Council of the European Union

COVER NOTE

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Delegations will find attached document SWD(2017) 221 final - PART 7/16.

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COMMISSION STAFF WORKING DOCUMENT

**INTERIM EVALUATION
of
HORIZON 2020**

ANNEX 1

{SWD(2017) 220 final}
{SWD(2017) 222 final}

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R.   Horizon 2020 networks - Countries and Gateways for newcomers

R.1.   Trans-national collaboration in projects

The figure below showcases Horizon 2020 cooperation networks between countries based on the number of collaborative projects they participate in. The size of each node represents the collaborative projects of a country with each link, or edge, indicating that partners from the two countries have collaborated on one or more projects.

This figure shows a centralisation around larger and older Member States such as the United Kingdom, Germany, Spain, Italy and France, with Third Countries and newer Member States in the periphery of the network. The figure includes countries with over 20 projects and over 20 collaborations.

**Figure 115 Collaborative Horizon 2020 networks between countries based on projects' participations**
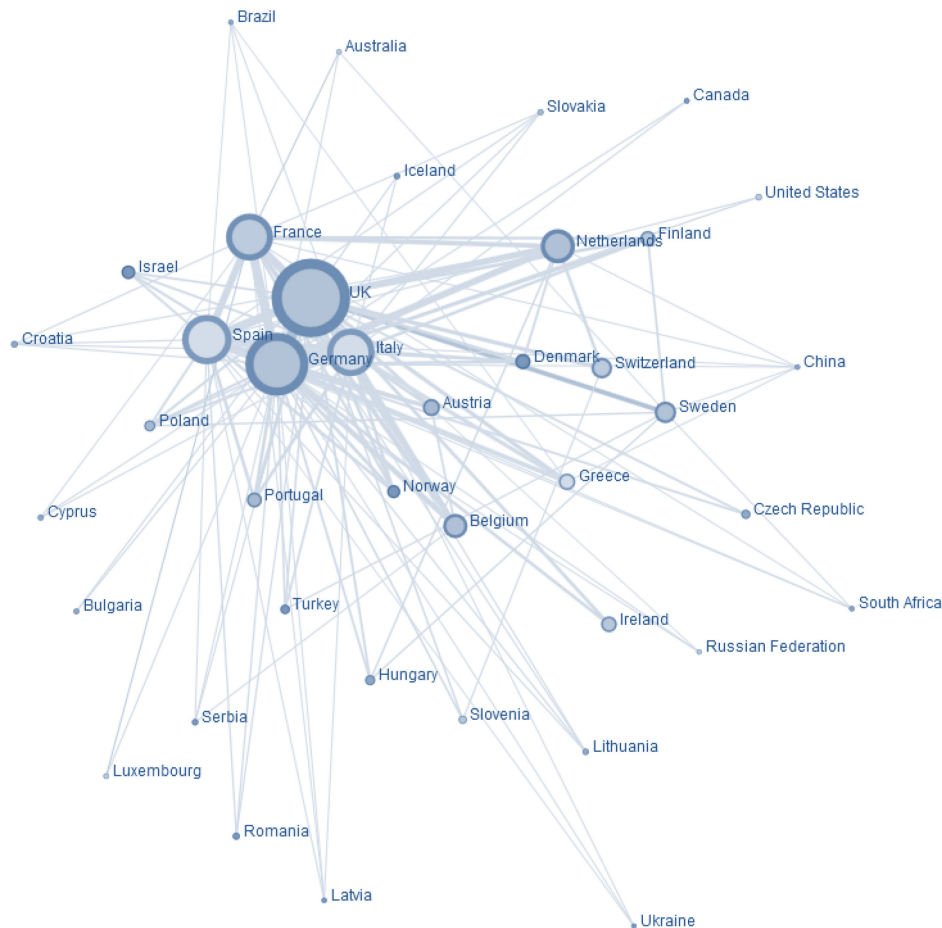
Source: JRC Technology Innovation Monitoring. Cut-off date: 01/01/2017

This is consistent with the measures of centrality[1] by country group, as can be seen from the below figures, where EU-15 countries are overall more central than other countries in the

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[1] Eigencentrality measures the extent to which a node is connected to important nodes in the network. Closeness centrality provides an average closeness measure to other nodes based on minimum path length between nodes.

network of FP7 and Horizon 2020 projects. EU-13 countries and associated countries are more or less equivalent in terms of centrality, with very large difference in the group of associated countries, in which Switzerland is as central as most EU-15 countries for example.

