INTRODUCTION

As you will no doubt be aware, the ERA Roadmap was agreed by ERAC at its last meeting in Riga on 16 April and will be given political endorsement at the Competitiveness Council on 29 May. The proposed Council Conclusions also call for the development of indicators to monitor progress on the Roadmap by the end of 2015 and a Working Group has been set up with the mandate of producing these.

This Group has been given the task of identifying a limited number of headline indicators. The intention is that these should be politically relevant and should enable key decision makers at European and national levels to tell whether progress is in fact being made on addressing the top implementation priorities identified in the Roadmap. Obviously there will also need to be a more detailed and sophisticated system for monitoring the full ERA agenda, which will underpin future ERA Progress Reports. The selected Roadmap indicators will form an integral, top level, part of this wider system, which will be developed in consultation with ERAC and the ERA Groups.

The attached fiches, drawn up in consultation with the Commission and other experts, seek to identify appropriate indicators (with the exception of Priority 2b on Research Infrastructures, where discussions at expert level are still on-going). The aim has been to identify one indicator per implementation priority contained in the Roadmap (eight in all) as trying to come up with too many indicators risks losing the focus which is essential to this exercise. Wherever possible preference has been given to output/outcome indicators rather than input ones as these are more relevant in measuring the success of policy initiatives. Wherever possible the chosen indicators draw on existing data sources to avoid creating new demands for data from national administrations/stakeholder communities and as far as possible they also integrate data on **all** ERA participants, not just the 28 European Union Member States. The inevitable price of this approach is that these chosen indicators may in certain cases be less than perfectly adapted to the Roadmap priority they relate to and are at best proxies for measuring policy developments. The fiches clearly recognise the shortcomings as well as the merits of the chosen indicators.

The intention is to have a meeting of the Working Group, supported by experts and with the participation of one member per ERA Group, in Vienna on 8 June.

PRIORITY 1 (Effective national research systems)

Text from road map (description top priority)

Top Action Priority identified is "Strengthening the evaluation of research and innovation policies and seeking complementarities between, and rationalisation of, instruments at EU and national levels."

Proposed indicator

The proposed indicator is EU Framework Programme Funding per thousand Euro GERD, expressed in percentage

Description of the indicator

- The Framework Programmes for Research and Technological Development are the EU's main instruments for supporting collaborative research, development and innovation in science, engineering and technology. All member states participate. The funding is on a competitive base and depends on evaluations.
- Numerator: total EU Framework Programme funding in the country.
- Denominator: total GERD
- The indicator does not prescribe an optimal percentage but suggests rather a corridor of a typical ratio between EU and national funding.   This means that both extreme ends of the graph are to be avoided.
- Countries with a share of EU Framework Programme funding at the highest end might consider the potential of substitution effects or an increasing dependency on EU funding instruments.
- Countries with a share of EU Framework Programme funding at the lowest end might consider the better exploitation of unused national potential in EU competition.

Justification

- Pro:
    - Captures research excellence since funding is distributed on the basis of independent international peer reviews and other evaluations
    - Reflects the relevance of the European priorities in national systems
    - There is no size bias, since the denominator is the country's GERD
- Con:
    - Does not fully capture all the complementarities between EU and national funding or the degree of alignment of instruments at EU level and national level

o Countries with low GERD have a small denominator and come out high like CY, EL, EE, MT. However, maximum is not optimum, there is an optimal zone that ought to be underlined.

