picture is similar with regard to the expectations for moving to a prestigious national university, 27% of the researchers perceive a strong or very strong effect and another 22% a moderate effect. The estimated effect on moving to a position in another organisation within the network of the FP project a researcher is involved in is similar.

The expected effects of FP participation are even lower when it comes to the effects of FP on **intersectoral mobility** of researchers. Only 17% of the respondents confirm that their FP participation has a strong or very strong effect on moving between industry and academia. Furthermore, 19% attribute moderate effects to FP participation.

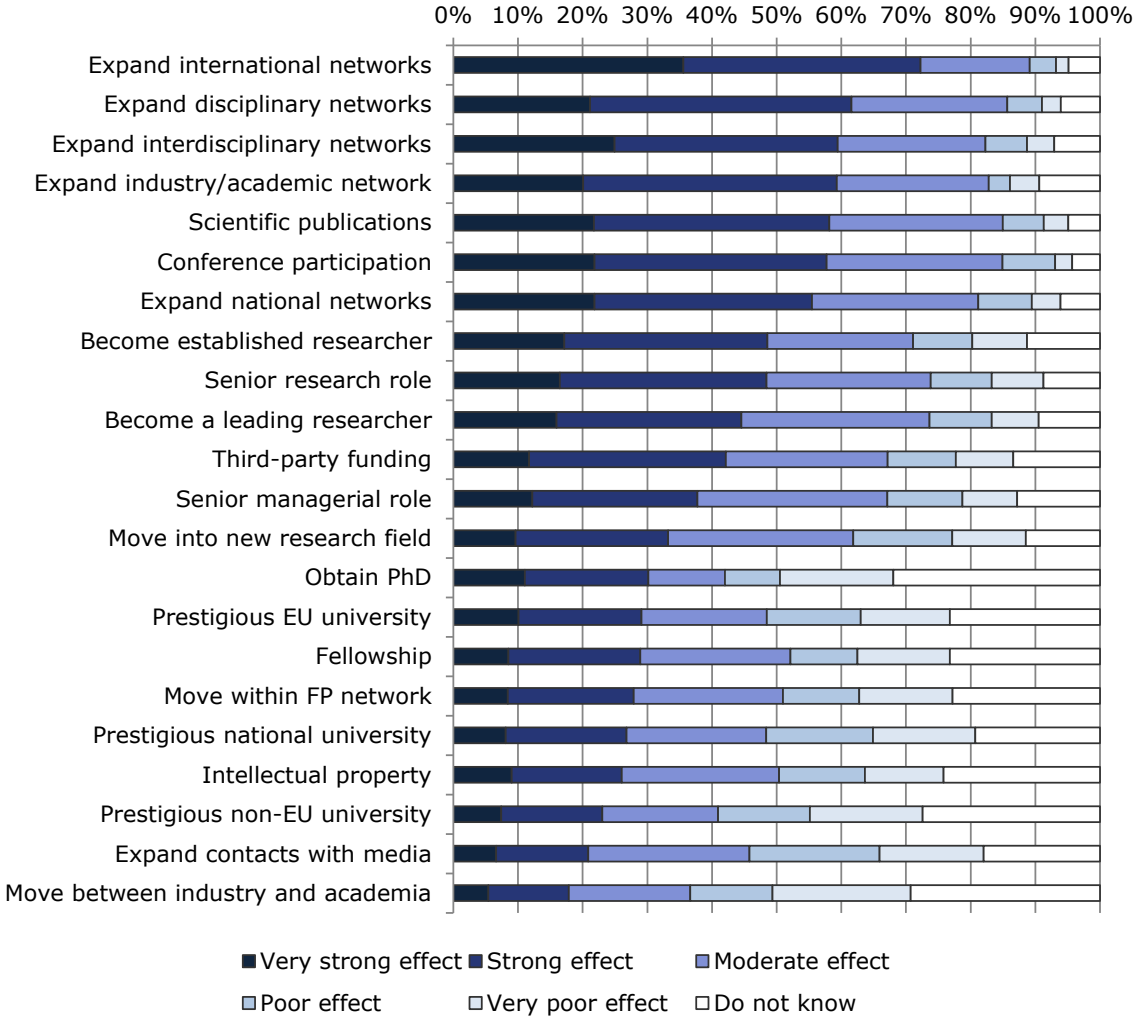
While the effects on moving between sectors are perceived to be rather limited, there are nevertheless positive effects on the interaction between industry and academia. In general, the strongest effects of FP participation are assigned to the various forms of **networking** which are enabled in the context of FP projects (compare also sections 3.1.3 and 0 with regard to the evidence gained in the case-study analysis on the effects of FP projects involving both academia and industry partners). Not surprisingly, international networks in particular have expanded due to FP involvement. In addition, networks between industry and academia – interdisciplinary as well as disciplinary – and also national networks seem to benefit from FP participation (see Figure 15; compare further sections 3.1.1 and 3.1.3, which confirm that researchers benefit the most from FP projects in terms of the acquisition of "teamwork" and "networking" skills). With respect to conference participation the findings are comparable. Again,

[46] The shares are based on 11,133 employment periods (635 FP and 10,498 non-FP employment episodes), hence excluding the latest or ongoing employment episode for the 3,682 respondents.

58% of the respondents perceive the contribution of their participation in an FP project as being strong or very strong.

Another area where researchers strongly benefit from FP participation concerns their **publication output**. 58% of the respondents attribute strong or very strong effects of their FP activities on their publication output. This assessment is confirmed by bibliometric studies that analysed the mid-term outcomes of FP according to the researchers' publication output (see above section 3.1.4).

Figure 15: Estimation of impact of participation in FP funded activities on career development (n=701)



Source: Analysis of the individual level survey data.
Notes:
- 701 FP project participants.
- The results refer to FP participants only.

In sum: while FP does not serve as a catalyser for the short-term career development of researchers, it has a positive impact on the mid- or long-term development of a researcher's career.

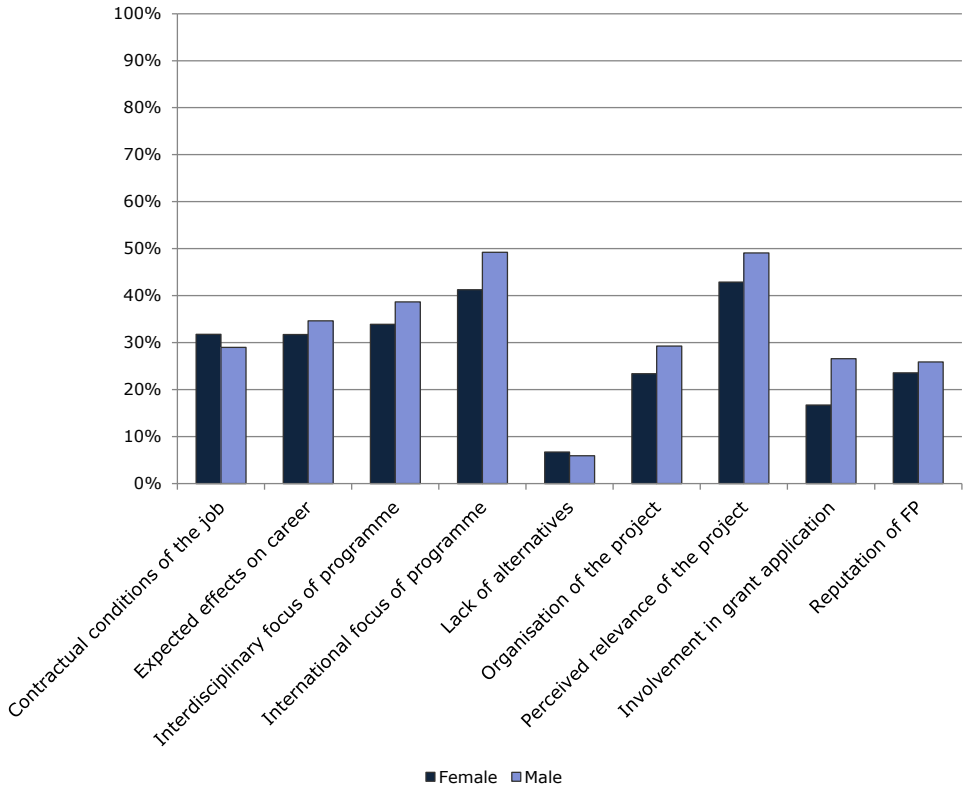
The positive evaluation of FP participation with regard to perceived career effects is confirmed by the MORE2 HEI survey results. Respondents were asked to rate the

degree of confidence they had in the future prospects for their research careers on a four-point scale. FP participants are slightly more optimistic for the future, with 77% of FP participants indicating that they feel very or somewhat confident about their future career. This applies to 71% of non-FP participants.

Importance: Career considerations or contractual conditions are not the main drivers for researchers to participate in FP projects.

Expected effects on a researcher's career are not among the main drivers motivating a researcher to engage in FP-funded projects. Only about one third of the researchers state that this is a motive for FP involvement, the share for male researchers (35%) being slightly higher than for female researchers (32%). Furthermore, the contractual conditions of positions available due to FP funding do not determine the decision whether to engage in a FP project or not for the majority of the respondents. More relevant factors are the international focus of the programme and its perceived relevance; again both motives are slightly more important to male than to female researchers.

Figure 16: Reasons for participation in FP funded projects (n=1,126)



Source: Analysis of the individual level survey data.
Note: 1,126 FP projects.

3.2.2. Case study evidence

Research interest and the acquisition of skills are the main **motivations** for researchers to participate in FP.

Evidence from the case studies points to the fact that the main motivation to participate in an FP project tends to be content-related – aiming at developing skills and competencies as well as the research interest – than expectations regarding career development - thereby confirming evidence for the individual level survey (see above section 3.2.1).

There is limited evidence suggesting that participation in a FP project positively affected individual researchers' career paths but also that contributions on individual careers depend on their career stage and ambitions (cases 1, 2, 5, 6, 7). Definitive career effects resulting in a specific career move during and/ or after the FP project might rather be indirect and are, thus, difficult to ascribe. However, the career paths of the FP-funded researchers are likely to have been (at least slightly) different had they had not been involved in a specific FP project.

Career impacts of FP depend on the current **career stage and seniority** of the researcher.

While positive effects were reported in terms of enhancing personal reputation and visibility both within the organisation a researcher belongs to and within the research field / the scientific community (including the expansion of ones networks), FP project involvement is not generally considered to be a career booster. However, for project coordinators and project leaders at the different partner organisations and/or researchers in later stages of their career who are already well-established or even leading in their field, participation in an FP project may boost their personal reputation further.

The situation for younger researchers differs slightly: there is limited evidence that researchers at earlier career stages profited directly from their involvement in a FP project, aside from personal reputation. In fact, they positively mentioned that due to the FP project they entered into an international network of leading scientists in a specific research area. In case 5, a post-doc reported that being involved in a FP project enabled learning about how to organise an international large-scale project and, thus, contributed to her transition into a research management position. This interpretation of the differential impact of FP (depending on the researcher's career stage) is supported by the findings of the individual level survey (see above 3.2.1).

Sporadic evidence points to improved contractual conditions after FP participation. For example, in case studies 1, 2, 5 and 9, some researchers moved from a fixed-term contract to a permanent position. However, it is difficult to ascribe this as a direct effect of the FP funding; in some cases it can be seen instead as the next step on the career ladder. Thus, employment effects might rather be indirect. For instance, in case study 2, a post-doc who received her PhD within the framework of the FP project reported that follow-up employment after the end of the project eventually led to her securing a permanent position (she moved from university to an industry partner from the FP project).

In terms of intersectoral mobility, only sporadic evidence was gathered for this issue. For example, in case study 1 a PhD student who worked in industry earlier was recruited for the FP project; he stayed in academia after the project expired, and then successfully pursued an academic career. He is currently holding an assistant professor's position.

Very limited evidence was gathered indicating that FP participation affected researchers actually moving to other organisations. Positive impacts were reported from cases 4 and 9: after the termination of the project all post-docs were able to continue their research career. The post-docs who were engaged in case study 4 were able to secure high-level fellowships which later led to more permanent positions e.g. associated professorships or managerial positions. In Case study 10, one researcher obtained her PhD based on the FP project and obtained a position at one of the other partner institutions after this. Case study 6 reported that as a researcher moved from academia to industry due to his involvement in the project, the contacts established due to the collaboration with industrial partners and the accumulation of relevant commercial expertise. In fact, in case study 6, career effects were experienced by researchers who actively took part in commercial activities; the experience gained during the project contributed to their move from academia to industry.

3.2.3. Evidence from desk research

Evidence on the short-, mid- and long-term impacts of different programmes or grants on researchers' careers is **mixed**. It is difficult to disentangle the different factors that jointly shape the development of careers.

Evidence reporting impacts of EU-funded research on researchers' careers, skills and expertise at the individual level is rather limited. Only very few studies have addressed these issues in the past. For example, in the context of the EURECIA project (Understanding & Assessing the Impact & Outcome of the ERC Funding Schemes) Laudel and Gläser (2012)[47], based on a limited number of interviews with researchers funded by the ERC, rather limited impacts of ERC funding on researchers' careers are evident. This is particularly the case for researchers who are already advanced in their career. "For several good reasons, the impact of the ERC funding schemes on academic careers that could be observed so far is much weaker than the impact on the grantees' research. It turned out that looking for impact on advanced grantees' careers does not make much sense because they all are very well established and independent, most of them being professors already. Owing to the eligibility rules for the first round of starting investigator grants (which set the limit to eight years after the PhD), many of the starting grantees were well established and completely independent, too" (Laudel and Gläser, 2012, p. 36).

However, according to Laudel and Gläser (2012, p. 31-32), there have been instances where grantees, due to the reputation of the ERC grant, were promoted, received extensions of their fixed-term-contract or were offered permanent positions. These were, however, limited to recipients of a starting grant only.

In addition, Laudel and Gläser also mention that these changes regarding the status of a grantee usually can only partially be attributed to the ERC grant. In addition, they also find that similar effects have been reported by recipients of important national grants (Laudel and Gläser, 2012, p. 31). It is also mentioned that due to the timing of the study, which was carried out while the grants are still effective, expected results regarding the impact on researcher careers were are rather limited as changes or career moves can only be assessed after the end of the project (Laudel and Gläser, 2012, p. 36).

[47] For details on the methodology and resulting limitations of the findings see Laudel & Gläser (2012).

As mentioned above, a study assessing the impact of FPs on individual researchers in the UK concludes that benefits of FP participation have had only a moderate impact on researchers' careers. Only about 29% of the survey respondents stated a high impact of FP participation while 39% said the impact was moderate. Another 33% perceived none or only low impact from FP participation on career development (Technopolis, 2010, p. 69). Altogether, these findings roughly confirm the mixed evidence from the individual level survey and the case studies with respect to the impact of FP participation on researchers' careers.

With regard to MSCA, the empirical evidence gained from the programme's evaluation points to some impacts on contractual conditions. According to the evaluation report covering FP4 to FP6-related activities most of the former grantees received permanent contracts. According to 53% of the supervisory respondents small improvements in the types of contract were achieved. However, only 31% of the respondents reported improved working conditions (The Evaluation Partnership, 2010, p. 92).

According to the findings of the evaluation of the FP6-related MSCA (The evaluation partnership 2010) career options and potential impact on career progression improved "with the duration of the fellowship" (p. 29). However, it was also the case that these effects seem to be less pronounced for researchers in later career stages (p.29). While on average 63% of the FP6-MCSA fellows reported that they perceived a significant impact of the fellowship on their career progression, this share was even higher among – at that time – fellows from candidate countries (77%) (p. 29-30). Nevertheless, if the fellows are to compare themselves with their peers, the share seems to be lower, e.g. 53% perceived more career progression than their peers and 51% perceived increasing job options (p. 31). Also the results from the interim evaluation of the FP7-related MSCA show rather high expectations regarding the impact of the fellowship on career development. The majority of fellows from various schemes estimated their career prospects to be good or very good (PPMI 2013, p. 62), with slight differences over the various schemes.

In sum, the above-cited studies seem to confirm the results of the present analysis with regard to the (more remote) *perceived* effects of FP on a researcher's career. As specified in sections 3.2.1 and 0, however, the impacts are likely to differ according to (a) at what point of her career and in what role a researcher was engaged in FP and (b) what type of impact the analytical focus on (e.g. immediate contractual conditions vs. mid-term contractual conditions; mid- vs. long-term publication records of the project consortium in evolving networks). This perspective also influences a researcher's personal evaluation of FP in terms of career implications.

3.3. Evaluation Question 3: Impact on contractual conditions

3.3.1. Survey evidence

Current use of contracts: Fixed-term contracts are prevalent in the Specific Programmes People and Ideas, whereas the teams in Capacities and Cooperation tend to employ their researchers on permanent contracts.

The survey data show clear differences between the research teams participating in Capacities, Cooperation, Ideas and People in terms of the prevailing types of contracts used. More specifically, 55% of the teams in Capacities and 53% in Cooperation employed the majority of their researchers (i.e. more than 50%) on **full-time permanent contracts**. The corresponding figure for Ideas was 9%, whereas People's research teams employed about 40% of their researchers on full-time permanent contracts. In terms of the organisation type, about 70% of the participating private industry companies and SMEs and only 26% of universities/HEIs employed the majority of their researchers on this type of contract.

Concerning the use of **full-time fixed-term contracts**, an opposite trend can be seen. Nearly half of the research teams in Ideas and a third in People employed the majority of their researchers on full-time fixed-term contracts, whereas in Capacities and Cooperation this type of contract was much less prevalent. The use of the fixed-term contracts was more widely practised in universities/HEIs (34%) than private sector companies and SMEs (14%).

Part-time contracts (both permanent and fixed-term) were rarely used across the four specific programmes of FP7. Around two thirds of the teams in these programmes had no researchers who worked on these types of contracts.

Concerning **grants, fellowships and stipends**, it can be observed that the teams in Ideas and People used them much more often than in those in Capacities and Cooperation. In the latter two programmes, nearly two thirds of the teams had no researchers employed through the use of grants, fellowships and stipends.

Table 8: Prevailing types of contracts used in FP research teams (n=4,832)

Type of contract	Number of researchers working on a particular type of contract	FP7 CAP	FP7 COOP	FP7 IDEAS	FP7 PEOPLE	Total
Full time permanent contracts	Majority (over 50%)	55%	53%	9%	40%	48%
	None	20%	18%	38%	24%	21%
Full time fixed-term contracts	Majority (over 50%)	18%	20%	49%	32%	24%
	None	44%	43%	12%	27%	38%
Part-time permanent contracts	Majority (over 50%)	7%	5%	1%	3%	5%
	None	63%	67%	85%	74%	69%
Part-time fixed-term contracts	Majority (over 50%)	9%	7%	7%	4%	7%
	None	58%	64%	67%	65%	63%
Grants, fellowships, stipends	Majority (over 50%)	4%	5%	19%	16%	8%
	None	65%	63%	34%	37%	57%

Source: Analysis of the team level survey data.

The table below points to further differences between the research teams of Capacities, Cooperation, Ideas and People. Crucially, more than 80% of the teams in Ideas relied primarily on **third party and project-based funding**, whereas the corresponding figure for both Capacities and Cooperation was 44%. The very strong reliance on third-party and project-based funding in Ideas appears to largely explain why so many of the researchers engaged in frontier research worked on fixed-term contracts.

In addition, the majority of the teams in Ideas included primarily junior researchers (69%), collaborated with academia (88%) and included mainly international researchers (67%). Although the teams in People were more similar to those in Cooperation and Capacities, they had some specific differences. In particular, the teams in People tended to include more junior researchers (52% in People versus about 35-36% in Capacities and Cooperation) and more often collaborate with academia (72% in People versus 50-55% in Capacities and Cooperation).

Table 9: Summary of key characteristics of the participating research teams (n=4,832)

Specific characteristics of the participating research teams	FP7 CAP	FP7 COOP	FP7 IDEAS	FP7 PEOPLE	Total
Relies primarily on the organisation's **own funds versus third-party funding**	44% vs. 56%	44% vs. 56%	17% vs. 83%	41% vs. 59%	41% vs. 59%
Includes primarily **junior researchers versus senior researchers**	36% vs. 64%	35% vs. 65%	69% vs. 31%	52% vs. 48%	41% vs. 59%
Pursues **specialised versus broad research agenda**	52% vs. 48%	55% vs. 45%	61% vs. 39%	57% vs. 43%	55% vs. 45%
Does research in **one versus a broad number of disciplines/scientific fields**	45% vs. 55%	48% vs. 52%	53% vs. 47%	49% vs. 51%	48% vs. 52%
Engaged in **national/regional versus international research networks and collaborations**	27% vs. 73%	24% vs. 76%	13% vs. 87%	25% vs. 75%	24% vs. 76%
Collaborates primarily with **academia versus industry**	50% vs. 50%	55% vs. 45%	88% vs. 12%	72% vs. 28%	59% vs. 41%
Includes researchers from a **single versus many different departments, divisions or centres within the organisation**	45% vs. 55%	52% vs. 48%	69% vs. 31%	56% vs. 44%	52% vs. 48%
Composed mainly by **national versus international researchers**	64% vs. 36%	59% vs. 41%	33% vs. 67%	52% vs. 48%	57% vs. 43%

Source: Analysis of the team level survey data.
Note: a continuous scale of 4 values was presented to the survey participants where they had to rank their team according to each of the statements. The first and the last two values of the scale were aggregated, following which the above results were computed.

Evolution in use of contracts: The use of fixed-term contracts has increased in the beneficiary teams since the start of FP projects. The growth rate of these types of contracts was also faster than that of permanent contracts.

The survey data show an increasing variety of employment contracts in the participating research teams. On average, the use of full-time permanent and fixed-term contracts rose by 20% and 27% in the participating research teams (see the table below for more details). An in-depth analysis also showed that 31% of the FP research teams that hired researchers primarily on full-time open-ended contracts had significantly increased the number of fixed-term contracts in their research teams since the beginning of the FP projects. In contrast, about 20% of the teams primarily

hired researchers on full-time fixed-term contracts and had significantly increased the use of full-time-fixed-term contracts since the start of the FP projects.

These findings imply a small overall **change in the ratio of permanent/fixed-term contracts** and a slight overall shift to the more widespread use of fixed-term contracts in the participating research teams. It must be noted, however, that the change was driven mainly by the **Ideas and People programmes**, where the growth of full-time fixed-term contracts was much faster than that of full-time permanent contracts. The ratio remained largely **stable in Capacities and Cooperation**, where the use of open-ended and fixed-term contracts grew at a similar rate.

Table 10: Changes in the number of researchers with different types of contracts (relative change from the start of the FP projects till the time of the survey)

Type of contract	Evolution	FP7 CAP	FP7 COOP	FP7 IDEAS	FP7 PEOPLE	Total
Full-time permanent contracts	Increased	23%	21%	11%	18%	20%
	Remained stable	70%	73%	83%	75%	74%
	Decreased	7%	6%	6%	7%	6%
Full-time fixed-term contracts	Increased	25%	24%	52%	31%	27%
	Remained stable	69%	72%	45%	64%	69%
	Decreased	6%	4%	3%	5%	4%
Part-time permanent contracts	Increased	12%	9%	5%	8%	9%
	Remained stable	84%	88%	91%	88%	87%
	Decreased	4%	3%	4%	4%	4%
Part-time fixed term contracts	Increased	18%	17%	20%	14%	17%
	Remained stable	77%	80%	76%	83%	20%
	Decreased	5%	3%	4%	3%	3%
Grants, fellowship, stipends	Increase	19%	18%	38%	33%	23%
	Remained stable	76%	78%	55%	62%	72%
	Decrease	5%	4%	7%	5%	5%

Source: Analysis of the team level survey data.

As will be further discussed in the section analysing the FP contributions to the team size (see section 3.7), the data also suggest an overall positive change in the size of the research teams. For all contract types, the number of the beneficiaries reporting an increase in their use was larger than the number of those who reported a decrease. A more detailed analysis based on inferential statistics shows that there is a significant positive association between previous participation in FP6 and FP7 and the changes in the mix of the contracts used. **More experienced organisations** (typically universities and HEIs compared to private research organisations and public sector research organisations) were more likely to **increase the use of full-time fixed-term contracts and fellowships/grants/stipends.** A similar trend was observed for the research teams that relied primarily on **third-party funding**. This illustrates the increasing incidence of project-based research work in these organisations.

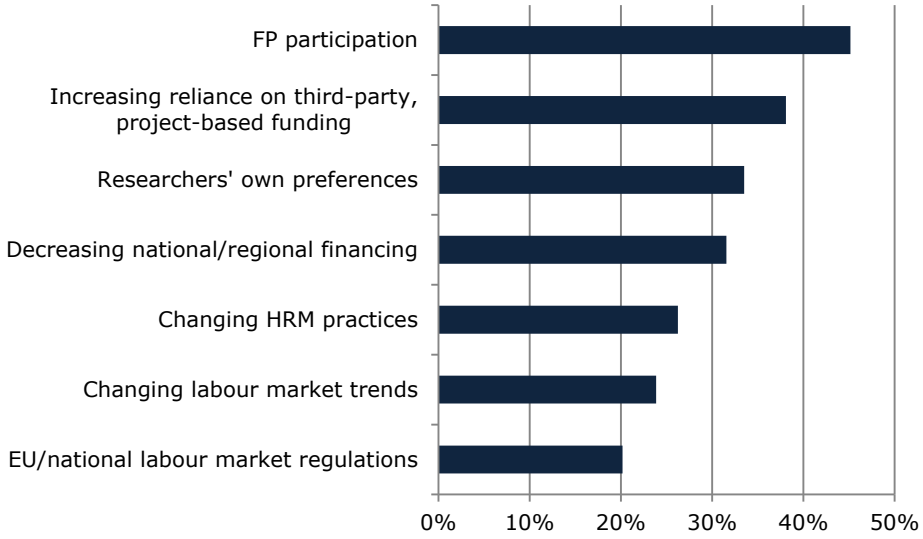
Moreover, the organisations whose top priority was to **attract more young researchers** also tended to increase the number of researchers working on fixed-term contracts and fellowships/grants/stipends. Private for profit organisations and organisations frequently collaborating with industry, on the other hand, experienced the highest relative increase in the use of full-time permanent contracts. The same could be said about the FP beneficiaries whose representatives mentioned

commercialisation of research results and creation of economic value/competitive advantage as important considerations when deciding to apply for FP funding.

FP participation was a key factor that contributed to the changes in the mix of the contract types used.

The figure below outlines the main factors that contributed to the presented changes in the mix of the contract types used. Almost half of the beneficiaries (45%) agreed to a large degree, or to some extent, that their participation in FP projects has influenced the use of the contracts over the past few years. A detailed statistical analysis of the data indicates that participation in FP-funded activities was the strongest factor contributing to the reported changes in the use of full-time permanent and full-time fixed-term contracts, as well as grants, fellowships and stipends. Increasing reliance on third-party research funding for short-term research projects (38%), researchers' own preferences (34%) and decreasing national/regional public financing (32%) were also mentioned as key reasons for the changes observed.

Figure 17: Main factors contributing to the changes the research teams' mix of employment contracts (n=4,832)



Source: Analysis of the team level survey data.

In the long term, however, FP participation translates into formal advancement and better working conditions as a result of the improved skills of researchers and their autonomy, gained through FP-funded activities.

The one-question follow-up survey among MORE2-respondents enabled identification of the differences regarding contractual conditions that emerged among the participants and non-participants of FP. The results showed that at the time of the survey the highest share of researchers employed under permanent contracts were the participants of both FP6 and FP7 (77%), followed by the participants of FP6 (63%) and FP7 (55%), while the overall average of permanently employed researchers was 55%. These differences can be attributed to the fact that the participants of FP6 were at later career stage or older at the time of the survey. With regard to position of employment (full-time/part-time), no differences among the participants and non-participants of FP were observed. On average, 91% of the researchers were in full-time employment at the time of the survey.

Although there was a small overall change in the ratio of permanent/fixed-term contracts and a slight overall shift to the more widespread use of fixed-term contracts as a result of FP participation, the results of the one-question survey show that in the long term FP participation translates into formal advancement and better working conditions, through greater skills and autonomy of the researchers involved in FP activities. The results of the individual level analysis confirm this explanation – although FP participation does not produce faster progress in career stages in the short term, it benefits FP participants in terms of more responsibility and greater autonomy.

3.3.2. Case study evidence

The use of particular types of contracts is highly **specific to organisation type**: industry participants and SMEs tend to offer permanent contracts, whereas universities and HEIs tend to employ their researchers on fixed-term contracts.

The case studies provided the supporting evidence that participation in FP projects enabled hiring additional researchers on fixed-term contracts. This can be attributed to the fact that the participating organisations were provided with an additional source of third-party funding which allowed them to employ more researchers on a temporary basis. In some countries such as Bulgaria, participation in FP-funded projects actually opened up the possibility for organisations to hire researchers on this type of contract, as otherwise only the use of permanent contracts was permitted. With regard to hiring practices at the end of the projects, it was observed that fixed-term contracts were generally more common in the participating academic institutions, whereas private industry companies and SMEs tended to employ researchers on full-time contracts more frequently.

The majority of case studies (case studies 3, 4, 5, 6, 7, 8, 9 and 10) showed that there were no significant changes in terms of contractual conditions at the organisation level. Typically, the institutional beneficiaries argued that they had already been applying leading HR practices and that there was no need to implement additional changes. Other explanations provided by the beneficiaries depended on the type of organisation. Public sector organisations (primarily universities and HEIs) suggested that they lacked autonomy in this area (see case studies 4 and 7) and were bound by national regulations and standards (e.g. regarding seniority-based promotions). Private sector research organisations were generally less likely to hire additional researchers and thus did not have an opportunity to practice new employment processes and procedures (see case studies 1, 2, 6, 8, 9). When they did hire new people, the companies and SMEs typically applied the recruitment practices that were common in their country and/or sector. **The case study findings thus indicate that participation in the FPs did not significantly change the ratio of fixed-term/open ended contracts in the majority of organisations.**

Although FP funding contributed to the greater use of fixed-term contracts, there was generally **no long-term impact at the organisation level**.

A significant share of the interviewed researchers was subsequently employed on open-ended contracts after working on fixed-term contracts before and during the projects. Based on the interview programme, researchers secured permanent employment contracts in seven out of the ten FP projects selected for the case studies.

However, even though a number of the interviewed researchers were offered open-ended contracts after the end of the EU-funded projects, there was no strong evidence to suggest that these changes had an impact on contractual conditions in the

participating organisations. Only a small minority of academic institutions acknowledged that certain marginal changes occurred as a result of their participation in FP projects. For instance, in case 1, the duration of temporary contracts became longer (i.e. from monthly to yearly contracts) because the institution was able to attract more funding due to participation in the EU-funded project. Another example is case 10, which showed that FP funding led to offering higher stipends or additional money to doctoral candidates. These two projects were supported by the Cooperation programme. The lack of changes in the remaining organisations (especially private sector companies and SMEs) was usually explained by the fact that private for profit organisations did not see the need for changing well-established practices and procedures as they were already essentially aligned with the leading practices found elsewhere.

3.3.3. Evidence from desk research

The analysis of desk research evidence confirms the information provided by survey and case studies, indicating that participation in FPs had a low positive impact on the contractual conditions (sometimes relating to the share of open-ended contracts) in the participant organisations.

For instance, the survey of COFUND beneficiaries carried out for the FP7 Marie Curie Life-long Training and Career Development Evaluation (Individual Fellowships and Co-funding Mechanism) showed that for 77% of beneficiary organisations participating in COFUND did not have an influence or had a weak influence on their approach to programme administration in terms of providing full employment contracts to researchers (23% indicate it had high influence in this area).[48] The Interim Evaluation of FP7 Marie Curie Actions showed only very low impacts on contractual conditions in the participant organisations: according to the survey results, 87% of beneficiary organisations indicated no changes in terms of introducing contracts with full social security to researchers, as a consequence of participation in the MCA (13% indicated at least some positive changes). Similarly, 79% of organisations indicated that there were no changes in terms of making salaries of researchers more financially attractive (21% indicated there were such changes).[49] Somewhat higher impacts on the type of contracts of FP beneficiary researchers were observed in the study on "Marie Curie researchers and their long-term career development": the study results showed that MC fellows were around 10% more likely to be employed on open-ended tenure contracts than other researchers.[50]

However, the evidence from previous evaluations also shows some positive impacts on other aspects of contractual conditions. For example, the FP7 Marie Curie Life-long Training and Career Development evaluation (covering individual fellowships and COFUND) showed that for 59% of MCA fellows, 63% of Individual Fellows and 50% of COFUND fellows the contractual conditions improved very much or at least to some extent during their Marie Curie Fellowship, compared with their previous research post. Thus, the available evidence confirms our findings that participation in FPs translates into formal advancement and better working conditions.

According to the qualitative evidence provided by the study "Marie Curie researchers and their long-term career development", for many researchers, participation in MC fellowships was the first step to become a leader of a research team (i.e. holding a principal investigator (PI) position). Participation in MC helped the participant fellows

[48] ECORYS, FP7 Marie Curie Life-long Training and Career Development Evaluation: Individual Fellowships and Co-Funding Mechanism, 2012.
[49] PPMI, FP7 Marie Curie Actions Interim Evaluation: Final Report. 7 February 2013.
[50] Economisti Associati, Marie Curie researchers and their long-term career development: a comparative study – Final Report, March 2014.

to develop their leadership skills and raise their degree of autonomy in research work: these horizontal skills were reported as making a major contribution to the acquisition of greater responsibilities and coordination roles after the fellowship. Statistical analysis confirmed these findings: MC fellows were around 11% more likely to hold a PI position in comparison to other researchers. Moreover, MC fellows were around 6% more likely to be associate professors and around 6% were more likely to be full professors, compared to control group researchers.[51]

[51] Ibid.

3.4. Evaluation Question 4: Impact on/of open recruitment

3.4.1. Survey evidence

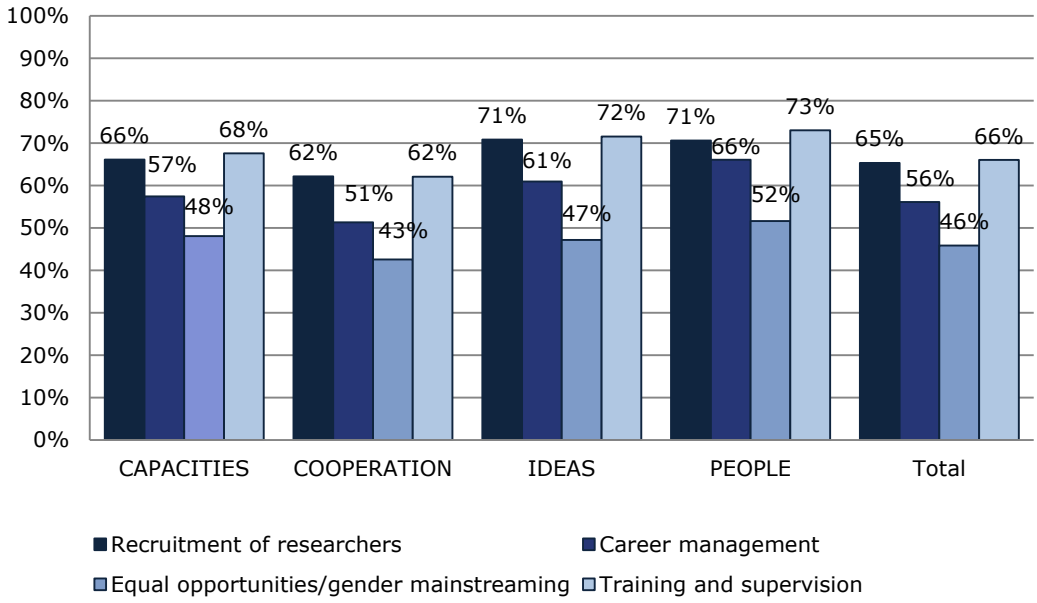
HR practices: FPs had a mixed effect on HR management in the participating organisations with variation across particular HR practices or country groups.

Based on the survey results, we estimate that a majority of FP beneficiaries improved their procedures and practices for the **recruitment, career management and training** of researchers. Nearly two-thirds (65%) of the beneficiaries strongly or rather agreed with the statement that their participation in the framework programmes contributed to the development of the procedures and practices for the recruitment of researchers. A similar share of the beneficiaries (66%) agreed with the related statement on the quality of training and supervision provided to researchers. On the other hand, the reported contributions to the policies and practices aimed at advancing equal opportunities and gender mainstreaming were assessed less positively (on average, 46% of the beneficiaries strongly or somewhat agreed with the associated statement).

The figure below shows a fairly similar distribution of impacts across the four Specific Programmes of FP7, although the contributions reported by the beneficiaries of the Cooperation were generally lower than the averages of other Specific Programmes. The survey also revealed that beneficiaries based in the EU-12 reported, on average, a higher contribution to the practices for the recruitment of researchers (60% of the surveyed strongly or rather agreed with the related statement) than their peers from the EU-15 (52%). Similar results emerge when the contributions are compared according to the results of the IMD World Competitiveness Scoreboard[52]. The analysis shows a statistically significant correlation between the reported level of contribution and the competitiveness score, meaning that the reported levels of the impacts were generally **lower for the more technologically advanced countries**. Discipline-wise, beneficiaries specialising in the humanities and natural sciences tended to report higher levels of contributions than in agriculture, education and services.

[52] The World Competitiveness Scoreboard presents the 2014 overall rankings for the 60 economies covered by the WCY. The economies are ranked from the most to the least competitive. < http://www.imd.org/uupload/IMD.WebSite/wcc/WCYResults/1/scoreboard_2014.pdf > [accessed on 2014 07 21]

Figure 18: Contributions to the HR and recruitment practices of the participating organisations (n=4,832)



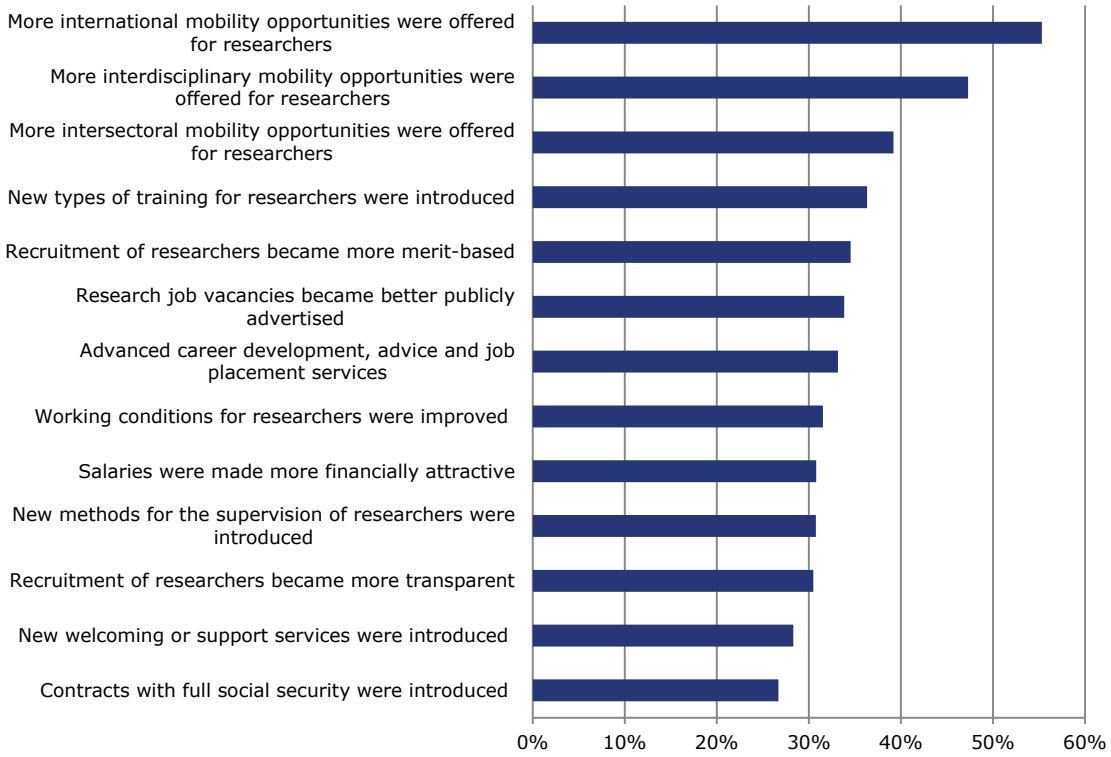
Source: Analysis of the team level survey data.

Inferential statistics was applied to further test the relationship between the outcomes reported and the beneficiaries' motivations and specific considerations when deciding to apply for FP funding. The in-depth analysis suggests that the beneficiaries whose top priorities were to **1) increase international, intersectoral and interdisciplinary cooperation; 2) attract more researchers; 3) enhance the career development of researchers;** or **4) improve the working conditions and gender balance of the team; also improved their HR policies and recruitment practices** to a significant degree. In contrast, the FP beneficiaries whose primary goal was commercialisation and increased competitiveness (i.e. largely organisations from the private sector) did not change their recruitment practices as significantly. Particularly strong impacts were reported by the organisations that acquired new and effective HR practices and techniques thanks to their participation in the FP. Previous participation in FP7 and FP6 projects also correlates positively with these HR impacts reported.

Recruitment: FPs contributed to a more transparent and merit-based recruitment of researchers in the participating organisations, differing depending on specific changes and types of organisations.

In addition to the more general question on the contribution to the organisations' HR policy, the beneficiaries were asked to detail the more specific changes to the recruitment and career management policies and practices. The survey results suggest (see the figure below) that participation in FP projects significantly increased the international (55% of the beneficiaries agreed with the related statement), interdisciplinary (47%) and intersectoral (39%) mobility opportunities offered to researchers. **Between 30-40%** of the beneficiaries indicated that their participation in the FP made the recruitment of researchers **more transparent and merit based** and contributed to the job vacancies becoming advertised more publicly. Private for profit organisations (including SMEs), on average, reported lower levels of impact in these areas (about 60% of these organisations indicated little or no impacts in these areas) than public research organisations (about 45-50% of the organisations reported little or no impact).

Figure 19: Specific changes in the beneficiary organisations' recruitment and career management practices (n=4,832)



Source: Analysis of the team level survey data.

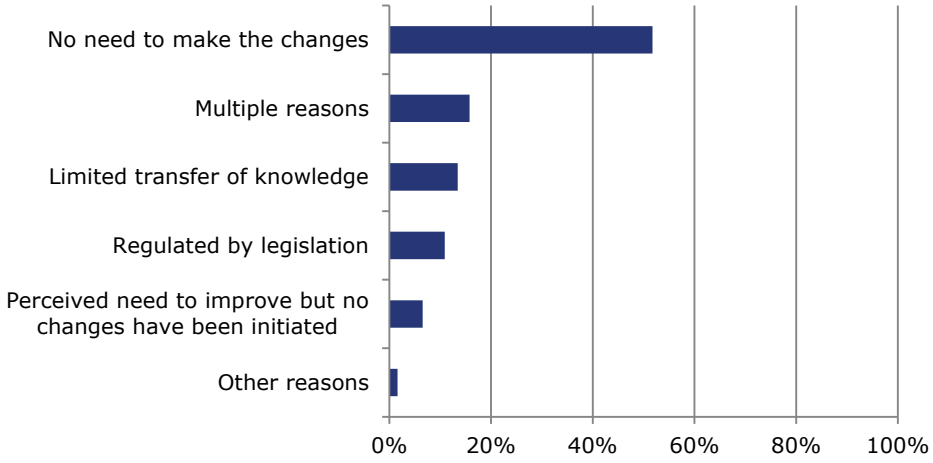
In-depth analysis of the survey results also points to the fact that the **organisations that changed their recruitment practices to a large extent also attracted a higher number of female researchers and researchers from other sectors** to their research teams. Moreover, the findings indicate that the organisations that made their job vacancies more public or applied more transparent and merit-based recruitment practices tended to attract **more researchers from abroad** (mainly the EU) **and other scientific disciplines** (than the dominating ones of the organisation).