Figure 116 Average eigencentrality by country group in FP7 and Horizon 2020, based on projects' participations
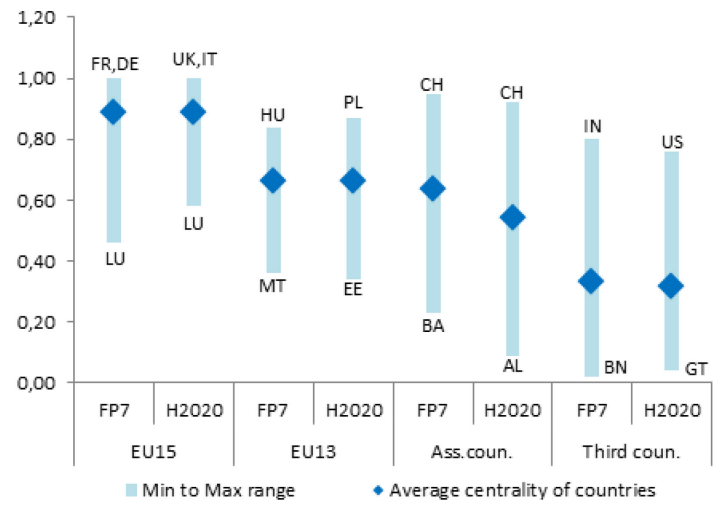
Source: European Commission – DG RTD

Figure 117 Average closeness centrality by country group in FP7 and Horizon 2020, based on projects' participations
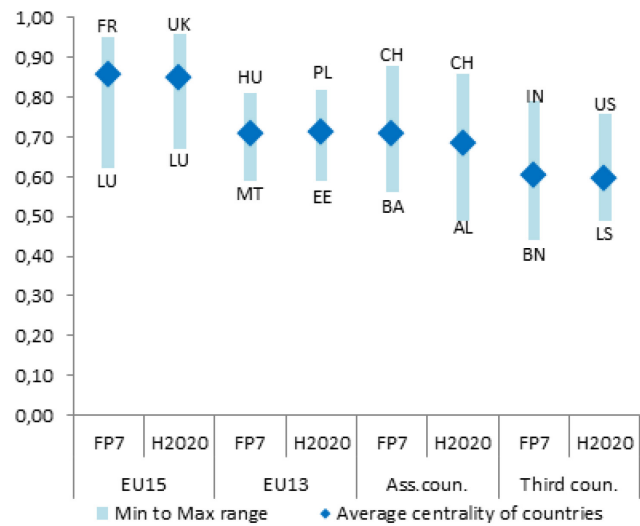
Source: European Commission – DG RTD

There is no significant change from FP7 to Horizon 2020 in terms of average centrality of the country groups.

The rate of collaboration with EU-13 countries is similar for all EU-15 countries, with an average of 9% of international collaborations of EU-15 countries performed with EU-13 countries. On the other hand, 74% of the total collaborations of EU-13 countries is performed with EU-15.

Table 80 Share of co-participations in Horizon 2020 projects

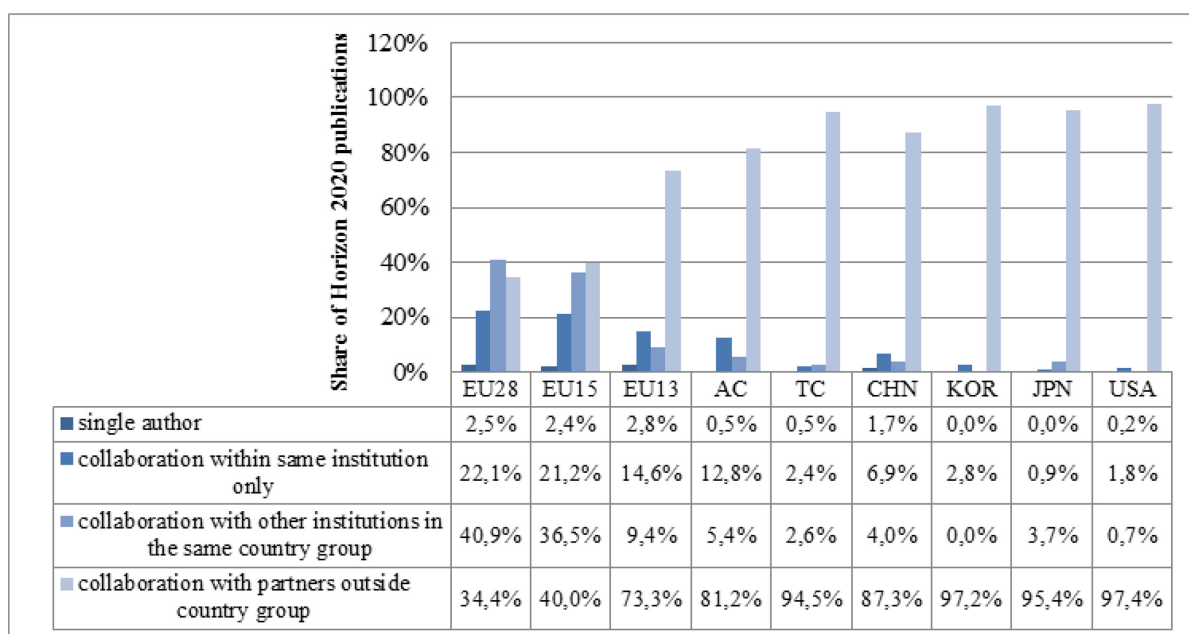|	EU-15	EU-13	Associated countries	Third countries	Total
EU-15	77%	9%	11%	4%	100%
EU-13	74%	11%	12%	3%	100%
Associated countries	77%	10%	9%	5%	100%
Third countries	65%	6%	12%	18%	100%
All	76%	9%	11%	4%	100%

Source: European Commission – DG RTD

R.2. Geographic collaboration networks in publications from the Framework Programmes

Co-publications in Horizon 2020 are strongly dominated by international collaborations. Figure 118**Error! Reference source not found.** presents the shares of publications from Horizon 2020 by collaboration type and by geographical group.