Source, frequency and coverage

Source: "Research and Innovation performance in the EU: Innovation Union progress at country level", European Commission,
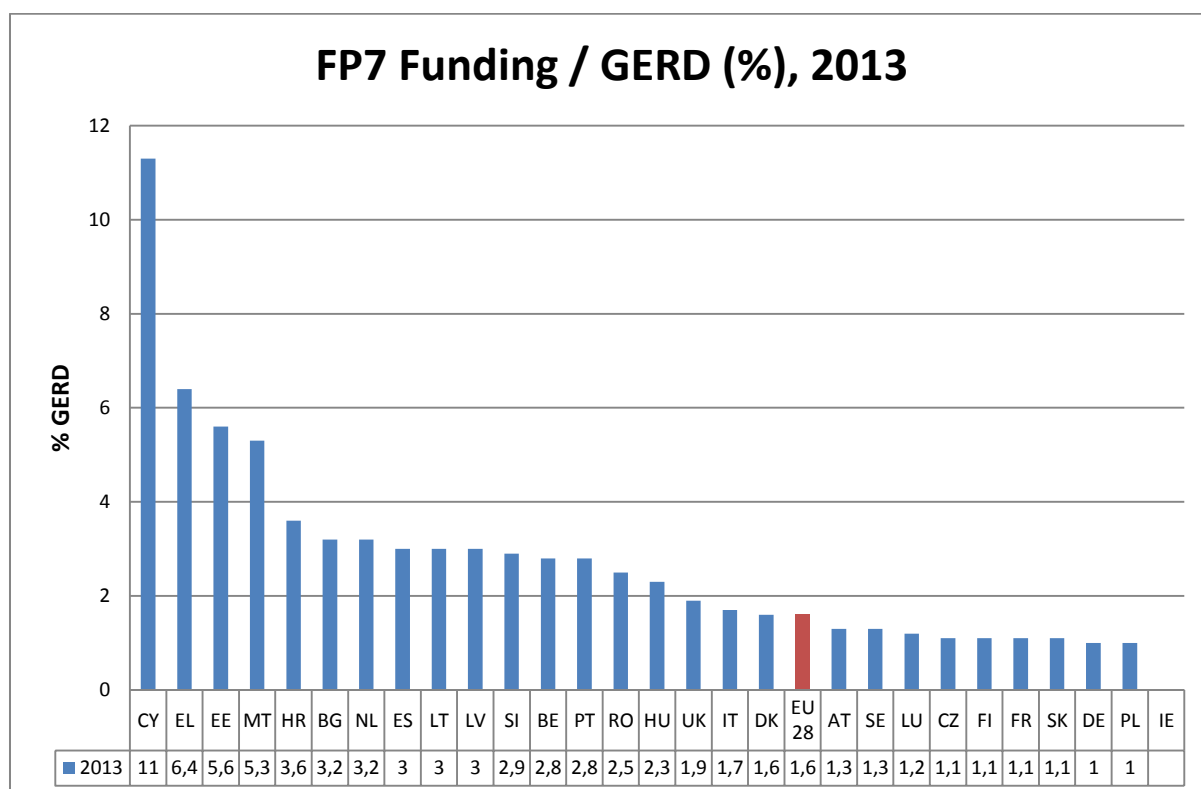
Frequency: yearly

Scope: all EU-28 countries (but should be enlarged to all of the ERA countries if possible).

Unfortunately, numerical values for the indicator are not available from that publication but they are available at the European Commission (FP Monitoring Reports and e-Corda)

Other indicators considered

- The same indicator but expressed as a distance from the EU average
- EU Framework Programme Funding over another denominator (public funding of R&D, per capita, per GDP, per GPD per capita,...)
- The Innovation Union Scoreboard (IUS) composite indicator
- The share of institutional vs. competitive funding
- The research excellence composite indicator from the Progress Report at Country Level
- The ICF Report also suggests using one of the following outcome indicators:
    o Trademarks as a per cent of GDP;
    o Number of patents per public R&D expenditure;
    o Revealed technological advantage in selected fields (e.g. bio- and nanotechnology, ICT and environment).
    o Patent applications in societal challenges per billion GDP
    o Share of top 10% scientific publications

Annex: example of the indicator

FP7 Funding / GERD (%), 2013

	CY	EL	EE	MT	HR	BG	NL	ES	LT	LV	SI	BE	PT	RO	HU	UK	IT	DK	EU 28	AT	SE	LU	CZ	FI	FR	SK	DE	PL	IE
■ 2013	11	6,4	5,6	5,3	3,6	3,2	3,2	3	3	3	2,9	2,8	2,8	2,5	2,3	1,9	1,7	1,6	1,6	1,3	1,3	1,2	1,1	1,1	1,1	1,1	1	1	

Y-axis: % GERD

Source: FP7 Monitoring Report 2015 and Eurostat.

PRIORITY 2a (Jointly Addressing Grand Challenges)

Text from road map (description top priority)

Improving alignments within and across the Joint Programming Process and the resulting initiatives (e.g. Joint Programming Initiatives (JPIs)) and speeding up their implementation.

Proposed indicator

Share of national GBAORD allocated to Europe-wide, bilateral or multilateral transnational public R&D programmes

Description of the indicator

National public funding to transnationally coordinated research is measured as the 'government budget appropriations or outlays for research and development (GBAORD)' directed towards three categories of research and development (R & D) performers and programmes: transnational public R&D performers located in Europe, Europe-wide transnational public R & D programmes and bilateral or multilateral public R & D programmes established between Member State governments or with EFTA and candidate countries. In the context of priority 2a it is most meaningful to include only the last two sub-classifications.