Overall, the survey results point to moderate impacts achieved at the organisation level in terms of the development of HR policy and recruitment practices. A significant proportion of the organisations (i.e. often up to 60%, depending on the question asked) did not experience such impacts. A follow-up question was thus presented to those organisations enquiring as to why the procedures and practices of HRM were not implemented. The figure below shows that the majority in this group (about 52%) thought that there was no need to make these changes as the procedures and practices were already essentially aligned with leading recruitment and career management practices. Private industry companies, including SMEs, were particularly likely to choose this response (more than 64% did so), whereas the corresponding figures for universities/HEIs and public/government sector organisations were 46% and 45%, respectively.

Around 13% of the organisations indicated there was limited transfer of knowledge about practices and procedures of HR development from the participating research teams to other entities of the organisation which did not take part in the FP projects. Around 11% of the beneficiaries who did not experience significant impacts on their

HR policies and recruitment practices stated that the practices and procedures were regulated by national or regional legislation, thus any changes in this area were not possible to make. A further 7% of the organisations in this group thought that, despite the perceived need to improve some of the practices and procedures, no changes have been initiated by the organisations after the end of the project.

Figure 20: Main reasons why changes to the procedures and practices of HRM were not implemented (n=2,145)



Source: Analysis of the team level survey data.

Charter and Code: FP participation contributed to the spread of the European Charter for Researchers and Code of Conduct for the Recruitment of Researchers.

According to the one-question follow-up survey, there was rather limited awareness about EURAXESS, the European Charter for Researchers and Code of Conduct for the Recruitment of Researchers. Awareness of EURAXESS' services was higher among the participants of FP rather than non-participants (29% vs. 12%; with the overall overage of 16%). Only 20% of the researchers were aware of the European Charter for Researchers and Code of Conduct for the Recruitment of Researchers, with awareness levels highest among both FP6 and FP7 participants (36%), followed by FP6 participants (31%). This illustrates the contribution of FP participation to the spread of these instruments.

A more frequent application of the principles of the Charter and Code was observed among FP participants. With regard to transparency of the recruitment practices, FP participants viewed the recruitment processes as more transparent than did non-participants (57% vs. 42%, with the average of 49% for all respondents). FP participants also viewed recruitment at their home institutions as being more merit-based than did non-participants (54% vs. 46%, with the average of 48%). However, no difference was observed between FP participants' and non-participants' satisfaction in terms of the extent to which research job vacancies are publicly advertised and made known by their institutions (43% on average). There is evidence that research teams with previous experience in FPs follow, to a greater extent, the principles of the Charter for Researchers and Code of Conduct for Recruitment concerning transparency of the recruitment procedures.

3.4.2. Case study evidence

Recruitment practice: Limited evidence of FP funding affecting the participating organisations' procedures and practices for the recruitment of researchers.

The case studies provided limited evidence of FP funding affecting the participating organisations' procedures and practices for the recruitment of researchers. When asked to specify particular changes in HR practices, most of the interviewed beneficiaries mentioned the enhanced international, interdisciplinary and intersectoral mobility prospects offered to their researchers. These increased opportunities were often regarded as increasing the organisations' appeal to their potential employees (see case studies 1, 4, 5, 8 and 10). Also, FP beneficiaries became more attractive to researchers because of the scope and international research activities they offer as a result of participation in FPs.

Virtually all of the interviewed institutional beneficiaries regarded their recruitment practices during the FP projects as transparent and merit-based. The vacancies were typically openly advertised, but EURAXESS was not frequently used and in some instances the vacancies were advertised only nationally. However, the relative openness of the recruitment practices was not attributed to participation in EU-funded projects but, rather, it was perceived as being an already established process in the interviewed institutions. Overall, there was limited evidence to suggest that recruitment practices became more closely aligned with the principles of the Charter and Code in the participating research teams and organisations as a result of their participation in the FPs.

Some of the interviewed institutional beneficiaries (mainly from universities) actually revealed that in some cases they relied on personal contacts and sought to hire national researchers when looking for new researchers for the projects. Fully open recruitment procedures and practices were thus not always pursued. The main motivations behind the recruitment of already known researchers were based on the perception that those researchers already had the competences and knowledge required for the project. Also, national researchers are usually employed for more junior positions that are more frequently available in FP projects. Moreover, it was claimed that these practices increased the possibility that such researchers would not leave the organisations after the end of the project if they were offered another employment contract. However, such practices followed by the participating organisations may reduce their ability to attract more qualified researchers.

With regard to spill-overs within networks, some of the interviewed institutional beneficiaries shared insights about the transfer of knowledge between the participating project partners. For instance, a university from case 9 indicated that, thanks to participation in FP, the organisation built a strategic partnership with the project coordinator, a large private research company. Through this partnership the two organisations jointly facilitated the exchange and hiring of some of the staff. The case studies found no spill-overs at regional or national levels in terms of transferring new or improved HR practices to other organisations operating at the same territorial level.

Gender balance: In some cases, achieving an appropriate gender balance in the project activities was challenging despite effort and the introduction of new practices.

The project consortia generally recognised the importance of gender equality within their planned activities and the subsequent project results. The institutional beneficiaries put strong efforts into following the EC's recommendations and targets set for achieving an appropriate gender balance. Despite the apparent efforts to

ensure an appropriate gender balance in the research teams, the targets were not always met. For example, only 31% of all researchers were women in case 9 (a project primarily run by SMEs). The result was unexpected, considering that the gender ratio in biosciences is typically fairly balanced and given the fact that the consortium applied various gender equality measures in the project. A possible explanation was that the project activities involved a large amount of technical/assembly work, which was typically carried out by men. Another possible explanation (also found in case 4) was that there was a general lack of qualified and experienced female researchers for more technical/engineering-based project activities. As a result, in some projects the apparent attempts to improve the gender balance were not successful. On the other hand, case 10 observed that the majority of researchers involved in this humanities project, which was carried out by higher education institutions, were women (including the coordinator and many team leaders). This points to considerable variation across different scientific domains in terms of gender balance.

HR practices: There was a general perception (especially among industry participants and SMEs) that the procedures and practices were already essentially aligned with leading practices found elsewhere, hence no additional change was needed.

To conclude, there is limited evidence to suggest that participation in FP-funded projects selected for the case studies improved the HR practices of the participating organisations. The practices and procedures were perceived as appropriate in the majority of the analysed case studies and most of the interviewed institutional beneficiaries (especially private sector companies and SMEs) believed that they had already complied with leading practices and procedures found elsewhere. However, these perceptions may not be fully in line with the principles of the Charter and Code concerning open and transparent recruitment procedures, especially for non-nationals.

As a result, the interviewees generally reported limited impacts on the closer alignment of recruitment procedures to the remaining principles of European Charter for Researchers and Code of Conduct for Recruitment of Researchers. The most significant contributions were related to the recognition of the value of geographical, intersectoral and inter-disciplinary mobility, as well as the increased attractiveness of the participating organisations to employees as a result of FP funding.

The relative lack of impacts may also be attributed to the fact that the majority of the selected cases studies involved participants from the more technologically advanced countries (based on the IMD World Competitiveness Scoreboard) that have more advanced HR practices. Another reason for the apparent lack of HR impacts observed in the case studies may be that a significant proportion of the projects selected for the case studies were run by or involved many private sector companies and SMEs. As shown by the survey results, those organisations were less likely to change their HR practices and recruitment policies and generally perceived little need for change in this area. Therefore, the further promotion of open recruitment and other HR practices of the Charter and Code should be addressed particularly to private sector organisations, including SMEs.

3.4.3. Evidence from desk research

In general, the results of the MORE2 HEI survey indicate that the satisfaction of European researchers with the recruitment process varies substantially from country to country. Overall, when asked their opinion about recruitment policies at their institution, around 34-40% of EU HEI researchers agreed that they were "dissatisfied" with levels of openness, transparency and the degree of merit-based recruitment. The researchers from the UK were the most satisfied with all three aspects of recruitment process (around 80% of researchers indicated satisfaction), whereas the Italian researchers were the least satisfied with open and transparent recruitment (between 30% and 45% were satisfied) and one of the least satisfied with merit-based recruitment. The survey also found that female researchers and researchers at early stage of their career were less satisfied with the recruitment process.[53]

The available desk research evidence confirms the findings from the team level survey and case studies, according to which participation in FPs had no or low impact on the openness of recruitment practices in the participant organisations. For instance, the results of the survey of COFUND and Individual fellowships (IFs) under FP7 People's Programme revealed that the majority (61%) of host organisations indicated that their participation as a host in the Marie Curie Actions (MCA) did not improve the openness of recruitment in terms of transnational and trans-sectoral mobility in their organisation. Similarly, 73% indicated that participation as a host did not contribute to the use of transparent evaluation criteria in the operational and administrative procedures in their organisation, 72% agreed that it did not contribute to the consideration of equal opportunities criteria in assessing applications and 71% indicated that participation as a host did not improve the transparency of the operational and administrative procedure in their organisation.[54]

Similarly, the results of the FP7 Marie Curie Actions Interim Evaluation confirmed that participation in FPs had either no or low impact on the openness of recruitment process in the research. According to the results of the survey of MC beneficiary organisations, when asked to what extent their participation in the Marie Curie project changed their practices for managing the careers of other (non-Marie Curie) researchers in their organisations, 70% of survey respondents indicated that the participation had no impacts in terms of recruitment of researchers becoming more transparent and another 74% indicated no impacts in terms of it becoming more merit-based.[55]

[53] IDEA Consult, Support for continued data collection and analysis concerning mobility patterns and career paths of researchers, Brussels, August 2013.
[54] ECORYS, FP7 Marie Curie Life-long Training and Career Development Evaluation: Individual Fellowships and Co-Funding Mechanism, 2012.
[55] PPMI, FP7 Marie Curie Actions Interim Evaluation: Final Report. 7 February 2013.

3.5. Evaluation Question 5: Impact on composition, size, organisation and management of research teams

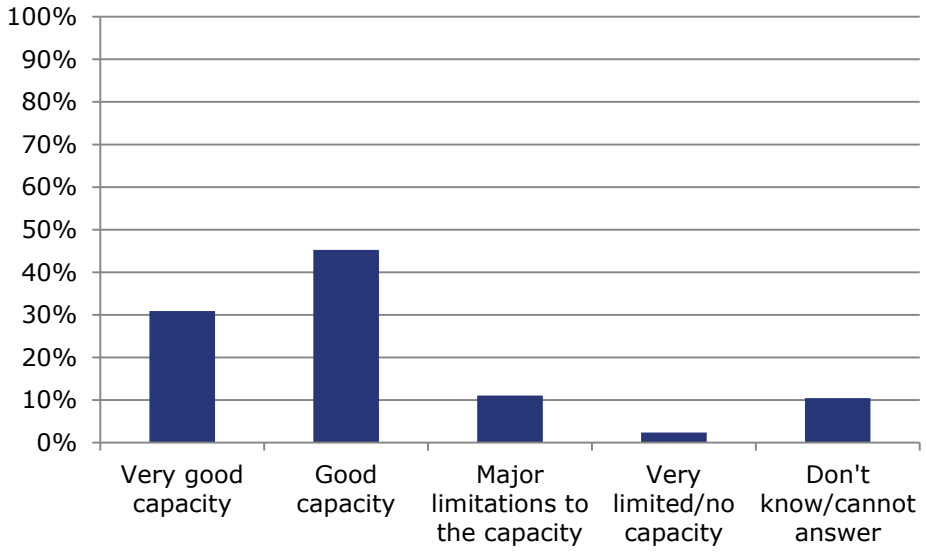
3.5.1. Impact on composition and size of research teams

3.5.1.1. Survey evidence

Impact on team size: Significant impact of around 142,000 additional researchers hired by the beneficiary research teams during the implementation of FP projects, which corresponds to an average of 1.3 researchers per research team.

FP research teams were first asked to indicate their capacity to carry out the FP projects before they began. The responses indicate that around one third of the research teams did not have any issues when finding enough researchers from the existing pool who were available before the projects started. Nearly half of the beneficiary teams indicated that their overall capacity to carry out the research activities was good and that they only had to look for some reinforcements. The majority of the activities in those teams were carried out by researchers who had been available before the projects started. Only about 15% of the teams had major limitations in terms of capacity and had to find significant numbers of reinforcements from outside their existing research teams. It is important to note, however, that about 30% of the teams in Ideas faced this kind of major limitation to their capacity, whereas the corresponding figures were substantially lower for Cooperation (16%), People (15%) and Capacities (14%, see Figure 21).

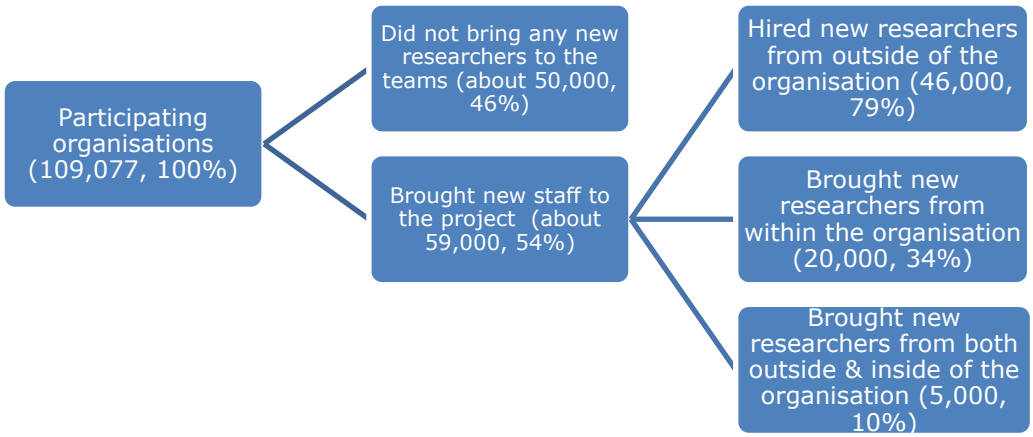
Figure 21: Capacity of the research teams to carry out collaborative research of the FP projects before they started (n=4,832)



Source: Analysis of the team level survey data.

Our estimates show that around 46% of the beneficiary research teams only used the researchers that were available before the start of the project. The remaining 54% of the beneficiaries (35-36% in Cooperation and Capacities, 79% in Ideas, 51% in People) brought new staff to their teams for project purposes. Nearly four fifths of those beneficiaries hired additional researchers from outside of their organisations, while some 34% attracted additional researchers from other research teams/departments/divisions/centres within their organisations. About 9% of the beneficiaries brought researchers from both outside and inside of their organisations.

Figure 22: Hiring patterns of the beneficiary research teams



Source: Analysis of the team level survey data.

Based on the data provided by the survey participants, our estimates show that the participating organisations hired more than 142,000 additional researchers from outside of the organisation[56]. Given that there were about 109,000 institutional FP beneficiaries at the time of the study, an average of 1.3 researchers was additionally hired per team.

The largest number of researchers was hired in the Cooperation programme (totalling almost 48,000 researchers), followed by Ideas (37,000), People (28,000) and Capacities (26,000). However, once the employment figures were adjusted for the number of participating organisations in each programme, it emerged that the beneficiaries of Ideas and People, on average, hired more additional researchers from outside of the organisation than the beneficiaries of Capacities or Cooperation (see Table below).

Statistical analysis shows that the number of additional, hired researchers was inversely related to the research teams' capacity to carry out their FP project activities. The less capacity the research teams had before the project start, the more researchers they recruited for project execution.

[56] The estimate is based on the weighted employment figures provided by the respondents. Some data cleaning needed to be performed to arrive at the figure. The data cleaning was performed in two stages. First, the data were checked for consistency and feasibility. In the second stage, the data that were assessed as inconsistent (e.g. where respondents reported higher number of female/international researchers hired than the total number of researchers hired) or not feasible (e.g. some respondents reported that they had hired thousands of researchers) were cleaned. Depending on the specific programme in which the respondents participated, the cleaned data were replaced with average employment figures for Cooperation, Capacities, Ideas and People. In total, about 10-15% of the responses were adjusted this way.

Table 11: Estimated number of researchers hired from outside of the organisation

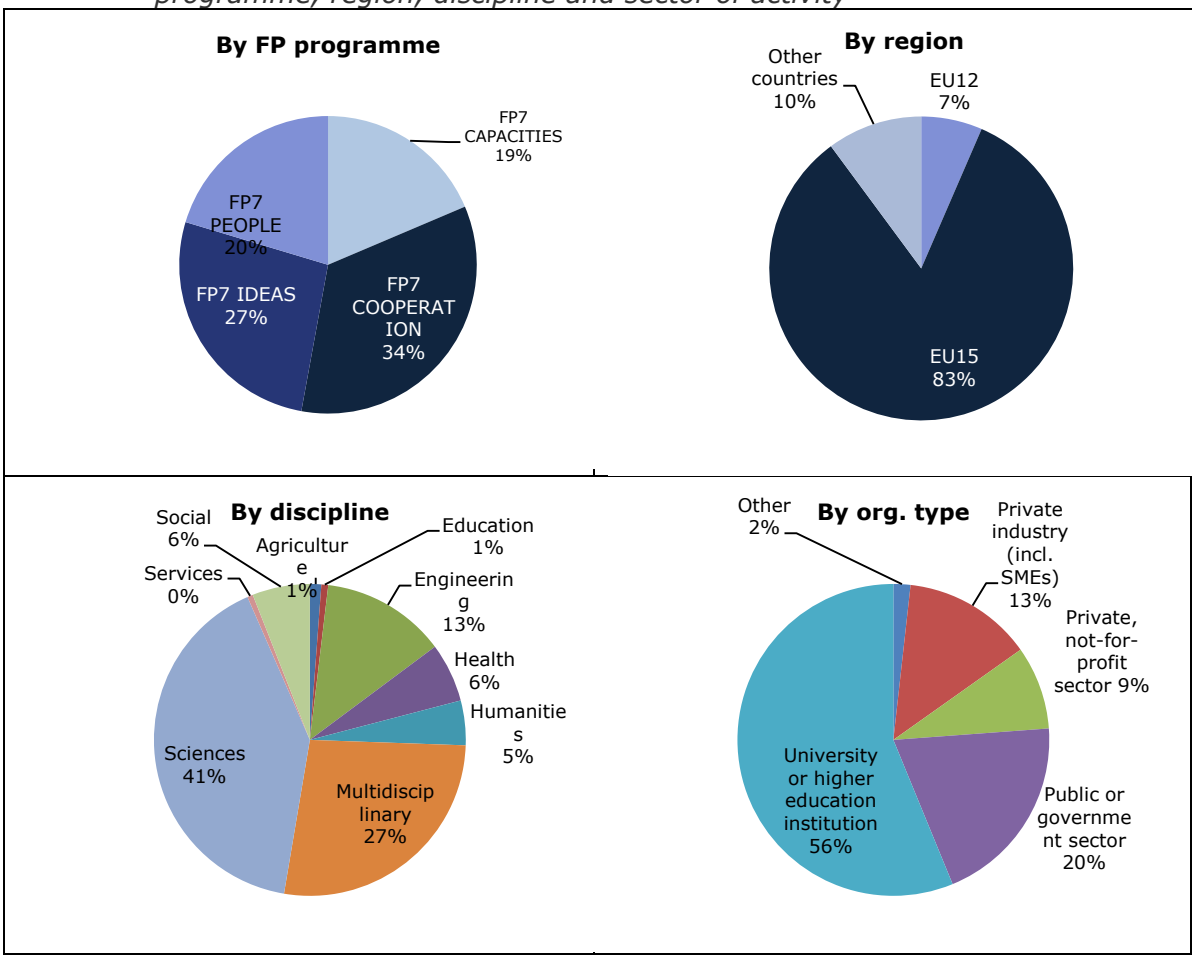
	FP7 CAP	FP7 COOP	FP7 IDEAS	FP7 PEOPLE*	Total
Estimated number of researchers hired	26,065	47,982	37,475	28,522	142,731
Number of participating organisations/research teams	17,381	78,790	4,450	8,456*	109,077
Estimated number of researchers hired per organisation	1,5	0,6	8,4	3,4	1,3

Source: Analysis of the team level survey data.
Notes: * - the figure includes only the participants of the host-driven actions of the Marie Curie Actions, including IAPP, IRSES & ITN.

Impact on team size per region, organisation type and discipline: The impact on the size of research teams was the most significant among HEI or public sector teams from EU-15 specialising in Engineering, Sciences or multidisciplinary research.

The figures below further specify the employment figures by region, discipline and organisation type. Our estimates suggest that the FP research teams based in the **EU-15** hired 83% of the additional researchers, whereas only 7% of the additional hiring was undertaken by the teams based in the EU-12. A breakdown by scientific discipline shows that projects in **Engineering and Sciences or the multidisciplinary** domains contributed to more than 80% of the hiring. More than three quarters of the researchers were hired by **universities/HEIs** (56%) or **public or government sector** institutions (20%). Private industry companies, including SMEs, which are smaller organisations compared to universities/HEI, hired approximately 13% of the researchers. On average, Universities/HEIs and public sector research organisations hired almost two additional researchers per organisation, as opposed to less than one additional researcher hired in private industry and private not-for-profit organisations.

Figure 23: Breakdowns of estimated number of additional researchers hired by FP programme, region, discipline and sector of activity



Source: Analysis of the team level survey data.

Impact on team composition: A significant impact, particularly by People and Ideas, on the composition of beneficiary research teams in terms of increasing the share of female and international researchers

Our estimates show that 44% of the additionally hired researchers were women. The figures were largely similar across the different framework programmes.

Concerning the hiring of international researchers, however, the research teams in Capacities and Cooperation were less likely to hire international researchers than the teams in Ideas and People. In People, more than two thirds of the additionally hired researchers came from abroad, closely followed by Ideas (62%). In Capacities and Cooperation, however, the share of additionally hired international researchers was substantially below the FP average of 50%.

Table 12: Estimated number of additionally hired female and international researchers by FP programme

	FP7 CAP	FP7 COOP	FP7 IDEAS	FP7 PEOPLE	Total
Estimated number of additionally hired researchers	26,065	47,982	37,475	28,522	142,731
Of whom are female researchers	44%	46%	43%	45%	44%
Of whom are international researchers	35%	35%	62%	68%	50%

Source: Analysis of the team level survey data.

The following two tables summarise the number of additionally hired female and international researchers by organisation type and scientific discipline. The estimates show that private industry organisations, including SMEs, hired a substantially lower proportion of female researchers (36%) than public or government organisations (47%) or universities/HEIs (46%).

A similar trend can be observed in the hiring of international researchers, where private sector research organisations kept the hiring of the researchers comparatively low as compared to universities/HEIs.

In terms of the scientific disciplines, it emerged that around 50% of the additionally hired researchers were female in the Agriculture, Health, Humanities, Services, Social Sciences and Multidisciplinary disciplines, whereas the share was substantially lower in Engineering (only 27%), Education (41%) and Sciences (43%).

At the same time, the teams specialising in Sciences and Humanities hired the largest share of international researchers (60% and 59%, respectively), significantly exceeding the related hiring in other scientific disciplines.

Table 13: Summary of hiring statistics of female and international researchers by organisation type

	Other	Private industry (including SMEs)	Private, not-for-profit sector	Public or govern-ment sector	University or higher education institution	Total
Estimated number of researchers hired from outside of the organisation	2,517	19,151	12,345	28,493	80,223	142,731
Percentage of whom women	55%	36%	42%	47%	46%	44%
Percentage of whom international researchers	45%	39%	38%	43%	57%	50%

Source: Analysis of the team level survey data.

Table 14: Summary of hiring statistics of female and international researchers by scientific discipline

	Agriculture	Education	Engineering	Health	Humanities	Multidisc.	Sciences	Services	Social	Total
Estimated number of researchers hired from outside of the organisation (in thousand)	1.7	1.0	18.4	8.7	6.6	38.7	58.2	0.8	8.5	142.7
Percentage of whom women	50%	41%	27%	53%	55%	50%	43%	52%	50%	44%
Percentage of whom international researchers	29%	38%	47%	43%	59%	40%	60%	38%	40%	50%

Source: Analysis of the team level survey data.

Further analysis revealed, however, that **participation in FP projects actually contributed to the improvement of gender balance in organisations and scientific disciplines where the hiring of female researchers was low**. As shown in the two tables below, the share of additionally hired female researchers in private industry companies and SMEs (36%) was higher than the overall share of female researchers working in these organisations (31%). Similar trends could also be observed in Engineering and Sciences, where the share of additionally hired female researchers, albeit significantly lower than 40%, was still higher than the overall share of female researchers in the teams.

Table 15: Share of female researchers in participating research teams by organisation type

	Other	Private industry (including SMEs)	Private, not-for-profit sector	Public or govern-ment sector	University or higher education institution	Total
Estimated total number of researchers working in FP research teams (in thousand)	20.6	260.2	155.4	256.7	433.8	1,126.8
Percentage of whom women (versus percentage of additionally hired researchers in FP projects who were women)	36% (vs. 55%)	31% (vs. 36%)	45% (vs. 42%)	38% (vs. 47%)	39% (vs. 46%)	38% (vs. 43%)

Source: Analysis of the team level survey data.

Table 16: Share of female researchers in participating research teams by scientific discipline

	Agriculture	Education	Engineering	Health	Humanities	Multidisc.	Science	Services	Social	Total
Estimated total number of researchers working in FP research teams (in thousand)	25.8	11.0	253.9	70.9	17.2	355.7	314.5	19.7	58.0	1,126.8
Percentage of whom women (versus percentage of additionally hired researchers in FP projects who were women)	48% (vs. 50%)	51% (vs. 41%)	24% (vs. 27%)	62% (vs. 53%)	54% (vs. 55%)	41% (vs. 50%)	39% (vs. 43%)	44% (vs. 52%)	37% (vs. 50%)	38% (vs. 44%)

Source: Analysis of the team level survey data.

Impact on team size is long-term: about 43%, or 61,000, of the additionally hired researchers stayed in their teams after the project completion. The impacts were highest for researchers hired by private industry organisations and SMEs.

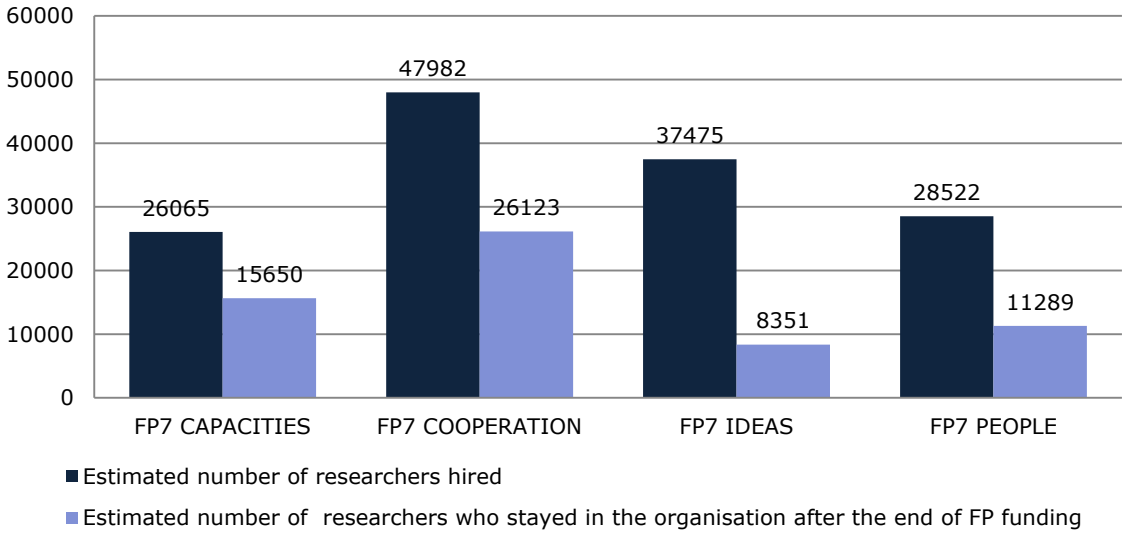
A follow-up question was presented to those beneficiaries who recruited additional researchers from outside of the organisation, requesting details on the number of researchers who stayed in the teams after the end of FP funding. Our estimates indicate that about **43%, or 61,000, of the additionally hired researchers stayed in the teams**.

The figures vary substantially across the different specific programmes, however. The largest share of the researchers staying in their teams was observed in Capacities (60%) and Cooperation (54%). In Ideas, meanwhile, about a fifth of the researchers stayed in their teams. Hence, although an average beneficiary of Ideas hired 8.4 additional researchers from outside of the organisation (Table 11), only about 1.8 of the positions were extended beyond the end of the projects.

The survey data also point to significant differences across the participating types of organisations. Our estimates suggest that more than two-thirds of the researchers hired by private industry organisations and SMEs stayed in their teams after the end of the projects. The corresponding figures were significantly lower for private, not-for-profit research organisations (46%) and public or government sector organisations (39%). Furthermore, only 25% of the additionally hired researchers stayed in the teams of universities and HEIs after the end of the FP projects.

Inferential statistical analysis showed a medium-strength correlation between the organisations whose researchers stayed and organisations which improved their practices and procedures for introducing contracts with full social security, improving working conditions, introducing new welcoming or support services, offering new types of training for researchers and interdisciplinary mobility opportunities, as well as providing guidance on career development and job placement.

Figure 24: Estimated number of researchers who stayed in the beneficiary organisations after the end of FP funding



Source: Analysis of the team level survey data.

Our estimates based on the survey data show that about 42% of the female researchers who were additionally hired for the project subsequently stayed in the research teams after the end of FP funding. Since 43% of all researchers remained working for the organisations that hired them, this suggests that male and female researchers were almost equally likely to stay in the organisations beyond the duration of the projects. The data clearly indicate, however, that **international researchers were less likely to stay** in their research teams after the end of the funding (i.e. 34% of the researchers stayed, versus the average of 43%).

Figure 25: Estimated number of female and international researchers who stayed in their research teams after the end of FP funding

Source: Analysis of the team level survey data.

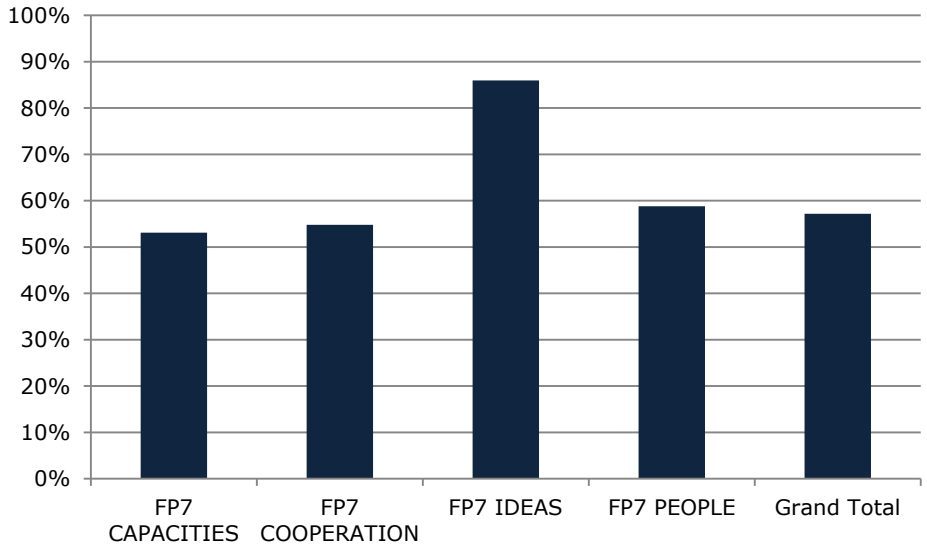
At the level of the individual teams: The majority of team level survey respondents confirmed that participation in FPs had a positive impact on the size of their research teams. A large share of respondents also indicated that FPs had a significant impact on the composition of their research teams.

Considering the figures presented above, it was not surprising that the majority of the beneficiaries experienced a positive change in the size of their research teams. More specifically, 60% agreed there had been an overall a positive change in the size of the research teams as a result of their participation in the FP projects. For Ideas the figure

was close to 90%, whereas for Capacities, Cooperation, People it ranged between 56-62%.

A more detailed statistical analysis showed that organisations for which FP contributions helped to improve their recruitment and career management procedures also tended to hire more researchers and keep them after the project. In addition, the beneficiaries claiming that FP contributions helped them to advance equal opportunities tended to hire more female researchers. The analysis also showed that the realisation of leverage of other types of funding to support research had a positive effect on the number of additionally hired new researchers. Closer collaboration with other countries, disciplines and sectors also correlated positively with the number of researchers who stayed in the teams after the end of the projects.

Figure 26: Percentage of research teams that experienced large or limited positive change in terms of their size



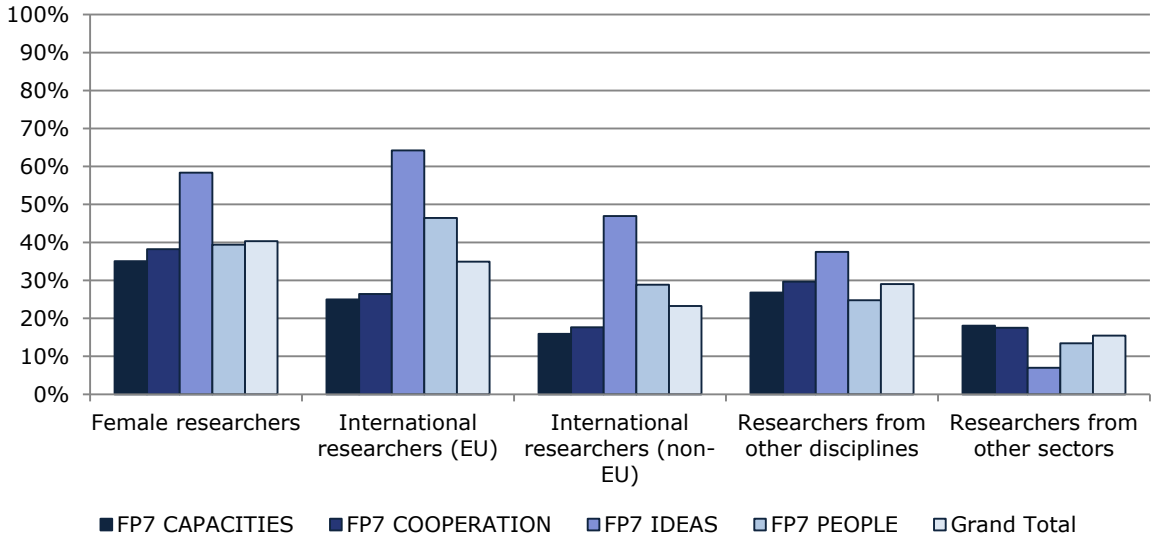
Source: Analysis of the team level survey data.

Regarding the overall change in team size and its composition, the most significant changes concerned the **attraction of more female researchers** (40% of the beneficiaries thought there was a significant or some increase), followed by attraction of researchers from other EU countries (34%) and disciplines other than the dominating disciplines of the research teams (29%). Attraction of researchers from non-EU countries (23%) and other sectors than the dominating ones of the research teams (15%) did not feature as prominently among the contributions mentioned.

It is evident from the figure below that the research teams in Ideas tended to report higher contributions than did the beneficiaries of Cooperation or Capacities.

When the results were compared across the different organisation types, it emerged that private industry organisations and SMEs tended to report fewer changes in the composition of their teams in terms of attracting additional female researchers (26% reported a significant/some increase) to the teams than did private, not-for-profit organisations (39%), public or government sector organisations (39%) or universities/HEIs (51%).

Figure 27: Changes to the research teams' composition (n=4,832)



Source: Analysis of the team level survey data.
Note: Percentage of the beneficiaries who thought there was a significant/some change to their research team compared to the situation before the project

3.5.1.2. Case study evidence

Moderate impact on team size: Although most of the case studies indicate growth in the size of the beneficiary research teams, in some the impact was not long-lasting and junior researchers left their teams after project completion.

The evidence provided by some of the case studies indicates that participation in FP projects had a limited direct effect on the composition and size of research teams involved. Usually in these cases, junior staff recruited specifically for the project left the participating organisations (often voluntarily and after completing their PhDs) after the project completion, whereas senior staff were already working at the organisation before the project started. In these cases, although there was some growth in the size of the research team during the project implementation, the effect was not long-lasting (see case studies 9 and 10).

Other case studies, however, revealed that research teams grew in the organisations that managed to attract additional FP funding. In some of these cases (see case studies 1, 3 and 6) the initial size of the research teams employed by respective organisations increased about three times *after* the successful project implementation (indirect job creation). In other cases, however, FPs had only a direct job creation effect: more researchers were employed during the project implementation but left the team after the project's end (see case study 5). Participation in FP projects helped employ more staff not only because of the direct financial support it provided but also as a result of the leverage effect it caused. Increases in reputation due to participation in successful FP projects raised organisations' competitiveness in applying for research funds and helped these organisations attract funding from private enterprises and venture capital firms.

In addition, the case study findings indicate that universities were more prone to hire new researchers and thereby employed larger research teams in comparison to private research organisations and SMEs that were more reluctant to hire new researchers. In these cases, where FPs made an impact on the size of the research teams involved, this usually led to permanent employment after successful project implementation for PhD researchers or young post-docs who had recently finished their PhDs.

Impact on team composition: Participation in FPs helped to increase diversity in terms of gender, nationality and scientific disciplines

Similarly, some positive impacts were also reported in terms of the composition of research teams. Usually, the interviewees reported that participation in their FP project helped reduce the gender and nationality barriers in their research team. As a consequence, more women and researchers from abroad were hired to help with the implementation of respective projects, at the same time improving the gender balance within the research team and encouraging its internationalisation (although the net effect on hiring international researchers was limited). The evidence provided by some case studies also indicates that the implemented projects helped hire more researchers with different skills sets and knowledge, resulting in increased capacities to undertake interdisciplinary research in future projects (see case studies 1, 3 and 10). Since universities tended to hire most of the new researchers, the impact on composition of research team was most evident among the university partners.

3.5.1.3. Evidence from desk research

Due to the lack of relevant previous studies and evaluations focusing on this question, there is little evidence from desk research on the impact of FPs on the composition and size of beneficiary research teams. However, some indirect evidence confirms the findings of our study indicating that participation in FPs had a positive impact on the employability of beneficiary researchers in their host organisations and contributed to the growth in the size of respective research teams. The survey carried out for the FP7 Marie Curie Life-long Training and Career Development Evaluation (Individual Fellowships and Co-funding Mechanism) provided evidence indicating that following the completion of their fellowship, 39% of MCA fellows, 41% of individual fellows and 32% of COFUND fellows expected to remain in the institution where they completed their fellowship. Similarly, analysis of the FP6 Marie Curie projects revealed that around 90% of the former MC fellows found a job and were in employment two years after the end of the MC project.[57]

Other studies also confirm our findings from surveys and case studies indicating that participation in FPs had a positive impact on the long-term employability of researchers and the size of beneficiary research teams. Results of the study on "Marie Curie researchers and their long-term career development" showed that experienced MC fellows had a 4% higher probability of moving from unemployment to employment after the fellowship than control group researchers. Moreover, the study also found that more than half of MC fellows remained within the host institution after the end of fellowship: in the case of multiple/long-duration MC fellowship (lasting more than 36 months), the probability that fellows remained in the host institutions after the end of the fellowship was 11% higher for MC fellows, in comparison to the control group researchers.[58]

[57] ECORYS, FP7 Marie Curie Life-long Training and Career Development Evaluation: Individual Fellowships and Co-Funding Mechanism, 2012.

[58] Economisti Associati, Marie Curie researchers and their long-term career development: a comparative study – Final Report, March 2014.

Similarly, there is evidence confirming our finding that participation in FPs has a positive impact on composition of beneficiary research teams. The survey of successful organisations participating in the IAPP and IRSES Actions under FP7 Marie Curie Actions, for instance, revealed that 76% of the surveyed organisations indicated that participating in MCA provided more opportunities to attract researchers to their organisations from abroad.[59] According to the results of the study on "Marie Curie researchers and their long-term career development", MCA had a positive effect on female researchers: MC female fellows reported on average one more country of employment than non-MC female researchers.[60]

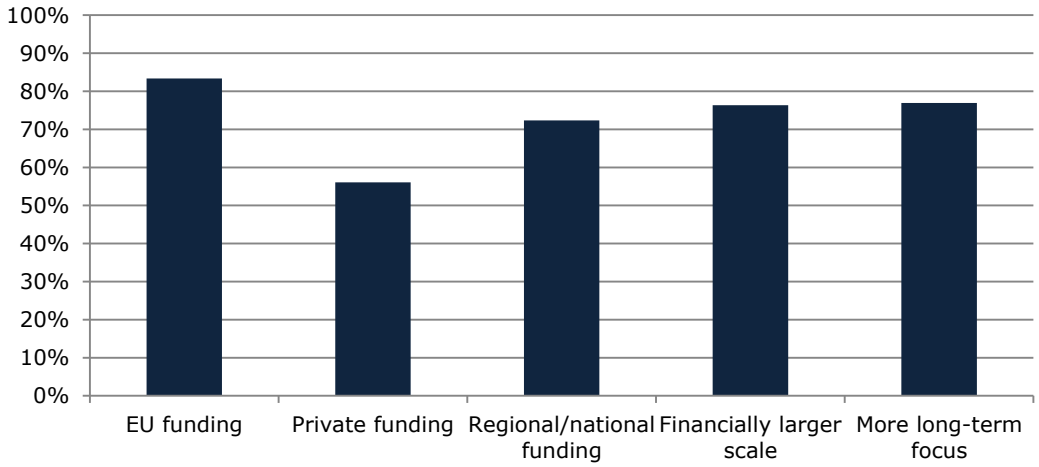
3.5.2. Impact on ability to attract additional funding

3.5.2.1. Survey evidence

A significant impact in terms of increasing the ability of participant organisations to attract additional funding from the EU, national/regional and, to a lesser extent, private funds.

A dedicated survey question on the ability of the beneficiary organisations to attract additional funding shed some light on the complementarity between FP and national/regional/private funding sources. More specifically, the question was aimed at determining whether the projects helped attract additional EU, private or national/regional funding. A significant majority of the beneficiaries strongly or agreed somewhat that FP funding affected their ability to attract EU (83%) as well as national/regional (72%) funding. The results were very similar in terms of the ability to run projects on a financially larger scale and with a more long-term focus. About 75% of the beneficiaries reported significant impacts in these areas. The lowest impacts were reported with respect to the ability to attract more private funds, where 56% of the beneficiary organisations strongly or rather agreed to the statement presented.

Figure 28: Impact of FP funding on the organisation's ability to attract additional funding (n=4,832)



Source: Analysis of the team level survey data.

[59] PPMI, FP7 Marie Curie Actions Interim Evaluation: Final Report. 7 February 2013.
[60] Economisti Associati, Marie Curie researchers and their long-term career development: a comparative study – Final Report, March 2014.