Shares of single-authored publications are low (just under 3%) for each group of countries. Collaborations within the same institution range from 0.9% for Japan to 22% for EU-28. Collaboration shares between EU-28 countries and between EU-13 countries are high.

For non-EU groups, third countries and associated countries, the share of collaborations with partners outside their country group is very high with over 80% of all publications.

Figure 118 Horizon 2020 share of publications by collaboration type and by geographical group

|	EU28	EU15	EU13	AC	TC	CHN	KOR	JPN	USA
■ single author	2,5%	2,4%	2,8%	0,5%	0,5%	1,7%	0,0%	0,0%	0,2%
■ collaboration within same institution only	22,1%	21,2%	14,6%	12,8%	2,4%	6,9%	2,8%	0,9%	1,8%
■ collaboration with other institutions in the same country group	40,9%	36,5%	9,4%	5,4%	2,6%	4,0%	0,0%	3,7%	0,7%
■ collaboration with partners outside country group	34,4%	40,0%	73,3%	81,2%	94,5%	87,3%	97,2%	95,4%	97,4%

Source: Elsevier, based on Scopus

Collaborations between the EU-28 geographical group and countries around the world are shown in the network map in **Error! Reference source not found.**. To draw attention to entities that collaborate frequently and repeatedly with the same partners, nodes are coloured to represent these clusters. Clusters are designated algorithmically. The degree of the nodes, that is to say the number of links from or to a node, and the volume of these links, generally indicated by the thickness of the links, are used to calculate which nodes show historically strong grouping characteristics.