Overall, the survey results seem to suggest that the FP and national or regional funding were highly complementary and that substantial leverage effects could be achieved nationally and at the EU level as a result of the organisations being beneficiaries of the framework programmes. There was less complementarity between FP funding and ability to attract additional private funds. Statistical analysis showed, however, that those organisations that mentioned commercialisation of research results & creation of economic value as a key consideration when deciding to apply for FP funding positively correlated with the ability to attract more private funds.

Furthermore, those organisations whose representatives indicated higher levels of effectiveness in research collaborations during the execution of FP projects also to a larger extent agreed that FP funding increased their ability to attract EU and private funding, as well as to run research projects on a financially larger scale and with a more long-term focus.

3.5.2.2. Case study evidence

***Significant impact on funding at EU level**: Experience in FPs helped beneficiaries to attract funding from other sources at EU level but had no significant impact in terms of attracting national level funding.*

The case studies provided solid evidence supporting the hypothesis that participation in FPs helps research organisations to leverage additional funding. Beneficiaries of all ten projects selected for the case studies suggested that they were successful in applying for funding after their projects were over. As reported by members of different consortia (see case studies 1, 8, 9 and 10), their FP experience usually helped lower application barriers at EU level, i.e. previous experience was extremely useful when applying for subsequent FP funding.

At the same time, the evidence that participation in FP projects positively affects the abilities of the organisational beneficiaries to attract national funding was lacking. Only participating organisations of Project 7 explicitly suggested that they were successful in applying for national initiatives as a result of the implemented FP project. This ability was negatively affected by the decreasing volume of project-based research and innovation funding in some EU Member States due to spending cuts in times of crisis. Hence, the acquisition of knowledge and skills required to attract additional funding might be of little use to the organisational beneficiaries if there are no FP calls or national-level funding opportunities in fields covered by their expertise.

The impact of FP in terms of research teams' ability to attract additional funding is two-fold. According to the evidence provided by the case studies, some consortia were successful in securing funding needed for the further development of outputs (e.g. development of a prototype) produced in the course of project (see case studies 6 and 8) or the implementation of follow-up projects (see case studies 7 and 9). These consortia built on excellent results of their last FP project when applying for funding and dealing with investors. Meanwhile others were successful in securing FP funding for projects that are not directly linked to projects analysed in the case studies (see case studies 2, 3 and 5). These consortia relied on experience and understanding in how to write a successful proposal, as well as the reputation earned when implementing their previous project.

*The impact on the ability of beneficiaries to attract funding from the third sources **depended on the effectiveness of research collaboration** during FP projects.*

The case studies also revealed that despite good project results, some consortia (see case studies 2, 4, 5 and 6) disbanded when project activities were over and did not collaborate in the future. The impact of FP on the abilities of research teams to attract additional funding in such cases was less pronounced. For instance, some organisations that were previously involved in Project 2 were successful when applying for new FP funding with other partners, while others were not.

There is also evidence that not all members of different project consortia are equally exposed to benefits of this type of impact. Factors such as agreements regarding intellectual property rights and varying intensity of cooperation between partners in different stages of the project can have a crucial impact on their abilities to attract additional funding. For instance, only the leading organisation claimed that the early success (production of a functioning prototype) of Project 6 helped attract significant investments from a global pharmaceuticals company. Meanwhile other partners in the project reported a very small, if any, influence of the project on their teams' ability to attract additional funding.

The case studies indicate that the following factors were important and affected the degree to which research teams were successful in attracting additional funding when their projects came to an end:

1) extent to which the project was used as a platform to position itself as pioneers or leader in the specific field of research;
2) extent to which the research team relied on partners who specialise at proposal writing and management of all administrative work in research projects instead of learning from such partners;
3) exposure to industry in the course of the project and commercial success of its results;
4) organisation of events (e.g. workshops) dedicated specifically to discuss the possible funding sources to implement the follow-up projects.

3.5.2.3. Evidence from desk research

The evidence gathered from desk research confirms that **participation in the FPs helps to leverage funding for R&D from national and private sources**, particularly by helping beneficiary organisations to develop skills and capacities that are necessary to compete successfully for research funding at national and international level (such skills and capacities include ability to coordinate a number of different stakeholders involved in research project, proposal writing and project management skills and others). The evaluation of long-term impact of FPs showed that these programmes triggered leverage effects and helped attract additional funding for the R&D in several case-study areas, including Quantum Information Processing and Computing, Brain Research, Ozone Research and Manufuture Technology Platform.[61] Similarly, the results of beneficiary organisation's survey conducted for FP7 Marie Curie Interim Evaluation showed that that the MCA and national or regional funding were highly complementary and that substantial leverage effects could be achieved nationally as a result of the organisations being beneficiaries of the MCA.[62]

[61] EPEC (2011) Understanding the Long Term Impact of the Framework Programme .Final Report to the European Commission DG Research Under Framework Contract No. DG BUDG No BUDG06/PO/01/LOT no.3 ABAC no. ABAC 101908. Access via http://ec.europa.eu/research/evaluations/pdf/archive/other_reports_studies_and_documents/long_term_impact_of_the_fp.pdf#view=fit&pagemode=none

[62] PPMI, FP7 Marie Curie Actions Interim Evaluation: Final Report. 7 February 2013.

On the other hand, recent studies confirm that the **ability of research organisations to attract additional funding from national sources were diminished by the recent financial crisis**, which had a negative effect on national public research and innovation funding in a number of European countries. According to the results of a study "Impact of the Crisis on Research and Innovation Policies", since 2008/2009 Greece, Romania and Latvia showed more than a 10% decrease in public funding of R&I due to spending cuts related to the financial crisis. Since 2011/2012 the same negative trends were evident in Bulgaria, Hungary, Ireland, Italy, Latvia, the Netherlands, Portugal, Spain and the UK.[63] Most of the European academic institutions reported major cuts to public funding, which represents up to 75% of European universities' financial structures.[64] Major cuts (up to 48%) were observed in Latvia, Italy, Greece and the United Kingdom. On the other hand, no direct cuts or minor cuts were reported by the Nordic countries (Norway, Sweden, Finland and Denmark), the Netherlands, Poland and Switzerland.

The available evidence also confirms that participation in FPs had a **particularly positive impact in terms of attracting EU-level funds**. A recent study on "Marie Curie researchers and their long-term career development" found that MC fellows had a comparatively greater access to the European Research Council (ERC) grants. The multivariate analysis showed that MC fellows had about an 3% higher access to ERC grants and 7% higher access to other EU and/or other international grants, in comparison to non-MC fellows.[65]

3.5.3. Management of human and financial resources

3.5.3.1. Survey evidence

Participation in FP projects helped to bring administrative and procedural changes that improved project management, as well as management of human and financial resources in the beneficiary organisations.

Concerning the impact on the management of human and financial resources, the beneficiary organisations were presented with a series of related statements on the administrative and procedural changes that had occurred or were expected to occur in the organisations. The data suggest that for a significant majority of the beneficiaries the projects improved the **capacity to engage in collaborative research projects** (71% strongly or rather agreed with the related statement), improved the **procedures to better suit the procedures of EU-supported projects** (70%) and contributed to the establishment/strengthening of **clearly defined administrative structures** that ensured the effective administration of research projects (61%). The impacts with respect to better research budget monitoring/controlling, stronger control mechanisms for financial risk management and financial reporting, as well as standardisation of the templates/forms for the management of financial resources were also frequently mentioned.

[63] Study for the European Commission DG Research, Directorate C–Research and Innovation under the framework contract Lot 2 "Impact of the Crisis on Research and Innovation Policies", December 2013. Access via http://ec.europa.eu/research/innovation-union/pdf/expert-groups/ERIAB_pb-Impact_of_financial_crisis.pdf.

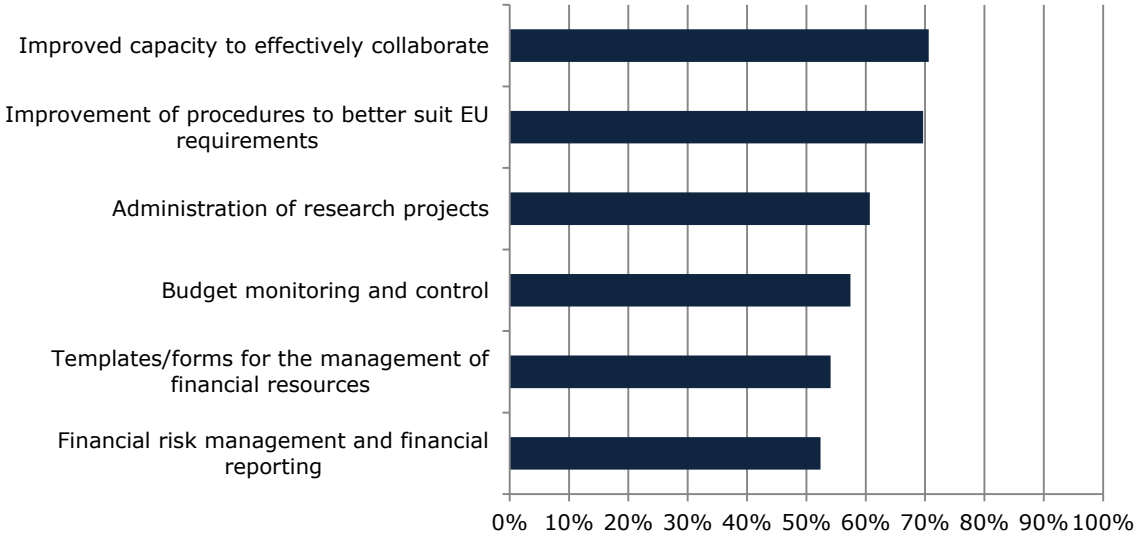
[64] European University Association (2011), Impact of the economic crisis on European higher education: the monitoring report. Available at: http://www.eua.be/Libraries/Newsletter/Economic_monitoring January2011final.sflb.ashx

[65] Economisti Associati, Marie Curie researchers and their long-term career development: a comparative study – Final Report, March 2014.

Statistical analysis also revealed that large research teams were particularly likely to improve their administrative procedures to better suit the procedures of EU-funded projects, whereas small teams were particularly eager to strengthen clearly defined administrative structures that ensured the effective administration of research projects.

Further analysis showed that the impacts occurred in the entire organisational entity for 47% of the beneficiaries. Private industry companies, including SMEs, were more likely to experience the impacts at the organisation level (49%) than were universities or higher education institutions (42%). Compared to other impact areas (e.g. the ability to attract additional funding and the strategic research agenda of the participating organisations) FP participation had a somewhat lower, but still substantial impact on the management of human and financial resources at organisation level.

Figure 29: Impact of FP funding on management of human and financial resources (n=4,832)



Source: Analysis of the team level survey data.

3.5.3.2. Case study evidence

FP participation had little impact on human resource management practices in beneficiary organisations.

The case studies provided no evidence of direct impacts on human resource management practices in the research teams involved. According to most of the project participants, the key principles of fair and transparent human resources management were **already practiced** in their institution (see case studies 1, 3, 6 and 9).

There are several other reasons explaining the modest impacts of FPs on human resources management practices in the research teams involved. For instance, the case study evidence showed that many projects **focused on the transfer of knowledge** rather than learning new human resource management practices (see case studies 4, 7 and 9 for instance). Preoccupation with the development of knowledge directly related to research activities thereby prevented the participant organisations from sharing new practices in other areas.

Furthermore, an **insufficient level of involvement** from certain participants was another potential reason explaining the modest impacts of projects in terms of developing human resource managing practices: some case studies showed there was a general lack of transfer of knowledge within the consortium. As a consequence, the participant research teams were limited to application of knowledge and practices they already had, without the opportunity to acquire new knowledge and skills, including those in the field of human resource management. In other cases, the overall level of knowledge transfer was sufficient but some research teams experienced difficulties in communication and thereby remained "outsiders" in the knowledge-sharing process (see case studies 6 and 8).

FP participation helped to increase project and financial management capacities.

Some moderate impacts on the **management of financial resources** in the research teams involved were reported in the case studies. The impact was most evident among the participant **SMEs** since they had little previous experience in international projects and therefore did not have opportunities to learn new financial management practices before the involvement in FPs. The available information shows that such SMEs successfully adopted financial management aspects borrowed from FP standards. Positive impacts in terms of learning new skills and practices in the management of financial resources were reported both among researchers and external support staff hired specifically for such tasks (see case studies 1, 10).

The case studies also found that participation in FP-funded projects contributed to the development of **international projects' management skills** in the research teams. The unequal availability of skilled staff and research infrastructures helped the research teams learn new ways of research planning and management. Participation in international FP-funded projects also contributed to the improvement of other horizontal managerial skills in the research teams involved, including project documentation and effective presentation of research findings, as well as planning and management of intellectual property rights (see case studies 4, 7, 8, 9).

In particular, the highest impact on project management and coordination skills in the research team was reported by the **coordinating institutions** that were responsible for most of the managerial tasks. Moreover, the amount of previous international project coordination experience among these project coordinators was reported as being one of the main factors influencing the extent to which they improved their project-managerial skills: coordinators that had no previous international project coordination experience benefited most in terms of learning new practices and ways of managing and planning research activities (see case study 10 for instance).

The evidence also shows that **SMEs** were another group of organisations that mostly benefitted in terms of improved international project management and planning skills. The reason was similar to that of coordinating institutions: for a significant share of SMEs it was their first major international project, which helped them to get acquainted with previously unknown practices and standards.

3.5.3.3. Evidence from desk research

During the survey of MC beneficiary organisations carried out for the FP7 Marie Curie Actions Interim Evaluation, the beneficiary organisations were asked if there had been any changes to their procedures and practices for the career management of researchers (greater alignment with the principles of the Charter and the Code) associated with their participation in the Marie Curie Actions. Similar to our analysis, the results showed that the majority of respondents indicated no such impact precisely

because the human resource management practices in their organisation were already aligned with the Charter and Code: 52% of the respondents indicated that there was no need to make any changes because their procedures were already essentially aligned with the principles, and another 10% indicated that there were only minor changes made.[66]

3.5.4. Impact on the participating institutions' strategic research agenda

3.5.4.1. Survey evidence

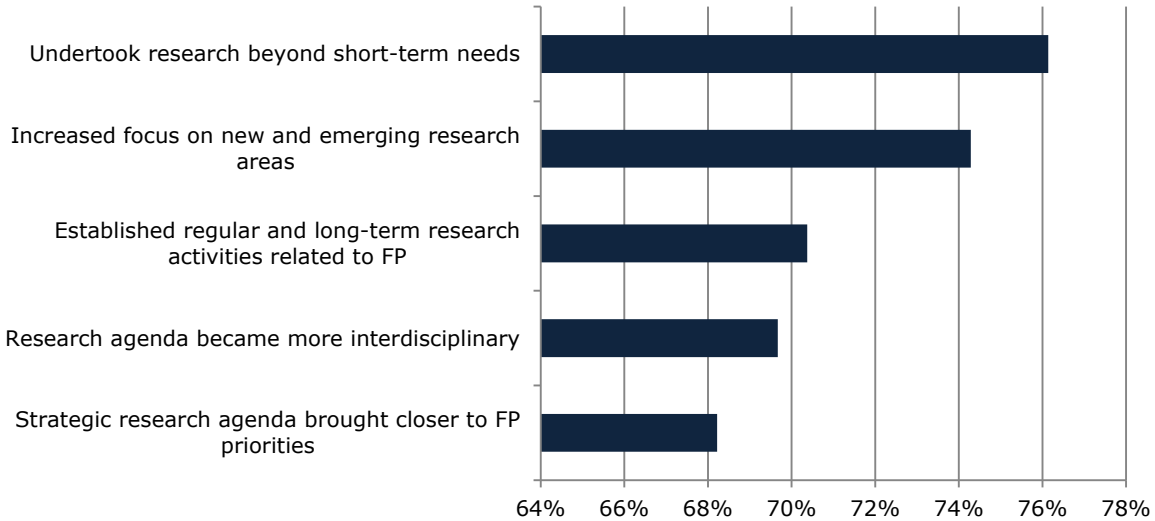
Positive impact of FPs on the strategic research agenda of beneficiary organisations.

The survey results revealed further significant impacts on the beneficiary organisations' strategic research agenda. The impacts were measured via a series of survey statements on the teams' ability to undertake research in areas beyond short-term needs and focus on new and emerging research trends. In addition, the beneficiaries were asked whether, as a result of FP funding, they a) brought their strategic research agenda closer to FP topics and priorities; b) established regular and long-term activities in areas closely related to FP themes or c) made their research agenda more interdisciplinary.

The survey results show significant impacts in all areas. It must be noted, however, that for 53% of private, not-for-profit research organisations and 45% of private industry companies and SMEs those impacts materialised at the organisation level, whereas the corresponding figure for universities and HEIs was only 16%.

Overall, the organisations that were motivated by strengthening positions in the EU research market, dissemination of research results to society or decision-makers and possibility to engage citizens and civil society stakeholders in research activities were most likely to bring their research agenda closer to FP topics.

Figure 30: Impact of FP funding on the organisations' strategic research agenda (n=4,832)



Source: Analysis of the team level survey data.

[66] PPMI, FP7 Marie Curie Actions Interim Evaluation: Final Report. 7 February 2013.

3.5.4.2. Case study evidence

Participation in FPs helped to strengthen the strategic orientation of beneficiary organisations towards EU priorities, in particular for the first-time participants of FP projects.

There is strong evidence from the case studies that participation in the FP projects **strengthened the conviction of participating organisations' to continue their research agenda as it was already in line with priorities set at EU level** (see case studies 3, 4, 5, 6, 7 and 9). One of the research teams that participated in case 4 suggested that a new course on prebiotic chemistry was introduced for the university's MSc students as a result of the experience gained during the project. There are also plans to introduce a separate MSc/PhD programme solely dedicated to synthetic biology. The leading organisation in case 7 revealed that as a result of participation in this particular project they updated their strategic priorities. Bio economy is now one of the five strategic focus areas of this university. In case 1 the participating organisations had different opinions regarding the impact that FP had on their research agendas. According to participants representing industry, such impact did not materialise, while universities suggested that FP helped them in defining their research topics. The research team that led case 6 stated that the prototype they developed in the course of the project became the core area of activity of their company.

There is also some evidence that participation in the FP project was particularly useful for those organisations who were **first-time participants of FP projects**. In particular, participation in the FP project was the first FP or EU-funded project for coordinators of case 1, 6 and 7. All these organisations very actively continued research activities in the same field when their projects were finalised. They also put research in respective research fields at the top of their research agendas.

These findings, on the other hand, are not applicable for organisations that already had the FP experience. The majority of the experienced participants claimed that involvement in yet another FP project had no direct impact on the strategic research agenda of their organisation (see case studies 2, 8, 9, 10). Aside from the particular FP projects selected for the case studies they were at the same time participating in other research projects. Other, yet less common, arguments were that after the project was over the research team dissolved/was disbanded (see case studies 4, 7) or that the participating organisations were reorganised (see case study 7).

There is some evidence that FP impact on SMEs and industrial actors is limited due to their determination to **participate in the research projects that already fit with their strategic agenda**. This finding was supported by leading organisations in cases 2, 3 and 9. The company which led case 2 claimed that its decision to participate in third-party funded projects is being made only if the focus of the project fits with the company's portfolio and if they see it as an opportunity to minimise certain risks associated with research and development. Meanwhile, the leading organisation in case 3 argued that the project implementation had relatively no impact on their strategic research agenda, because it is already to a large extent aligned with the themes of European calls (inflows from this source represent 30% of the company's revenue). Similarly, the company which led a consortium in case 9 indicated that any significant changes to their research agenda were prevented by their previous experience with EU-funded projects: the company's research agenda was already aligned with EU priorities.

Despite reports on the limited impact of FP participation on strategic research agendas in some research organisations, the indirect effects reported by beneficiaries of case 10 are likely in all organisations where researchers, who were able to work on a topic

for several years continuously, remained within the organisation. In particular, the organisational beneficiaries of case 10 suggested that these researchers have **become experts and do set the research agenda by continuing to work in the field and steer the direction of research within their organisations**.

3.5.4.3. Evidence from desk research

The evidence available from desk research confirms the above information on the positive impact on research teams in terms of shaping their research agenda. At least in some research areas, especially those related to technical and natural sciences (Engineering, Physics, Chemistry and Biology), the FPs help in "redirecting" the research agendas and facilitating the development of new scientific interests in line with research priorities identified at EU level. Therefore, by stimulating the adoption of new and relevant lines of research, FPs contribute to the development of HRC at the organisation level.[67]

[67] Min-Wei Lin and Barry Bozeman, "Researchers' Industry Experience and Productivity in University–Industry Research Centers: A ''Scientific and Technical Human Capital'' Explanation", *Journal of Technology Transfer*, 31, 269–290, 2006.

3.6. Evaluation Question 6: Contribution to brain circulation

3.6.1. Survey evidence

Some evidence of contribution of FPs to attract non-EU researchers to Europe, particularly the HE sector and through Ideas and People programmes, but small in absolute terms and less frequently sustained after the project (outcome effect).

Ex-ante, making the research team more international is a very (42%) to somewhat (33%) important motivation for team leaders to apply for FP funding. To analyse the extra-EU dimension specifically, and the real contribution of FP to brain circulation by attracting non-EU researchers to Europe, we look into the participation patterns of non-EU researchers.

8% of the researchers in the subsample of the FP participants that currently work in the EU[68] are non-EU citizens. This compares to 7% in the total sample of researchers working in the EU. To put this in perspective, in the MORE2 study[69] the share of non-EU researchers working in EU27 HE institutions in 2012 was estimated at 5.6%. The Innovation Union Scoreboard[70] shows, specifically for the early career researchers, that 24% of all doctoral students working in the EU28 in 2011-2012 are from non-EU countries. The sample from the individual level survey on FP participation is not fully comparable to the MORE2 data, as the latter is limited to data for the HE sector only. Nevertheless, if we assume that the share of non-EU researchers in private and government sectors is not higher than that in the HE sector, there is reasonable indication that non-EU researchers are relatively more represented in FP projects than in general in EU-based research.

Of all non-EU citizens, 19% participate in an FP project compared to 16% of all EU citizens. In absolute terms this corresponds to approximately 16,500 non-EU researchers and 193,000 EU researchers participating in FP in their EU employment. The difference in shares is small, but could suggest that non-EU researchers are hired relatively more often on FP projects – and thus that FP facilitates this. However, difference between both groups is small and we cannot draw definite conclusions based on this information alone.

The share of researchers that do not know whether they have participated in a FP project is substantially higher among the non-EU citizens than among the EU citizens. This logically points to a lower awareness about the FP among non-EU citizens.

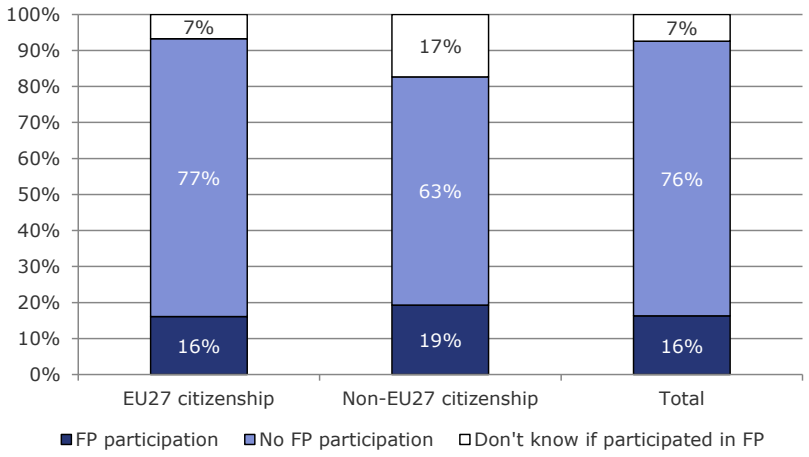
The share of non-EU researchers in the sample of FP participants that currently work in the EU is largest for the first stage researchers (R1) (32%). This share decreases over the career stages.

[68] FP participants that currently work in the EU are defined as researchers who have indicated that in their last employment episodes they have a contract from an employer which is located in the EU27.

[69] IDEA Consult et al, 2013. MORE2 - Support for continued data collection and analysis concerning mobility patterns and career paths of researchers, Final Report. European Commission, DG Research and Innovation. http://ec.europa.eu/euraxess/pdf/research_policies/more2/Final%20report.pdf

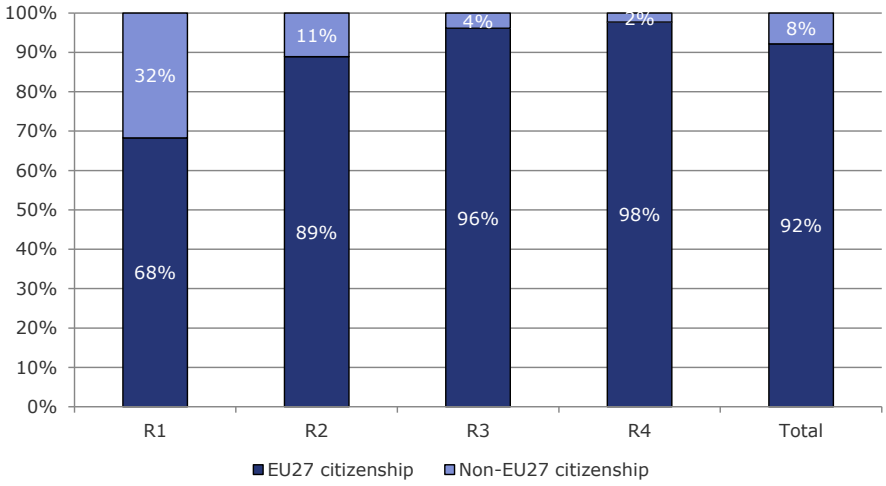
[70] http://ec.europa.eu/enterprise/policies/innovation/policy/innovation-scoreboard/index_en.htm

Figure 31: Researchers that currently work in the EU, by citizenship and FP participation (n=1,282,880)



Source: Analysis of the individual level survey data.

Figure 32: FP participants that currently work in the EU, by citizenship and current career stage (n=1,282,880)



Source: Analysis of the individual level survey data.

At team level, two thirds of the organisations find no change in the number of researchers from non-EU countries as a result of their participation in FP. For 23%, there was a small to significant increase -almost no organisations report a decrease.

The outcome effect is largest for the FP7 specific programmes Ideas (47%, including 19% significant increase and 28% some increase) and People (29%, including 7% and 22% respectively). Similarly, teams situated in EU15 report a higher increase of foreign researchers than teams situated in EU12 (25% versus 12%). When looking at the fields of science, we find that the effect is strongest in the fields of Humanities and Science (35% and 32% respectively). The indicator is also higher than average in universities and higher education institutions (32%).

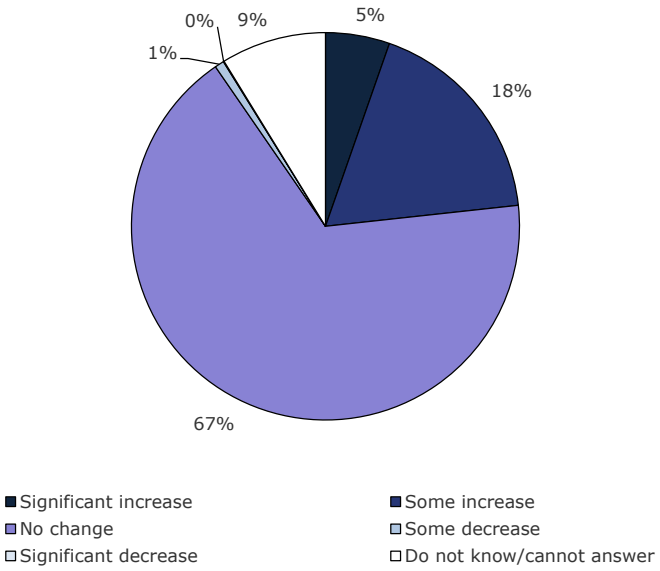
Comparing this indicator from the team level data with the information on organisations' share of the workload for the project in the European Commission's

eCORDA database, shows that organisations with a higher share in the workload also see a stronger increase in the recruitment of non-EU researchers. In organisations with more than 75% of the workload, 37% of team leaders see a significant or some increase in the number of non-EU researchers (compared to 14% in organisations with a share of less than 10%).

This indicator confirms the broader findings in section 0 on EQ5 – team composition and size, where it is calculated that the largest shares of foreign researchers (EU and non-EU) were hired in the People (68%) and Ideas programme (62%). Similarly, almost 60% of the researchers hired in the Humanities and Sciences are international researchers.

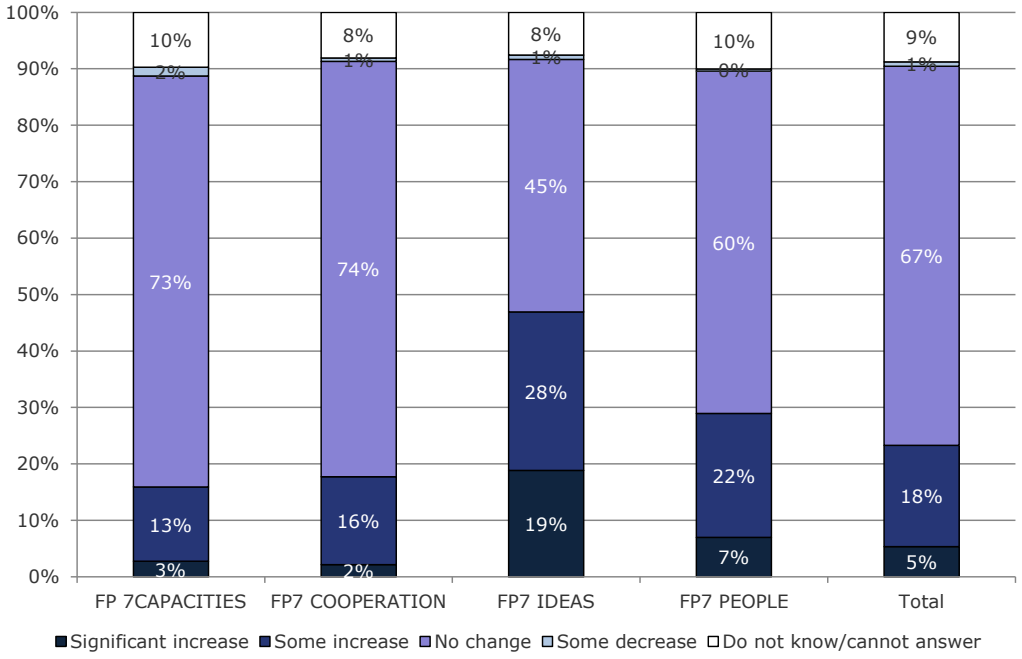
Also elaborated upon in section 3.5 (EQ5) is the finding that international researchers are less likely to stay after the project ends (34% versus the average of 43%), so the net and intermediate effect is smaller.

Figure 33: Change in number of researchers from other foreign countries (i.e. non-EU countries) during their FP project compared to the situation before the project (n=91,981)



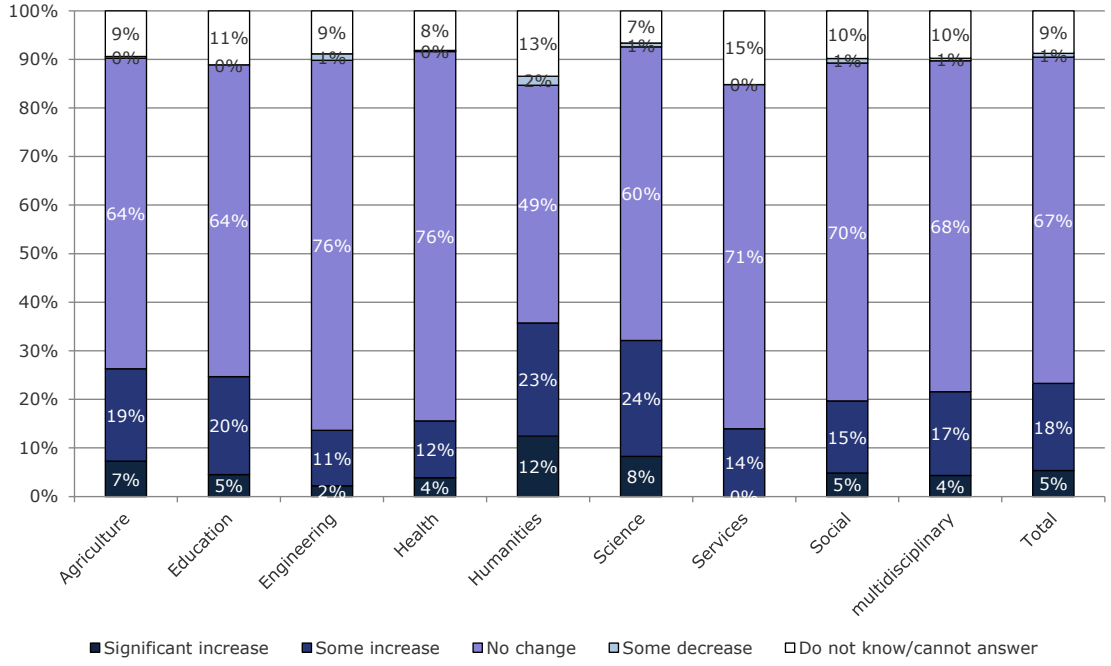
Source: Analysis of the team level survey data.

Figure 34: Change in number of researchers from other foreign countries (i.e. non-EU countries) during their FP project compared to the situation before the project, by type of FP participation (n=91,981)



Source: Analysis of the team level survey data.

Figure 35: Change in number of researchers from other foreign countries (i.e. non-EU countries) during their FP project compared to the situation before the project, by field of science (n=91,981)

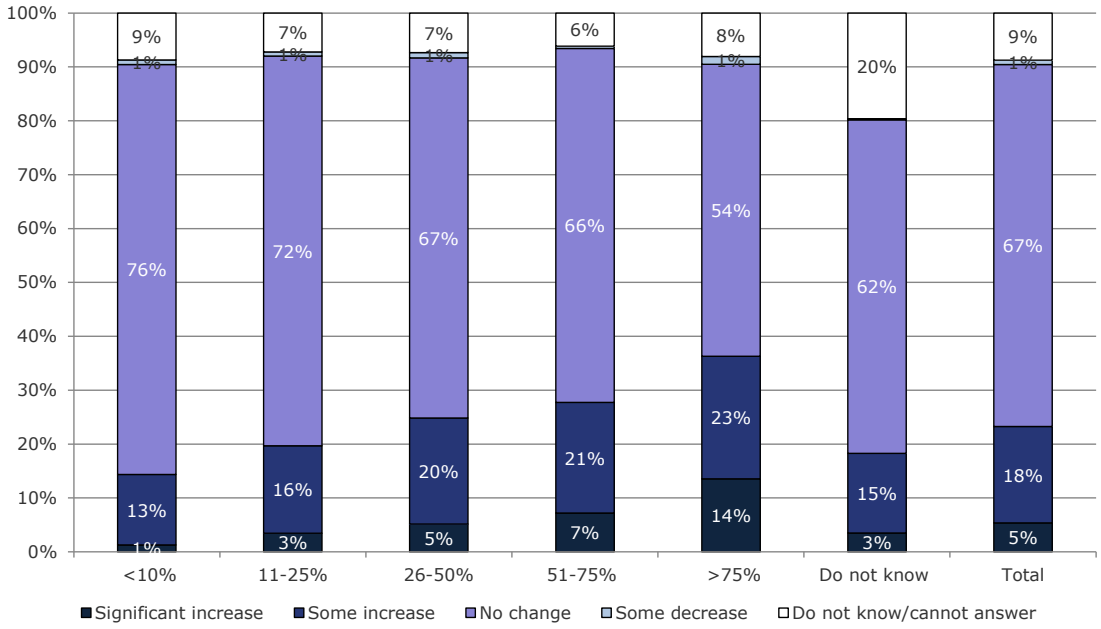


Source: Analysis of the team level survey data.

Figure 36: Change in number of researchers from other foreign countries (i.e. non-EU countries) during their FP project compared to the situation before the project, by type of organisation (n=91,981)

Source: Analysis of the team level survey data.

Figure 37: Change in number of researchers from other foreign countries (i.e. non-EU countries) during their FP project compared to the situation before the project, by share in the total workload of the project (n=91,981)



Source: Analysis of the team level survey data.

Positive impact on return mobility of EU27 researchers: 13.2% of all moves in which EU researchers return to the EU coincide with FP participation, compared to 8.6% of all moves of the EU researchers.

In order to analyse the return mobility of EU27 researchers that have returned to the EU27 to participate in an FP project, we look at the approximately 5 million different employment episodes of approximately 1.2 million EU researchers. 8.6% of these episodes coincided with FP participation. In total, 170,000 employment episodes concern return mobility of EU27 researchers coming from non-EU countries to take an employment in an EU country (this is 3.5% of the total 5 million episodes). When specifically looking at the correlation between return mobility and FP participation, we find that 13.2% of the moves undertaken by EU researchers from non-EU to EU positions coincide with FP participation (compared to the 8.6% of all moves by EU researchers). Based on eCORDA data, 14% of the participating organisations are non-EU27 based. This corresponds to a total of over 13,000 organisations out of 92,000. 14% among the subsample of non-EU27 participants are coordinator, compared to 15% coordinators among the subsample of EU-based participants.

Table 17: Number of organisations participating in FP projects, by nationality and role in the project (n = 92,027)

	Coordinator	Participant	Total
EU27	11,882	66,926	78,808
Non-EU27	1,898	11,321	13,219
Total	**13,780**	**78,247**	**92,027**

Source: Analysis of eCORDA data.

14% of participating organisations are non-EU27, the ratio coordinators-participants is similar among EU27 and non-EU27 organisations (14%)

Compared to the average, there are more non-EU27 organisations among the participants from the public and government sector (23% compared to the average of 14%) and higher education sector (19%). There is a lower share of non-EU27 organisations among the private research companies (9%). There is no real difference in the share in work load – proxy for the involvement in the project. Non-EU27 organisations thus appear equally involved in the project, once part of the consortium.

This participation of non-EU27 organisations is also translated in international (extra-EU) consortia for the FP projects. In total, 10,452 out of 16,909 consortia (62%) consist of only EU27 organisations. Thus, in a large share of projects, at least one non-EU27 organisation participates. In most of these 'international' set-ups the number of non-EU participants is limited to 1 (58%) or 2 (19%).

Table 18: FP funded projects with international (extra-EU27) collaboration

		Number	**Share in total**	***Share in subgroup***
No international (extra-EU27) collaboration		10,452	62%	
International (extra-EU27) collaboration		6,457	38%	
	1	*3,763*	*22%*	*58%*
	2	*1,213*	*7%*	*19%*
	3	*588*	*3%*	*9%*
	4	*359*	*2%*	*6%*
	5	*184*	*1%*	*3%*
	6	*117*	*1%*	*2%*
	7	*71*	*0%*	*1%*
	8	*50*	*0%*	*1%*
	9	*30*	*0%*	*0%*
	10	*20*	*0%*	*0%*
	more than 10	*62*	*0%*	*1%*
Total number of projects		**16,909**	**100%**	

Source: Analysis of eCORDA data.

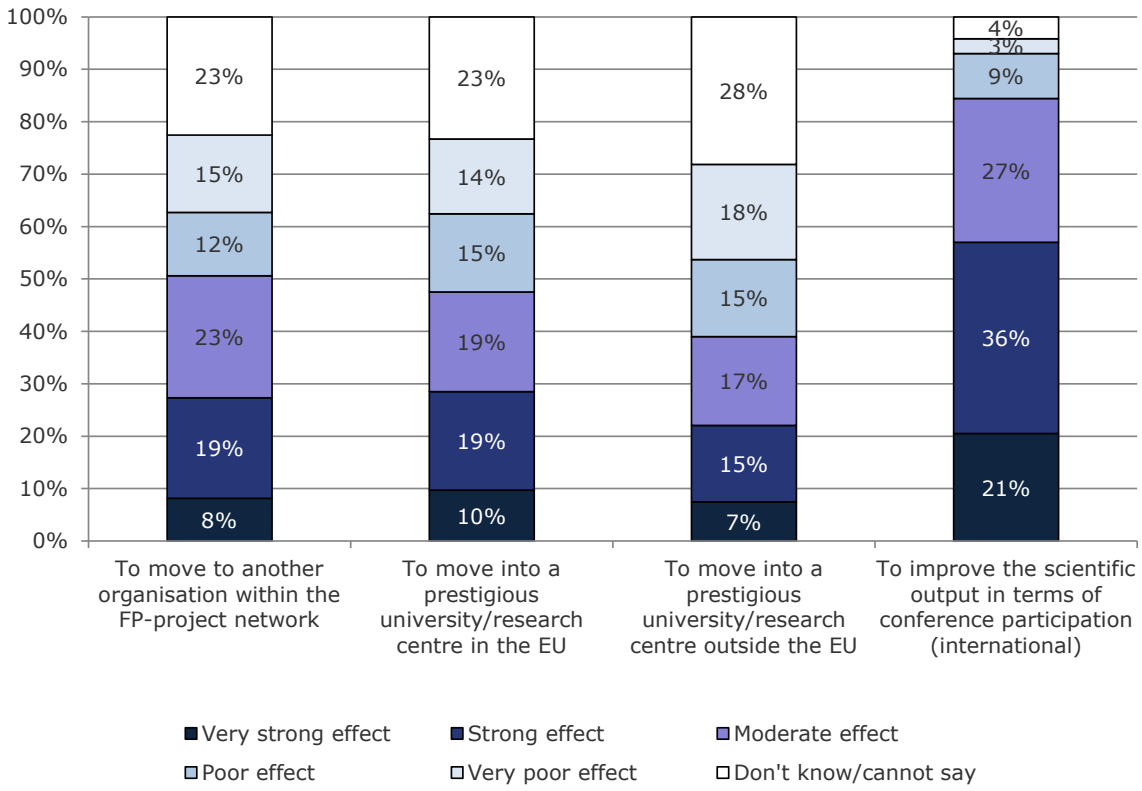
International mobility and cooperation for brain circulation: FP increases opportunities for international mobility (outcome), but there is no evidence of impact on actual moves outside the EU (immediate impact).

Next to 'formal' cooperation in the consortia or by attracting non-EU27 researchers, mobility and cooperation could also encourage brain circulation from a non-EU27 perspective. More than half of the team leaders find that FP participation has to a large (26%) or moderate (27%) extent offered more international mobility opportunities to researchers. 14% and 16% respectively find only a small or no effect, 18% do not know. The effect is slightly stronger in the People (34% large +27% moderate extent) projects and in the fields of Humanities (29%+32%) and Education (37%+25%). The effect is also highest in universities and higher education institutions (30%+30%) and lowest in private industry (16%+23%). In consortia led by EU12 organisations, 33% indicate a strong effect on international mobility and 31% a moderate effect, compared to 25% and 26% in EU15.

At the individual level, 21% of the moves of international researchers were to another country than they had worked previously. Most of these international moves were to a position without FP funding (17% of all moves or 82% of the international moves). Also, when asked directly, there is little evidence provided that FP participation has a positive impact on international moves to other organisations for individual EU27 researchers. 22% see a strong to very strong effect on moving into a prestigious university or research centre outside the EU, but a higher share of 31% see a poor to very poor effect. 28% is undecided. The effect is somewhat more positive for moves to other organisations in the FP consortium (27% strong to very strong versus 27% poor to very poor) or within the EU (29% versus 29%). Only in the case of international conference participation, the responses are clearly positive: 57% see a strong to very strong effect and another 27% see a moderate effect.

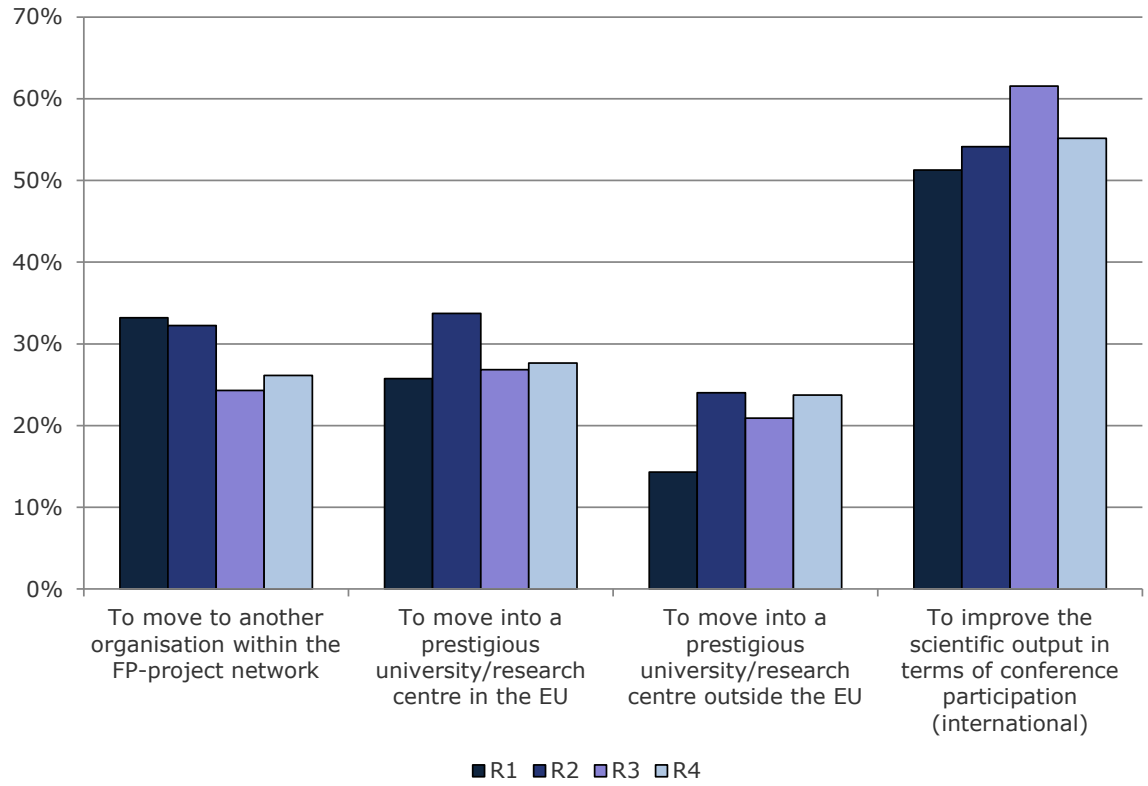
The impact of FP participation on this kind of international move to other organisations is indicated as highest by researchers who are currently in the R2 career stage and particularly for moves to other universities or research centres in the EU (34% strong to very strong effect compared to average of 29%). Moving to another organisation in the consortium is also high for researchers who are currently R1 and R2 (33 and 32% compared to average of 27%). Moves to outside the EU are more important for researchers who are currently in later career stages, R1 researchers show a relatively poor effect here (14% strong to very strong effect) compared to R2 (24%), R3 (21%) and R4 (24%).

Figure 38: Estimated impact of FP employment on career in terms of different types of mobility (n=259,580.50)



Source: Analysis of the individual level survey data.

Figure 39: Estimated impact of FP employment on career in terms of different types of mobility, by current career stage (n=259,580.50)



Source: Analysis of the individual level survey data.

Knowledge transfer and networking for brain circulation

Brain circulation can be defined more broadly than the physical mobility of researchers. Transferring knowledge through networking and international cooperation is equally important in this respect. Cooperation in all its forms, and particularly international cooperation, is an important incentive for teams when deciding to apply for FP participation. More than two thirds of the team leaders find international cooperation a very important motive, another 20% find it somewhat important. Intersectoral and interdisciplinary cooperation are also very or somewhat important to respectively 65% and 80%.

International and intersectoral mobility are less important in the FP7 Ideas projects (respectively 49% versus 68% in total and 9% versus 33% in total). For private organisations, international and interdisciplinary cooperation are less important (60% versus 68% and 38% versus 43% in total), but intersectoral cooperation is more important (47% versus 33% in total). Intersectoral cooperation is important to only 24% of the respondents in universities and higher education institutions.

Also between fields of science, the main differences occur for intersectoral mobility. Only 13% of the team leaders in Humanities call this form of cooperation important when deciding to apply for FP participation. Science and Education team leaders (24%) also attach less value to intersectoral cooperation. On the other hand, those from the Agricultural Sciences (51%), Services (48%) and Engineering (42%) attach most value to this, followed by Health and Life Sciences (36%) and Social Sciences

(18%). Interdisciplinary cooperation is in particular important for Humanities teams (63% versus 43% in total).

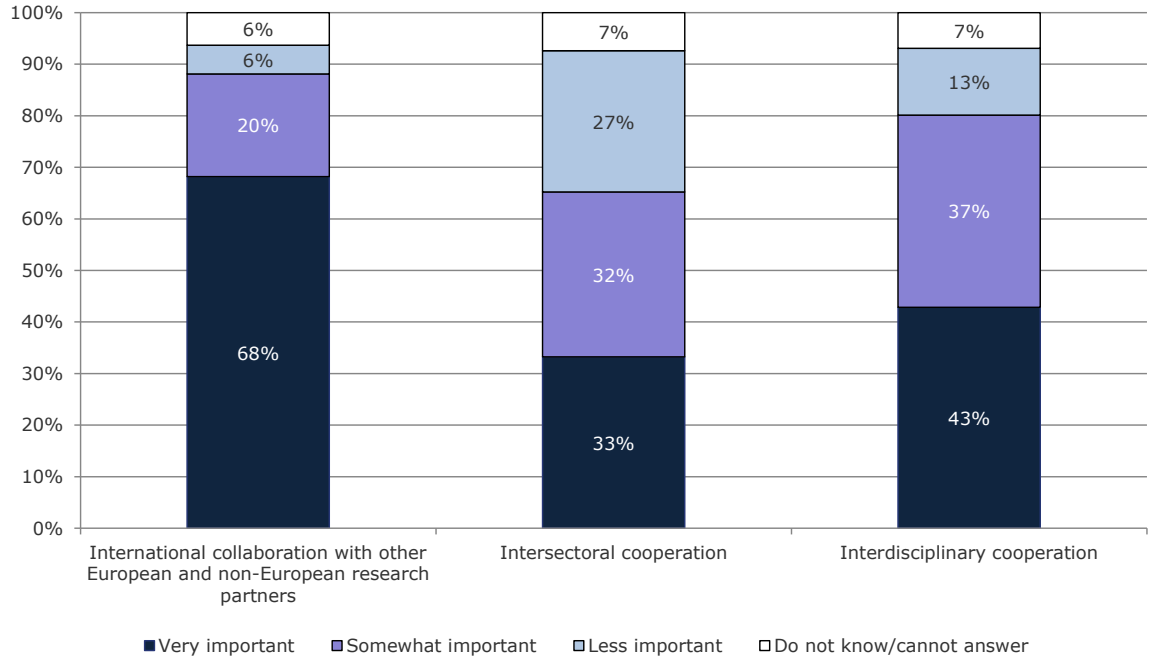
Closer cooperation is effectively realised as an outcome effect of FP participation with research teams in other countries (81% of team leaders see a large or moderate effect), in other sectors (53%) and in other disciplines (64%). The same patterns are found as in the analysis of the ex-ante motivation to participate. The FP7 Ideas programme has a lower share of team leaders (72% versus 81%) that believe that closer international cooperation has materialised during their participation. For interdisciplinary cooperation in Ideas projects, this is only 27% versus 53% on average. Closer intersectoral cooperation is least often realised in the People programme (45% versus 60% in total) and most in Cooperation (74%).

Also here, intersectoral cooperation is more important in terms of realised effects in private organisations (67%) than in universities and higher education institutions (45%). With respect to fields of science, Service and Humanity teams find intersectoral mobility most realised (73% and 72% respectively); Health and life sciences, Social sciences, Engineering, agricultural sciences, science and education all range between 55% and 65%.

Evidence at individual level confirms that researchers (both EU and non-EU) see a very strong immediate impact on their career in terms of networking thanks to participation in FP projects. Again, the international dimension carries most importance for researchers. 36% see the impact of FP participation on their international scientific networks as very strong and another 37% as strong, compared to between 20-25% and 34-40% respectively for other types of networks, such as national, disciplinary, interdisciplinary and intersectoral networks.

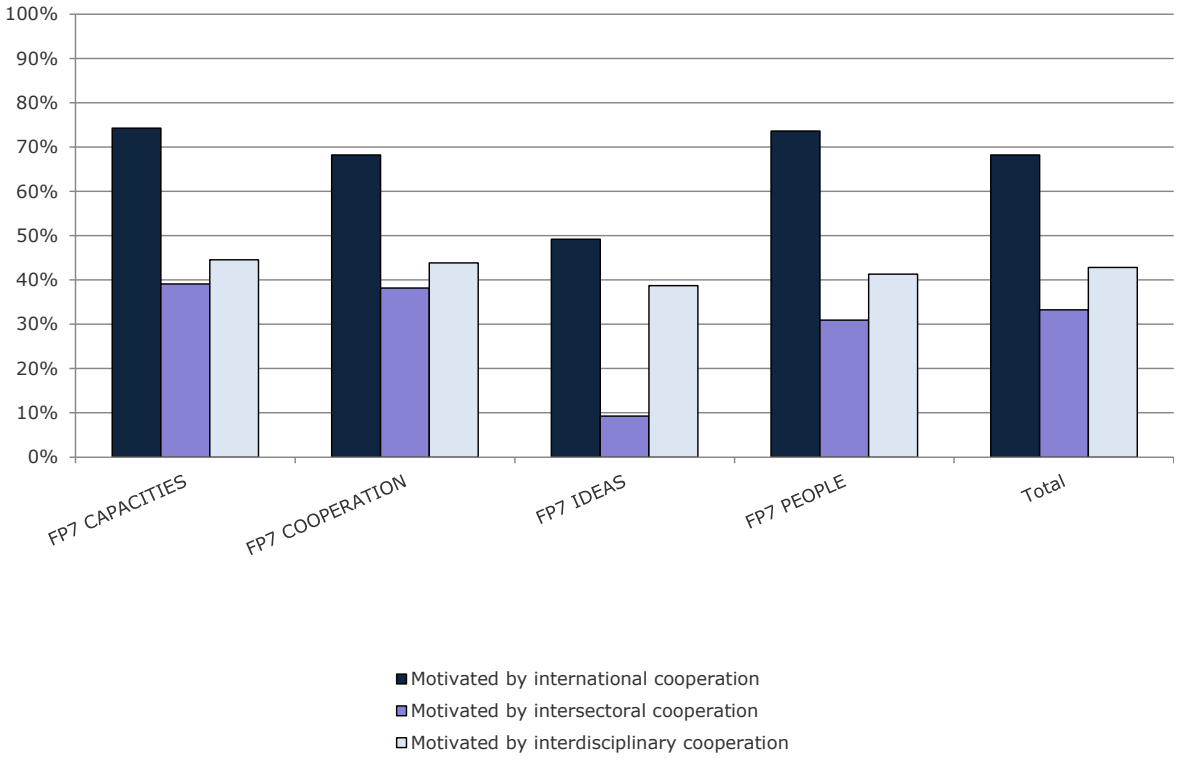
The transfer of knowledge through closer contacts with the media has not been influenced considerably by FP participation. 21% see a strong to very strong effect, but 36% see a poor to very poor effect and 18% indicate they cannot give an indication. There is little difference between career stages, although a lower share of R1 researchers sees strong or very strong effect, on their national or interdisciplinary networks in particular. R3 score above average for all types of networks – but the differences are small (between 1 and 5% difference with average value).

Figure 40: Importance of cooperation when deciding to apply for FP funding (n= 92,027)



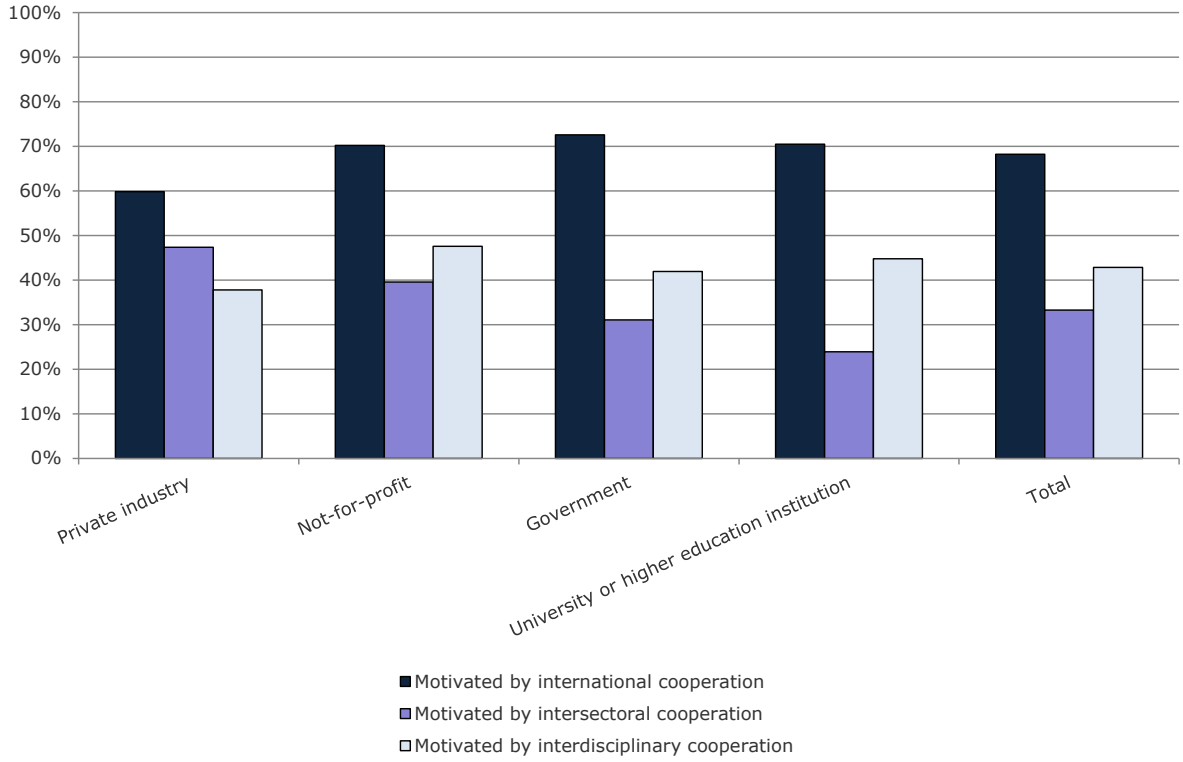
Source: Analysis of the team level survey data.

Figure 41: Importance of cooperation when deciding to apply for FP funding, by type of FP funding (n= 92,027)



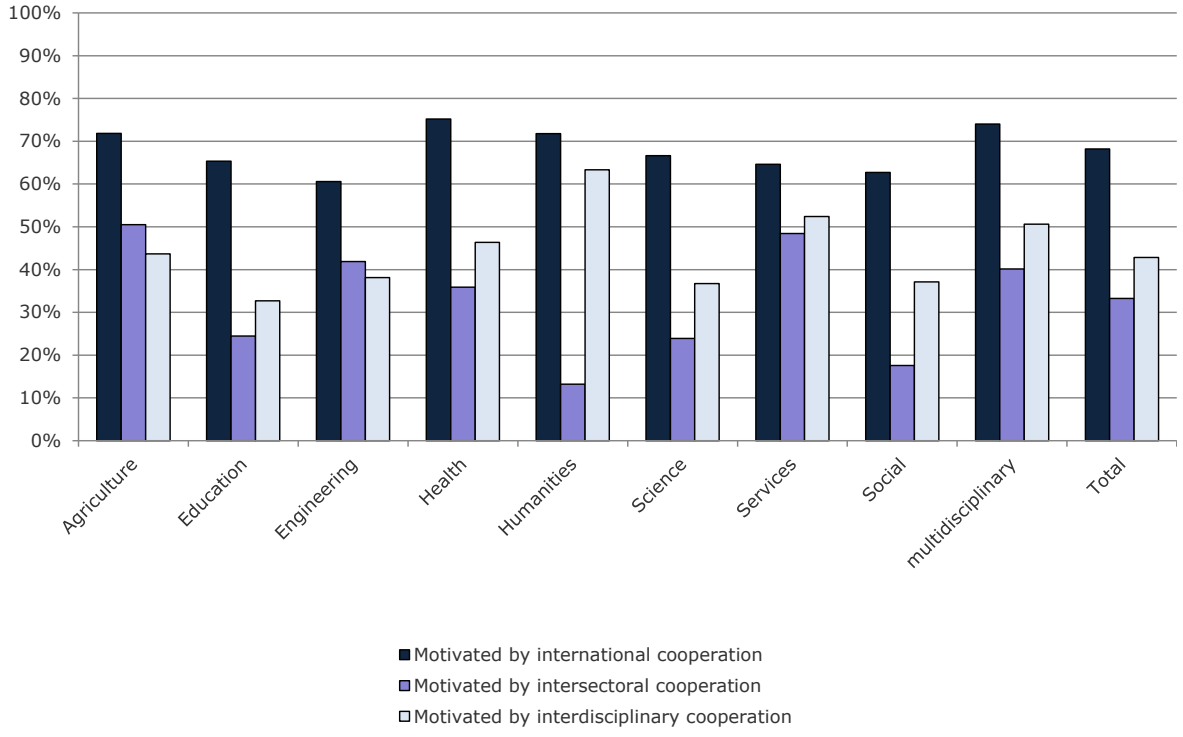
Source: Analysis of the team level survey data.

Figure 42: Importance of cooperation when deciding to apply for FP funding, by organisation type (n= 92,027)



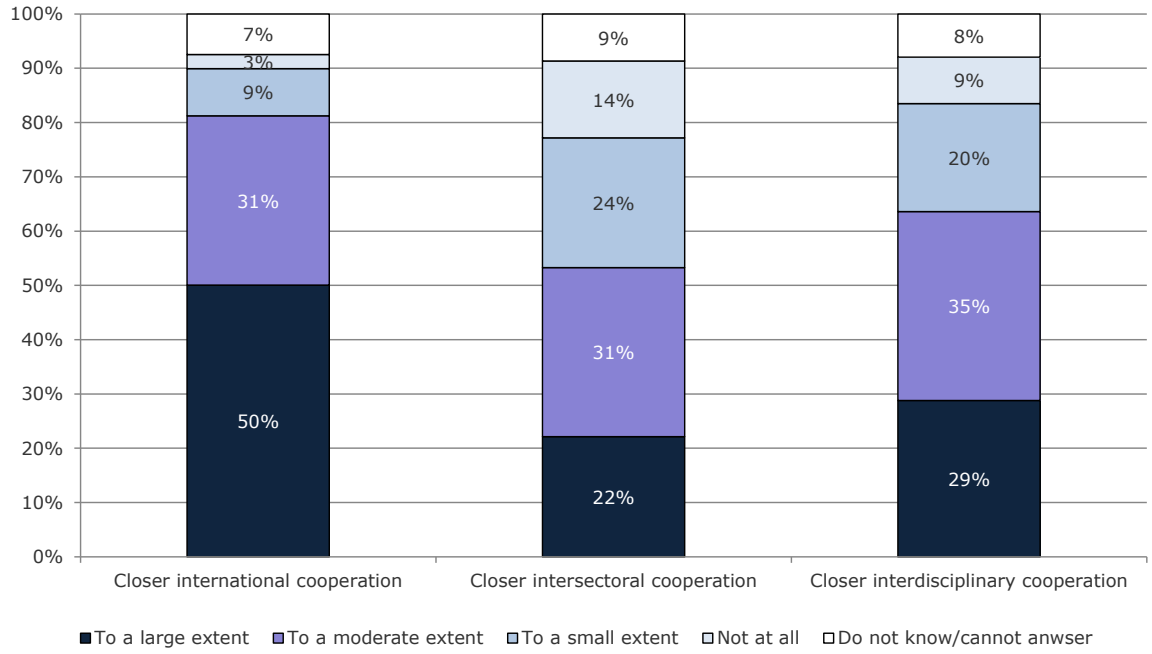
Source: Analysis of the team level survey data.

Figure 43: Importance of cooperation when deciding to apply for FP funding, by field of science (n= 92,027)



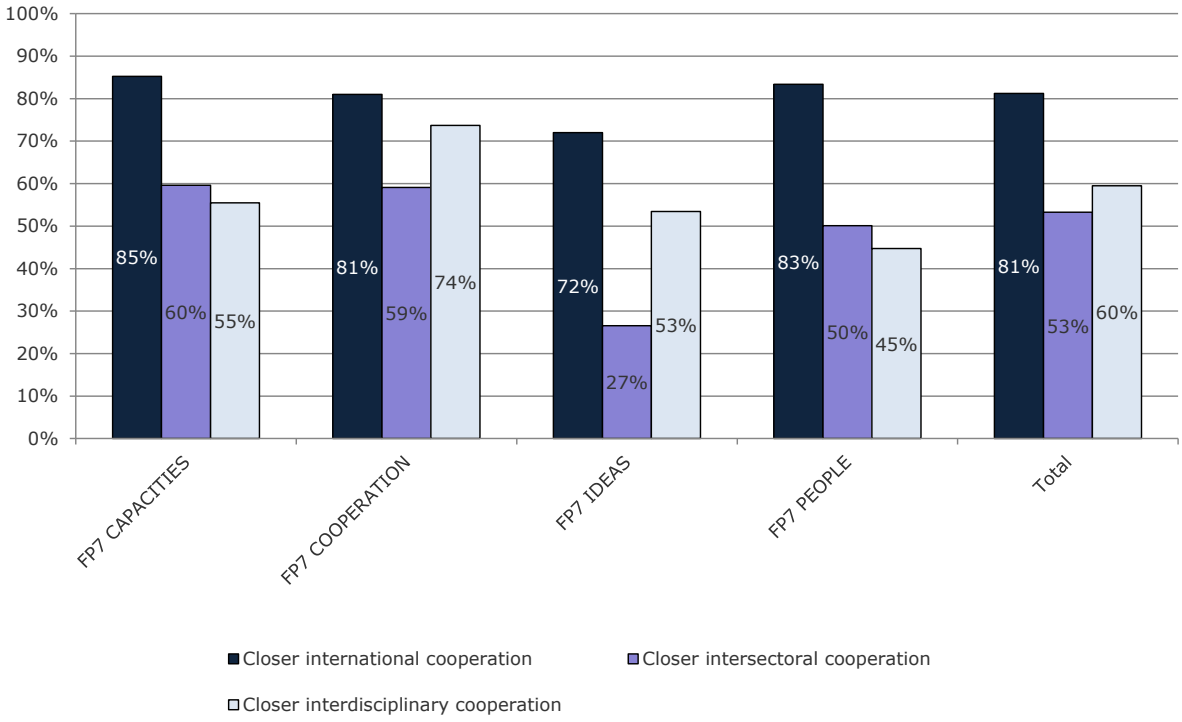
Source: Analysis of the team level survey data.

Figure 44: Materialisation of cooperation for the research team as a result of participating in the FP project (n=92,027)



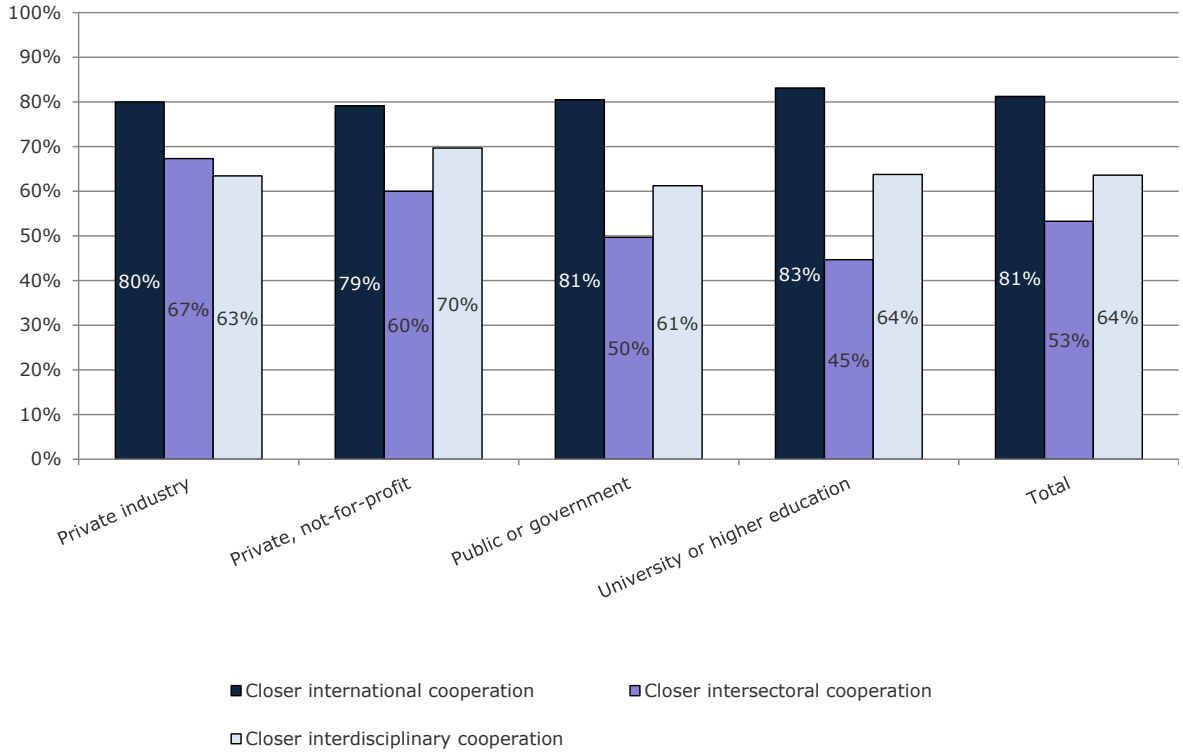
Source: Analysis of the team level survey data.

Figure 45: Materialisation of cooperation for the research team as a result of participating in the FP project, by type of FP funding (n=92,027)



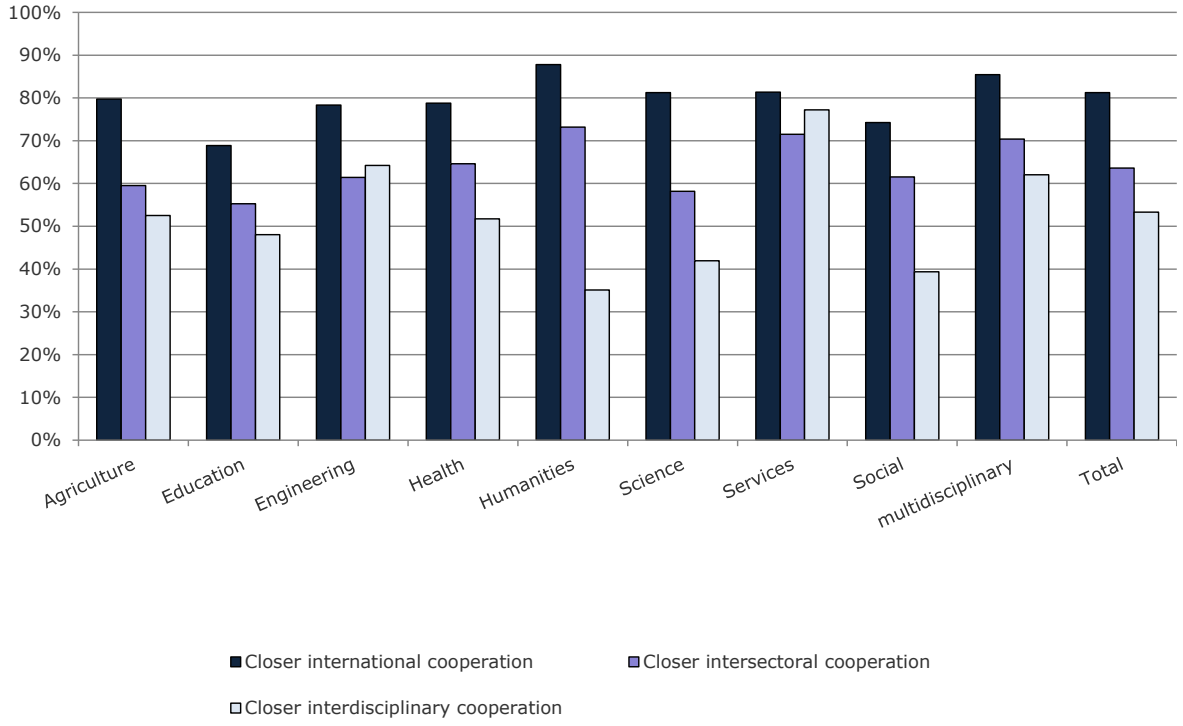
Source: Analysis of the team level survey data.

Figure 46: Materialisation of cooperation for the research team as a result of participating in the FP project, by organisation type (n=92,027)



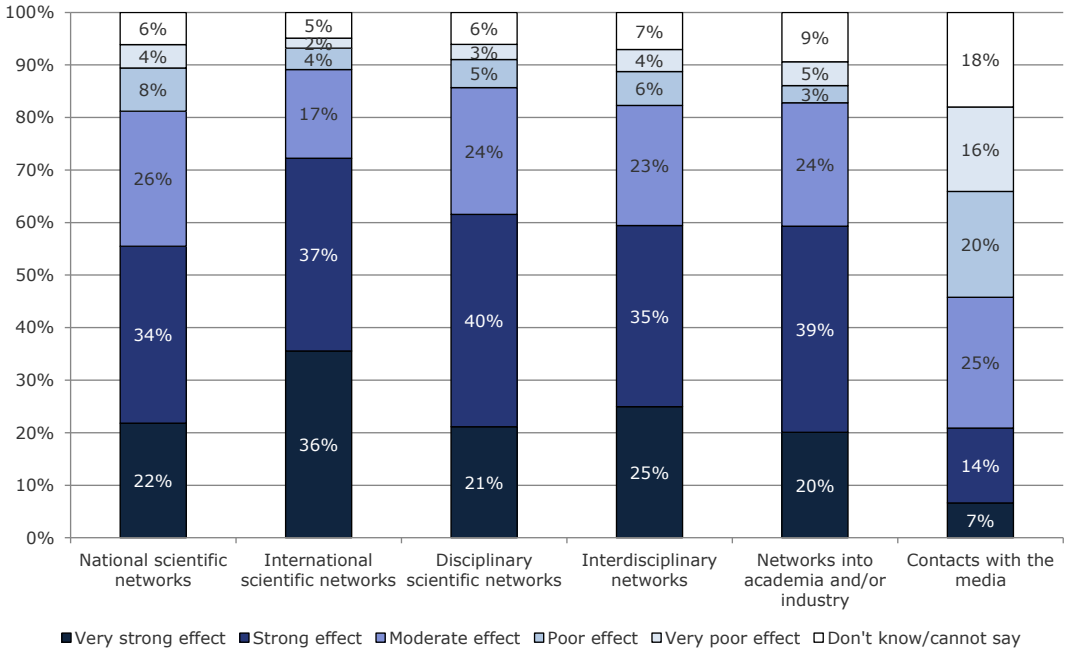
Source: Analysis of the team level survey data.

Figure 47: Materialisation of cooperation for the research team as a result of participating in the FP project, by field of science (n=92,027)



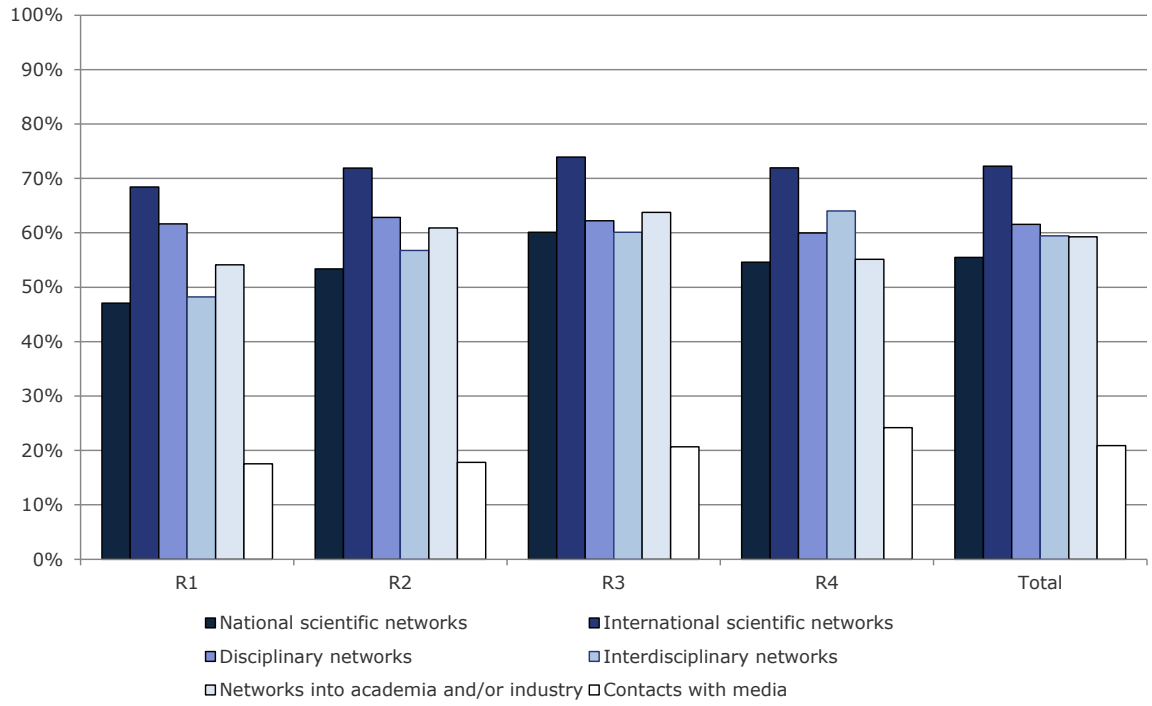
Source: Analysis of the team level survey data.

Figure 48: Estimated impact of FP employment on career in terms of expanding networks into academia and/or industry (n=298,880)



Source: Analysis of the individual level survey data.

Figure 49: Estimated impact of FP employment on career in terms of expanding networks into academia and/or industry, by current career stage (n=298,880)



Source: Analysis of the individual level survey data.

3.6.2. Case study evidence

There is no evidence of substantial brain circulation by attracting researchers from outside the EU27 or cooperating with organisations from outside the EU27.

In the ten cases that were analysed in-depth, there is little to no recruitment of non-EU27 researchers for the project in the organisations that were interviewed. There is no clear explanation given, except in one case where confidentiality issues were a barrier to hiring foreign researchers. Of the three cases where one non-EU researcher worked on the project, two were situated in the science field and one in life sciences. Two were led by HE organisations and one by a private company.

In 2 out of 10 cases, one of the partners was non-EU27 based. One partner was situated in Turkey, another in Thailand. The latter was only involved for specific technical tasks. In both cases the coordinating organisation was a private company.
In none of the cases was it reported that project participation attracted researchers returning from outside the EU to an EU position.

FP participation contributes to increased mobility, but the majority are inter-EU moves. The international dimension is important in terms of building HRC (acquiring skills, new knowledge and new perspectives; for networking).

In the majority of the cases, short moves for the purpose of conferences and meetings are common. In about half of the cases, a long term stay in another institution and country is reported. Both individual moves of researchers working in the partner institution for a fixed period, and collective moves of teams to meet and exchange knowledge have taken place. Mobility outside the EU is reported in 2 cases, both led by HE organisations, one in science and one in life science. It concerns research visits to universities in the US and Tokyo, based on common interests. In both cases, the hosting universities were not part of the project consortium.

In those cases where international mobility was reported, the interviewees acknowledge the effect of FP funding and indicate that it offered opportunities that would otherwise not exist for the researchers of the team. The international dimension is very important in FP projects. In the majority of the cases, several interviewees see this as one of the main advantages and view it as one of the key factors resulting in new skills and perspectives on research. Nevertheless, the focus is on inter-EU rather than global cooperation and networking.

Knowledge transfer takes place and is explicitly organised, both between partners and more broadly. Confidentiality issues can be a barrier for knowledge transfer in commercially oriented projects led by private companies.

Knowledge transfer occurs in all cases but one case. The one exception that did not report knowledge transfer effects was a project with a strong commercial focus, where the private company leading the project coordinated the other partners bilaterally on specific tasks. In all other cases, there was a strong perception of the importance of knowledge sharing activities and effects. Knowledge transfer takes place both as spillover effect of the cooperation as well as through specific networking and sharing activities. Examples of indirect transfers are:

- joint publications,
- interaction and communication throughout the project.

Examples of direct transfers are:

- staff exchange for learning new methods and techniques or for implementing the technologies,
- consortium meetings,

- workshops,
- training sessions,
- summer schools.

In several cases, knowledge is also transferred to a broader public of researchers and stakeholders. Again, both indirect and direct transfer takes place. Examples of indirect transfers are:

- department meetings where findings are reported to other researchers in the institution,
- spillovers to other teams in the institution in terms of proposal writing and management,
- spillovers to students through inclusion of results in teaching (HE organisation),
- awareness raising on the topics in the research community.

Examples of direct transfers are:

- stakeholder meetings and conferences at regional/national level,
- cooperation with institutions outside the consortium that work on related topics
- or for implementing related projects.

It can be noted that the three cases where knowledge transfer outside the consortium is explicitly mentioned are all led by a HE organisation. Their fields of research are diverse: one in science, one in life science and one in SSH. This is not surprising when we compare the evidence from cases with a more commercially-oriented objective stating that this kind of indirect or broader dissemination of results is not allowed for reasons of confidentiality and IPR. In one case, it is even reported that this hinders transfer within the consortium in some cases.

Networking and cooperation effects are inherent to FP project participation: networks are extended before and during the project, cooperation often continued after the project (outcome, immediate and intermediate impacts).

Networking is an important part of FP projects. Networks are extended, participants cooperate with organisations they did not know before. The intersectoral dimension is also important here. Even though the ex-ante situation is not elaborated upon in detail in all cases, the reports indicate that it is common that networks are extended in the proposal stage for an FP project. A general pattern is that the consortium starts from a bilateral relationship or small group of institutions that have cooperated before, and new partners are sought to complete the consortium for the particular project. In the case of cooperation between industry and academia, one case reported that the academic partners knew each other but explicitly extended their network with the private partners.

When the project ends, it is not uncommon for the consortium partners to maintain their network. In the majority of the cases, and particularly in universities and higher education institutions or the public sector, some form of continuation is given to the cooperation. In academic networks, joint publications based on the project are completed after the project, or new collaborations for publications are initiated. In 4 cases, interviewees report that new proposals for international projects are written by partners of the same consortium (though not always same set-up with all partners). In 1 additional case, partners are currently looking for new opportunities to cooperate.

In projects that include private partners, the responses are more diverse. In one case, the academic partners continue cooperation without the SMEs involved. In another case where the cooperation was bilateral on specific tasks, the coordinator continued alone to further develop the project results. And in a third case, cooperation was continued in the form of strategic partnerships with the private company leading the

project. In sum, in the private sector continuation of cooperation depends to a greater degree on the initial objectives of the project and the potential of the results for further development.

3.7. Evaluation Question 7: Contribution to job creation

As described in the introductory section on policy context, the creation of the ERA is one of the cornerstones of the Europe 2020 strategy towards growth and jobs. The Framework Programme is one of the principal instruments to support the process of making the ERA a reality. The Innovation Union Flagship Initiative[71] states that, to reach the target of 3% of the EU's GDP being invested in R&D, 1 million new researchers will be needed on top of the current 1.5 million. The required number of researchers is even higher since more newcomers are needed to take the place of those who will retire over the next decade.

The total share of FTE researchers in the active population is already increasing in the EU27 (e.g. from 0.52% to 0.69% between 2002 and 2012). When accounting for the total R&D personnel, this is 0.92% and 1.10% in 2002 and 2012 respectively. But it is currently and will be important in future to expand the existing pool, for example by attracting female researchers and by increasing the number of researchers in the business sector. Concerning the first, the right conditions need to be supported or created to attract or retain female researchers within the research profession. With regard to the business sector, there is room for growth when we compare the EU to the US, China or Japan. Whereas 45% of all researchers in the EU work in the business sector, this is 78% in the US, 62% in China and 74% in Japan[72].

As mentioned above, the Framework Programmes are an important instrument in the realisation of the ERA and the Europe 2020 objectives. Increasing the researcher stock in Europe, and more generally creating jobs and growth thus underlie the vision and objectives of the FP and are therefore key indicators in this assessment on how FP6 and FP7 contribute to building human research capacity in Europe.

3.7.1. Survey evidence

Direct job creation is limited: 61,000 additional research positions after FP7 projects, the majority of which follow a Cooperation project.

As discussed in detail in section 3.5.1, 54% of the beneficiary organisations hire new staff to the project and most of these personnel are hired from outside of the organisation (89%). This results in an estimated total of more than 142,000 researchers hired on FP7 projects, or 1.3 per organisation[73]. Of these, 43% or 61,000 researchers stay employed in the research team after the end of the project (intermediate impact).

We cannot make a comparison to exactly the same kind of data (in HC) but, to at least put this in a broader perspective, we can refer to the FTE based Eurostat data on the growth in the EU27 stock of researchers. This growth amounts to 202,806 additional FTE researchers between 2007 and 2012 (latest available data). Although 2013 is not included in this data (FP7 runs from 2007-2013) we have 61,000 new research positions (HC) stemming from FP7, versus 202,806 new researchers (FTE)

[71] European Commission, "Europe 2020 Flagship Initiative – Innovation Union, SEC(2010) 1161 final, Brussels, 6 October 2010.

[72] European Commission, DG Research and Innovation, Researchers' Report 2013, Final report, based on Eurostat data. http://ec.europa.eu/euraxess/pdf/research_policies/20130911_Researchers%20Report%202013_FINAL%20REPORT.pdf

[73] The figure includes only the participants of the host-driven actions of the Marie Curie Actions, including IAPP, IRSES & ITN.

between 2007 and 2012. There is no direct comparison possible between these figures, but their relative magnitude does suggest a considerable contribution of FP7 to the creation of research positions.

26,000 researchers remain employed after an FP7 Cooperation project, 16,000 after an FP7 Capacities project; 11,000 after an FP7 People project and 8,000 after an FP7 Ideas project. It is thus noted that the specific programmes (Ideas and People) and the organisation types (higher education institutes and public or government sector) that hire the largest share of researchers at the start of the project have the lowest share of researchers staying after the project.

When we relate these absolute numbers to the total number of projects, we find that on average 4.3 additional research positions are created per FP project. The additional employment effect is relatively highest in the Capacities and People Specific Programmes, where we find, respectively, 8.4 and 8.2 additional research positions per project. This compares to respectively, 3.7 and 2.2 for the Cooperation and Ideas Specific Programmes. It should be noted that the People projects and in particular the Ideas projects have on average lower budgets per project than the Capacities and Cooperation projects and the types of investments can be different between Specific Programmes and projects (e.g. next to research positions also infrastructure, tests, conferences, administrative work, etc.).