[2] The EU 28 group is very central with its core collaborators in close proximity. Many countries appear to collaborate in publications with only authors in the same country and in EU-28 countries. These countries are shown as the single-linked nodes in the top left of the figure. The most frequent collaborations occur between the EU-28, the US, Japan, Canada, China, Russia and Switzerland.

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[2] The mechanics and process of the clustering algorithm can be found in '*Fast unfolding of communities in large networks'*, Vincent D Blondel, Jean-Loup Guillaume, Renaud Lambiotte, Etienne Lefebvre, Journal of Statistical Mechanics: Theory and Experiment 2008 (10), P10008 (12pp).
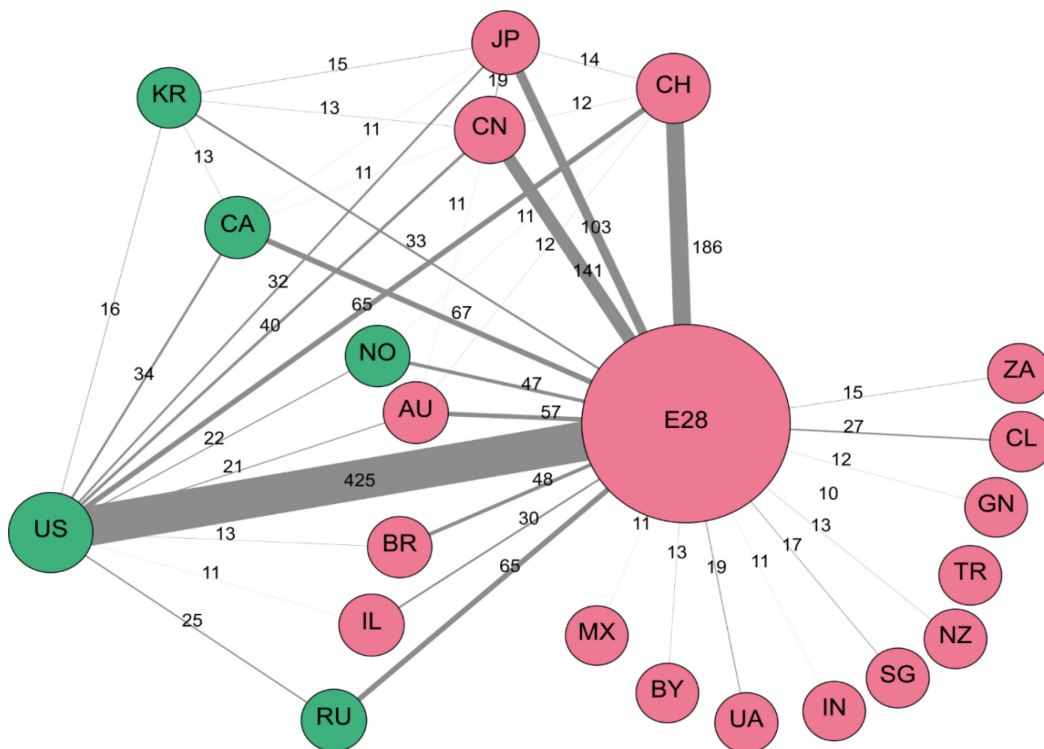
Figure 119 FP7-funded collaborations between EU-28 geographical group and non-EU-28 countries, 2007-2016
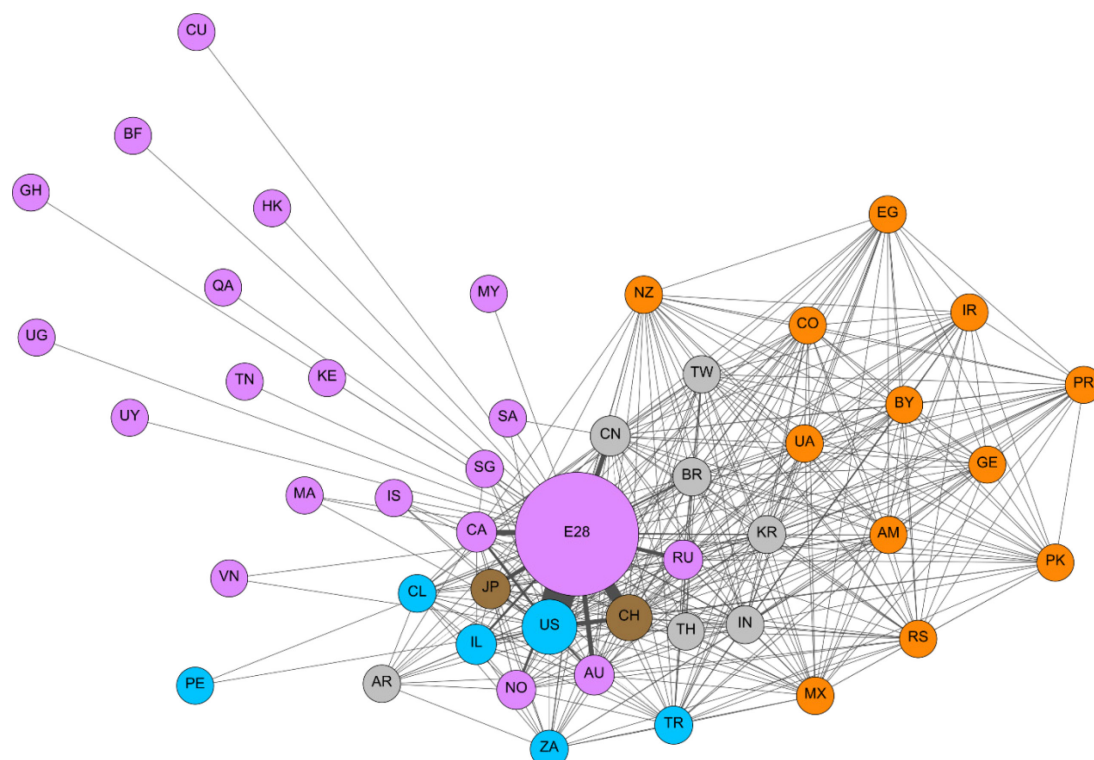
Source: Scopus. Node colour is determined algorithmically to designate clusters. Nodes that have similar collaboration patterns and volume of collaborations have the same colour. Node size is number of FP7 publications. Edge thickness is number of collaboration publications between entities. Collaborations with less than 100 publications have been removed to improve readability