Table 19: Overview of number of researchers hired, project cost and EC financial contribution, by type of FP project

Programme	Additional research positions	Number of projects	Additional research positions per project
FP7 CAPACITIES	15,650	1,853	8.4
FP7 COOPERATION	26,123	7,146	3.7
FP7 IDEAS	8,351	3,803	2.2
FP7 PEOPLE	11,289	1,378	8.2
Total	**61,413**	**14,180**	**4.3**

Source: Analysis of the team level survey data and eCORDA data.

The direct job creation calculated here is to be interpreted as a lower barrier to the exact number. When researchers are hired from inside the organisation and replaced in their original position, this is also a form of net job creation. In the team level survey, a question is included to estimate this but the responses are not sufficiently accurate to calculate an accurate figure. Applying a rough calculation on a subsample of more accurate data suggests that 12% of the researchers recruited from within the organisation are replaced in their original position. This therefore suggests relatively limited net job creation for researchers through this channel.

Positive outcome effect of FP6-7 participation on obtaining a PhD degree: 70% of current R1 researchers see a strong to very strong effect.

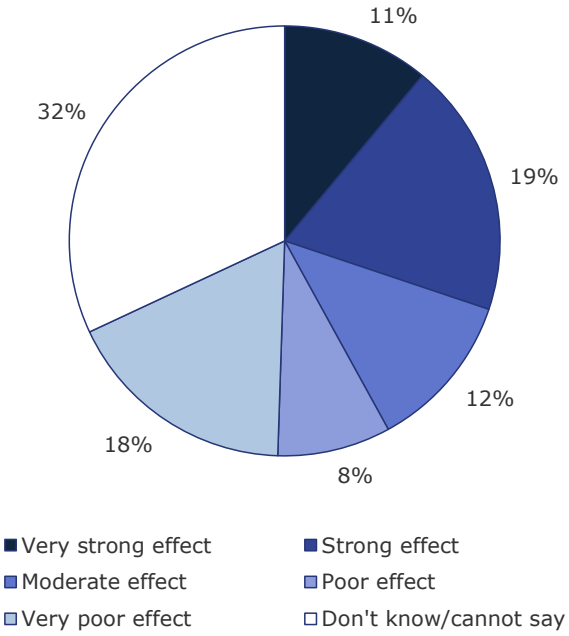
From section 0 on EQ2 – individual career paths, we know that 30% of the participating researchers see a strong to very strong effect and another 12% a moderate effect on career progress in terms of obtaining a PhD (or other formal qualification). Not surprisingly, the effect is indicated as strongest by R1 (70%) and decreases strongly in the subsequent stages (34%, 26% and 21% respectively)[74].

[74] Note that this analysis is based on the unit 'researcher' while the analysis in section 3.2 is based on the unit 'employment episodes'.

The share is lowest for researchers working in the private not-for-profit sector (8%) and highest in the private industry sector (44%). The group that sees a very strong effect is highest in the universities or higher education institutions (12%).

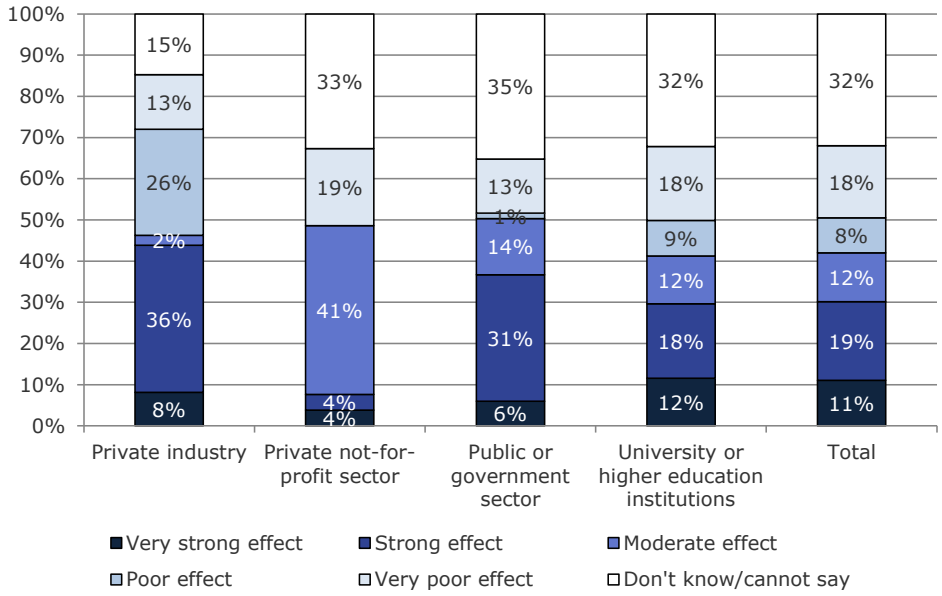
Except for a slightly lower share in the Social Sciences (22% compared to an average of 30%), differences between fields of science are limited when we aggregate the 'strong' and 'very strong' categories. However, when only looking at the 'very strong' category, in Agricultural Sciences a considerable share of 23% of the researchers see a very strong effect. There is also a small gender difference observed, between 32% for male researchers compared to 26% for female researchers.

Figure 50: Estimation of impact of FP employment on career in terms of obtaining a PhD or another formal qualification (n = 289,880)



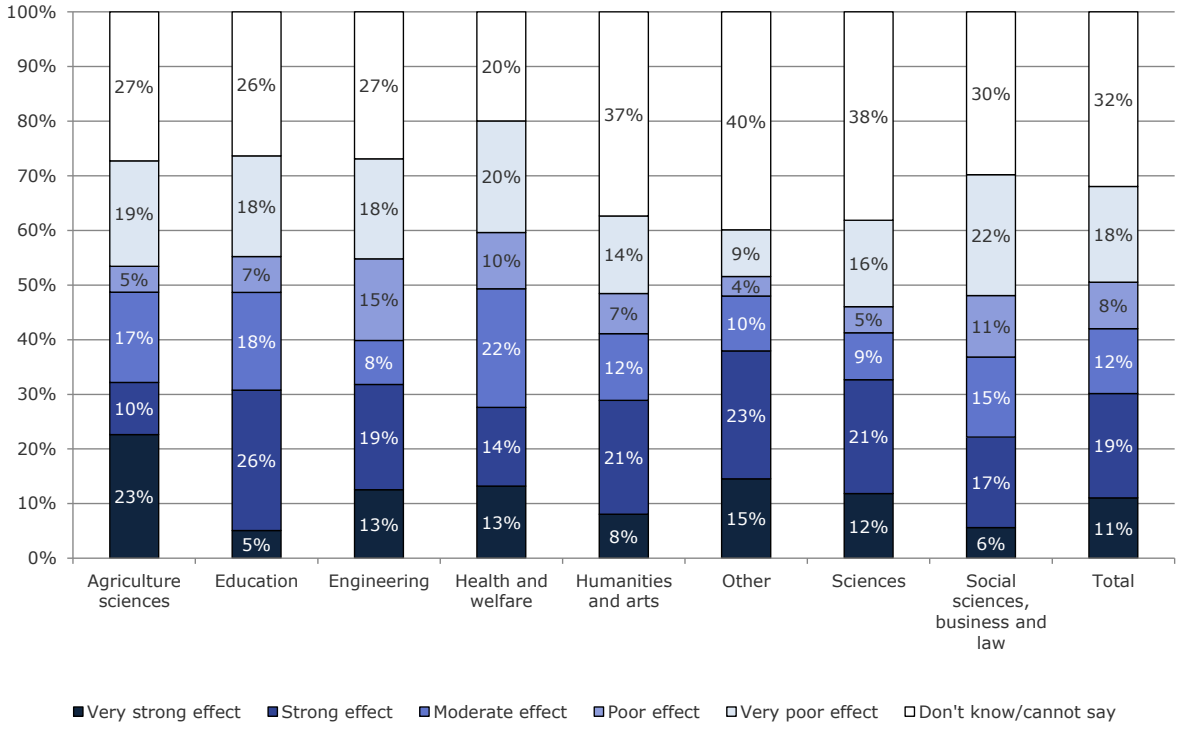
Source: Analysis of the individual level survey data.

Figure 51: Estimation of impact of FP employment on career in terms of obtaining a PhD or another formal qualification, by current organisation type (n = 289,880)



Source: Analysis of the individual level survey data.

Figure 52: Estimation of impact of FP employment on career in terms of obtaining a PhD or another formal qualification, by field of science (n = 289,880)



Source: Analysis of the individual level survey data.
Note: The field 'Services' is excluded from the graph due to insufficient number of observations.

Positive immediate and intermediate impact on attractiveness which is mainly due to the international focus and research content of FP projects.

Several indicators from both the individual level and team level survey relate to the contribution of FP to the overall attractiveness of the region or institution for researchers. The motivation of researchers to participate in an FP project tells us something about the ex-ante expectations they have vis-à-vis the project. Both the content-related motivations (international focus or research content) and the contract or conditions-related motivations can play a role.

As indicated in section 0 on EQ2 – contribution to the individual career path - the international focus of the framework programmes is the main motivation for participation. 51% of the researchers have ticked this option among a list of 9 potential motivations. The relevance of research goals (50%) is the second most frequently mentioned motivation, followed by interdisciplinary research and expected effect on future career development (39% and 37% respectively). On the other hand, contractual conditions are a motivation for 30% of the participants.

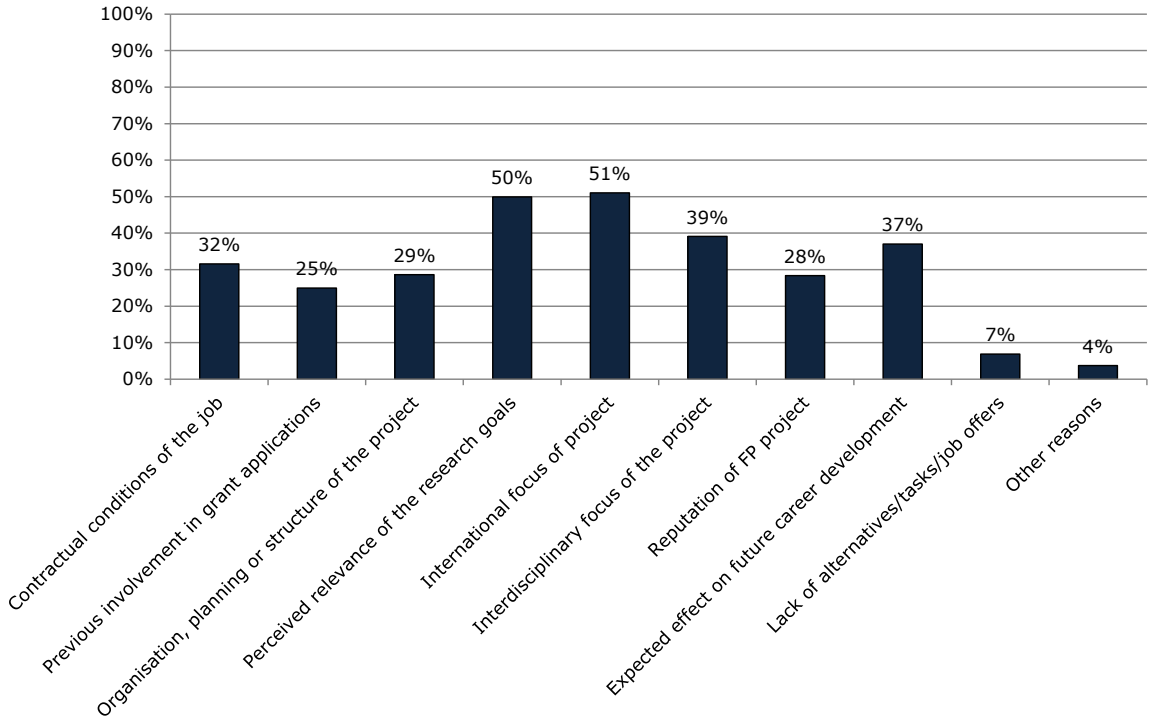
The attractiveness of both international focus and research content are higher for researchers who participated in both FP6 and FP7 (62% and 66% compared to 51% and 50% of all researchers). The motivation in both cases is lower in private industry. In the private not-for-profit sector, it seems that the research content plays a substantially more important role than the international focus (56% versus 43%). Somewhat surprisingly, both aspects are deemed more important in terms of motivation to participate to FP by researchers in the R4 career stage than those in the R1 and R2 career stages.

With contractual conditions as motivator, the share is highest for participants in both FP6 and FP7 projects (44%) and lowest for only FP7 participation (24%). Remarkably, contractual conditions specifically motivate particular researchers in private industry (56%) to participate. This may be related to the findings at team level (EQ3-5) that contractual conditions in universities and higher education institutions are determined by the legal and institutional context, rather than by the type of funding.

Furthermore, R2 researchers attach most value to this motivation (46%) compared to researchers at other career stages (35% in R1, 32% in R2 and 21% in R4). Again, this can be explained by external factors such as the institutional context for PhD candidates in R1 and the smaller impact of one FP project on a leading researcher who already has built up a wide research experience and curriculum.

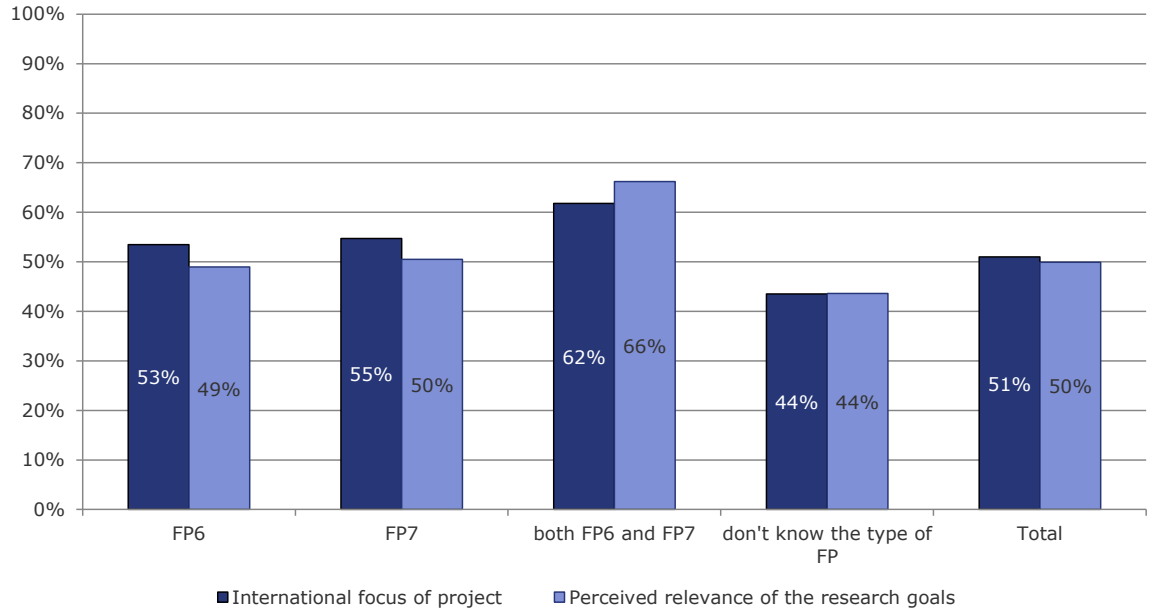
Finally, there are small differences between regions (34% for EU12 participants and 31% for EU15 participants, and between genders (35% for female participants and 30% for male participants).

Figure 53: Different motivators to participate to FP (n=291,293)



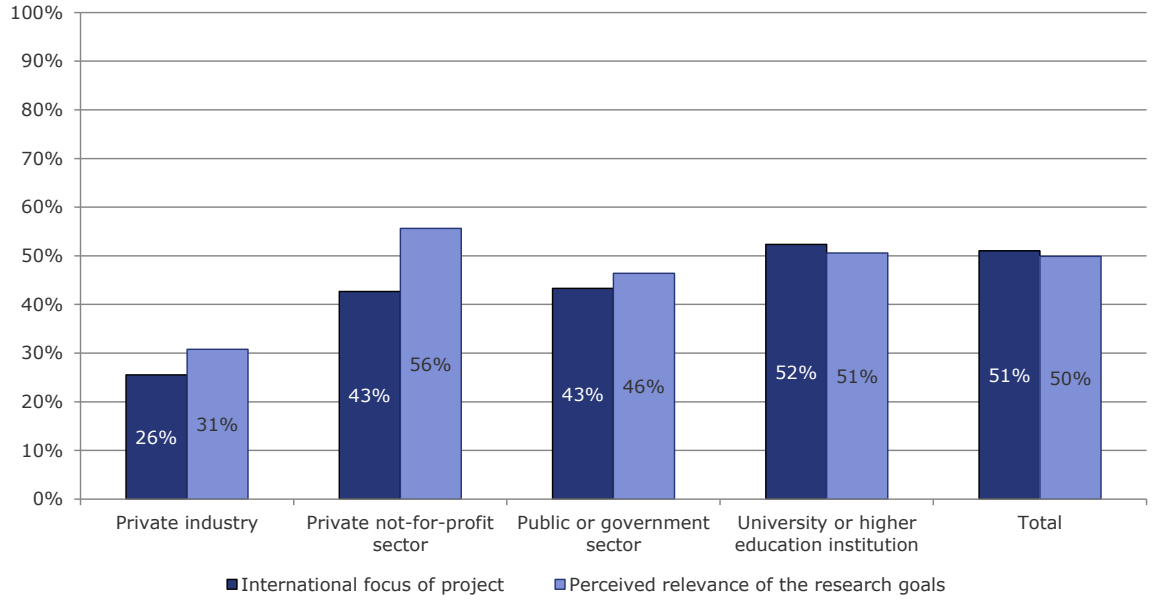
Source: Analysis of the individual level survey data.

Figure 54: International focus and perceived relevance of the research goals as a motivator to participate to FP, by type of FP (n=291,293)



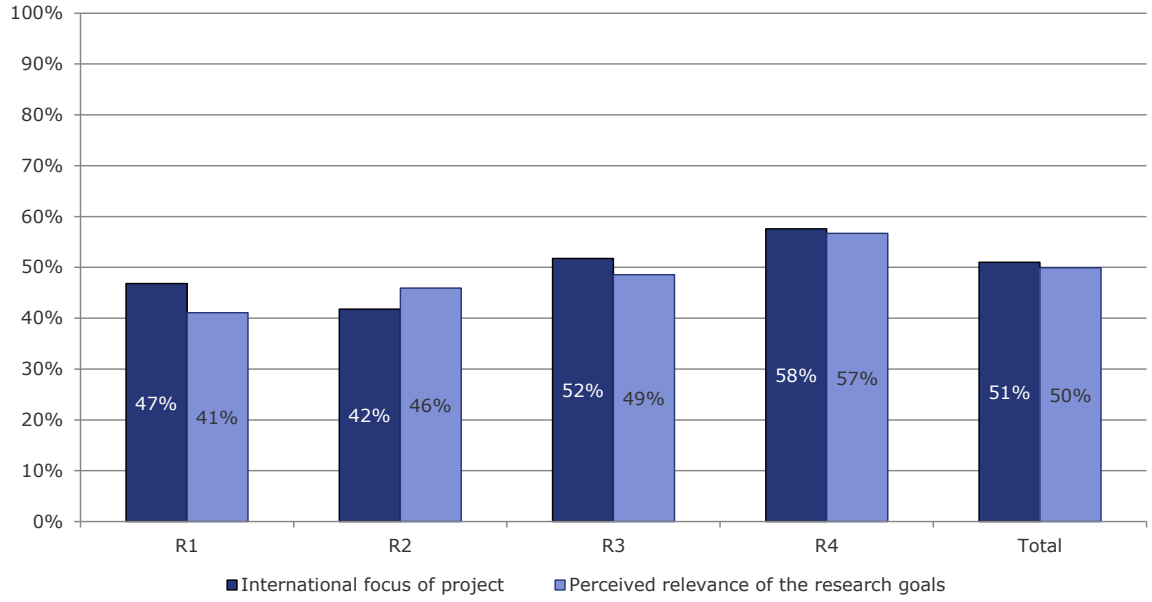
Source: Analysis of the individual level survey data.

Figure 55: International focus and perceived relevance of the research goals as a motivator to participate to FP, by type of organisation (n=291,293)



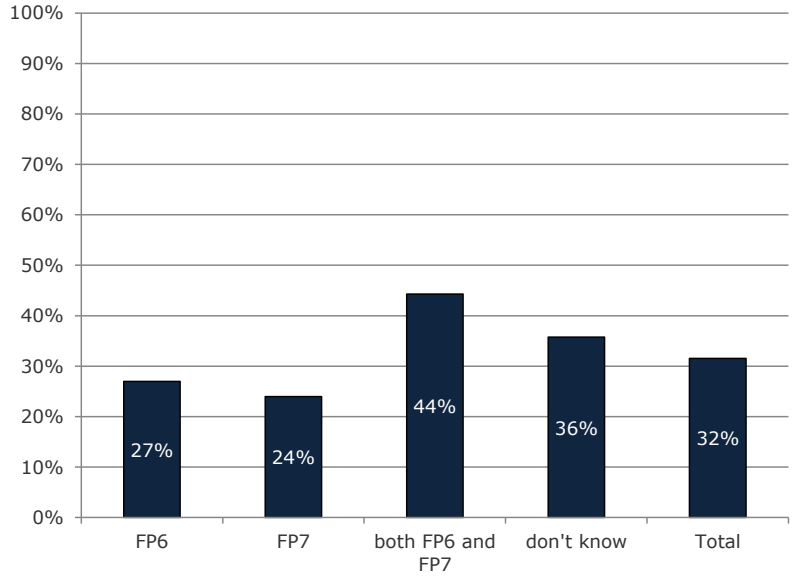
Source: Analysis of the individual level survey data.

Figure 56: International focus and perceived relevance of the research goals as a motivator to participate to FP, by career stage (n=291,293)



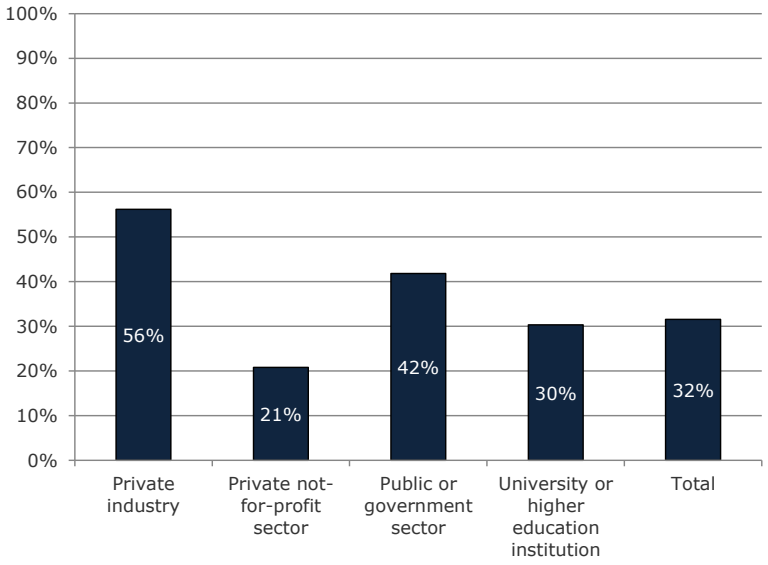
Source: Analysis of the individual level survey data.

Figure 57: Attractive contractual conditions as a motivator to participate to FP, by type of FP participation (n=291,293)



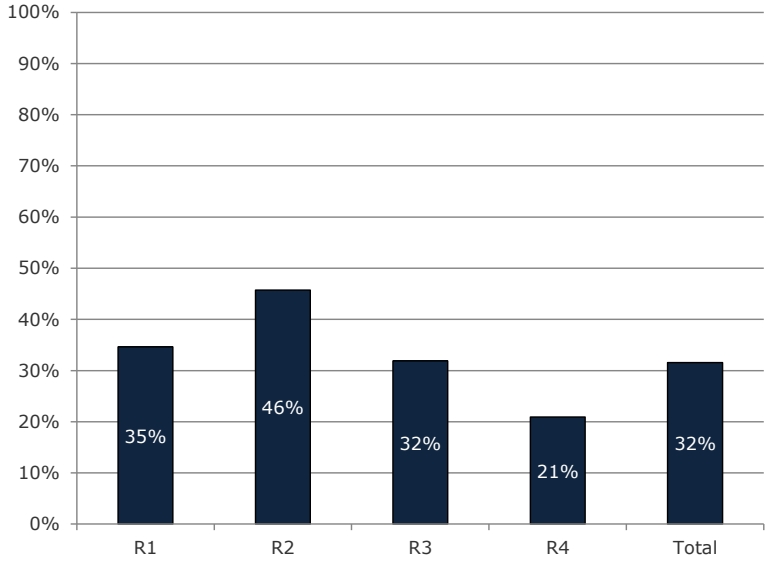
Source: Analysis of the individual level survey data.

Figure 58: Attractive contractual conditions as a motivator to participate to FP, by type of organisation (n=291,293)



Source: Analysis of the individual level survey data.

Figure 59: Attractive contractual conditions as a motivator to participate to FP, by career stage (n=291,293)



Source: Analysis of the individual level survey data.

3.7.2. Case study evidence

FP participation results in only limited direct and permanent job creation.

According to the case study evidence, there is limited direct and permanent job creation due to participation in European Framework Programmes. In 4 out of 7 cases with *non-academic* partners, new employees were recruited by the private organisations that were interviewed. However, the absolute numbers are low (1, 2, 4) and are reported to have limited to no effect on team size. Most recruited researchers offered to stay after the project ended and did so. In one particular case, researchers from universities were recruited by the private company leading the project after the project was completed.

In 7 of the 9 cases that report on this, new researchers were recruited by the *academic* organisations that were interviewed. The number varies from 1-2 to 22. Again, the overall effect is limited. It is also suggested that the profiles recruited are predominantly early stage researchers, some of which are PhD candidates. The senior research and management expertise is available in the team and additional capacity is recruited when the project is won to carry out research tasks. This is the typical researcher profile – someone who will not stay after the project ends, but will go on naturally to another employment post-doc or as an established researcher (also see section 0 on EQ5 - team size and composition).

In relation to this profile, one interviewee (a PhD candidate in the project) points out the risk of not providing the necessary support and training to PhD candidates throughout the project when the project cooperation and deadlines have priority. On the other hand, this same practice enables organisations to train researchers on the project so that they can use their experience in subsequent employment after the project comes to an end.

Even though the net direct job creation effect is small, it is suggested in interviews that the main employment effect is not additional job creation, but continuous employment of the research team for a longer period of time. One of the interviewees mentions that this is important in terms of further development and specialisation of the research, and thus by extension for strengthening the knowledge base, expertise and research capacity in Europe. Building and strengthening the knowledge base is also reflected in the examples of the FP participating researchers being asked to advise on policies as experts in their national or institutional context.

Indirect job creation can be substantial if the project leads to increased awareness or commercial outcomes (intermediate impact).

Case study evidence suggests that indirect job creation can be substantial, particularly when the result of the project is successfully commercialised, or (to a lesser extent) when the research moves higher up on the research agenda and leads to more attention and funding for the topic. The main effect is realised in private industry, when the results are successful and can be valorised/implemented in products and processes. In this case, additional investments are made by the company or attract external investors. The unit that develops the product or technology grows exponentially as a result (for example, realised in case 6 and potentially expected in the future – based on patenting activities – for case 8 and case 9). Commercialisation of the results is realised or planned in case 1, 6, 7, 8 and 9. 2 of these are led by HE organisations, 3 by private companies. 4 are in the field of life sciences.

In case 3, an SME participant reports that they became familiar with the concept of PhD research in their company through the project and now take the initiative to

cooperate more with PhD researchers in their activities. Also, awareness of the importance of the topic, both in higher education and the private industry setting, can indirectly increase the funding and number of researchers working on this research (case 1, case 3, case 7, case 9, case 10). A similar effect is obtained from strengthening proposal writing skills in the team (case 8, case 10). When the leverage effect in terms of attracting research projects and funding is substantial, to the extent that an increase of administrative staff is realised, this can also be considered an indirect effect of FP participation (case 10). In sum, several dynamics can lead to indirect employment effects during and after FP participation. However, the evidence is based on specific examples from one or two cases each, so no general conclusions or estimation/measurement of this kind of effect can be drawn from the case studies.

It is common that one or more PhDs are based on an FP project.

It is common in the case projects that a number of PhD degrees are completed within one project. This is the case in both academically- and commercially-oriented projects. The numbers reported by the interviewed institutions go from 2 to 4. In 3 cases, a PhD candidate worked on the project but the PhD was not entirely based on this research alone. However, no indication is given of PhD trajectories started but not completed. This observation also relates to the finding that early stage researchers are attracted to work on these projects in order to reinforce research capacity, next to the senior expertise already present in the team. One interviewee (case 10) reports that the data collected in the project were used as basis for two Masters theses.

FP participation increases the attractiveness of participating institutions both directly and indirectly, predominantly in academia.

FP participation is reported to have positive effects on the attractiveness of the institution, particularly in academia. In most cases, public research and HE institutes think that the attractiveness of their institution has increased thanks to the project. The main reason for this is the international networking and scope of the projects, which result in important visibility and reputation effects. These are highly ranked values in the research community and support further development of networking and potential cooperation. The effect is larger the first time that an organisation participates.

The effect is less clear for potential candidates for research positions, who are not aware of the role and significance of EU funding when they apply. In particular, non-EU researchers are not familiar with these kind of projects. However, both the use of English as working language and the interesting content (international, interdisciplinary, intersectoral, technically challenging and new) are factors specific to the FP projects that attract researchers to apply. This is considered an indirect effect, as researchers are generally not aware about the underlying funding modalities. This is a general observation; there is no specific evidence on non-EU researchers.

Private organisations give the impression that this effect is of less importance to them. Although new cooperation opportunities do result from their participation in EU-funded projects, they see no effect in terms of attracting researchers to apply for positions.

4. Synthesis per evaluation question

4.1. Impacts situated on the 'individual level'

4.1.1. Contribution to individual skills and expertise (EQ1)

The development of individual skills and expertise clearly benefits from FP participation.

We used an employment episode approach in order to assess the contribution of FP involvement on the development of researchers' skills and expertise. With the majority of respondents (between 64% and 76%, depending on the individual skill) stating that they received their strongest training during FP related employment episodes, the evidence clearly points to the fact that participating in FPs has a positive impact on skill development.

FP participation has a significantly positive effect on almost all skills and capacities. Especially those skills rated as particularly relevant for career development, benefit from FP involvement, which also points to potential mid- and long- term effects of FP participation.

While there are differences regarding the extent of the effect to which FP participation contributed to the development of the various skills, more than half of FP participants attribute strong or very strong effects to a variety of skills developed in the course of their FP project involvement. This is particularly the case for skills such as team working (73%), networking (71%), communication (65%), research methods (62%) and problem solving (59%), which were, at the same time, regarded as particularly essential for career development. FP participants generally assigned these skills more importance for career development than those who had not been involved in FP activities during their career. However, less pronounced is the effect of FP participation on some of the 'enterprise skills' e.g. entrepreneurship; 26% of the respondents perceive very strong or strong effects of FP activities on the development of this particular skill and commercialisation (23%) but also on teaching skills (29%), which are, however, also regarded as less relevant for career development.

Career stage is an important factor influencing skill development.

Skill development is particularly strong in episodes during which researchers participated in FP activities with more than 70% of FP participants indicating that their training of a number of key skills (such as "networking", "leadership", "use of science in policy", "negotiating", "commercialisation", "innovation" and "project management") coincided with FP project involvement. Regardless of FP, training effects are stronger in later career stages than during earlier stages especially with regard to certain management skills (e.g. 58% of the researchers receive strongest training of leadership skills as established or leading researchers during R3 or R4). This effect is even stronger for FP participants. FP participants tend to be more advanced in their career than non-FP participants when it comes to the training or acquisition of skills. While 26% of researchers without FP-project involvement received their strongest training in "networking" skills as early career researchers (during R1), this applies to only 18% of FP participants.

FP participation also contributes to increased independence of researchers.

FP participation as well as career stage also has a bearing on the tasks that were carried out by researchers. While FP participation has a positive effect on almost all the tasks fulfilled, career stage is an important factor for explaining the timing of first-time fulfilment of most of the tasks. This holds true particularly in terms of tasks fulfilled without supervision. The majority of researchers who have been involved in FP-related activities state that they were able to fulfil their tasks for the first time without supervision in FP-related employment episodes (between 58%, data analysis, and 71%, patent application). In general, evidence gathered from the case studies as well as the desk research confirms to a large extent the findings from the survey. Thus, FP engagement contributes to researchers' increasing independence and autonomy, at least with regard to taking over responsibility for individual tasks.

FP participation contributes to further enhancing the mobility of researchers.

While collaboration in research is generally a typical pattern, we find evidence that it further benefits from FP participation. Specifically, mid- or long-term mobility of researchers seems to be fostered by FP participation. While 39% of FP researchers have worked abroad for more than 3 month in the last 10 years, this is the case for only 26% of the non-FP researchers. With regard to short-term mobility, however, the differences between FP participants (38%) and non-participants (43%) are rather minimal. For the latter, career stage seems to play a stronger role with a higher share of senior researchers (50% among R4 researchers compared to 36% of R2 researchers) working abroad for up to 3 months.

4.1.2. Contribution to individual career paths (EQ2)

The relevance of the research to be carried out in a project and the international focus of the programme are the main motives to participate in FP-related activities.

Expectations with respect to career development were not explicit motivating factors for the decision to participate in FP-related activities. For only 35% of the male researchers and 32% of the female researchers, expected career effects or effects on the contractual conditions (32% female researchers, 29% male researchers) were motives for engaging in FP activities. Also, the perceived outcomes or effects of participation are not considered particularly influential for the career development. These results are confirmed by the results from the survey as well as the case studies carried out.

FP participation does not function as an immediate 'career catalyser'; the impact of FP participation on career development or progression is rather modest in general.

Still, some positive effects can be identified. E.g. involvement in FP projects offers mid- and longer-term career perspectives to researchers at all career stages.

With regard to contractual conditions, evidence points to the fact that employment episodes which involve FP-related funding generally last longer than those based on other funding sources e.g. 23% of FP related employment episode last only up to 1 year, while this is the case for 51% of non-FP related employment episodes. Thus, FP-funded projects seem to allow for longer contracts (share of contract duration up to one year with FP activities 34% as opposed to 56% of non-FP related contracts) and less fluctuation in employment. This, however, is only true as long as the duration of fixed-term positions is concerned. When it comes to distinguishing between fixed-term and permanent positions the picture is rather unclear. Changes between fixed-term

and permanent positions occur in all directions, meaning from fixed-term positions to permanent positions as well as the other way around. However, the share of non-FP participants moving from a permanent position to a fixed-term position is lower than the other way around. One explanation for this finding might be that contractual conditions are in general not a decisive factor for researchers when it comes to choosing for or against employment options.

As regards career progression, the average length of a certain career stage decreases as researchers progress towards seniority – independent of whether or not a researcher is involved in FP activities – with the share of researchers that complete the respective career stage in up to three years, amounting to 47% (R1), 55% (R2) and 59% (R3). However, researchers participating in FP projects seem to remain longer on a certain career stage than those who are not engaged in FP activities. While 45% of early career researchers (R1) with FP-project involvement remain on this career stage for more than 5 years, this applies to only 24% of the researchers without FP project participation.

However, despite the evidence gathered based on the analysis employment episodes and their characteristics, almost half of the researchers perceive positive effects of FP participation on their research career. FP participation is perceived to have positive effects on the researchers' progression to the next career stage, even though evidence suggests that it takes longer for FP participants to move along the research career ladder.

Expectations are rather moderate regarding the acquisition of new positions due to FP participation. This concerns expectations towards the acquisition of new positions in another organisation, e.g. moving to either a national (27% of researchers expect that their FP participation might contribute to acquiring a new position at a prestigious national university), European (29%) or non-European university (23%). Expectations are lower when it comes to intersectoral mobility. Here even fewer researchers (17%) attribute potential effects to their FP activities. This also means that with regard to the interaction between academia and industry, networking plays a stronger role than actual moving of researchers between the sectors.

Thus, notwithstanding the still somewhat positive expected effects of FP participation on career development, evidence from both the case studies and the survey suggests that FP participation does not function as a short-term career catalyser. On the contrary, researchers who have not been involved in FP activities are more likely to experience a promotion to the next career stage during a subsequent employment period than FP participants. Not surprisingly, in general and independent of FP participation, promotion is more likely for early career researchers than those in later career stages. Corresponding to evidence from other studies, FP participants attribute mid-term and long-term benefits to FP in terms of the general development of their career.

4.3. Impacts situated on the 'team level'

4.3.1. Impact on contractual conditions (EQ3)

FP funding contributed to a small overall change in the ratio of permanent/fixed-term contracts and a slight overall shift to the more widespread use of fixed-term contracts in the participating research teams

The use of full-time fixed-term contracts rose in 27% of FP research teams, whereas the use of full-time permanent contracts grew by 20%. Participation in FP-funded activities was the strongest factor contributing to the reported changes in the mix of the contract types used, followed by an increasing reliance on third-party research funding for short-term research projects, decreasing national/regional public financing and researchers' own preferences.

The teams in Ideas relied primarily on third-party, project-based funding, collaborated with partners from academia and employed mainly junior researchers. The teams in Capacities and Cooperation tended to rely more on the organisation's own funds and included primarily senior researchers. These differences appear to explain why the largest relative increase in the use of fixed-term contracts occurred in the Ideas programme.

The reported changes in the mix of the used contract types varied across different types of FP beneficiaries

A positive and significant association was found between the use of fixed-term contracts and previous participation in FP6 and FP7. Universities and HEIs were more likely than private research organisations and public sector research organisations to increase the use of full-time fixed-term contracts and fellowships, grants and stipends. Similar trends were observed for the research teams that relied primarily on third-party funding or whose top priority was to attract more young researchers. Private for profit organisations and organisations frequently collaborating with industry, on the other hand, experienced the highest relative increase in the use of full-time permanent contracts. The same result was found for those FP beneficiaries whose primary motivation was commercialisation of research results and creation of economic outputs/value/competitive advantage. This suggests that particular types of networks formed (especially involving SMEs and organisations whose primary motivation is commercialisation of the results) can have a positive impact on the use of permanent contracts.

It is suggested that monitoring and assessing changes in the balance between permanent and fixed-term contracts in future EU-funded projects (see recommendations below) continues.

Although FP funding contributed to a greater use of fixed-term contracts, there was generally no long-term impact at the organisation level

No strong evidence was found to suggest that the contractual conditions of researchers who were already employed by the beneficiary organisations changed as a result of the teams' participation in FP projects. Many organisations, including most universities and HEIs, were bound by national regulations and standards and thus lacked autonomy in setting their employment conditions. Research organisations from the private sector that are usually smaller organisations compared to universities/HEI were generally less likely to hire additional researchers and thus did not have as many opportunities to introduce new types of contracts.

If the additionally/externally hired researchers were offered an opportunity to stay after the end of the projects, the beneficiary teams typically applied recruitment practices that were common in their organisation before FP funding. SMEs tended to offer full-time permanent contracts to researchers who stayed in the teams after the end of the projects, whereas the use of fixed-term contracts was more prevalent in universities and HEIs.

In the long term FP participation translates into formal advancement and better working conditions for the researchers involved in FP activities

Employment of researchers through fixed-term contracts and grants, fellowships and stipends was particularly widespread in Ideas and People, where many young researchers were recruited. The study results suggest that first-stage and recognised researchers were generally offered fixed-term contracts after the end of the project, whereas established/leading researchers with more experience tended to receive permanent contract offers with higher financial remuneration. This was particularly the case in public sector research organisations, where achieving formal recognition and advancement takes time and may require taking up a number of fixed-term employment contracts.

The results of the individual-level survey showed, however, that the highest share of researchers employed under permanent contracts were the participants of FP6 and FP7. For example, 77% of the participants of both FP6 and FP7 were employed under permanent contracts, while the overall average of permanently employed researchers was 55%. This suggests that, in the long term, FP funding brought about better working conditions to the majority of the participating researchers thanks to the skills and level of autonomy obtained in FP-funded projects.

4.3.2. Impact on/of open recruitment (EQ4)

FPs had a mixed structuring effect on HR management in the participating organisations, with a weak influence on gender mainstreaming

The impact of FPs on the participating organisations varied according to the particular HR processes and procedures. This impact was higher for recruitment procedures, training and supervision practices (about two-thirds of the beneficiaries experienced the related impacts), but it was smaller for gender mainstreaming and advancement of equal opportunities (46%). Although the project consortia generally recognised the importance of gender equality within their projects, the Commission targets for the involvement of female researchers were not always met. Therefore, there is a need to continue promoting gender equality through work programmes and grant agreements (see recommendations below).

FPs contributed to a more transparent and merit-based recruitment of researchers, in particular in the EU-12 and less technologically advanced countries

The recruitment of researchers became more merit-based, transparent and more publicly advertised in about one third of the participating organisations. The influence of FPs on recruitment practices was higher in the EU-12 and less technologically advanced countries where there was a greater need for such changes. The fact that the participants of FPs viewed the recruitment processes as more transparent than non-participants illustrate the impact of FPs.

However, there is evidence that in some cases the research vacancies were only advertised nationally, and EURAXESS was not always used when implementing FP-

funded projects. Therefore, it is important to strengthen the emphasis on openness and transparency of recruitment practices in the implementation of the Horizon 2020 programme (see recommendations below).

The impact of FPs on HRM was uneven across the participating organisations, with less influence on private research companies and SMEs

The impact of FPs on the participating organisations depended on the need to implement changes and on the actual changes implemented at the organisation level. Some organisations saw no need to make appropriate changes or no changes were possible because of existing national or regional legislation. Necessary HRM changes could be constrained by the overly positive perception of the participating organisations that their practices are fully in line with the principles of the Charter and Code or leading practices found elsewhere, as well as the insufficient attention paid to the HRM issue on the agenda of some research organisations.

More organisational changes occurred in those organisations that had previous FP participation experience and whose top priorities were related to different types of cooperation and specific objectives of HR management. In contrast, the FP beneficiaries whose primary goal was commercialisation and increased competitiveness (i.e. primarily private research companies and SMEs) did not change their recruitment practices as significantly. Therefore, it is suggested that supporting the implementation of the Charter and the Code through various instruments and on various levels, as well as raising awareness and exchanging good practiced on HR management practices (see recommendations below) continues.

Effective collaboration and transfer of knowledge contributes to the spread of good practices in HR management

Those research teams that established more effective collaboration during project implementation tended to produce better outcomes in terms of knowledge transfer (including on HR management practices). Those organisations that engaged in knowledge transfer more frequently also experienced more HR changes. Therefore, it is beneficial to further develop research networks and collaboration in order to promote transfer of knowledge on various issues of HR management, as well as developing 'good project management principles' (see recommendations below).

4.3.3. Impact on composition and size of research teams (EQ5)

FPs had a significant impact on size of the beneficiary research teams, particularly by increasing the number of researchers employed.

In terms of FP outputs, participation contributed to direct job creation in research teams: around 142,000 additional researchers were hired by the beneficiary research teams during the implementation of FP projects, or an average of 1.3 researchers per research team. The majority of these research teams hired additional researchers from outside of their organisation.