Collaboration patterns for Horizon 2020-funded research occurs in a different pattern to FP7-funded research. This, however, is likely due to the lower number of publications in general so far from Horizon 2020. The network map of Horizon 2020-funded collaborations between the EU-28 group and non-EU-28 countries is presented in **Error! Reference source not found.**. As with FP7-funded collaborations, the most frequent collaborations occur between the EU-28, the US, Japan, Canada, China, Russia and Switzerland. More noticeable in this network map is the prominent role that the US has in collaborations with the EU-28.

Figure 120 Horizon 2020-funded collaborations between EU-28 geographical group and non-EU-28 countries, 2015-2016

The intra-EU-28 collaborations for FP7-funded publications are shown in **Error! Reference source not found.Error! Reference source not found.**. For clarity, only collaborations with more than 100 publications are shown. The most frequent collaborations occur between the larger and more R&D-intensive countries. Collaboration frequencies are highest between these countries, but the smaller research nations do collaborate often with each other and with at least one of the R&D-intensive nations. The UK, Netherlands and Germany form one cluster of countries, and Spain, Italy and France form another cluster. Two smaller clusters can be identified: a first one with the Nordic countries, Belgium and Ireland, and a second one with eastern European countries.
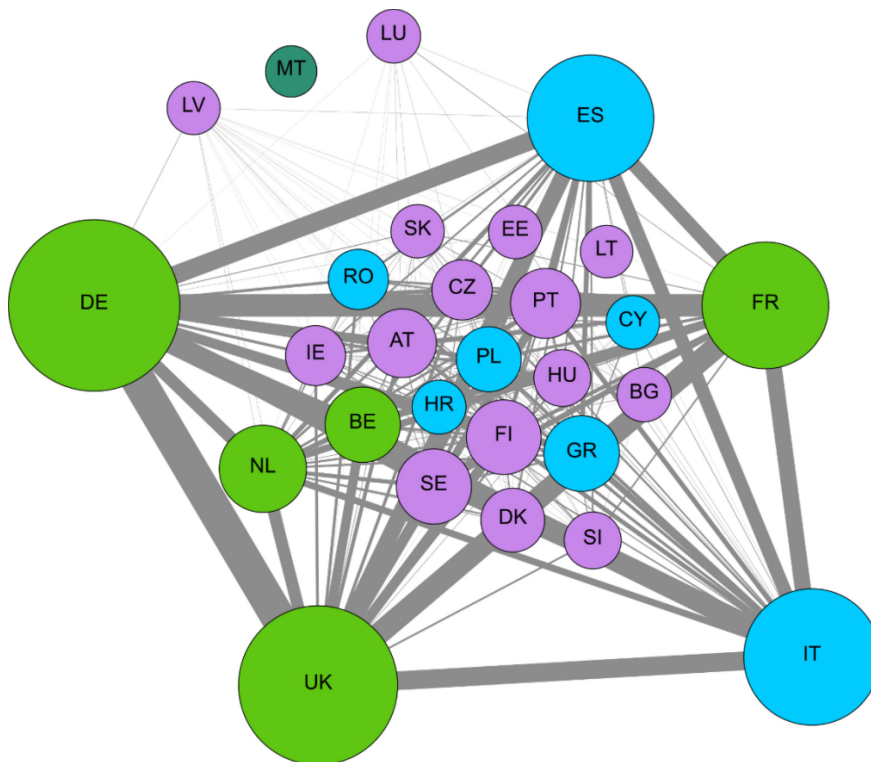
Figure 121 FP7-funded intra-EU-28 collaboration, 2007-2016
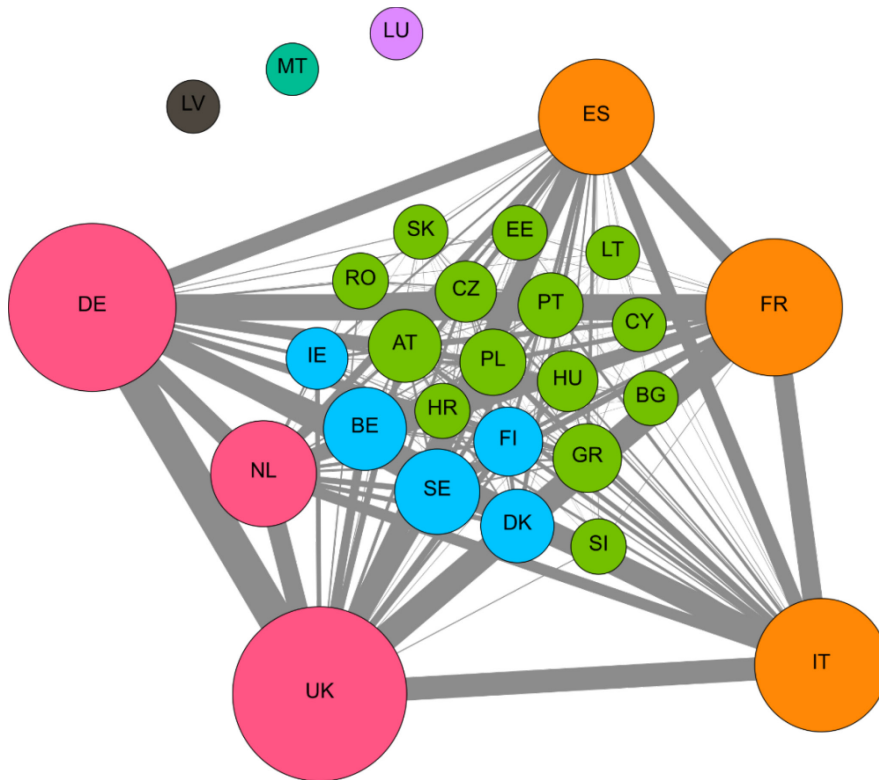
Source: Scopus. Node colour is determined algorithmically to designate clusters. Nodes that have similar collaborations and volume of collaborations have the same colour. Node size is number of FP7 publications. Edge thickness is number of collaboration publications between entities. Collaborations with less than 100 publications have been removed to improve readability. LV, MT and LU have less than 100 collaboration publications with any one partner

Error! Reference source not found.Error! Reference source not found. presents the Horizon 2020-funded intra-collaboration map of EU-28 countries. For this figure, collaborations with less than 100 publications are also shown. The position of the nodes is the same as in **Error! Reference source not found.** to facilitate the comparison between the two Framework Programmes. However, the clusters identified in both figures are different. Belgium and France are now part of the same cluster as Germany, the Netherlands and the UK. Spain and Italy remain together in a cluster that now also includes smaller countries. While the Nordics and Ireland formed their own distinct cluster in FP7, they are now joined by several eastern European countries.

Figure 122 Horizon 2020 intra-EU-28 collaboration, 2015-2016

Source: Scopus. Node colour is determined algorithmically to designate clusters. Nodes that have similar collaborations and volume of collaborations have the same colour. Node size is number of Horizon 2020 publications. Edge thickness is number of collaboration publications between entities. Node position has been preserved between this figure and Figure 4.2 to compare FP7 and Horizon 2020 collaborations. MT has no Horizon 2020 collaborations with any other EU-28 member.

R.3. Analysis of newcomers to the Framework Programme

The purpose of this analysis is to examine how newcomers (defined as participants in Horizon 2020 that did not participate in FP7) are integrated in Horizon 2020 and which are the main knowledge brokers they use in order to enter the network.

R.3.1. Main groups of newcomers

Given the increased accent on open innovation in Horizon 2020, almost three quarters (73%) of the newcomers are private firms according to Corda data. Other institutions represent 12%, while Public bodies account for 8%. With respect to Research Organisations and the Higher and Secondary Education Sector, these represent barely 7% of participations altogether.

Out of all the groups of newcomers (defined by the type of institution and country) registering more than 100 collaborative projects, all of them are companies. Spanish newcomer companies collaborate the most (662 projects), followed by German (621 projects) and British ones (612 projects). There is one EU-13 representative in this top 100, namely Polish newcomer companies (113 projects). Swiss newcomer companies are outside the top (85 collaborative projects).

The EU-13 Members States account for a much higher share of participations in collaborative projects (11%) in terms of newcomers than in terms of returning participants (3%). This suggests that the Framework Programme is opening up the "clubs", with EU-13 entities recording a significant increase in terms of new participants. To a lesser degree, the same applies for Associated and Third Countries.

**Figure 123 Geographical distribution of participations in collaborative projects**
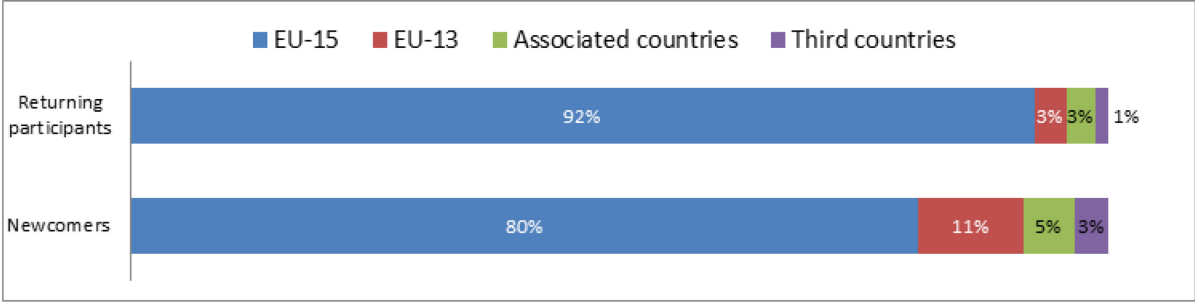
Source: European Commission – DG RTD

R.3.2. *Main collaborations of newcomers*

The majority of collaborations involving newcomers occur between companies and different types of institutions. Most of the collaborations involving the largest categories of newcomers (based on institutional and geographic distribution) occur between the newcomers and returning participants from the same country.

Only few of the most frequent types of collaborations involving newcomers in Horizon 2020 are trans-national and 4 of them involve German newcomer companies which collaborate with British (174 projects) and Italian (127 projects) universities, Spanish research organisations (131 projects) and French companies (124 projects). Other frequent trans-national collaborations involving newcomers are between Spanish newcomer companies and British universities (133 projects), between British newcomer companies and German companies (123 projects) and between British newcomer companies and German research centers (120 projects).
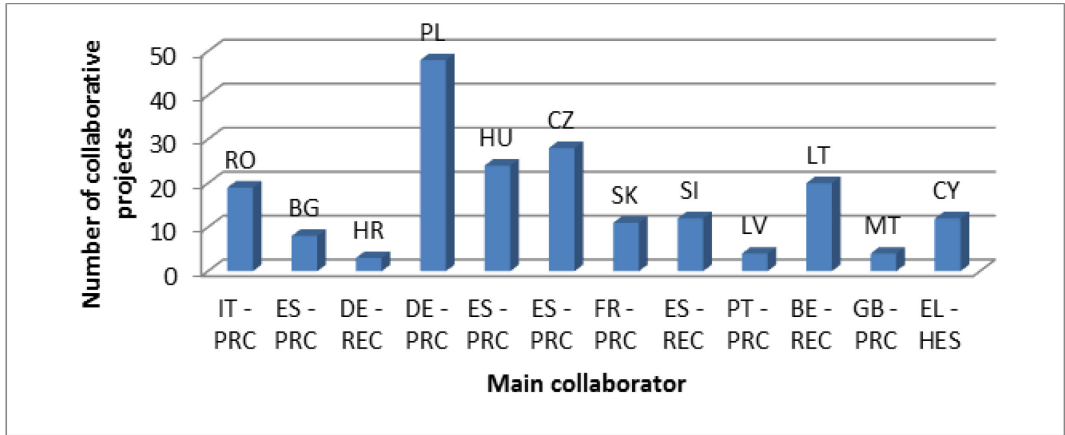
Figure 124 Most frequent types of collaborations involving newcomers in Horizon 2020
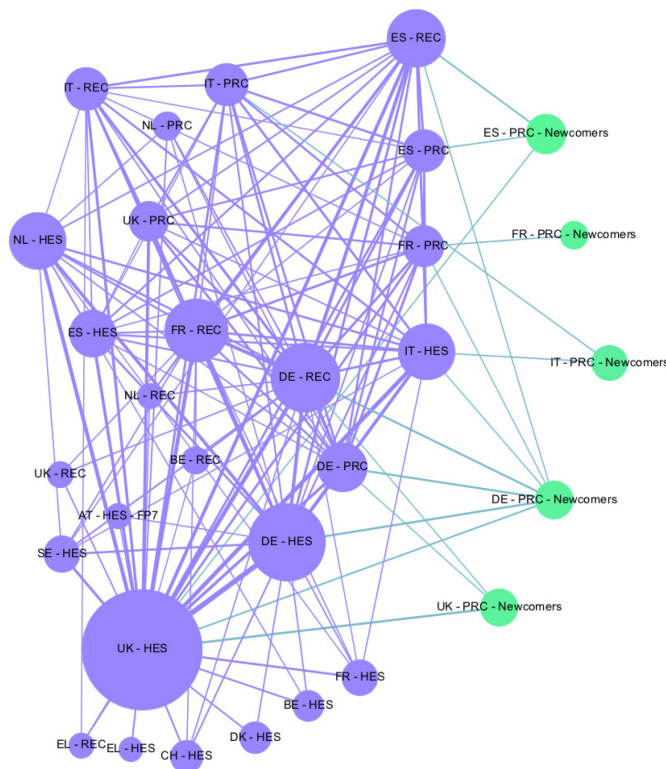
Source: JRC Technology Innovation Monitoring. Cut-off date: 01/01/2017, Graph: European Commission – DG RTD, Note: PRC stands for Private for profit, HES for Higher and secondary education and REC for Research organisations. Categories of returning participants and newcomers are shown respectively in violet and green