These impacts on direct job creation varied substantially across specific programmes, regions and disciplines. The beneficiaries of Ideas, which specifically focuses on the involvement of more junior researchers in frontier research, and the beneficiaries of People hired more additional researchers in comparison to those of Capacities or Cooperation. Likewise, the research teams from EU-15 countries, which had greater financial capacities to hire new staff, as well as universities/HEIs or public/government sector institutions hired more researchers than EU-12 teams and/or private organisations.

The impacts also depended on the varying demand for new research staff across different scientific disciplines: research teams working in Engineering, Sciences and Multidisciplinary scientific disciplines were more likely to hire additional researchers, in comparison to research teams specialising in other disciplines.

A large part of those additionally hired researchers stayed in the beneficiary research teams

By contributing to indirect job creation, FPs also produced immediate outcomes in terms of the increased size of beneficiary research teams: about 43%, or 61,000, of the additionally hired researchers stayed in their teams after project completion.

These immediate outcomes also varied across specific programmes and types of organisations. Although the specific programme of Ideas contributed mostly to the short-term growth in the size of the beneficiary research teams, the majority of these additionally hired researchers left their team after project completion. By contrast, most of additionally hired researchers in Capacities and Cooperation stayed in their teams even after the end of the project. The allocation of additional research funding (especially in the form of project-based competitive funding) at national/regional level can enhance the sustainability of the FP research teams.

The outcomes of FPs also depended on the flexibility of organisations to permanently hire new research staff: more than two-thirds of the researchers hired by private industry organisations and SMEs stayed in their teams after the end of the projects, whereas the corresponding figures were considerably lower for private, not-for-profit research organisations, public or government sector organisations and HEIs/universities. Therefore, supporting the industry dimension and encouraging SME participation in the Horizon 2020 programme can contribute to the sustainable impact of FP funding on team size in the future.

FPs had a significant impact on the composition of beneficiary research teams, in particular by increasing the share of women and international researchers among them

Since a large proportion of the additionally hired researchers were women and international researchers, FPs also contributed to diversity in the composition of the research teams involved. Moreover, this impact was often long-term: a large number of additionally hired women and more than one-third of additionally hired international researchers stayed in their research teams after the project completion.

The FPs' impact on the composition of research teams greatly varied across specific programmes, disciplines and types of organisations. The share of additionally hired international researchers among the research teams in Capacities and Cooperation was significantly lower than 50%. By contrast, among the teams involved in specific programmes that emphasise the strategic goal to attract more researchers from abroad (Ideas and especially People), international researchers constituted about two-thirds of all additionally hired researchers.

Private institutions and particularly SMEs, whose recruitment procedures were less limited by external regulations and standards, tended to hire fewer women and international researchers, in comparison to public or government organisations or universities/HEIs. Finally, research teams working in Agriculture, Health, Humanities, Services, Social Sciences and Multidisciplinary disciplines tended to hire more female researchers in comparison to teams working in Engineering, Education and Sciences.

4.3.4. Other evidence of contributions at team level

There was a significant level of complementarity between FPs and national, regional and (to a lesser extent) private funding

FPs had a significant impact in terms of increasing the ability of the organisational beneficiaries to attract additional funding from the EU, national/regional and, to a lower extent, private funds. Also, because of FP participation these organisations increased their ability to run projects on a larger scale financially and with a more long-term focus. FP contributed to achieving these outcomes in the participating organisations through several mechanisms or outputs: developing or extending research networks, building on the excellent results of FP projects, improving scientific reputation and increasing project management skills in participating organisations. However, recent cuts in research and innovation spending in some EU Member States constrained the ability of some beneficiary organisations to secure funding for new research and innovation projects at national level.

The impact on the ability of beneficiaries to attract funding from the third sources depended on the effectiveness of research collaboration during FP projects. This illustrates the importance of not only developing research networks, but also managing them effectively in order to enhance sustainable funding. Higher levels of agreement between FP project partners regarding intellectual property rights further facilitated their cooperation in the future. Also, the motivation of beneficiaries to participate in FP was an important factor: the impacts on ability to attract private funds were higher among the teams whose key motive was commercialisation of research results and creation of economic value.

FPs had significant impacts on the management of human and financial resources, as well as on project management capacities in the beneficiary research teams

Participation in FPs had the most significant impacts on the capacity of beneficiary organisations to engage in collaborative research projects, improving the procedures to better suit the procedures of EU-supported projects, as well as on the establishment and strengthening of clearly defined administrative structures that ensured the effective administration of research projects. To a somewhat lesser extent, FPs also had positive impacts on improving research budget monitoring/controlling, stronger control mechanisms for financial risk management and financial reporting, as well as standardisation of the templates/forms for the management of financial resources.

These immediate outcomes of FPs largely depended on the effectiveness of collaboration between project partners, which was key to successful transfer of knowledge (the acquisition of new knowledge, skills, HRM and project management practices) (see recommendations below concerning 'good project management principles').

FPs had a significant impact on the strategic research agenda of the beneficiary organisations

FPs particularly influenced the ability of beneficiary organisations to undertake research in areas corresponding to their long-terms needs, to better focus on new and emerging research trends, bringing strategic research agenda closer to FP topics and priorities, establishing regular and long-term activities in areas closely related to FP themes and making the research agenda more interdisciplinary.

4.4. Impacts situated on the 'system level'

4.4.1. Contribution to brain circulation (EQ6)

FPs help the Higher Education institutions to attract non-EU researchers to Europe, in particular through the Ideas and People programmes, but the magnitude is limited and the effect not lasting

The individual level survey shows that the share of non-EU researchers working in the EU and participating in an FP project is higher than the total share of non-EU researchers working in the EU (8% versus 5.6% of non-EU researchers working in the EU27 HE institutions, as based on the MORE2 study). This suggests that the concentration of non-EU researchers is higher in the FPs than in the EU HE environment, hence there is a sort of pull effect stemming from the FPs, particularly in the Humanities and Science. Further projections suggest that about 16,500 non-EU researchers participate in the FPs versus 193,000 EU researchers. FPs thus have an international pull effect, but the magnitude of this effect seems to be rather limited when put in perspective. Furthermore, the evidence suggests that non-EU researchers are less likely to stay after the project ends, compared to the EU researchers (34% versus 43%). This is also confirmed at the team level where two thirds of the organisations see no change in their team size with respect to the number of researchers from non-EU countries.

FPs strongly involve non-EU institutions, hence facilitating extra-EU brain circulation and knowledge transfer, nevertheless the real impact on longer term extra-EU mobility seems to be limited

The analysis of the eCORDA participation data shows that about 14% of the participating organisations (mainly from the public and government sector, and less from the private sector), and 14% of the coordinators, are non-EU based. Even though the case study evidence suggests that non-EU partners may be involved mainly for specific technical tasks, the eCORDA information contradicts this finding. There are no substantial differences between the average work load of EU and non-EU organisations that would suggest different responsibilities or roles in the project. In terms of brain circulation, mobility, on the team level, more than half of team leaders indicate that FP participation offered more international mobility opportunities to researchers. On the individual level, when asking the researchers directly, the majority of international moves were even unrelated to FP funding.

FPs contribute to a higher level of connection between research organisations and researchers, between different subsystems of the economy and society

Increasing levels of networking and national and international cooperation is very important, also from a systemic point of view. Team leaders find international and intersectoral cooperation important motives to participate in the FPs. The survey results show closer cooperation and increased networking as prominent effects. Researchers see a strong impact on their career in terms of networking thanks to participation in FP projects, with particular importance given to the international dimension. In general, the FPs contribute to achieving a higher level of interconnectedness, both inside and outside the EU. The case studies nicely illustrate this: new and often lasting partnerships are built across sectors and regional borders. Networking is very important as a vehicle for knowledge sharing and future collaboration. There is ample evidence suggesting that the FPs contribute to the realisation of different dimensions of the European Research Area.

4.4.2. Contribution to job creation (EQ7)

FP7 participation has led to the hiring of 142,000 researchers and an estimated direct new job creation of at least 61,000, the majority under the Cooperation programme

On the basis of the team level survey results, it has been estimated that the direct job creation (defined as the additional employment positions in participating organisations after the end of the project) amounts at least 61,000. About 54% of the beneficiary organisations hire new staff 'on the project', the majority of which comes from outside the organisation, resulting in more than 142,000 researchers hired on FP7 projects. About 43% of these researchers or 61,000 stay employed in the research team after the end of the project. This number does not include the replacement of internal staff recruited for an FP7 project (estimated to 12%). As a result we see a net retention rate of 1 out of 2.3 hired researchers, after the end of the project. The largest impact comes from the Cooperation projects, followed by Capacities, People and the Ideas programme.

Next to direct job creation, indirect job creation is significant but impossible to estimate; moreover, FPs strongly contribute to maintaining existing levels of researcher employment in Europe.

Indirect job creation as a result of valorisation and commercial exploitation of the FP project findings, is equally if not more important than direct job creation. The case study findings mainly indicate that indirect job creation can be substantial as a result commercialisation or prioritisation of the explored research subject on the organisation's strategic research agenda, and the subsequent hiring of new researchers. Whereas direct job creation is mainly situated in the public sector, indirect job creation is more prominent in the private (business) sector. Unfortunately, precise numbers are impossible to generate, but assuming the case studies have a predictive value, ex-post commercialisation leads to significant job creation. Finally, again on the basis of the case studies, several companies and also research institutions have indicated that FP funding helps them to maintain the size of the existing researcher team. So next to the creation of new jobs, FPs help to maintain existing employment levels.

Regional and institutional attractiveness are positively influenced by FP participation and the overall FP participation 'track record'; it leads to increased 'recognition'

Several indicators from both the individual and team level survey relate to the contribution of FP to the overall attractiveness of the region or institution for researchers. FP participation is reported to have positive effects on the attractiveness of the institution, particularly in academia. In most cases, public research and HE institutes think that the attractiveness of their institution has increased thanks to the project. The main reason for this is international networking and the scope of the projects, which result in important visibility and reputation effects. These are highly ranked values in the research community and support further development of networking and potential cooperation. The effect is obviously larger the first time an organisation participates.

The case study results have indicated that, especially for smaller companies, the attractiveness and recognition effect is of major importance for future collaboration as it can function as a reference point to attract new clients ('open doors') and for working with new partners.

5. Conclusions and reflections

C1. FP participation leads to several positive effects with respect to human research capacity development.

This study clearly brings forward a number of positive effects on human research capacity, related or directly attributed to FP participation. These positive effects are, topic-wise, discussed in detail in the responses to the evaluation questions and in the following overarching conclusions. Nevertheless, it is a telling picture when we bring them together in a graphic scheme which thereby illustrates the full diversity of the positive impacts we have identified. Their identification is important in order to point out and create awareness about the effects stemming from FP and support/maximise their realisation through a targeted approach (cf. section 6 on recommendations).

C2. Internationalisation possibilities and state-of-the-art research are the distinguishing features that make FP attractive to researchers.

&

C3. Internationalisation is the main impact realised at team and individual level.

Team leaders find international cooperation the most important motive (C2) to participate in FP, along with the ability to deepen or broaden the knowledge of the team on the research topic. Similarly, individual researchers consider international cooperation and interesting research content more important as a motive to participate in FP than e.g. contractual conditions. This clearly demonstrates the two main strengths that determine the attractiveness of FP projects for teams and researchers.

It is not only a matter of motivation and ex ante expectations: closer cooperation and networking are also identified as the most prominent effects (C3) of FP participation for both research teams and individual researchers. One aspect that is specifically emphasised is the effect of participation on individual skills, such as networking and language skills and the ability to appreciate and work in different (national) contexts. At team level, participation results in increased recognition and attractiveness of a team in universities or HEI, particularly due to the highly ranked value of international cooperation and research content in the academic environment.

This effect of international cooperation is further reflected in the higher rate of long term international mobility among FP participants compared to the non-FP participating researchers. Short international mobility does not seem to be affected.

In general, international cooperation and networking continue and have intermediate impact after completion of the project. Several examples are given in

the case studies where organisations have prepared other project proposals together or continued cooperation in order to commercialise the research results from the projects.

With respect to intra-EU cooperation, the international context of FP projects enables a pull effect on non-EU researchers, supported by the English working language that is used. Compared to the total pool of researchers in the EU, there is a higher share of non-EU researchers among the FP participants. However, this effect is not sustained in the intermediate/long run as non-EU researchers are less often kept employed (retention) at the same institution after the project ends than are their EU counterparts.

C4. The main career effect is not formal career progression and promotion but recognition, responsibility and increased self-dependency and autonomy.

The case studies show that FP participation is recognised in the academic research environment and leads to strong networking and organisation skills in the participating/coordinating researchers. This recognition takes the form of invitations to national expert boards or advisory roles for national policy, institutional management roles, etc., all as a result of FP participation.

Formal advancement from one career stage to another is not observed during or immediately after participation in an FP project. The employment episodes are longer, which is related (e.g. in case studies) to the longer funding periods under FP participation. The intermediate impact is however considered positive – through the recognition process and by acquiring skills that are relevant for future research, networking and attracting additional funding. This observation is confirmed in the individual level survey and counterfactual analysis, which both show that formal advancement cannot be attributed directly to FP participation, but that increased responsibility and autonomy can.

For later career stage researchers, who are already in a stable position, the longer term funding provided by FP projects enables them to build a (temporary or sustained) research team and to explore in-depth the research topic of the project. They thus benefit from advanced knowledge development and expertise building, and in the longer run specialisation and potentially a stronger competitive position in their field of research.

C5. The realisation of the impact of FP participation on the development of human research capacity is higher for first participation and is facilitated through successful cooperation and awareness/inclusion in the team's objectives of the project.

When a team or individual researcher participates of the first time, the impacts are more pronounced. This counts in particular for acquiring HR, administrative and management practices and for networking effects. Also at the individual level, a researcher acquires most new skills in these fields during the first participation. In this sense, this observation relates directly to effects for early stage researchers. At organisational level, first participation also leads to the strongest effect on strengthening the strategic orientation of the organisation towards EU priorities.

Another factor that facilitates exchange of knowledge and practices is the success of the cooperation. Successful cooperation leads to a maximum of knowledge transfer between participating teams, both content-related and in terms of HRM practices.

Next to first participation and successful cooperation, the awareness of and importance attached to HR and recruitment practices also increases the probability that actual knowledge sharing in this respect takes place. Beneficiaries whose top priorities were to: 1) increase international, intersectoral and interdisciplinary cooperation; 2) attract more researchers; 3) enhance the career development of researchers; or 4) improve the working conditions and gender balance of the team also improved their HR policies and recruitment practices to a significant degree. In contrast, the FP beneficiaries whose primary goal was commercialisation and increased competitiveness (i.e. largely organisations from the private sector) did not change their recruitment practices as significantly.

It is worthwhile to note that next to these participation-specific factors, external factors will also favour or impede the materialisation of the FP effects. Factors that are linked to the national context, regulations, social and investment structures, higher education and research systems, etc. will have an important influence external to the specific project, participants or researchers. For instance, the leveraging of funding is an identified effect at EU level, but is highly dependent on the specific regulations and available funding (crisis) when looking at the national level. These kinds of factors need to be taken into account in the recommendations and monitoring of effects at this level (cf. section 6).

C6. Academic and industrial partners take a different strategic and operational approach in terms of team development and sustainable employment.

Academia and industry each have their own objectives, motivations to apply for FP funding and expectations in terms of outcomes. In this sense, it is logical to see different practices emerge when it comes to team development and employment.

In academia, the main employment effect is the hiring and training of young researchers and the stability offered to already employed senior researchers. When a project is won, the senior research capacity (that has written the proposal) is in place and junior research capacity is hired on new positions. Moreover, universities and HEI are more likely to increase the use of full-time fixed term contracts, stipends, fellowships and grants. Early stage researchers thus often flow out to other positions and organisations after the end of the project. Senior researchers hope to further deepen their knowledge thanks to the long-term project and thus to strengthen their position in their field.

Despite the fact that in academia, international researchers are frequently hired to participate in an FP project, there is little evidence that HRM procedures become more open, transparent and international/publicly advertised. Organisations prefer to give priority to training young (national) researchers.

In industry, FP project work is preferably carried out by the existing pool of employees. When researchers are hired in industry to participate in an FP project, they are likely to stay after the project has ended. They are sometime hired only after the end of the project (from a HEI partner for instance) to further develop the outcomes of the project. We observe less diversity in industry: a lower share of women and international researchers are hired than in universities/HEI.

In general, private organisations are more outcome-oriented and pay less attention to internationalisation effects or effects on HRM practices. On the other hand, the focus on valorisation of outcomes eventually leads to indirect job creation when researchers are hired to lead this process after the project. Overall, the direct employment effect is higher in universities and HE; the indirect employment effect (as a result of successful commercial exploitation/valorisation) is higher in industry.

C7. Indications of improved gender balance in FP teams.

Female researchers are well represented in FP projects, particularly when compared to the total and even in disciplines or sectors that have traditionally low shares of women. For example, in the field of Engineering 24% of the researchers in FP projects are women, but 27% of the newly hired researchers are women so even though far from 50%, gender balance improves slightly in these teams.

Similarly, a lower share of women is hired than in universities/HEI, but the share of women among the newly hired researchers was higher (36%) than the share of women among the existing staff in private industry and SMEs (31%), pointing to an increase in the overall share of women in the private sector and SMEs thanks to FP participation.

In terms of responsibilities and position, female researchers (slightly) less often exercise the role of project coordinator. Female researchers less frequently see themselves as carrying out tasks independently than do male researchers.

C8. The Specific Programmes each show a different pattern in terms of team development and employment sustainment.

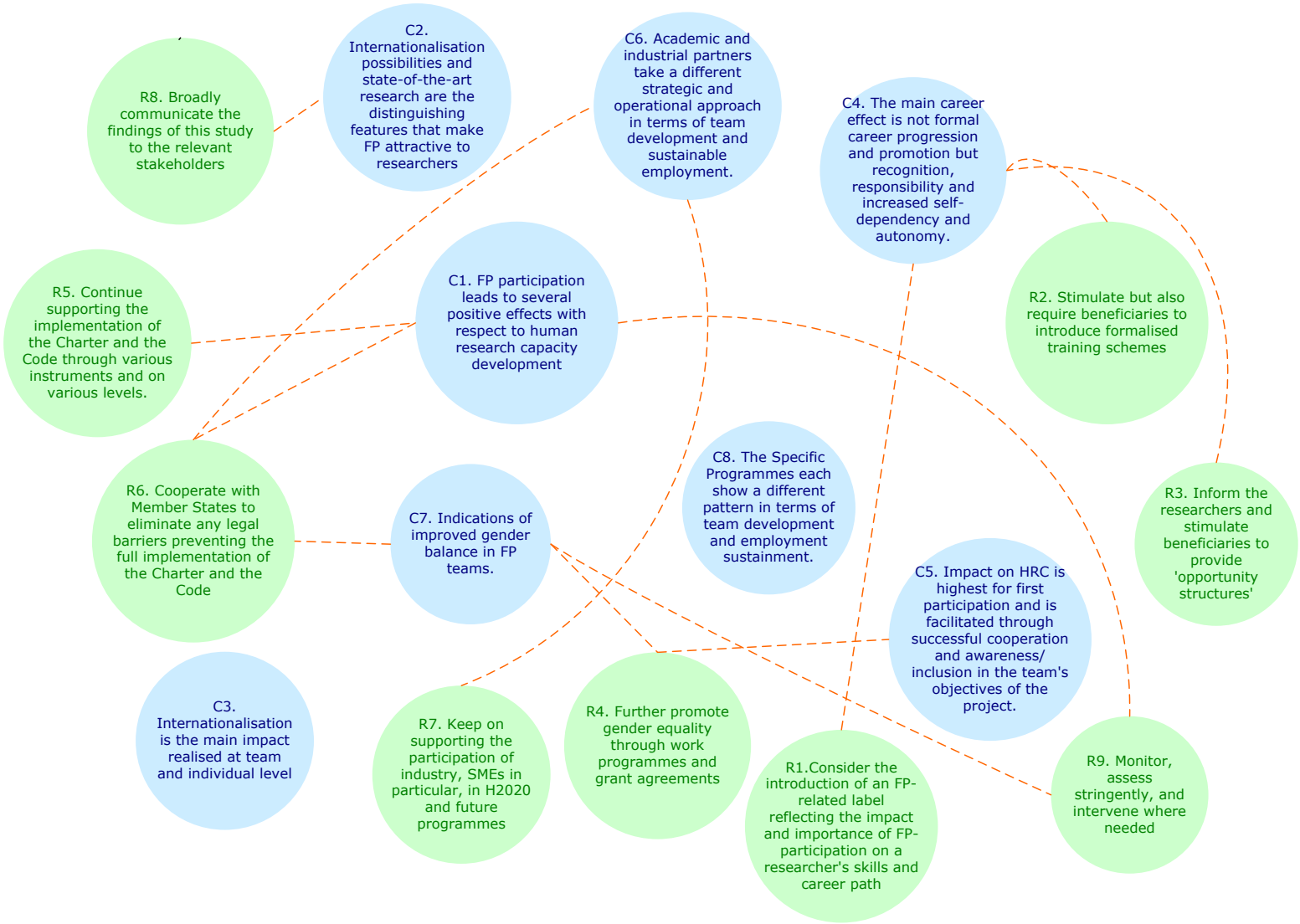
Analysis of three dimensions clearly shows the different approaches in the four FP7 Specific Programmes. In terms of hiring new researchers (job creation), the Ideas and People Specific Programmes hire a higher number of researchers on the project but less researchers stay after completion of the project. In the Cooperation and Capacities Specific Programmes, the direct job creation is smaller but sustained more often in the intermediate/long run.

This observation is consistent with the finding that in the People and Ideas Specific Programmes, full-time permanent contracts are less common. In these projects, researchers are more often hired through grants, fellowships and stipends, given the higher degree of third-party funding and project-based funding in these Specific Programmes and in particular in the Ideas Specific Programme.

In terms of internationalisation, the Ideas and People Specific Programmes again hire more non-EU researchers compared to the Cooperation and Capacities Specific Programmes, but on the other hand participants in Ideas projects find international mobility and cooperation less important than those in other types of projects.

The findings of the study and in particular these key conclusions lead to the formulation of recommendation for EU policy and future research Framework Programmes, in particular the ongoing Horizon 2020 Programme. How the Conclusions and Recommendations are interlinked is shown in the figure below.

Figure 60 - Overview of, and interplay between key conclusions and recommendations (blue: conclusions; green: recommendations)



6. Recommendations

6.1. Introduction

The main objective of underlying evaluation has been to shed light on the impact of the framework programme on human research capacity, a topic that has not been sufficiently dealt with and understood to this point. Human research capacity has different dimensions involving skills and expertise, career paths, working conditions and in particular contractual arrangements, recruitment practices and human resource management, mobility, etc. These aspects have been investigated intensively in this study.

The specific design of a research and innovation programme, including rights and obligations of beneficiaries, provides the sole basis for ensuring that beneficiaries put in place the necessary conditions and principles to create and maximize the impact on human research capacity, thereby keeping in mind that in each country, each beneficiary is different as it operates in a different context and culture. The programme owners (the European Commission and the Member States) should ensure that the beneficiaries are motivated, and if necessary, obliged, to create the conditions in order to maximize the impact of public funding on human research capacity. As a principle, it is important to respect the autonomy of the institutions involved as much as possible. Interfering in the current or future design of a programme like H2020, is a 'hands-on' approach, and requires that choices are made with respect to the key objectives of the programme and the overall associated intervention logic (as analysed and presented in this study). On this basis obligations and rights, rules and procedures, should be developed and implemented.

Two routes to intervention: 'hands-on', interfere with the programme design; 'hands-off' focus on monitoring, communication and awareness creation

Next, or in conjunction with this hands-on approach, a more 'hands-off' approach is also needed. It is important to monitor how and to what extent public research programmes impact on the European human research capacity development, and to create awareness among beneficiaries and regional and national authorities on this matter. Awareness of the potential impact of programmes like H2020 may further strengthen the realisation of specific objectives of the European Research Area, and is often a first step in behavioural change and the implementation of measures needed to maximise the impact of public funding on human research capacity. The recent ERA progress report[75] strongly advocates the need for (renewed) action at Member State level in terms of creating the necessary conditions for further positive impacts to occur. Hence, monitoring, communication and outreach are essential as well.

These two 'routes to intervention' are further operationalised below. Important to acknowledge is that the recommendations presented below are written from the perspective of maximising the impact of current and future research programmes on human research capacity.

[75] http://ec.europa.eu/research/era/eraprogress_en.htm

6.2. The way forward

6.2.1. With respect to the recognition of the impact of FP-type of funding on human research capacity…

R1. Consider the introduction of an FP-related label reflecting the impact and importance of FP-participation on a researcher's skills and career path

The results of this evaluation clearly show the positive impact of FP participation on different aspects of a researcher's career, working conditions and skill development. Autonomy and self-dependency are important effects, particularly for early career researchers. However, PhD candidates suggested that the acquired organisation, networking and management skills are not recognised to the same extent at their level, because research skills and outputs (publications, conference presentations) are more highly regarded when defending the PhD. This is despite the fact that the FP participants obtain a whole new set of valuable knowledge and (transferable) skills, increasing their 'employability' later on.

FP-participation should be recognised by current and future employers. This can be made possible through the introduction of an FP-related label reflecting the impact on and importance of FP participation for the skills-base and the potential career path of researchers. It could be considered to highlight the importance of FP by introducing a special recognition for PhDs and early career researchers that can be used for recruitment and career development. The label should reflect the implementation principles and benefits obtained for the participating researcher, as identified in this study. Labels for PhD programmes like the MSCA ITN or IDP-EJD have already been recognised by the Ministries of some countries (for example Spain and Italy) as criteria for accreditation at the national level on the basis of approval within the competitive supranational call at the EC level.

6.2.2. With respect to transferable skills and alternative career options…

R2. Stimulate but also require beneficiaries to introduce formalised training schemes

Training for skills and career development is of enormous importance to researchers as it may increase their employability both inside and outside academia. Specific attention should go to the so-called commercial/entrepreneurial skills on which FPs currently have a less pronounced effect. To date, most of the training in the context of the FP participation seems to take place as on-the-job training. Mentoring schemes may enhance the benefits. Facilitating the exchange and the sharing of good practices is a good starting point, to be followed by clear requirements in this respect from beneficiaries while allowing for sufficient flexibility in the implementation.

R3. Inform the researchers and stimulate beneficiaries to provide 'opportunity structures'

Measures should be taken to raise awareness about alternative career options and corresponding pre-requisites regarding skills and competencies, and the potential role of FP-type project involvement in this respect. This is of particular importance when taking into account the observation in the academic and public research organisations that early stage researchers are hired and trained on projects on fixed

terms and often do not stay after the project ends. But also in later career stages, researchers experience recognition of their FP participation and see opportunities for other responsibilities and roles.

It is thus important to make the potential effects of FP participation – as identified in this study – and the resulting opportunities explicit in the first place to researchers. This will enable researchers to take the initiative in the development of their individual career path as well as to consider different career ambitions and options. Researchers need to be supported and enabled to develop a clear career development plan (analogous to the required Career Development Plan under the Marie Skłodowska-Curie programme). Beneficiaries, as employers, should be engaged as well. Where relevant, provision of opportunity structures that allow researchers to be exposed to non-academic environments, e.g. through staff-exchange programmes especially between industry and academia, should be offered.

6.2.3. With respect to gender equality…

R4. Further promote gender equality through work programmes and grant agreements

The results of this study show that the gender balance has improved in general, particularly in teams where low shares of female researchers are traditionally found. However, particularly in the private sector, where recruitment procedures are less influenced by external regulations and standards, there is a tendency to hire fewer women and international researchers, in comparison to public or governmental organisations or universities/HEIs.

All in all, the improvements are small compared to the existing stock of researchers in the teams so it is strongly recommended that promotion of gender equality in the implementation of Horizon 2020 should be continued, through greater awareness of the gender dimension (its goals, implementation mechanisms and good practices) and its integration into work programmes and grant agreements (through specific targets, provisions of grant agreements and their monitoring). Particular attention should be paid to this in the scientific disciplines of Engineering, Education and Sciences and research activities with a strong involvement of private sector companies and SMEs. The associated principles present in the Charter and the Code should be highlighted and strongly promoted.

6.2.4. With respect to the Charter and the Code…

R5. Continue supporting the implementation of the Charter and the Code through various instruments and on various levels.

In the implementation of Horizon 2020 adequate attention should be paid to the European Charter for Researchers and Code of Conduct for the Recruitment of Researchers promoting open recruitment and adequate working conditions (while respecting their voluntary nature). The European Commission should continue supporting the implementation of the Charter and the Code through various instruments (the Human Resources Strategy for Research, the EURAXESS Jobs portal, a European Accreditation Mechanism for Charter and Code-based human resources management in universities and publicly-funded research institutions, etc.) and expecting the application of these guidelines and principles by all the funded participants, especially universities and HEIs which more frequently increased the use of full-time fixed-term contracts and fellowships, grants and stipends, as well as the

specific group of early stage researchers whose careers are more often characterised by unstable employment conditions.

Under H2020 it is important to recognise that the Model Grant Agreement puts an obligation on the grant beneficiary to make every effort to implement the European Charter for Researchers and Code of Conduct for the Recruitment of Researchers. Efforts here should go towards monitoring and validating that this implementation has indeed taken place.

R6. Cooperate with Member States to eliminate any legal barriers preventing the full implementation of the Charter and the Code

About 84% of European universities are aware of the Charter and the Code, but only 41% had all aspects implemented and 35% of universities were in progress[76]. One of the three key obstacles preventing full implementation is the national legislative framework.

To maximise the impact of EU funding on open recruitment and other HR practices in the context of the European Research Area, the European Commission should closely cooperate with the Member States in order to better align their legislation and standards with the principles of the Charter and Code (as also underlined in the 2014 ERA Progress Report). Legal barriers to the application of open, transparent and merit-based recruitment of researchers, and the development of an enabling framework for the implementation of the HR Strategy for Researchers need to be removed. Further harmonisation of the European Higher Education System and the European Research Area should also push toward the harmonisation of European Academic and Extra-Academic Researcher's Market and job opportunities and the related fiscal and contractual conditions.

6.2.5. With respect to industry participation…

R7. Keep on supporting the participation of industry, SMEs in particular, in H2020 and future programmes

The staff retention rate (i.e. share of researchers hired for a specific FP project that remain employed after the end of the project) among private industry organisations and SMEs is considerably higher than for private, not-for-profit research organisations, public or government sector organisations and HEIs/universities. In other words, this seems to suggest that the employment effect is more durable in the private sector. The indirect job creation – in particular in case of commercial success after the research project – can also be substantial.

In order to help increase the use of open-ended contracts and maximise the sustainable impact of FP funding on team size, the European Commission should continue supporting the industry dimension, encouraging SME participation in the Horizon 2020 programme and increasing industrial leadership in research and innovation, thereby creating more collaboration opportunities and possibilities for bringing new ideas to market. Specific attention should be paid to research and innovation activities aimed at the commercialisation of research and creation of economic value, which may lead to the unlocking of the so-called 'indirect' job creation potential (commercialisation after the end of the project).

[76] EUA (2014), "Europe's Universities: Main drivers in achieving the European Research Area (ERA).

6.2.6. With respect to 'public dissemination' and 'future monitoring'

R8. Broadly communicate the findings of this study to the relevant stakeholders

The underlying study provides systematic and reliable evidence on the impact of FP funding on Europe's research capacity. It also discusses shortcomings and conditions needed in order to maximise this impact. As awareness is important, communicating the study results broadly provides an excellent opportunity to further empower the on-going discussions on research careers and working conditions. The different EC facilitated working groups on Human Resources are an adequate platform to do so, as is the ERAC platform. Next, the results could be made available on the Euraxess website.

R9. Monitor, assess stringently, and intervene where needed

The European Commission should continue monitoring and assessing (through studies and evaluations) changes in e.g. the balance between permanent/fixed-term contracts in the teams that actively participate in EU-funded projects, as one of the possible indications of sustained and stable employment conditions. The contractual situation is not only important in this respect, but attention should also be paid to the broader framework in which researchers operate and, in particular, to the relationship between researcher and employer.

The Horizon 2020 programme should underline and strengthen the emphasis on openness of recruitment practices and career development during the selection, implementation/monitoring and evaluation of research activities. In this regard, the related aspects should be more closely monitored and better reflected in interim and final project assessment reports.

6.3. On future monitoring

It has been suggested above that monitoring particular aspects of the impact of FP on human research capacity is essential. It is important to have sufficient evidence, first of all to be able to justify and to account for the value added created by EU funding, and secondly to design future actions and interventions. Monitoring related to the development of human research capacity should take place on two levels.

6.3.1. Level 1: Monitoring of 'framework conditions'

The first level concerns the implementation of the framework conditions required to obtain maximum impact of H2020 and other European funding programmes on human research capacity. On an institutional level, this comes down to monitoring progress with respect to the implementation of the Charter and the Code, in light of the implementation of the HR strategy for researchers (as is done in the context of the MoU between the EUA and the European Commission, for example). Concerning monitoring on this level, the following recommendations can be made.

R1. Seek for synergies with on-going monitoring exercises and mechanisms

Monitoring of the implementation of the Charter and the Code by institutions and Member States is already on-going. Examples are the earlier mentioned EUA work on the implementation of the Charter and the Code. Formal implementation of the Charter and the Code, and the use of Euraxess, can lead to a

formal recognition by the European Commission and obtaining the 'HR Excellence in Research' logo, which so far has only been obtained by 102 institutions.

A major initiative in the context of monitoring the implementation of the ERA is the so-called EMM, or ERA Monitoring Mechanism. The EMM is becoming an essential component in ERA policy-making as it enables monitoring of the degree to which Member States, research funders and institutions are supporting and implementing ERA. The EMM does indeed monitor the share of organisations by country that have implemented the Charter and the Code, and the Gender Equality Plans (on the basis of a country specific survey, complemented by information collected under the Researcher's Report and the MORE2 studies). It should be considered whether these measurements indeed capture the essential elements from the perspective of human research capacity. If they do, monitoring through these initiatives seems to provide enough information in order to understand what is happening on the level of the overall context, the presence of the necessary conditions.

R2. It is also an option to monitor the 'conditions' through the SESAM reporting system

In H2020, the Model Grant Agreement puts an obligation on the grant beneficiary to make every effort to implement the European Charter for Researchers and Code of Conduct for the Recruitment of Researchers. The beneficiary should be asked to indicate the efforts and progress made (if this is not already the case) in order to obtain precise information on the micro level. This information could then be analysed in light of the macro information available in the context of the previous recommendation.

6.3.2. Level 2: Monitoring of effects and impacts

The second level concerns the frequent monitoring of the effects/impact of H2020 funding on the specific dimensions of human research capacity (like career path, working conditions, skill development etc.), on the basis of a set of key indicators, developed in this study, that best reflect 'human research capacity'. The following recommendations can be made in this respect.

R3. Harmonise concepts and definitions

Several ad-hoc studies have touched on the issue of research careers, working conditions and skills development. Examples are the MORE studies, or the Researchers' Report study, or even the CDH project managed by the OECD. What is urgently needed is to align concepts and definitions in order to have a common base that allows comparability and integration of data.

R4. Seek synergies with existing or new to be developed data collection efforts

If, in the near future, new studies on researchers are launched, it will be of major importance to coordinate different sub-areas of policy making of relevance to 'researchers'. This can start inside the European Commission by coordination within various working groups and DGs dealing with researchers. Integration under the umbrella of the earlier mentioned EMM, which should also coordinate future studies in this area, makes a lot of sense. Integration of existing data sets relevant to human research capacity is another important step that can be taken. For example, the RISIS project aims to establish a research infrastructure

enabling access to data and evidence from ongoing data collection activities/surveys etc. which could be used for monitoring purposes and if actively pursued could also be further developed by implementing relevant questions on human research capacity in already ongoing activities without adding just another "survey".

R5. Investigate the potential of setting up an integrated pan-EU career tracking system departing from FP participation

Instead of targeting different groups of researchers over time, it makes a lot of sense to set up an EU-wide career tracking system. Career tracking is about initiatives that follow up researchers' careers over a certain time period in order to understand their career pathways. Surveys that trace back careers over several years, cohort studies at several moments in time (not just one) or longitudinal surveys are considered to fit the definition.

ESF in collaboration with the Fonds National de la Recherche Luxembourg developed a report on how to track researchers' careers in the context of a joint ESF-FNR Workshop in Luxembourg in 2012. There are different forms of career tracking: 1) international studies like CDH (and to some extent the MORE studies), 2) national/regional surveys, 3) institutional data and surveys, and 4) national/regional register data. It should be explored further to what extent FP-participating young researchers could be followed over time.

R6. Distinguish between 'need to know' versus 'nice to know'

Regardless of how selected information will be collected, it is important to distinguish between primary and secondary indicators. On the basis of the work carried out in this study, we consider the following indicators to be key in the context of measuring the effects and impact of FP on human research capacity. Following the developed conceptual framework (see inception report), the following list of 12 key indicators are proposed to measure the most essential aspects of FP impact on human research capacity.

Level	Indicator	Motivation
Individual	1. Share of researchers who indicate that their level of skills has improved thanks to their participation in FP.	Generic indicator that reflects well the impact of FP participation on different types of skills.
	2. Share of FP researchers who report a promotion as a result of FP participation.	Indicator that reflects the effect of FP participation on a researcher's career.
	3. Share of FP researchers in a short-term position who received a permanent position in the same organisation as a result of FP participation.	Indicator that reflects an improvement in the working conditions of FP participating researchers.
Team	4. Ratio fixed-term and open-ended contracts in participating and non-participating research teams and the influence of FP participation on that ratio.	Indicator that reflects an improvement in the working conditions of FP participating teams.
	5. Degree of implementation of the Charter & Code at organisational level (cf. recommendations R1 and R2 on monitoring).	Indicator that reflects an improvement in the working conditions and recruitment practices of FP participating teams.
	6. Additional number of researchers in research teams as a result of FP	Indicator that reflects the direct employment effect as a result of FP

	participation.	participation.
	7. Improved gender balance in research teams as a result of FP participation.	Indicator that reflects gender diversity and team composition effects.
	8. Evidence of FP projects bringing other areas of research teams'/organisations' research closer to the thematic areas and research topics of FP.	Indicator that reflects the influence of FP participation on a team's strategic research agenda.
System	9. Share of non-EU27 researchers that currently work in the EU27 as a result of FP project participation.	Indicator that reflects the international attractiveness of FP and the role of FP in attracting researchers from abroad (through direct involvement).
	10. Share of non-EU27 researchers that currently work in the EU27 for reasons indirectly related to FP projects (attractiveness of the institute, of the region, working conditions, leverage effect).	Indicator that reflects the international attractiveness of FP as a leveraging factor in attracting researchers to Europe.
	11. Number of researchers that have been employed additionally on FP projects and their retention rate.	Indicator that reflects the direct employment effect as a result of FP participation.
	12. Number of researchers that have completed their PhD or other academic qualification stages as a result of FP participation.	Indicator that reflects the importance of FP for early stage researcher training.

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Annexes

1. Data collection

In this Annex, we briefly summarise the process and outcomes of the different data collection methods. Three channels were used to collect the necessary and complementary information:

1) **Case studies**: a selection of projects in which the organisational and systemic level were central, even though also taking into account the individual level and the interactions between all three levels. Focus was on Cooperation and Capacities Specific Programmes.

2) **Surveys**:

   a. Team-level: A survey of scientific team leaders among the FP participants (FP6 and 7) on the basis of contact information and data available in eCORDA;

   b. Individual level: A general researcher survey focusing on HEIs in European countries including data for the counterfactual analysis.

   c. A one question survey among MORE2 respondents to assess if they participated to an FP project and open up the MORE2 data to further analysis and counterfactual analysis.

3) **Desk research**: inventory of what is known to complete or provide context for the findings.

1.1. Case studies

Case studies were employed in this project as one of the methods to collect information on the impacts of FP projects on human research capacity. A case study is frequently defined as the detailed examination of a single example of class of phenomena. Although this method cannot provide reliable (statistical) information about the broader class, it offers detailed information which is in particular useful to help understand context and process of a particular phenomenon, as well as what causes it, linking causes and certain outcomes. For the study of human research capacity a multiple case design with cases defined at the level of FP projects was chosen.

1.1.1. Case selection

Only finished FP6 and FP7 projects were included in the case study programme. Also, it was agreed with the Steering Group to focus on FP projects implemented by industry where less empirical evidence was available about human resource capacity issues.

A case selection matrix was elaborated based on the following main criteria:

- Type of project (Cooperation, Capacities, Ideas, People);
- Scientific domains (physical sciences (incl. computing), engineering, manufacturing and construction; life sciences, health and welfare; education, humanities and arts, social sciences, business and law);
- Region (EU15[77], EU12[78], and other countries participating in the FPs);
- Institution type (higher or secondary education; private for profit; research organisation; other categories).

[77] EU15 refers to Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden, and United Kingdom.

[78] EU12 refers Bulgaria, Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Romania, Slovenia, and Slovak Republic.

The eCORDA database was first screened for projects that had already ended or had to finish before June 2014. A long list of projects to be selected for the case studies was proposed, of which the Steering Group selected ten specific projects for the case studies.

Table 20 specifies the FP projects selected for the case studies. They covered three specific programmes of FP7, namely Capacities (5 projects), Cooperation (4 projects) and People (1 project), or their analogues in FP6. Out of ten projects, one project (project 7) represented the category of the cooperation and support action. In terms of scientific domains covered by the case studies, the largest number of the selected projects belonged to the fields of Engineering and Technology (4 projects) and Medical Sciences (3 projects). The remaining projects represented Social Sciences (2 projects) or Natural Sciences (1 project). A set of five projects selected for the case study programme were implemented by private for profit organisations, including SMEs.

Table 20: FP projects selected for the case studies

Case	Project name (abbreviation)	Specific programme	Type of project	Scientific domain	Region	Institution
1	Flexible assembly processes for the car of the third millennium (MY-CAR)	Cooperation	Research and Innovation Action	Engineering and technology	EU15	REC
2	DIagnostic NAnotech and MICrotech Sensors (DINAMICS)	Cooperation	Research and Innovation Action	Engineering and technology	EU28+ AC	IND
3	Efficient 3D Completeness Inspection (3DCOMPLETE)	Capacities	Research and Innovation Action	Engineering and technology	EU28	PRC
4	Approaches to the bio-engineering of synthetic minimal cells (SYNTHCELLS)	Capacities	Research and Innovation Action	Natural sciences	EU15	HES
5	Prostate cancer molecular-oriented detection and treatment of minimal residual disease (PROMET)	Cooperation	Research and Innovation Action	Medical sciences	EU15+ AC	HES
6	Rapid, robust & scaleable platform technology for fully automated reference laboratory grade Polymerase Chain Reaction (PCR) based diagnostics regardless of global setting (RANGER)	Cooperation	Research and Innovation Action	Medical sciences	EU15+ AC	PRC
7	Developing innovation and research environment in five European regions in the field of sustainable use of biomass resources (BIOCLUS)	Capacities	Coordination and Support Action	Engineering and technology	EU28	HES
8	Highly sensitive and specific low-cost lab-on-a-chip system for Lyme disease diagnosis (HILYSENS)	Capacities	Research and Innovation Actions	Medical sciences	EU15	PRC
9	Development of Biotechnology derived alternatives for sustainable detergents and innovative strategies of using Sustainable ingredients by encapsulation and surfactants structuring (BIOSEAL)	People	Research and Innovation Action	Social sciences	EU15+AC	IND
10	Towards a Lifelong Learning Society in Europe: The Contribution of the Education System (LLL2010)	Cooperation	Research and Innovation Action	Social sciences	EU28+AC	HES

Source: The authors.