Though British universities typically act as the main knowledge brokers, the situation is very different when looking at EU-13 newcomer patterns. We observe that the main collaborators for EU-13 newcomers are companies (in 9 out of 13 countries), without any clear gateway (albeit a slight propensity for collaborating with Spanish companies).

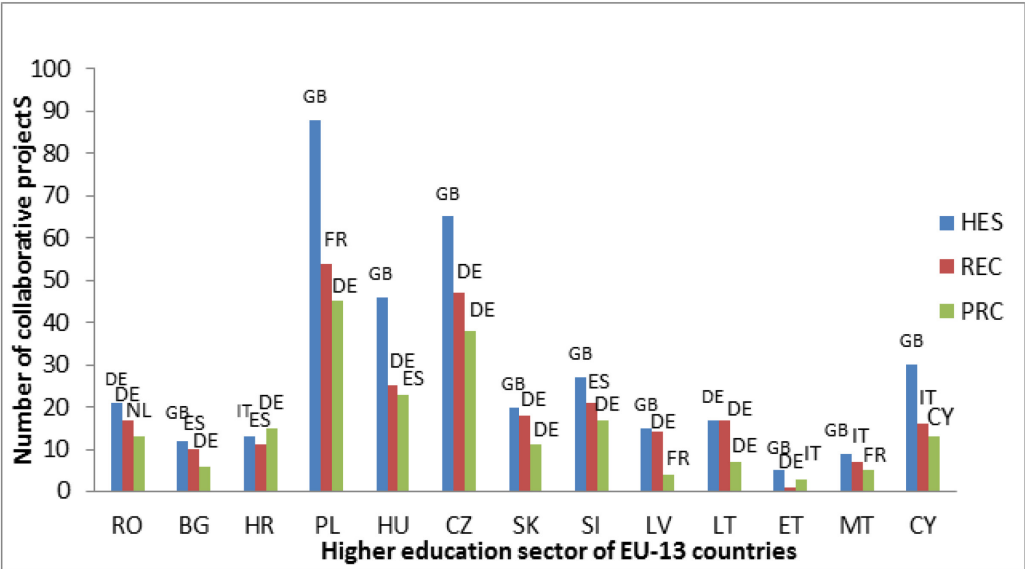**Figure 125 Top Horizon 2020 collaborators for EU-13 Newcomers**

Source: JRC Technology Innovation Monitoring. Cut-off date: 01/01/2017, Graph: European Commission – DG RTD, Note: PRC stands for Private for profit, HES for Higher and secondary education and REC for Research organisations

In order to study the gateways used by new Member States to enter in Horizon 2020, EU-13 newcomers were analysed separately by type of institution to determine the dependency of participants from EU-13 countries on established players.

Firstly, the relationship between academia in EU-13 countries and different institution types was investigated. Universities from EU-13 countries collaborate the most with British universities, with 10 countries out of 13 Member States having as their main academic collaborator the British academic sector. On the other hand, universities from EU-13 countries have a slight propensity for collaborating with both German research organisations as well as private firms, with universities from 7 out of 13 countries preferring Germany as their main research organisation partner or company partner

Figure 126 Main collaborators in Horizon 2020 for each EU-13 higher education sector by types of institutions

Source: JRC Technology Innovation Monitoring. Cut-off date: 01/01/2017, Graph: European Commission – DG RTD, Note: PRC stands for Private for profit, HES for Higher and secondary education and REC for Research organisations

Secondly, the relationship between the research sector (excluding education) in EU-13 countries and different institution types was investigated. Research organisations from EU13 countries exhibit a systematic pattern of collaborating mainly with British universities (9 out of 13 countries), German research organisations (10 out of 13 countries) and with French companies (6 out of 13 countries).

Figure 127 Main collaborators in Horizon 2020 for each EU-13 research organisation sector by types of institutions
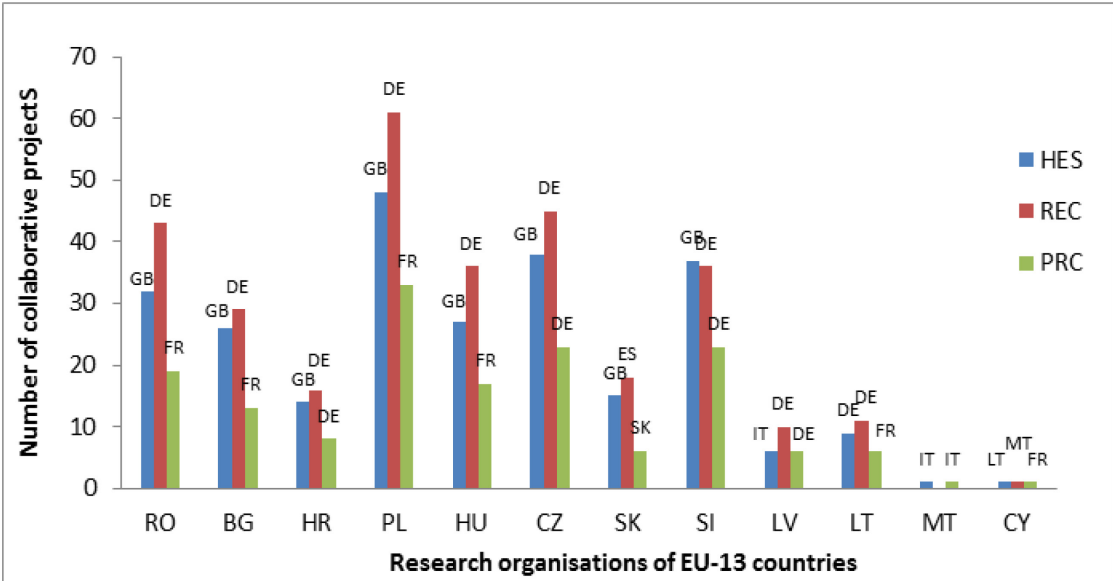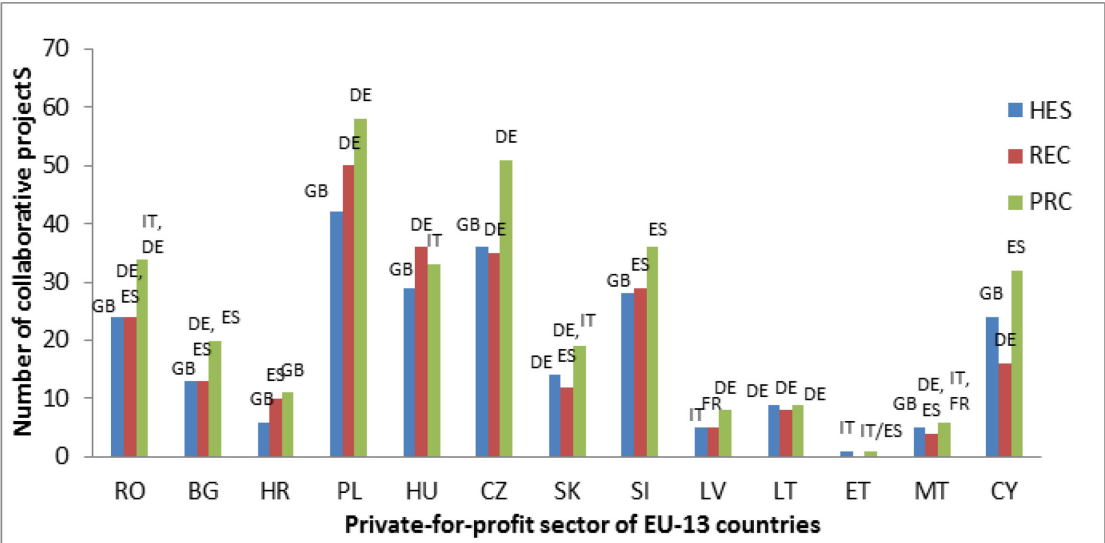

Source: JRC Technology Innovation Monitoring. Cut-off date: 01/01/2017, Graph: European Commission – DG RTD, Note: PRC stands for Private for profit, HES for Higher and secondary education and REC for Research organisations

Thirdly, the relationship between the private-for-profit sector in EU-13 countries and different institution types was examined. British universities are the first academic partner of private firms from EU-13 countries, with the private firms sector of 9 countries out of 13 having as their main academic collaborator British universities.

Private firms from EU-13 countries present a more heterogeneous pattern of collaborations with other companies without a clear hub of partner countries.

Figure 128 Main collaborators in Horizon 2020 for each EU-13 private-for-profit sector by types of institutions

Source: JRC Technology Innovation Monitoring. Cut-off date: 01/01/2017, Graph: European Commission – DG RTD, Note: PRC stands for Private for profit, HES for Higher and secondary education and REC for Research organisations