1.1.2. Implementation and data

In total, ten case study reports were prepared on the basis of the case study guidelines and interview questionnaires agreed with the Steering Group as well as following the uniform structure and content.

All the case studies were informed by desk research and interviews carried out with coordinators of the selected FP projects and researchers who were actively engaged in project activities. The European Commission provided documents on the implementation of the projects selected for the case studies. Additional primary and secondary sources of information were analysed by responsible project experts in the preparation of the case studies.

It was planned to conduct a total of 50 interviews during the implementation of the case study programme (about 5 interviews of one hour each per project). Altogether, 62 stakeholders were interviewed, of which 22 stakeholders were interviewed face-to-face during project visits, while 40 of them were interviewed by phone or skype (see Table 21 which provides the breakdown of all interviews by the selected projects).

Table 21: Results of the interview programme

Project No.	Face-to-face interviews	Interviews by phone or skype
1	0	5
2	0	5
3	0	4
4	2	7
5	2	2
6	3	2
7	10	3
8	0	5
9	4	2
10	1	5
Total	**22**	**40**

Source: The authors.

The collected data was used for writing up case study reports, linking FP participation with the development of human research capacity through process tracing. The case study reports are made available to the European Commission as internal project deliverables. Also, the case study information was synthesised in the main report according to each evaluation question and was used for triangulation with other evidence obtained from the surveys and desk research.

1.2. Surveys

Next to the 10 case studies, two main surveys were developed to correspond to the conceptual framework of the study: one at the individual level of researchers in higher education institutions (HEI) – either or not participants to FP projects - and one at the team level of research teams on FP6 and/or FP7 projects. The sampling approach and questionnaires were finalised and approved by the EC in the Inception Report. The surveys were based on a stratified random design which allows for estimates with 95% confidence and 5% error for each stratum. This means that there is a 95% probability that the interval of 5% around the reported indicator value contains the 'true' value of the population in the stratum. Or in other words, in 95 out of 100 times

a sample is taken from the population, the indicator is estimated within a 5% range of the true value.

In addition to the two main surveys of the study, a short follow-up on the MORE2 survey of HEI researchers was organised to identify which respondents of this broad-scale survey are FP participants and which are not. This additional information opens up the variables and indicators on a broad range of topics on research careers, working conditions and mobility for this study.

In the following sections, we give more details on the set-up and implementation of each of the surveys.

1.2.1. Individual level survey

1.2.1.1. Scope: HEI researchers in Europe

Two important aspects characterise the individual level survey. First, we included not only FP participating researchers, but also researchers who have not yet participated in an FP project. This is important in view of building comparative and counterfactual material for the analysis.

However, such approach means we needed a general sample of individual researchers (i.e., regardless of whether or not they participated in FP), which in turn would require a full list of researchers in all sectors Europe-wide to draw from. Without a register (or sampling frame), any kind of sampling falls within the world of "quota sampling". To circumvent this methodological barrier, we turned to a useful but limited alternative that is available through the MORE2 frame database[79]. The MORE2 frame database is limited because it only includes researchers employed in European higher education institutions (HEI), but at the same time is very suitable as register for this subgroup since it makes available more than 50,000 emails of researchers in 33 countries, tested and classified not only by faculty but also by field of science, country and gender.[80,81] As information is available on the total population of the analysis unit (researchers) broken down by field of science for each country, it was possible, even though lacking a full sampling frame of researchers, to develop a feasible stratified random sampling design.

In sum, the focus of the individual level survey is thus on both FP participants and non-participating researchers working in Higher Education Institutes (HEIs) in 27 EU Members States plus two associated European countries (Norway and Switzerland).

1.2.1.2. Sampling strategy

The following strata are used to implement the stratified random sampling design:

[79] IDEA Consult et al, 2013. MORE2 - Support for continued data collection and analysis concerning mobility patterns and career paths of researchers. European Commission, DG Research and Innovation.

The frame database was built based on the integration and update of the EUMIDA database and MORE1 database of researchers. The update and completion of the database was further organized through web search routines on the most relevant directories of universities and official sources (for instance Research Ministries). Through this database, information is available on the total population of researchers broken down by FOS for each country.

[80] This frame of 50,000 units was the basis from which a sample was drawn for the MORE2 survey. This means, practically, that not all units have been contacted in the MORE2 study. We can use this same frame to draw another sample for the survey in this FP study and thereby avoid duplication of the efforts to collect a similar sampling frame or register.

[81] The main sources was Eurostat New Cronos database. Data were collected in 2011/2012 and an update on their validity was performed.

- Gender: Female, Male
- Country aggregations: EU15[82], EU12[83] and 2 associated countries Norway and Switzerland
- Field of Science: Natural (Natural sciences and Engineering and technology), Health (Medical sciences and Agricultural sciences) and Social (social sciences and humanities).

At the start of the implementation process, the reference database of MORE2, was cleaned and updated (eliminate overlapping units with the team level survey; eliminate units out of the target region of this study; update contact details). From the updated frame, the sample for the individual level survey was drawn from this population according to the random stratified sampling strategy. The full sample consisted of 46,461 researchers.

Table 22: Updated frame for the individual level survey, based on the MORE2 frame database, by field of science and region

	Health	Natural	Social	Total
EU15	7,769	7,506	9,622	24,897
EU12	4,086	5,411	7,350	16,847
Associated countries	1,599	1,292	1,826	4,717
Total	**13,454**	**14,209**	**18,798**	**46,461**

The final sample of the survey is weighted on the total number of researchers per stratum, in order to represent the whole population of researchers in headcount in HEIs in EU according to the most updated Eurostat figures. For the analysis, the strata combination field of science and region was selected as standard weighting system[84].

1.2.1.3. Questionnaire

The survey consists of two main parts: one for all researchers on their skills and career development, and one for the subgroup of FP participants on the impact of FP.

The idea for the first part of the questionnaire is in part based on work done by Bozeman et al. (1999)[85], who proposed a "scientific and technical human capital" approach to be used for the evaluation of science and technology programmes, as an orientation. In their approach the authors focus on scientists' careers and their "sustained ability to contribute and enhance their capabilities" (Bozeman et al, 1999, p. 2)[38].
As a tool to be used the analysis of researchers CVs (Curricula Vitae) (see also Dietz et al. 2000[86] or Gaughan 2009[87]) has been suggested as CVs contain longitudinal data

[82] EU15 refers to Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden, and United Kingdom.

[83] EU12 refers Bulgaria, Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Romania, Slovenia, and Slovak Republic.

[84] The combination of the three strata into one weighting system was no option due to changes in the frame based on the survey.

[85] Bozeman, Barry; Dietz, James S.; Gaughan, Monica (1999), Scientific and Technical Human Capital: An Alternative Model for Research Evaluation. Atlanta, Georgia.

[86] Dietz, James S.; Chompalov, Ivan; Bozeman, Barry; O'Neil Lane, Eliesh; Park, Jongwon (2000), Using the curriculum vita to study the career paths of scientists and engineers: An exploratory assessment, Scientometrics 49 (3), p. 419–442.

regarding important steps in a researcher's career and accomplishments (Bozeman 1999, p. 29)[38].

While in the context of this study we did not attempt to implement a "full-fledged" CV analysis, we at least partly took up the ideas behind this concept. Thus, in the first part of the individual level survey, respondents were asked to provide information on individual employment episodes and characteristics thereof such as working conditions, especially contract relevant aspects, funding sources, tasks carried out and skills developed. In doing so we are now able to present evidence on skill development and career progression and their link to funding sources.

The second part of the questionnaire focusses on the assessment of FP funding from the perspective of FP participants. Thus, the second part of the questionnaire was only presented to those addressees who in the first part indicated at least once that they received FP funding.

The full questionnaire is included in Annex 2.

1.2.1.4. Implementation

Both the individual and the team level surveys are implemented as an online survey with telephone follow-up. The methodology used for the surveys are initial CAWI (Computer-Aided Web Interviews) activities, with the support of reminders, followed by CATI (Computer-Aided Telephone interviews) activities aimed at contacting the remaining units not yet responding.

The CAWI is based on an invitation sent via email with a personalised link to the on-line questionnaire to all 46,461 units in the sample. A first e-mail reminder was provided to those not responding after a period of 7 days and a second e-mail reminder followed after an additional 7 days. At the end of the CAWI, the CATI activity was implemented only for those not responding to the last reminders.

The CAWI operations started on May 8th and finished on May 30th; the CATI activity started at the end of May and lasted till June 13th. The total number of completed questionnaires was 3,862. The individual level survey has a response rate of 8%. Of these 3,862 completed questionnaires, 661 were partially filled[88]. A donor technique was applied to edit the 661 nearly-completed responses in order to maximise the available information. 32% of the responses were obtained via CATI, 37% via CAWI and 31% via reminders.

[87] Gaughan, M. (2009), Using the curriculum vitae for policy research, Research Evaluation 18(2), p. 117-124.

[88] The overall number of partially filled questionnaires was quite low since the contact systems, CATI and CAWI finalized the procedures to minimize errors during the interviews.

Table 23 provides an overview of the responses by field of science and region.

Table 23: Distribution of responses, by field of science and region

	Interview Completed	Email Sent	Appointment	No Answer	Not Existing Number	Refusal	Total
Health	1,092	5,936	1,714	4,140	368	204	13454
EU15	577	4,215	688	1,984	194	111	7,769
EU12	386	1,579	736	1,270	62	53	4,086
Associated countries	129	142	290	886	112	40	1,599
Natural	1,112	9,321	473	3,055	95	153	14,209
EU15	543	5,099	157	1,537	70	100	7,506
EU12	427	3,981	183	784	12	24	5,411
Associated countries	142	241	133	734	13	29	1,292
Social	1,478	11,460	961	4,345	349	205	18,798
EU15	715	5,595	459	2,513	213	127	9,622
EU12	564	5,756	306	628	88	8	7,350
Associated countries	199	109	196	1,204	48	70	1,826
Total	**3,682**	**26,717**	**3,148**	**11,540**	**812**	**562**	**46,461**

The total sampling error for the individual survey is 1.6 per cent. The sampling for each stratum included in the strata combination "Region" and "Field of sciences" is reported in Table 24. In most strata the error is estimated below 5%, as planned. In some cases this was not possible; for the strata with the associated countries, the error is estimated above 5%. Even after an intensive CATI process where researchers were contacted via telephone to participate to the survey, the necessary number of responses to obtain an error below 5% was not obtained.

Table 24: Sampling error per strata

Region	FOS	n (sample design)[89]	n (sample)	N (population)	Error
EU15	Health	411	577	279,903	4.1
EU15	Natural	574	543	452,070	4.2
EU15	Social	530	715	415,206	3.7
EU12	Health	377	386	42,184	5.0
EU12	Natural	375	427	73,953	4.7
EU12	Social	375	564	70,226	4.1
Associated countries	Health	370	129	16,411	8.6
Associated countries	Natural	370	142	20,785	8.2
Associated countries	Social	371	199	22,924	6.9
		3,753	3,682	1,392,962	

1.2.1.5. Data

As context for the further interpretation of the data and analysis, we provide a short description of the data in this section. The description of the sample will provide insights into the respondents' perceived relevance of FP funding in general and relevant differences regarding gender, career stage, sector and field of science.

[89] Sample for each stratum with a planned error of 5% maximum.

Sample and population

With regard to "field of science", the share of researchers belonging to "natural sciences" is underrepresented in the sample, whereas "health sciences" and "social sciences" are overrepresented. The share of natural scientists amounts to 30% in the sample and is approximately 39% in the population of the countries included in this study. Health sciences are represented by 30% of the respondents, while holding a share of 24% in the population. For social scientists the shares in the sample and the population amount to 40 and 36% respectively.

Compared to the divergence between sample and population with respect to "field of science" the weighting regarding regional affiliation is much stronger. 50% of the respondents in the sample belong to one of the EU15 countries, whereas 35% of the respondents are from the region of EU12 and 15% are residents from associated countries. This suggests a considerable underrepresentation of EU15 countries in the sample with shares of 82% (EU15), 13% (EU12), and 4% (Associated countries) in the population.

The results of this study take this error into account by including weights to correct for the observed divergence between population and sample.

Relevance of FP funding

Among the 3,682 individual researchers who responded to the survey, 21% indicated they were involved in FP funded activities (see Table 25). While approximately one third of those who were engaged in FP projects did not recall the specific FP programme, FP6 or FP7, another third was involved in FP7 only. 14% of the respondents were active in FP6 as well as FP7.

Table 25: Share of individual researchers reporting FP funding (n=3,682)

	Absolute number of respondents	**Share of respondents (weighted)**
Respondents who did not know whether or not they received funding	312	8%
Respondent without FP funding	2,663	71%
Respondents with FP funding		21%
Among which were funded:		
○ Only in FP6	128	16%
○ Only in FP7	236	34%
○ Funded in both FP6 and FP7	91	14%
○ Programme unknown	252	36%

Source: Analysis of the individual level survey data.

The participation of the respondents in FP projects occurs in all four career stages (cf. Annex 5: "R1 First Stage Researcher", "R2 Recognized Researcher", "R3 Established Researcher" and "R4 Leading Researcher"). Over all respondents and employment episodes, 20% of the specified FP projects are attributed to R1, while 30%, 29%, and 21% fall into R2, R3, and R4 respectively.

In order to estimate the role of FP involvement, we differentiate the responses of the individual respondents according to the employment periods in which they received FP funding and those without FP funding. In other words, respondents were asked to report their employment episodes including whether or not the position they held was at least partly funded by FP grants. This perspective allows us to assess the effects of FP involvement more thoroughly. Table 26 further illustrates that the share of FP project episodes of the total is highest for more advanced career stages (R3 and R4).

Here, the respondents specify FP participation for 11% and 17% of the episodes respectively.

Table 26: FP and non-FP employment episodes per career stage (n=14,815)

		FP project participation			
		Yes	**No**	**Don't know**	**Total**
Career stage	R1	5%	88%	7%	100%
	R2	8%	87%	5%	100%
	R3	11%	84%	5%	100%
	R4	17%	78%	5%	100%
	Total	9%	86%	6%	100%

Source: Analysis of the individual level survey data.
N: 1,137 (FP), 12,704 (non-FP), 974 (unspecified) employment episodes.

Overall, the respondents reported 14,815 employment episodes; approximately 9% of all employment episodes involve FP funding. While most of the 707 FP participants (457 or 65%) indicate that they were involved in only one employment episode with FP projects, approximately 35% state their involvement in FP projects in more than one employment episode. Overall, 41% of the FP funded employment periods relate to FP6 and 59% to FP7.[90]

Table 27 reflects the distribution of FP relevant employment episodes by type of specific programs, instrument or scheme. Almost one third of the employment episodes with FP involvement entail participation in the FP7 Cooperation programme followed by the FP7 People programme (16%). With regard to the Sixth Framework Programme Integrated projects (IP) and Specific targeted research projects (STREP) are among the most prominent programmes with 13% and 12% of all FP employment episodes in the sample.

Table 27: Distribution of FP relevant employment episodes by specific programme

	Share of employment episodes with financing from the respective specific programme / instrument / scheme (weighted)
FP6 Coordination action (CA)	6%
FP6 Integrated project (IP)	13%
FP6 Network of excellence (NOE)	9%
FP6 Specific support action (SSA)	2%
FP6 Specific targeted research projects (STREP)	12%
FP7 Capacities	6%
FP7 Cooperation	29%
FP7 Ideas	7%
FP7 People	16%

Source: Analysis of the individual level survey data.
N: 709 (out of 1,137) FP employment episodes, for which the respondents were able to specify the type of FP programme; for these 709 employment episodes a total of 943 projects were indicated.

Regional distribution

Most of 707 FP participants belong to the region of EU15 (85%). 11% are residents of an EU12 Member State whereas 4% of the respondents with FP experience come from one of the Associated countries.

[90] This information is based on the information by 70% of FP employment episodes only. This is due to the fact that for 30% of FP employment episodes the respondents were not able to specify the type of FP programme. Please note that Table 25 above refers to FP *participants* and their participation in FP projects whereas these figures concern FP *employment episodes*.

The picture is the same when it comes to the distribution of FP projects over the three regions (see Table 28).

Table 28: Regional distribution of FP projects (n=943)

	Share of total FP projects	Share of total FP7 projects	Share of total FP6 projects
EU12 countries	13%	13%	12%
EU15 countries	84%	84%	84%
Associated countries	3%	2%	3%

Source: Analysis of the individual level survey data.
N: 943 FP projects (comprising 553 FP7 and 390 FP6 projects) that were indicated by the respondents in different employment episodes.

Sector of employment

Since the majority of the respondents are employed in Higher Education Institutions (HEI), also the majority of employment episodes refer to HEI. The distribution of sectors of employment is comparable over different types of employment episodes (including and excluding FP funding, see Table 29).

Table 29: Share of respondents with FP funding by sector of employment (n=13,841)

Sector of employment	Share of employment episodes with FP funding (weighted)	Share of employment episodes without FP funding (weighted)
University or higher education institution	86%	85%
Public or government sector	11%	9%
Private not-for-profit sector	1%	2%
Private industry (including SMEs)	2%	4%

Source: Analysis of the individual level survey data.
N: 1,137 FP episodes and 12,700 non-FP episodes; excluding 978 employment episodes for which the respondents neither confirmed nor disconfirmed FP participation.

Financing

Scholars involved in FP projects are more likely to be at least partly funded by third-party sources (i.e. third-party or mixed funding) than their counterparts in employment situations that do not involve FP participation. Approximately 50% of FP employment episodes are partially covered by external financing while this is true for only 25% of the non-FP episodes (see Figure 61).

Figure 61: Type of funding for employment episodes (n=10,608)

Source: Analysis of the individual level survey data.
N: 578 FP episodes and 10,030 non-FP episodes.

Gender and Career stage

40% of the respondents are female and 60% male individual researchers. This distribution corresponds to the distribution between women and men in the population. Compared to the group of female researchers, male scientists are more likely to be involved in FP projects with shares of 18% of the female and 23% of the male researchers with FP project experience (see Table 30).

Table 30: Share of respondents with FP funding by gender (n=3,682)

Gender	Share of respondents	% with FP funding	% without FP funding	Don't know whether FP funding or not
Female	40%	18%	74%	8%
Male	60%	23%	69%	8%

Source: Analysis of the individual level survey data.
N: 707 FP participants, 2,663 non-FP participants and 312 respondents that neither confirmed nor disconfirmed FP participation.

In absolute terms the sample comprises 1,561 female and 2,121 male respondents. On average, female researchers have had 3.7 employment episodes per person of which 0.3 involve FP project participation. As for the male researchers, the average number of employment episodes per person amounts to 4.1 with 0.4 entailing FP funding. However, the numbers need to be interpreted with caution as the sample involves researchers on all career levels and the distribution of the respondents over career stages varies over gender (see Table 31).

While 39% of the female researchers in the sample belong to first or second career stage (R1 or R2), this is true for only 28% of the male researchers. Analogously, 25% of the female researchers consider themselves as leading researcher (R4) as opposed to 31% of the male respondents.

Table 31: Share of respondents in career stages by gender (n=3,682)

Gender	First stage researcher (R1)	Recognized researcher (R2)	Established researcher (R3)	Leading researcher (R4)
Female	17%	22%	36%	25%
Male	13%	15%	36%	35%
Total	15%	18%	36%	31%

Source: Analysis of the individual level survey data.
N: 1,561 female and 2,121 male respondents.

This distribution is also reflected in the respondents' degrees. The vast majority of respondents, 82%, hold a PhD degree, 17% have obtained a graduate degree and 1% of the respondents hold an undergraduate degree.

Participation in FP-related activities started for the majority of respondents in the early stages of their career. More than a quarter of researchers participated in FP-related activities for the first time already during their first career stage (see Table 32). The share of those who started in the second career stage is slightly higher with 30% of all the respondents. The situation is roughly the same for female and male researchers. Overall, women seem to engage in FP-related activities slightly earlier than their male counterparts with 60% of the female researchers starting participation in FP projects during the first or second career stage (R1 and R2). Analogously, men have a higher share of respondents with first-time FP participation as a leading researcher (R4) with 19%.

Table 32: Timing of first involvement in FP funded projects (career stage) by gender

Gender	First stage researcher (R1)	Recognized researcher (R2)	Established researcher (R3)	Leading researcher (R4)
Female	25%	35%	28%	12%
Male	28%	28%	26%	19%
Total	27%	30%	27%	16%

Source: Analysis of the individual level survey data.
N: 273 female and 434 male FP participants.

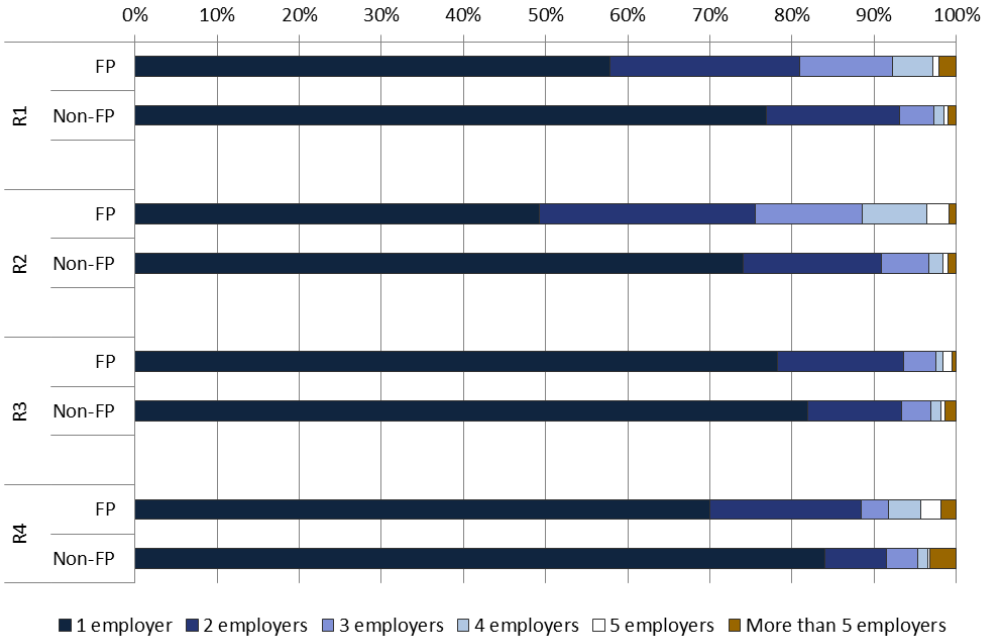
However, the differences between female and male researchers with respect to the timing of the first FP involvement are much smaller when we are to weight the data according to the distribution of the respondents over career stages (see above Table 31) because we are likely to miss out possible future FP participation of the respondents that are currently in an early stage of their career. In other words, the fact that we have less female than male leading researchers (R4) in the sample decreases the possibility to observe first-time FP participation for this category of respondents.[91]

Most researchers are involved in only one or two FP projects at a time (i.e. during an employment period). There are, however, differences over gender and career stage. 80% of both female and male FP researchers are involved in only one FP project at a time during their first career stage (R1). While this share increases in the case of female researchers (reaching a share of 89% during the last career stage, R4), there is a stronger tendency of male researchers to work on two or more projects at a time at the following career stages (e.g. 26% of the male respondents do so during their second career stage, R2).

[91] The weighting exercise yields an average of 71% of the female respondents engaging in FP activities during the first two career stages. The same applies 76% of the male researchers. As for the first-time FP involvement as leading researcher (R4) the shares for the two groups amount to 11 and 10% respectively.

If we are to assess the degree of mobility of researchers in terms of changing employers and/or organisations, the findings suggest differences between researchers with FP project experience and those that have not participated in FP projects so far. Figure 62 illustrates the number of employers researchers have had on different career stages according to whether they have been involved in an FP project on that particular career stage or not. The tendency to stay with only one employer is significantly higher for persons without FP experience. During the first career stage (R1) 77% of the researchers without FP experience stay with one single employer or organisation. This is true for only 58% of researchers with FP involvement. While this trend applies to all career stages, it is however notably smaller with regard to the third career stage (R3).[92]

Figure 62: Number of employers per career stage and type of projects carried out in that career stage (including or excluding FP participation)



Source: Analysis of the individual level survey data.
N: 983 cases with FP involvement (career stage with FP participation), 9,078 cases without FP involvement (career stage without FP participation or for which FP participation cannot be confirmed).

Field of Science

[92] The Kruskal-Wallis equality-of-populations rank test shows that the respondents of the two groups in the respective career stage systematically differ in the number of employers except for the third career stage (R3). In all tests but the one on „R3" the probabilities have values below 0.005.

Table 33 specifies the share of FP participants in the sample according to different fields of science.[93] The numbers indicate that with the exception of the "Services" category, the share of FP participants in the sample ranges between 11% (Humanities and arts") and 25% ("Sciences").

[93] This study follows the ISCED 1997 fields of education-classification.

Table 33: Share of individual researchers reporting FP funding according to field of science (n=3,682)

		FP project participation			
		Yes	No	Don't know	Total
Field of science	Agriculture	23%	64%	13%	100%
	Education	18%	75%	7%	100%
	Engineering	30%	59%	11%	100%
	Health and welfare	16%	78%	6%	100%
	Humanities and arts	11%	81%	8%	100%
	Sciences	25%	65%	10%	100%
	Services	3%	97%	0%	100%
	Social sciences, business and law	19%	74%	7%	100%
	Other	22%	75%	3%	100%

Source: Analysis of the individual level survey data.

1.2.2. Team level survey

1.2.2.1. Scope: team leaders of participants in FP7

The team survey has as main purpose to provide a representative picture of the participants in FP7 as provided by the eCORDA database. Therefore, the survey targets a representative sample of scientific team leaders (called Contact Persons for Scientific Aspects in the eCORDA database) from all specific programmes in FP7.

1.2.2.2. Sampling strategy

In order to identify our relevant sample, we defined a 'team' in eCORDA as a combination of a project and participating organization. Each project thus has as many teams as participating organisations, and each organisation can deliver as many teams as projects they participated in.

According to this definition, and excluding the individual Fellowships and the Euratom Programme, there 92,027 teams with a contact person in eCORDA.

The following strata are used:

- Programme types: Cooperation, Ideas, Capacities, People;
- Reference periods: 2007-2010 and 2011-2013;
- Country aggregations: EU15, EU12, Associated Countries and different types of third countries involved;
- Organisation types: Higher or secondary education (HES), Private for profit (PRC),Private for profit, small to medium size enterprises (SME), Public body or Research organisation (PUB), other.

The final sample of the survey is weighted on the total number of organisations participating to FP7, in order to represent the whole population of FP7 participants. For the analysis, the strata combination organisation type and region was selected as standard weighting system[94].

[94] The combination of the four strata into one weighting system was no option due to changes in the frame based on the survey (e.g. when eCORDA did not provide the right information on a team or individual). In chosing one standerd weighting procedure, we considered organisation-specific information instead of participation-specific information.

1.2.2.3. Questionnaire

Each contacted person received an invitation to fill out the survey for one project, which was assigned to that person through the eCORDA data[95]. The reference project for each person was explicitly mentioned in the email invitation to the survey, as well as in the survey tool.

The questionnaire was constructed to gather information on the experiences of the beneficiaries of FP project as team leaders. It first collects information on the characteristics of the research team in general and its participation patterns in FP projects. It then zooms in on the participation in the reference project and asks about ex ante motivations and ex post materialisations of effects on various dimensions of the team, its skills, knowledge, cooperation, etc. Detailed questions are dedicated to the effect on human resource policy and recruitment practices, composition and size of the research team, and other impacts such as leverage effects on funding, administrative support and effects on the research agenda of the organisation.

The full questionnaire is included in Annex 2.

1.2.2.4. Report on implementation

The eCORDA database is the reference database to provide a representative picture of the participants in FP7. eCORDA contains 92,027 records of participating teams (with each a team coordinator) of which 23,107 teams were sampled.

Table 34: Sample per organisation type, per programme and per region

Organisation Type	
HES	7,744
OTH	2,441
PRC	4,585
PUB	3,084
REC	5,253
Total	**23,107**
FP Programme	
FP7 CAPACITIES	5,118
FP7 COOPERATION	11,206
FP7 IDEAS	2,167
FP7 PEOPLE	4,616
Total	**23,107**
Region	
EU15	12,147
EU13	5,245
Extra-EU	5,715
Total	**23,107**

Source: Analysis of eCORDA data.

For the team level survey, the same implementation strategy was used as for the individual level survey, including both CAWI and CATI interviews. 23,107 team leaders

[95] If the same person happened to participate in more than one FP project and was included in our survey sample more than once, then only one project was left in the sample. The remaining project(s) were randomly replaced with projects having identical characteristics to those of the removed project(s). This process was repeated to the point where no person was included in the sample more than once.

were first sent an email invitation to participate in the team level survey. Double or invalid email addresses were replaced with new, in terms of characteristics corresponding, records extracted from the eCORDA database. After the enrichment of the original sample with new data extracted from eCORDA to reach the planned quotas for each stratum of the sample, the total number of contacted team leaders in the end was of 27,278. The CAWI operations started on May 8th and finished on May 30th; the CATI activity started at the end of May and lasted till June 13th.

The total number of completed questionnaires was 4,832. The team level survey has a response rate of 20%. Of these 4,832 completed questionnaires, 329 were partially filled[96]. A donor technique to edit the 329 nearly-completed responses was applied in order to maximise the available information.

31% of the responses were obtained via CATI, 55% via CAWI and 14% via reminders. Table 35 provides an overview of the responses per organisation type, programme type and region.

Table 35: Analysis of the activity per organisation type, programme type and area

	Interview Completed	Email Sent	Appoint-ment	No Answer	Non-existing Number	Refusal	Total
Organisation type							
HES	1,344	6,458	161	867	23	36	8,889
OTH	572	98	92	1,549	134	267	2,712
PRC	1,074	2,368	315	1,693	91	191	5,732
PUB	780	193	223	2,040	202	271	3,709
REC	1,062	3,870	95	1,107	47	55	6,236
Total	**4,832**	**12,987**	**886**	**7,256**	**497**	**820**	**27,278**
FP type							
FP7 CAPACITIES	1,194	1,873	326	2,079	147	263	5,882
FP7 COOPERATION	2,454	5,938	295	4,617	278	404	13,986
FP7 IDEAS	320	1,701	66	206	11	16	2,320
FP7 PEOPLE	864	3,475	199	354	61	137	5,090
Total	**4,832**	**12,987**	**886**	**7,256**	**497**	**820**	**27,278**
Region							
EU15	2,155	8,214	364	3,673	277	354	15,037
EU13	1,321	2,300	209	1,267	83	201	5,381
Extra-EU	1,356	2,473	313	2,316	137	265	6,860
Total	**4,832**	**12,987**	**886**	**7,256**	**497**	**820**	**27,278**

The total sampling error for the team survey is 1.4 per cent. The sampling for the strata Region and Organisation type is included in Table 36. In most strata the error is estimated below 5%, as planned. In some cases this was not possible; for the strata with organisation types "public organisation" and "other organisation" in combination with region EU13 and other countries, the error is estimated above 5%. Even after an

[96] The overall number of partially filled questionnaires was quite low since the contact systems, CATI and CAWI finalized the procedures to minimize errors during the interviews.

intensive CATI process where researchers were contacted via telephone to do the interview, the planned number of responses was not obtained.

Table 36: Sampling error per strata

Region	Organisation Type	N (Sample design)[97]	n (Sample)	N (Population)	Error
EU15	HES	379	584	27,653	4.0
EU13	HES	337	371	2,717	4.7
Other countries	HES	361	389	5,298	4.8
EU15	OTH	326	360	2,183	4.7
EU13	OTH	175	101	323	8.1
Other countries	OTH	199	111	369	7.8
EU15	PRC	377	413	21,342	4.8
EU13	PRC	323	349	2,021	4.8
Other countries	PRC	340	312	2,338	5.2
EU15	PUB	337	365	2,777	4.8
EU13	PUB	235	181	607	6.1
Other countries	PUB	278	234	948	5.6
EU15	REC	376	433	18,564	4.7
EU13	REC	321	319	1,965	5.0
Other countries	REC	348	310	2,922	5.3
		4,712	**4,832**	**92,027**	

1.2.2.5. Data

In total, 4,832 team coordinators responded to the team level survey. These 4,832 observations are coordinators of research teams representing 3,415 FP projects. This means that within one FP project, responses were obtained from different teams (at different organisations).

The largest share of team coordinators has a position of researcher/senior researchers in their organisation (27%) or head of department/division/centre (21%). An additional 21% holds multiple positions. Half of the team coordinators have more than 10 years of experience in managing research teams while only 5% has less than two years of experience.

Table 37: Main position of the team coordinator in the organisation (n=4,830)

Main position in organisation	Number	Share
Researcher/senior researcher	1,303	27%
Research manager	681	14%
Head of department/division/centre	996	21%
Head of all research activities in a faculty/institute or the whole organisation	440	9%
Multiple positions	1,036	21%
Other positions	374	8%
Total	**4,830**	**59%**

Source: Analysis of the team level survey data.

[97] Sample for each stratum with a planned error of 5% maximum

Table 38: Experience of the team coordinators with managing research teams (n=4,830)

Experience in managing research teams/projects	Number	Share
Less than 2 years	248	5%
2 to 5 years	993	21%
6 to 10 years	1,233	26%
More than 10 years	2,356	49%
Total	**4,830**	**95%**

Source: Analysis of the team level survey data.

When applying the weight based on type of organisation and geographical region, we obtain representative information on the population of 92,027 teams. We then find that in total, 37% of the teams have participated in more than one FP6 and/or FP7 project. With respect to the specific reference projects, 46% of the population of research teams participated in the FP7 Cooperation programme, 20% in Capacities, another 20% in People and 13% in Ideas. The difference between teams that have previously participated to FP6/FP7 and teams for which this is their first FP7 participation is very similar among the different FP7 specific programmes.

Most of the research teams in the sample are located in Germany (7%), followed by Italy, Spain, United Kingdom, Switzerland and Poland (6%). In total, 46% of the research teams in the sample are located in EU15, 26% in EU12 and 28% in other countries. The largest share of the teams is embedded in a university or HEI (42%), followed by private industry organisation (25%), public or government sector (20%) and private not-for-profit sector (10%). In the private industry and private not-for-profit sector, the share of research teams with only one FP project is slightly higher.

Table 39: Distribution by type of organisation (weighted)

	Only one FP project	Other FP6/FP7 projects
Private industry	67%	33%
Private, not-for-profit sector	69%	31%
Public or government sector	61%	39%
University or higher education institution	60%	40%
Other	64%	36%
Total	**63%**	**37%**

Source: Analysis of the team level survey data.

29% of the respondents indicate that their research team is multidisciplinary. Most research teams are active in Science (31%) and Engineering (18%).

In Agriculture, Science and Social Sciences, research teams have more frequently been involved in other FP6/FP7 projects (cf.

Table 40). 78% of the research teams in Education Sciences on the other hand have only been involved in one FP project only.

Table 40: Distribution by type of field of science (weighted)

	Only one FP project	Other FP6/FP7 projects
Agriculture	55%	45%
Education	78%	22%
Engineering	66%	34%
Health	68%	32%
Humanities	68%	32%
Science	60%	40%
Services	65%	35%
Social	60%	40%
Multidisciplinary	64%	36%
Total	**63%**	**37%**

Source: Analysis of the team level survey data.

1.2.3. One-question survey

1.2.3.1. Scope and question

In addition to the two main surveys of the study, a short follow-up on the MORE2 survey of HE researchers was implemented. The MORE2 Higher Education Institutions (HEI) study contains the results of a survey carried out in the spring of 2012 among HEI researchers in the 27 EU Member States, Associated countries (Norway, Switzerland, Iceland) and Candidate countries (Croatia, Turkey, and the former Yugoslav Republic of Macedonia). The scope is thus similar to that in the individual level survey.

This one-question survey asks the respondents of the MORE2 sample whether or not they have participated to an FP project, and if so which type of project. This survey thus allows us to identify which respondents of this broad-scale survey are FP participants and which are not. The additional information opens up the variables and indicators on a broad range of topics on research careers, working conditions and mobility for this study.

1.2.3.2. Sample and implementation

To create a direct link to FP participation of the individual researcher, we sent out a one-question survey to 4,549 respondents of the MORE2 study (random sample of the total 10,500 respondents). The MORE2 data are representative at the country level for many of these aspects and are thus a solid reference point (though this may be influenced by the response rate to the one-question survey).
The researchers in the sample were invited by email to fill in the question on their participation in an online tool.

In total, 830 responses were obtained. The one-question survey thus has a response rate of 18%.

1.2.3.3. Description of data

The results of this one-question survey were linked to the MORE2 data of each individual respondent. This additional data allows us to answer to some evaluation questions in more detail and to establish links and causalities between FP support and the observed outcomes (i.e. to establish whether impacts have occurred) by comparing the outcomes of FP participants and non-participants based on

counterfactual design (see next section and analysis of the individual level in chapter 3 of the report).

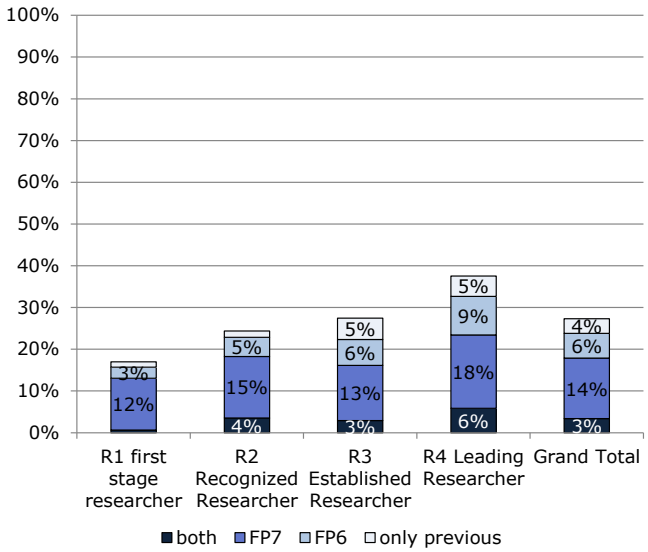
When briefly describing the sample, we see that of the 830 respondents, 15% participated in FP7, 6% in FP6 and 3% participated in both FP programmes. 73% did not participate in any FP project. FP6 and FP7 participation is highest among R4 (leading researchers). 83% of the R1 have never participated to FP before. FP participation is slightly higher among male researchers. These results are also in line with the results obtained from the individual level survey. Overall, Engineering and Technology is the field with the highest participation rate, in particular in FP7. Also Natural Sciences has a relatively high participation rate (35%). The lowest participation is seen in Social Sciences (18%). Remarkably, Agricultural Sciences is the field with the highest share of FP6 participants (16%).

Table 41: FP participation (n=830)

FP participation	Number	Share
Both FP6 and FP7 participation	28	3%
FP6 participation	49	6%
FP7 participation	121	15%
Only previous FP participation	29	3%
No FP participation	603	73%
Total	**830**	**100%**

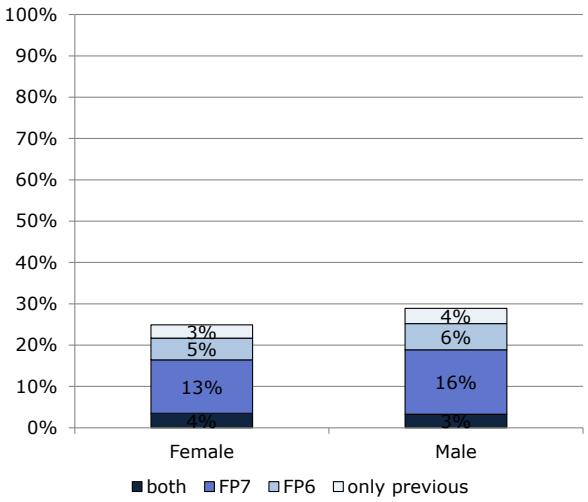
Source: Analysis of one-question survey data.

Figure 63: FP participation, by career stage (n=830)



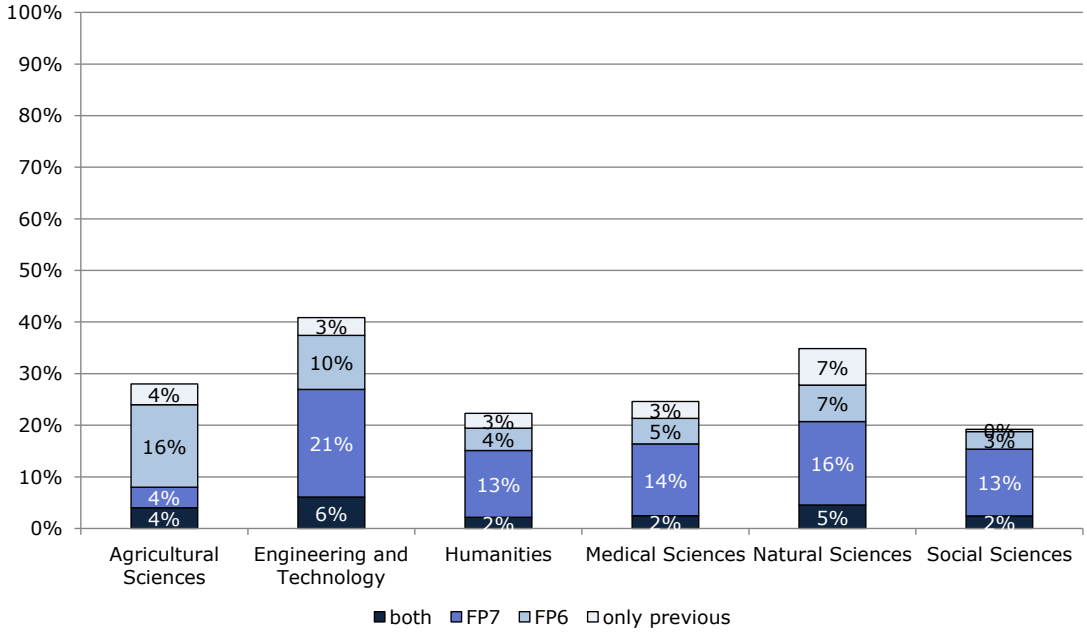
Source: Analysis of one-question survey data.

Figure 64: FP participation, by gender (n=830)



Source: Analysis of one-question survey data.

Figure 65: FP participation, by field of science (n=830)



Source: Analysis of one-question survey data.

1.3. Counterfactual analysis

In the following paragraphs, we briefly summarise the different analyses and results, and the key finding from the counterfactual analysis. For the detailed description of the methodology of the counterfactual analysis, we refer to Annex 4.

The counterfactual analysis was based on the individual survey data. The purpose of the analysis was to assess the impact of FP7 participation (the 'treatment') on the career progress of the individual researchers. For this effect, we use the variables on career stage in each of the different employment episodes and the progress in case of FP participation.

First, a propensity score matching was carried out, which did not result in evidence of relevant changes in career stages due to FP7 participation. Second, we focused on each specific programme of FP7 separately, but there was no evidence of different effects here either. Also using different reference years did not change the outcome. An alternative, based on propensity scores for single countries, was attempted but there were too few observations to obtain a stable model.

To further examine the impact on career progress, the one-question survey was linked with the MORE2 database which also describes the career stages and furthermore allows linking to information on professional satisfaction on several aspects of the research employment and careering. Again, no significant effects were found.

Finally, an alternative approach was to look at a researcher's role in the team, next to his or her formal career stage. This specific analysis did find significant differences that point at a positive impact of FP7 participation on the autonomy of researchers.

In sum, no effect of FP7 participation on the formal career progression is found, but evidences indicates that FP7 participants are more inclined to receive more autonomy in their position than non-participants. As the analysis in chapter 3 shows, this confirms our findings from the individual level survey and case studies that participation does not directly result in promotions or moves up the career ladder, but that there is an evolution within the existing position towards more responsibility or in taking up additional tasks like scientific committee member or advise groups etc. This in turn of course, in the longer run, could lead to 'formal' advancement as well.

1.4. Scope and interpretation of the results

A number of characteristics of the collected data are to be taken into account and determine the interpretation and scope of the information.

- The samples for team and individual level survey are constructed to collect **representative data** in the pre-defined strata. When taking these strata into account in weighting, we obtain representative information for the population. However, careful interpretation is advised. For example, the geographical dimension is reflected in the regions, but within one stratum/region, the countries are not necessarily represented in a fully proportionate manner. For example, in the individual level data small countries seem overrepresented compared to larger countries in the EU15 region. Conclusions should therefore be focused on the regional level, rather than the national level. **The data do not allow for detailed cross-country analysis.** A similar observation is made in the team level survey with respect to overrepresentation of the private organisations (including SMEs) within the stratum.

- Related to this, specific national characteristic are not explicitly part of the statistical analysis. Where relevant and possible, we pay attention to this and we do not draw conclusions at this level. In particular in formulating recommendations, the **national context is part of the external factors** we account for.
- In the individual level survey, both **analysis at the level of the researcher and at the level of the employment episodes** (cf. curricula approach) are possible and will be presented in the analysis section. Attention is paid to the distinction where relevant.
- As indicated in the sections on sampling and implementation of the surveys in Annex 1, it was not possible to calculate one single weight for the different dimensions of the stratification. The main reason was the materialisation of ex post changes to the frame based on survey information, due to incorrect information in the original frame extracted from the eCORDA database. The ex post changes lead to situations where more responses are collected per stratum than the estimated population; which does not allow calculating weights on these strata separately. Given this, the research team in cooperation with the European Commission has selected **one standard weighting approach** for each survey. The **individual level survey** information presented in the chapter 3 is thus interpreted as **representative for the population in terms of fields of science and region**; the tea**m level survey in terms of organisation type and region**. The other dimensions are systematically analysed as subindicators.
- The **definition of human research capacity** builds on a review of relevant literature, and shows the perspective of this study as defined in the Terms of Reference. Where the definition deviates from the 'general understanding' of the concept in literature due to the specific focus of the project, we will clearly indicate this.

2. Survey Questionnaires

2.1. Individual level survey

Cf. separate file

2.2. Team level survey

Cf. separate file

3. Graphic materials

Cf. chapter 4 and annex 1

4. Counterfactual analysis: methodology

Propensity score matching based on the individual level survey data

Approach

The objective of the counterfactual analysis is to assess the impact of FP7 participation on a researcher's career. This analysis uses the individual level data from the survey.

The model we selected for the counterfactual analysis is the propensity score matching. In particular the team adopted the Rubin's Causal Model (RCM) approach (Holland, 1986) that provides a conceptualization of causal inference. RCM, and causal inference in general, rely on several assumptions, such as the strongly ignorable treatment assignment and the stable unit treatment value assumption (SUTVA).

- The strongly ignorable treatment assignment assumption focuses on the process of assigning units to conditions;
- The stable unit treatment value assumption (SUTVA) focuses, instead, on the relationships between the units. SUTVA is defined as an "a priori assumption that the value of Y for unit u when treated with t will be the same no matter what mechanism is used to assign treatment t to unit u and no matter what treatments the other units receive" (Rubin, 1986). Simply put, SUTVA assumes the outcomes from two individuals, irrespective of the treatment assignment, are independent from one another.

When experiments employ random assignment, both these assumptions are presumed satisfied, and the estimated treatment effects are considered accurate (Lanehart *et al*., 2012).

In a first step, the main dimensions of the model are defined:
- a variable describing the 'treatment': FP7 participation
- a variable describing the effects of the treatment: career stage
- a score system in order to obtain a quantitative degree of the effects: the 4 subsequent career stages R1, R2, R3 and R4.

Variables: FP7 participation (treatment)

The FP7 participation is based on the categories of question P18 in the individual level survey (cf. Annex 2 for the full questionnaire). In particular we consider the first 4 categories of question P18 that take in account the participation to the different FP7 programmes (Cooperation, Capacities, People, Ideas). A positive answer to one of question categories is sufficient to assign the individual to the treated group.

Variables: career stage (effect)

The effect variable is the researcher career stage. This variable has 4 categories, from R1 to R4. To estimate the effect, we determined both the career stage before and after the participation in FP7.

Variables: career stage classification (score system)

The adopted score system is based on the career stage classification[98].

- R1 First Stage Researcher (up to the point of PhD);
- R2 Recognised Researcher (PhD holders or equivalent who are not yet fully independent);
- R3 Established Researcher (researchers who have developed a level of independence);
- R4 Leading Researcher (researchers leading their research area or field).

[98] European Commission (2011), Towards a European Framework for Research Careers. Brussels, p.2.

Each career stage is assigned a score equal to the numbering of the career level itself: 1, 2, 3 and 4. The difference between the final and the initial career stage score then yields the effect to be assessed.

Propensity scores and stratification

Considering the FP7 participants only, 327 out of 3,628 individuals were "treated" (i.e. participated in FP7).

The following logistic model, including the basic dimensions and stratification variables field of science, gender and region, was tested:

1) $Treat\ (P = 1) = \beta_0 + \beta_1 Fos + \beta_2 Gender + \beta_3 Region + \beta_4 Degree + \beta_5 Degree\_Date$

Further explanatory variables were added, namely: higher education degree (Degree) and the corresponding year of graduation (Degree_Date). Since only field of science and region yielded significant results for the logistic model, the subsequent steps of the analysis included only those variables.

Based on this, propensity scores were estimated and further used to split the sample into five equal strata based on the value of the propensity scores. Thus, the stratification allocates individuals into subclasses on the basis of their propensity scores.

The optimal number of strata depends on the sample size and the amount of overlap or common support between the treatment and control groups' propensity scores. Here, as in the majority of propensity score studies, five subclasses are used which allows deleting 90% of the bias due to measured confounders.

Results

Treatment effects are determined for each subclass and averaged across strata using stratum-specific weights:

$$\hat{\mu}_{1i} - \hat{\mu}_{2i} = \frac{\sum w_i\ (\bar{X}_{1i} - \bar{X}_{1i})}{\sum w_i}$$

, where w_i is the square of the standard error of the difference between means and the variance of the estimated mean difference is given by $Var\ (\hat{\mu}_{1i} - \hat{\mu}_{2i}) = \frac{1}{\sum w_i}$ (Lanehart *et al*., 2012).

The following table shows the results of these elaborations for the sample of individuals.

Table A4.1: *T test for the effects (ex-ante and ex-post career stages differences) for treatment and propensity score classes*

5 variables logit (FOS, Gender, Area, Degree, Degree-Data)

Ps classes	Higher mean; 0=non-treat, 1 treat	Treatment difference significance
0	0	No
1	1	No
2	0	No
3	0	No
4	1	No
Weighted Total	0	No

2 variables logit

(FOS, Area)

Ps classes	Higher mean; 0=non-treat, 1 treat	Treatment difference significance
0	1	No
1	1	No
2	0	No
3	0	No
4	1	No
Weighted Total	0	No

The results suggest no relevant changes due to FP7 participation in the sample. These results do not change when we consider a complete or reduced model.

The same analysis at specific programme level (Cooperation, Capacities Ideas, People) did not result in significant differences between FP7 participants and non-participants in any of the programmes. The results are showed in the following Table A4.2.

Table A4.2: *T test for the effects ex-ante -ex-post career stages differences for treatment, ps classes Test t and FP7 project*

	Cooperation		Capacities		People		Ideas	
Ps classes	Higher mean; 0=non-treat, 1 treat	Treatment difference significance	Higher mean; 0=non-treat, 1 treat	Treatment difference significance	Higher mean; 0=non-treat, 1 treat	Treatment difference significance	Higher mean; 0=non-treat, 1 treat	Treatment difference significance
0	0	No	0	no	1	no	1	no
1	1	No	0	no	1	no	1	no
2	0	No	0	yes 5%	0	no	1	no
3	0	No	1	no	0	no	0	no
4	0	No	1	no	0	no	1	no
Weighted Total	0	No	0	no	0	no	0	no

Two similar analyses were carried out to estimate propensity scores and assess the FP7 impact on individual career progression. The first was based on an alternative definition of the FP7 reference year. No different results were found. The second analysis consisted in estimating the propensity scores for single countries. In this case, we were not able to identify the logistic model for single country due to limitations in the number of observations.

Analysis of matched information from MORE2 data and individual level survey

Approach

Part of the MORE2 respondents was invited to the one-question survey. The selection was random. In total, 830 researchers filled in the individual level survey after having filled in the MORE2 survey.

Both sources, the original MORE2 data and the new one-question information for one specific respondent, are matched to increase the available information and thus have more options for the counterfactual analysis.

Variables

Again career stage is the effect variable. This variable is now identified in the MORE2 data, instead of in the individual survey data. MORE2 contains the 'current' stage (career2), as well as the start (career0) and end (career00) career stage in different steps/moves of the researcher. The following variables represent the final effect:

diff_c=career2-career0
diff_cc=career2-career00

Another type of information relevant to assess FP7 impact, is the professional satisfaction with different aspects of the research position or career, namely dynamism, intellectual challenge, responsibility, independence, value for society, career advancement, mobility, social status, salary, benefits, job security, job location and reputation. Based on this information, two indicators were set up: the first one summarises the response to the different categories, simply adding the value 1 each time an aspect is found satisfactory. This indicator thus varies between 0 and 15.

$SATI = \sum_1^{15} q_i^{25}$

The 15 answers can also be weighted if they are considered not equally important. If we assume that aspects linked to the dynamism, the career advancement and reputation are considered more important, SATI2 is calculated in the following way:

$$SATI2 = 2 * q_1^{25} + \sum_2^5 q_i^{25} + 2 * q_6^{25} + \sum_7^{12} q_i^{25} + 2 * q_{13}^{25} + + \sum_{14}^{15} q_i^{25}$$

Propensity scores and stratification

Next, the following two logistic models were considered:

a) *Treat (P=1) = f(fos; birth)* logistic model with more significant variables
b) *Treat (P=1) = f(fos; q9year1)* better t test for the propensity score groups

, with birth=year of birth and q9year1=year in which the highest educational degree is obtained.

Results

Based on both SATI and SATI2, negative differences of the impact variables (=control-treated) are obtained in all propensity score groups. However, most of these differences have no statistical significance, though the box-plot of the treated and control distributions of propensity scores shows a good overlapping. The outcomes of the models estimated with the diff_c and diff_cc did not provide results significant different from the individual sample ones.

Adding information on researcher's role within research team

Approach

In these final exercises the team combined the information on the career stages with the information on the role of the researchers in the research team in which he or she operates.
Question p19 in the individual level survey provides this additional information: it details whether the researcher worked under supervision or in an autonomous way (without supervision).

In order to proceed with this information, we needed to link between:

a) information on the organization and career stage coming from questions p12;
b) information on the career stages in the different episodes of the researcher (questions p12b, as in the first analysis);

c) information on the researcher's autonomy in a specific episode, career stage and organization (questions p19).

Variables

Once organization and career stages are linked, then this information is linked to question 19 based on the organisation in order to assess whether the researchers worked under supervision or autonomously in the (first) career stage related to this organisation. If he or she worked autonomously, an indicator 'super' was given the value 1. This autonomy is then analysed first as a new variable that corresponds to the career stage; and second as an effect in itself.

Propensity score matching and stratification results for the integrated individual sample information

In this section the logistic model and test for propensity score classes are shown for the dataset including question p19 on autonomy. So the effect is represented by the difference between final and initial career stage as well (diff2) but to the final career stage (from 1 to 4) is added the role played by researcher within the research team (0=under supervision, 1=autonomous).

Referring back to the first analysis, the logistic model is again estimated considering only variables that present statistical significance i.e. field of science and region, but the model with 5 variables yields the same results.

Table A4.3 and Table A4.4 present the usual tests for model fitting. All tests confirm the goodness of fit and the model appropriateness.

Table A4.3: *Model Fit Statistics*

Criterion	Intercept Only	Intercept and Covariates
AIC	2209.557	2195.852
SC	2215.768	2214.486
-2 LOG L	2207.557	2189.852

Table A4.4: *Testing Global Null Hypothesis: BETA=0*

Test	Chi-Square	DF	>Pr > ChiSq
Likelihood Ratio	177,048	2	0.0001
Score	171,312	2	0.0002
Wald	169,647	2	0.0002

In Table A4.5 parameters of the estimation for the logistic model are shown.
Field of science and region present significant values and can be considered as the ones that most influence the probability to participate in FP7.

Table A4.5: *Analysis of Maximum Likelihood Estimates*

Parameter	DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq
Intercept	1	-2.1554	0.2116	103.7329	<.0001
Fos2	1	0.1608	0.0753	4.5664	0.0326
Area	1	-0.3197	0.0892	12.8336	0.0003

The logistic model then supplies the propensity scores that are grouped in 5 classes in order to estimate the mean difference between treated group and control group.

Results

Table A4.6 shows the means of effect for both groups and the t-test to detect if the differences are significant.

Table A4.6: *Means difference t-test for propensity score classes*

	Variable	fp7 participation	N	Mean	T test		
Ps =0					Method	t value	Pr > |t|
	diff2	0	672	1.955	Pooled	-1.41	0.1578
	diff2	1	42	2.262	Satterthwaite	-1.32	0.1934
	diff2	Diff (1-2)		-0.307			
Ps =1					Method	t value	Pr > |t|
	diff2	0	650	1.7831	Pooled	-1.30	0.1943
	diff2	1	56	2.0179	Satterthwaite	-1.27	0.2079
	diff2	Diff (1-2)		-0.2348			
Ps =2					Method	t value	Pr > |t|
	diff2	0	518	1.7831	Pooled	0.09	0.9288
	diff2	1	59	2.0179	Satterthwaite	0.08	0.9334
	diff2	Diff (1-2)		-0.2348			
Ps =3					Method	t value	Pr > |t|
	diff2	0	1044	1.7395	Pooled	-0.56	0.5752
	diff2	1	98	1.8163	Satterthwaite	-0.52	0.6059
	diff2	Diff (1-2)		-0.0768			
Ps =4					Method	t value	Pr > |t|
	diff2	0		1.5796	Pooled	-1.54	0.1246
	diff2	1		1.8194	Satterthwaite	-1.44	0.1546
	diff2	Diff (1-2)		-0.2398			

Weighted total	mean_diff	SE_diff	t	
	-0.15131	0.074652	-2.03	*

For all groups the treatment means difference is negative (i.e. having participated in FP/ has a positive effect on career stage + role in the team). Moreover the total weighted difference presents a negative value too, and a statistical significance at 10 per cent level. The propensity score treated and control distribution have a good overlap in the box-plot. This means that we find a the positive and significant effect of FP7 participation on researchers in terms of increased autonomy (versus working under supervision).

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OECD (2012), Transferable Skills Training for Researchers: Supporting Career Development and Research, OECD Publishing, see p. 20.

Interpersonal skills:
- Working with others/teamwork
- Mentoring and supervisory skills
- Negotiating skills
- Networking skills

Organisational skills:
- Project and time-management skills
- Career planning skills

Research competencies:
- Grant application writing skills
- Research management and leadership
- Knowledge of research methods and technologies beyond the PhD project
- Research ethics and integrity

Cognitive abilities:
- Creativity and the ability for abstract thought
- Problem solving

Communication skills:
- Communication/presentation skills, written and oral
- Communication/dialogue with non-technical audiences (public engagement)
- Teaching skills
- Use of science in policy making

Enterprise skills:
- Entrepreneurship

- Innovation
- Commercialisation, patenting and knowledge transfer

LERU and EC typology of career path

European Commission (2011), Towards a European Framework for Research Careers. Brussels, p.2.

The four career stages are (note that the stages have been further defined in terms of profile and characteristics):

- R1 First Stage Researcher (up to the point of PhD);
- R2 Recognised Researcher (PhD holders or equivalent who are not yet fully independent);
- R3 Established Researcher (researchers who have developed a level of independence);
- R4 Leading Researcher (researchers leading their research area or field).

6. Management Report

Cf. separate file

7. Essay comparing the EU and US findings

Prepared by Alina Martinez

The *EU2020 Strategy*, and the creation of the European Research Area (ERA), focuses attention on the Framework Programmes (FP), as the main instrument of research funding in Europe, and its role on developing human capital. This essay discusses some of the key findings from the *Study on Assessing the Contribution of the Framework Programmes to the Development of Human Research Capacity* (conducted by IDEA Consult, iFQ, and PPMI) and draws some comparisons with work that similarly focuses on research collaborations and human resource development in the United States of America (US).

This evaluation of FP provides supporting evidence of the important role that FP is playing in realizing the ERA through the development of human research capacity. The findings from this evaluation are particularly pertinent because of the limited attention that human research capacity has received in prior evaluation efforts. Key strengths of the evaluation include the multipronged approach taken, and the multifaceted treatment of human research capacity, which includes an investigation of diverse dimensions involving skills and expertise, career paths, contractual arrangements, recruitment and mobility.

The centralized FP funding mechanism is analogous to mechanisms in the US centralized within federal agencies. Funding for international science and engineering partnerships in the US is concentrated in a handful of federal agencies: the Department of Defense (DOD), the National Institutes of Health (NIH), and NSF.[99] Among these agencies, NSF is unique in its emphasis on basic science and engineering. The US National Science Board (NSB) has called for increased government commitment to promoting international science and engineering (S&E) research and education,[100] and identified an important leadership role for the US National Science Foundation (NSF) in international science and engineering research and education activities.[101] Investigations of funded programs reveal the importance of research policy in framing national research and human capital development.

There is no correspondingly comprehensive investigation of a US research program's effect on human capital development, thus comparisons are made to evaluations of several NSF programs, including:

- The International Research Fellowship Program (IRFP) provides financial support to postdoctoral scientists for a research experience abroad. Findings from the evaluation parallel several of the findings from the FP evaluation, and provide evidence of the role that a funding program can play in seeding productive collaborations.[102] The evaluation of IRFP compared the outcomes of fellows to those of unfunded applicants, using pre-award characteristics of applicants to mitigate the potential threat of selection bias. Below, findings

[99] National Science Board. 2008. *International Science and Engineering Partnerships: A Priority for U.S. Foreign Policy and Our Nation's Innovation Enterprise.* NSB-08-4. National Science Foundation, Arlington, VA.

[100] National Science Board. 2001. *Toward a More Effective Role for the US Government in International Science and Engineering.* NSB-01-187. National Science Foundation, Arlington, VA.

[101] National Science Board. 2000. *Toward a More Effective NSF Role in International Science and Engineering, Interim Report.* NSB-00-217. National Science Foundation, Arlington, VA.

[102] Martinez, A., Carter, E., Parsad, A. & Whittaker, K. 2012. *Evaluation of NSF's International Research Fellowship Program: Final Report*. Abt Associates Inc., Cambridge, MA. Available http:/www.abtassociates.com/Reports/2012/Evaluation- of- NSF's- International- Research-Fellows.aspx

from the IRFP evaluation are compared to selected findings from the FP evaluation, particularly at the level of the individual investigator.[103]

- The International Research Experience Program (IREP) a program that encouraged international partnerships of students to train future generations of scientists and engineers through international science experiences and strengthen collaborations with NSF-funded Science and Technology Centers (STC). The evaluation investigated activities as well as compared pre- and post-participation survey responses.
- The International Research and education in Engineering (IREE) program provided supplemental funding to NSF awardees to support international travel by early-career researchers in the United States to enable them to gain international research experience and perspective, and to enable closer research interaction between U.S. institutions and their foreign counterparts. The evaluation of IREE investigated the reported activities and outcomes of these projects.
- The Industry and University Cooperative Research Program (I/UCRC), through which NSF provides a small investment in university/industry partnerships to catalyze research centers that typically receive funding from industry members. The centers contribute to human workforce development through the integration of research and education. An evaluation of cooperative research centers, which consisted primarily of I/UCRCs, investigate the reported outcomes and satisfaction of center researchers, as well as correlations between these and organizational, center, and individual-level characteristics.
- The Science and Technology Centers program Integrative Partnerships program (STC) supports large-scale research centers created by partnerships among institutions (including academic, national laboratories, organizations, other public/private entities) that create research. The evaluation of the program comprised review of extant sources as well as surveys of program participants.

FP researchers ascribe to FP an important role related to their skills development. Researchers reported having received their strongest training in a variety of skill areas during employment episodes that involve FP. Important skills that were developed during these periods include skills relevant to networking, leadership, negotiation and science in policy contexts. Researchers were also more likely to identify FP episodes, over non-FP episodes, as central in strongly cultivating key career development skills, including communication, leadership, networking, problem solving, project management, research methods and team work. Less difference was seen in entrepreneurial and teaching skills. Similarly, IRFP participants reported that their IRFP experiences played an important role in developing knowledge and research skills, and broadening their understanding of the research enterprise more broadly. The evaluation of NSF's International Research Experience Program, a program for undergraduate and graduate students that ended in 2008, found that students who engaged in an international research experience reported gaining technical, communication, and language skills; developed an appreciation for cultural differences; and felt that their research experience would "create opportunities for future international collaboration."[104] Finally, the evaluation of NSF's International Research and Education in Engineering (IREE) pilot program also found that program

[103] An evaluation of NSF's largest program to support international research collaborations, Partnerships for International Research and Education (PIRE) Program, is currently underway, but findings are not available.

[104] Spencer, D. 2008. *International research experience program: International research opportunities for students at NSF science and technology centers.* Retrieved from http://66.116.177.96/IREP%20Evaluation%20Report.pdf

participants, especially graduate and postdoctoral students, reported acquiring new research capabilities, and that they planned to continue collaborations with their international counterparts at the end of their program experience.[105]

Importantly, the FP evaluation found greater collaboration among FP researchers compared to non-FP researchers. Collaboration is important as successful research partnerships will increasingly play a larger role in maintaining leadership in research and development, and leading to economic growth and social well-being. A recent analysis of research publications in the US and Europe,[106] showed that researchers in the US were more likely to collaborate with researchers outside the US than were researchers in Europe likely to collaborate with researchers outside Europe.[107] The analyses revealed that the percent of papers in EU that involved inter-country collaboration increased from 2003 to 2011, which was interpreted as an indication that EU efforts to encourage EU cross-national collaboration are having an influence. This collaboration in EU among countries was similar to the levels of collaboration in the US across states.

While there is evidence that FP projects utilize longer contracts and correspondingly result in more stability in employment, there is also evidence that FP researchers' duration in a career stage is longer than their non-FP counterparts. Findings from the comparative analyses suggest that FP researchers follow a slower career progression, yet FP researchers perceive FP as having a positive effect on their careers. Unlike FP participation, the IRFP evaluation found that participation in IFRP did not come at the expense of professional career advancement, with both IRFP and non-IRFP participants following similar career trajectories. A key difference may be the timeframe during which researchers may participate in each of the programs—researchers may participate in FP during any career stage, but only early career postdoctoral researchers may participate in IRFP.

Similar to the FP evaluation, which found differences in some important outcomes but not across all outcomes investigated, the IRFP evaluation found that the effects of the program were based not on overall research productivity, but specifically on the extent of international research collaborations. IRFP fellows had a larger number of publications with a foreign co-author compared to non-funded applicants, and the percentage of publications with a foreign co-author was also greater for fellows.

There was some evidence that FP leads to researcher mobility and international exchange, as seen in three key indicators: (1) FP projects involved non-EU institutions, facilitating circulation of researchers across regions; (2) FP-funded researchers were more mobile than their non-FP counterparts when comparing longer-term employment episodes; and (3) FP research projects attracted non-EU researchers. Whether this mobility and collaboration seeds long-lasting changes and collaborations is unclear. In contrast, while IRFP participants reported that their professional relationships endured beyond their IRFP period, and that they were committed to international research collaboration, there was no evidence that their international mobility was greater than their non-IRFP peers.[108] However, researcher

[105] Flattau, P.E., Lal, B., Laskey, A., & Ford, J. J. 2009. *Portfolio Evaluation of the National Science Foundation's Grants Program on "International Research and Education in Engineering" (IREE).* Washington, DC: Institute for Defense Analyses, Science & Technology Policy Institute.

[106] Europe included the 27 EU countries and 14 associated countries eligible for FP7.

[107] Science Europe & Elsevier. September 2013. *Comparative Benchmarking of European and US Research Collaboration and Researcher Mobility*. Available http://www.elsevier.com/__data/assets/pdf_file/0010/171793/Comparative-Benchmarking-of-European-and-US-Research-Collaboration-and-Researcher-Mobility_sept2013.pdf

[108] Martinez, A., Carter, E., Parsad, A. & Whittaker, K. 2012. *Evaluation of NSF's International Research Fellowship Program: Final Report*. Abt Associates Inc., Cambridge, MA. Available http:/www.abtassociates.com/Reports/2012/Evaluation- of- NSF's- International- Research-Fellows.aspx

mobility can also be viewed as mobility within member states across which knowledge exchange is also important. From this perspective, a comparison of research mobility found that there was more researcher migration across US states than EU countries.[109]

Within FP research projects, the use of full-time fixed-term contracts rose relative to full-time permanent contracts, which the evaluation suggests was influenced by both FP funding and reliance on third-part research funding. However, there was no evidence that these changes resulted in long-lasting changes. Importantly, the evaluation suggests that the potential role of FP in influencing employment conditions is limited due to national regulations. Research on organizational conditions in university research centers and team science in the US has been more focused on challenges due rather than the influence of the research activities or funding.[110] While not exploring the ability of a funding mechanism to affect administrative obstacles, research on cooperative research in the US has highlighted the importance of contextual variables in the tangible and intangible benefits experienced by researcher in research collaborations. For example, a survey of researchers involved in cooperative research centers, including primarily centers funded by NSF's Industry and University Cooperative Research Program (I/UCRC), found that organizational and center-specific variables—including benefits, university funding, and primary discipline of the center—were related to faculty perceptions of their experiences.[111]

Some important organizational influences were observed. FPs contributed to a greater transparency and merit-based recruitment practices, especially in EU-12 countries. As a result of FP participation, the beneficiary organizations became more attractive to their employees because of the scope and international research activities they offered. Some variation in institutional effects reflected previous FP participation and alignment to human resources priorities. While the organizations become more attractive because of the international research activities, the impact of FPs on the participating organizations varied according to the particular HR processes and procedures. This impact was higher for recruitment procedures, training and supervision practices, but it was much smaller for gender mainstreaming and advancement of equal opportunities. While the importance of gender equality and involvement of female researchers was recognized by team leaders, improved gender equality within projects was not always achieved. An evaluation of the NSF-funded Science and Technology Centers Integrative Partnerships Program (STC), which funds research partnerships that include university and non-university partners, found similarly, that the emphasis placed on diversifying the workforce by STC was used by individual STC partnerships influences both recruitment and retention of individual participants. Correspondingly, the participation of females was higher than national trends at all levels, including the proportion of postdoctoral scholars and faculty involved. [112] One study that specifically investigated the role of research centers as

[109] Science Europe & Elsevier. September 2013. *Comparative Benchmarking of European and US Research Collaboration and Researcher Mobility*. Available http://www.elsevier.com/__data/assets/pdf_file/0010/171793/Comparative-Benchmarking-of-European-and-US-Research-Collaboration-and-Researcher-Mobility_sept2013.pdf

[110] See for examples, Boardman, C, & Bozeman, B. 2007. Role strain in university research centers. *The Journal of Higher Education, 78*(4), 430-463; Garrett-Jones, S., T. Turpin, and K. Diment (2013) Careers and Organizational Objectives. Managing Competing Interests in Cooperative Research Centers. In Boardman, C., D. Gray, and D. Rivers (2013) (Eds.) C*ooperative Research Centers and Technical Innovatio.* New York: Springer.

[111] Coberly, B. & Gray, D. 2010. Cooperative research centers and faculty satisfaction: A multi-level predictive analysis. *Journal of Technology Transfer, 35*(5), 547-565.

[112] Chubin, D., Derrick, E., Feller, I. & Pallavi, P. (2010). *AAAS Review of the NSF Science and Technology Centers Integrative Partnerships Program (STC) 2000-2009*. American Association for the Advancement of Science, Washington DC.

change agents found that the institutional context mediated the change, however, research centers at times operated outside the regular institutional governance.[113]

A central finding of the FP evaluation relates to the larger size of the FP research teams, and the corresponding increase in the number researchers employed on these projects. Combined with the related findings that the FP projects were of financially larger scale and longer-term focus, the findings suggest that the FP may make a valuable contribution to the scientific enterprise. A comparative assessment of research productivity from NSF's STC program was not conducted, in part, because of the challenges in finding the appropriate counterfactual on which to make a comparison to the typically larger-scale research projects.

The importance of research collaborations, and in particular international collaborations is recognized as important for the continued economic growth and social well-being, in prominent with in the US as in EU. Through international networks of scientists, resources can be shared and ideas can be developed, tested, and implemented across traditional boundaries.[114] The US NSB has highlighted the importance of science and technology in the US economy and recognized the globalization of STEM research and education, and the associated opportunities and challenges for the U.S. as revealed by trends that underscore the growing competitiveness of other economies.[115] Other policy makers, convened by the National Research Council in a focused workshop, have also highlighted the potential of science policy and science diplomacy to meet international challenges, and the value of providing opportunities and incentives for U.S. researchers to engage in science in an international arena.[116]

In considering the findings from a US or comparative perspective, it is useful to return to the workshop convened a decade ago that pondered ways to enhance international mobility, fund collaborative research, and negotiate legal and regulatory differences, as well as envisioned what future collaborations might look like.[117] Among the issues explored in the workshop investigated were ideas for enhancing collaboration, the complexity of difference legal and regulatory systems, and how to measure collaboration. More recently, a workshop convened by the US National Academy of Sciences explored the role of culture, administrative, and legal considerations play in research collaborations.[118]

As noted earlier, no completed evaluation of an NSF program has taken the comprehensive approach that the FP evaluation has taken. However, an evaluation of NSF's largest program to support international research collaborations, Partnerships for International Research and Education (PIRE) Program, has plans for a more comprehensive investigation of the outcomes, although no findings are currently available. Nevertheless, the EU/US comparisons above raise important issues to consider including:

[113] Rogers, J. 2012. Research Centers as Agents of Change in the Contemporary Academic Landscape: Their role and impact in HBCU, EPSCoR, and Majority Universities. *Research Evaluation, 21*, 15-32.

[114] National Science Board. 2008. *International Science and Engineering Partnerships: A Priority for U.S. Foreign Policy and Our Nation's Innovation Enterprise.* NSB-08-4. Arlington, VA: National Science Foundation.

[115] National Science Board. 2010. *Globalization of Science and Engineering Research: A Companion to Science and Engineering Indicators 2010.* National Science Foundation. Arlington, VA.

[116] National Research Council. Council, Committee on Global Science Policy and Science Diplomacy. 2011. *U.S. and International Perspectives on Global Science Policy and Science Diplomacy:* Report of a Workshop. National Academies Press, Washington, DC.

[117] President's Council of Advisors on Science and Technology (2004) S&T *Collaboration Ideas for Enhancing European-American Cooperation: Summary of a Workshop*. PCAST, Washington DC Available http://www.whitehouse.gov/sites/default/files/microsites/ostp/pcast-04-stcollab.pdf

[118] National Research Council. 2014. *Culture Matters: International Research Collaboration in a Changing World Summary of a Workshop).* Washington, DC.

(1) There are important geopolitical differences between the EU and US, and their corresponding member states. For example, while EU Member States each may have different foreign policies and national priorities, while US states share at least a common foreign policy. That is not to say that the US does not have regional variation in research environments and priorities. [119] Also, to be considered is the role that greater variation in culture, language, administration, benefit and pension structures may play in EU collaboration and subsequent development of human research capacity.

(2) In investigating the effect of research programs, the identification of an appropriate counterfactual is always a challenge. The varied approaches to evaluation raise the question of how one can construct a suitable comparison, what outcomes can or should be compared, and whether distinct comparisons need to be identified for outcomes at different levels.

(3) The question arises as to whether there is evidence that indicates a career stage in which a researcher participates and the responsibilities that are assumed during participation that yield the most benefits. There is evidence from across the evaluations that researchers perceive benefits from participation in these collaborative research experiences. Findings from the US suggest the potential of educational opportunities and early-career opportunities to foster collaboration.

(4) Another question is whether the FP mechanism can realistically be expected to influence key human research capacity outcomes at all three levels of interest—individual, team and systemic—or whether it needs to be coupled with additional strategies in order to have influence at particular levels or on particular outcomes.

(5) Potentially relevant to the question of human capital development is the ongoing work in the growing field of team science, which is investigating the conditions and interactions under which successful research collaborations function.[120]

Promoting national and international engagement at all levels is crucial to fostering successful research partnerships and developing productive transformative research projects. As a key mechanism in funding research, FP has an important role to play in furthering the creation of the ERA. This evaluation explored the contribution of the FP to the development of human research capacity and provides evidence that the FP is making progress toward achieving objectives related to developing human research capacity.

[119] See for example, PCAST, 2004. *Federal-State R&D Cooperation Improving the Likelihood of Success.* . PCAST, Washington DC Available http://www.whitehouse.gov/sites/default/files/microsites/ostp/pcast-04-fedstate.pdf

[120] Stokols, D., Hall, K., Taylor, B. & Moser, R. (2008). The Science of Team Science: An Overview of the Field and Introduction to the Supplement. *American Journal of Preventive Medicine. 35,*(2 Suppl) S77-S93

8. Summary of the round table discussion

Brussels, 18.9.2014, 13:30-17:00

Participants

- European Commission: Sean O'Reagain, Anne-Sophie Paquez, Claus-Martin Bucholz, Jurate Vaznelyte
- Experts:

Name expert	***Affiliation***
Louise Ackers	University of Salford
Laudeline Auriol	OECD - Directorate for Science, Technology and Innovation'
Hubert De Neve	IMEC
Matthijs De Jong	School of Economics **-** Erasmus University Rotterdam
David Kolman	Helmholtz Gemeinschaft
Alina Martinez	Abt Associates
Emanuela Reale	CERIS-CNR
Annamaria Silvana de Rosa	Sapienza University of Rome
Janica Ylikarjula	Confederation of Finnish Industries EK
Miriam Van Hoed	IDEA Consult
Arnold Verbeek	IDEA Consult
Anna Vosečková	Czech Liaison Office for Research, Development and Innovation (CZELO)

- Research team: Arnold Verbeek, Miriam Van Hoed, Annelies Wastyn (IDEA Consult), Sybille Hinze, Sophie Biesenbender (iFQ), Vitalis Nakrosis (PPMI)

Agenda

		Lead
13.30 – 13:45	Welcome and introduction (tour de table, agenda, and expectations)	IDEA
13.45 – 14.15	Presentation of the study: approach, main results and recommendations	IDEA
14.15 – 15:30	Session 1: Open discussion on the main results *Key question: can the presented analysis and conclusions be subscribed to?*	ALL
15.30 – 16:45	Session 2: Open discussion on the future *Key question: how can the impact of the future Horizon programme on research capacity can be strengthened? What are the main challenges?*	ALL
16.45 – 17:00	Final reflections and rounding up	ALL

1. Intro and welcome by Sean O'Reagain (HoU RTD A5) – objectives of the study

2. Tour de table and presentation of main results

3. General comments

4. Discussion on conclusions

Career progression:

- One of the findings of the study is that career progress seems to decrease in FP participation. More specifically, employment episodes are longer in FP than in non FP participating episodes.
  It is suggested that this can be expected given the longer funding periods under FP participation.
- Related to and at the same time nuancing this finding is the observation that research autonomy is higher / comes sooner for researchers in FP. FP participants also develop transferable skills during the project *[cf. also counterfactual analysis*]. FP participation creates sustainability among senior researchers and offers the opportunity for stability to specialise in research topics. It is important to notice that career progression also entails promotion within career stages, to be distinguished between formal and informal progression. Sufficient context should be provided in the conclusions.

- A possible follow-up question is to what extent FP is different compared to national programmes. In many countries though there is no/only limited national fund available. Maybe the crisis can offer some more context.
- Productivity, which is not measured here, could be related to HRC as this can further drive careers. Do FP researchers produces more/higher quality of publications, patents, spin-offs,...? It is suggested to differentiate between "skills" and "expertise" or "technical" vs "research" skills. what is the dimension of quality? Objective criteria of success, efficiency and productivity of research are important here.

Mobility:

- For the long-term career paths there is a paradoxical condition: people may want to stay but cannot stay due to framework conditions. Does this induce forced mobility?
- The motives to participate to FP are focused on internationalisation and mobility. Contracts are to a lesser extent important. It might be relevant to keep in mind the two different universes: EU project versus university contexts.
- Do not only stress the international mobility but also focus on intersectoral and interdisciplinary implications

Attractiveness of EU and brain circulation:

- Brain circulation is important (I.e. collaboration across member states). Being able to attract non-EU people could also be an indicator of attractiveness. In addition it could be an implicit indicator of excellence: does employment of non-EU researchers rather reflect shortage in the EU?

Industry and higher education profiles:

- Interesting to see the differences between the profiles; both sectors have different objectives and are thus likely to have different practices as well (e.g. in industry there is a lot of on the job training). It is good to point these out and take them into account in a more pronounced way.
- These differences also point at the rich exchanges that can take place from cooperation between both.
- The fact that industry participants tend to look for further valorisation of the outcomes of a project, and eventually hire researchers to lead this process, is an excellent result from the study.

Methodological remarks:

- Put job creation in the right context (Eurostat data are too different (FTE versus HC)).
- Narrow definition of brain circulation (non-EU perspective). Also, what is the real interpretation of high/low share of non-EU researchers hired on FP projects: attracting excellence or inability to hire from inside the EU?
- Analytical level of country or field/discipline is important in the analysis and could show important nuances in the general conclusions/discussion statements.
- Concerning career progression, causality might be an issue. Is FP hindering advancement? Maybe not. It depends if the best researchers participate to FP.
- Results concerning impact on international activities might be due to selection effects. Many FP participants are international by definition.

Formulation of conclusions:

- The formulation of the conclusions is very normative, which is due to the tender indicating that some distance from the results need to be maintained and critical reflection is needed.
- Conclusions are not enough grounded in the results yet. A stronger link between that data and the conclusions needs to be made. Recommendations need to be linked to the conclusions.
- Bring out the positive in the conclusions:
    - Researchers are driven by content (confirmed from other studies).
    - Researchers in FP are more autonomous in carrying out tasks.
    - FP has significant impact on attracting funding
    - FP is a unique occasion for networks (ERA-Net stories)
    - Improvement in skills with regard to research methods
    - Not sure whether influence on the research agenda is to be considered positive or negative? It is also contra-intuitive to a couple of the experts.
    - ...
- Include the limitations in the conclusions
    - Results differ over fields/disciplines
    - External factors such as context, country regulations, R&D investments influence the results
    - Spill over effects are not included/considered
    - Too limited differentiation between the different FP programmes

Written feedback on conclusions is provided by the experts via email.

5. Discussion on recommendations

Focus:

- Recommendations are too broad and should be limited in terms of scope to the level at which a direct (hands-on) effect can be obtained: the future research funding programmes.
- In terms of content, the recommendations should focus on those aspects that are really central to the researchers' careers and employment: transferable skills, mobility, autonomy, recognition (e.g. of PhD candidates or early career researchers within FP and the specific contribution FP participation has to their development).
- In this sense, a label, branding, comes in the picture. FP should be seen as valuable and attractive by future employers. *[This is indeed a finding of the case studies and thus realised to some extent. We could emphasise the positive effect in terms of transferable skills, networking, management, autonomy etc. that we find in this study related to FP participation – in order to give the 'label' a specific and evidence-based content]*
- The recommendations should certainly also build on positive effects (e.g. increased skills, transferable skills, research autonomy, importance of research content, etc.). Elements which work well should be indicated and motivated to continue (indication of good practices).
- Has the change in focus of FP an impact on careers development (Horizon 2020 to be more market-driven)?

Sustainability:

- Sustainability at individual level: Contractual insecurity (in particular for early stage researchers) is an issue but on the other hand also inherent to project funding mechanisms. Industry-oriented experts confirm the finding that industry employment after the project is more long-term/permanent in nature. This is an important finding that could lead to recommendations in the direction of cooperation with industry/awareness of alternative career options/...
- Sustainability at system level: it should not stop with one project or study, the FPs should have a stronger objective of creating/supporting the development of a sustainable and strategic research agenda.
- Sustainability should NOT come from automatically implementing national or regional funding to institutionalise teams after an FP project (could codify a lock-in mechanism/Matthew effect). Competition is necessary at all levels to stimulate excellence and give also early stage researchers a chance. Should the focus be more on integrating national and EU funding?

Awareness creation / principles and guidelines:

- There is discussion on the further encouragement of the implementation of the C&C. One finds it a good idea to give this a prominent position in the recommendations, others find it not relevant to the subject nor building on the evidence and conclusions. If included, the link with the specific evidence and conclusions needs to be clarified and the expected effect shown.
- The C&C should not only focus on HEIs (so also cover public research institutes). At the system level there should be a monitoring of effective implementation of the C&C.

Continuity:

- recommends going beyond life span of individual projects: a few years after FP participation transversal analysis of e.g. networks (that are volatile)
- Commission should focus on long-term impacts: (sustainability e.g. of collaboration), EC should take care of long term productivity of their investment and follow up trough transferal analysis with a longitudinal approach and a central database, create big data and a digital infrastructure to integrate levels, time and countries
- recommendation is that programmes should help to develop a longer perspective and a sustainable strategic research agenda

PhD education

- Some of the recommendations indicate that FP is a key moment in training of researchers (PhD). It was suggested to promote the recognition of involvement, the role of FP in promoting early career researchers. On the other hand it was indicate that FP already has many goals and it should be questioned if specific PhD training should be one of them.

Contractual conditions:

- Contractual insecurity: claims that FP should promote permanent contracts are contradictory because projects themselves are temporary.
- There are differences between academia and industry; industry offers more permanent contracts, FP/third-party funding constitutes important vehicle
- The perspective is important: High level of temporary contracts does not reveal bad institution, temporary contracts though might be bad for the individual.

Monitoring:

- How far can you go with recommendations (e.g. monitoring)? The goal is to maximise the impact of the programme.
- Monitoring should be harmonised with existing initiatives/tools/questionnaires to collect information (avoid increase in administrative burden).
- Monitoring should be harmonised with existing databases (big data, longitudinal data, how data 'dialogue' e.g. productivity and output with respect to HRC). Try to limit new monitoring burdens for organisations or HEIs
- The gap in monitoring today is the individual perspective: career tracking (e.g. ask team leaders to register the first employment step after the project of each researcher/team member).

  I would be helpful to track people and their career progression and the kind of employment after FP (like with MC fellows)
- Monitoring requires an overarching approach instead of single or micro-data based analysis, it is suggested that it is the role of the institution to do this (refers to Bonaccorsi work).

Written feedback on the recommendations is provided by the experts via email.