Numerator: GBAORD allocated to transnationally coordinated research

Denominator: Total GBAORD

Justification

- **Pro:**
  - Reflects the extent of transnational cooperation between governments
  - Highlights the budgetary efforts undertaken to create more transnational cooperation
  - It is an input indicator but as the funding invested in transnational programmes can be viewed as the result of policy decisions at national level this indicator can also be seen as an output indicator
- **Con:**
  - May understate the "true" figure as many research programmes may have a transnational dimension even though the funding was not explicitly allocated with such a condition attached
  - Does not provide information how well the funding links with the European grand challenges nor on how far overall Member State research expenditure has increased overall.
  - Potential country size bias
  - Countries with low GBAORD will come out high
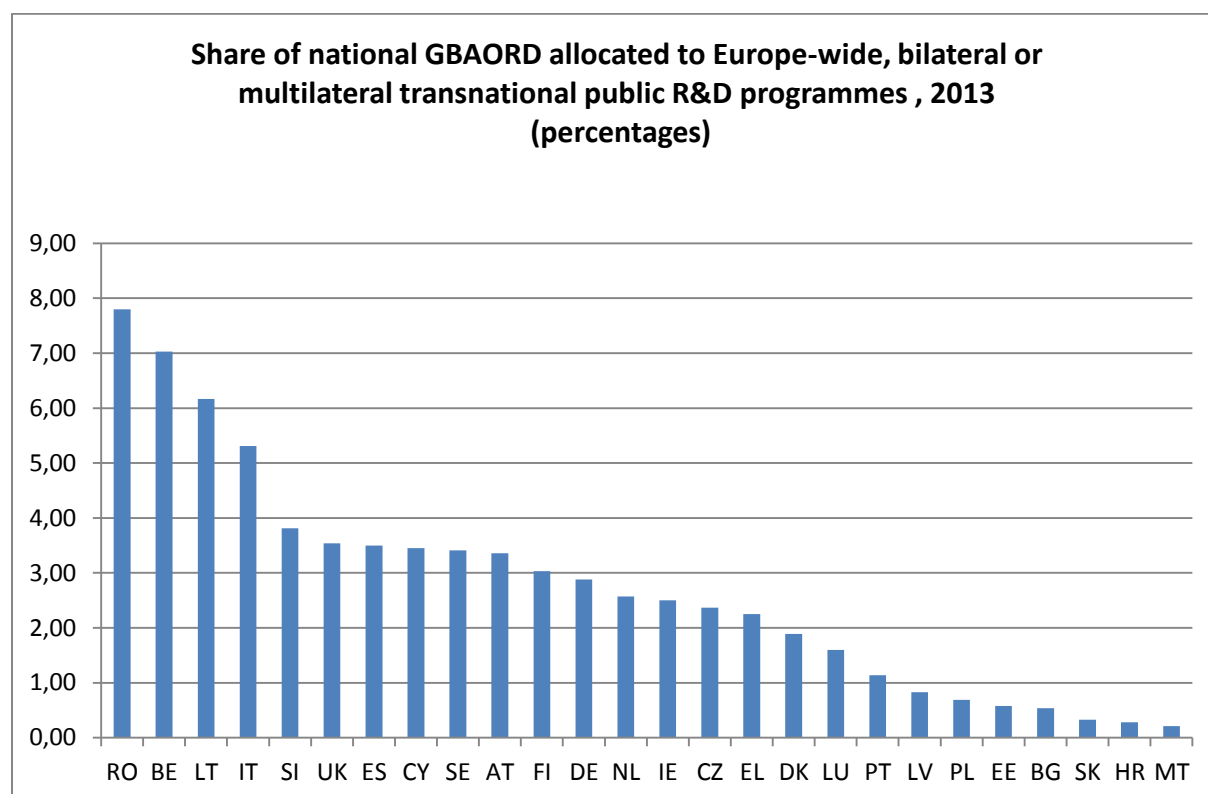
Source, frequency and coverage

Source: Eurostat

Frequency: Annual

Scope: all EU-28 countries, for reasons still to investigate France and Hungary are missing

Alternatives suggested in the ICF report or in the debates:

- Cross-border ownership of patents (OECD)
- Degree to which Member States engage in transnational cooperation via Horizon 2020, pillar 3 on societal challenges. (could be based on EU data, supposes a certain relation with JPI)
- The IUS indicator 1.2.1 on "international scientific co-publications". Only the international co-publications related to disciplines relevant for societal challenges should be taken into account here. Again, this would require a measurable definition of grand challenges.
- International mobility of researchers (inflows/outflows)
- International collaboration in science and innovation
- Technology balance of payments
- Patent applications in societal challenges (from the Innovation Union Scoreboard)

Annex: example of the indicator

Share of national GBAORD allocated to Europe-wide, bilateral or multilateral transnational public R&D programmes , 2013 (percentages)

Source: Eurostat.

PRIORITY 3 (Open Labour Market for Researchers)

Text from road map (description top priority)

Top Action Priority identified is "Using open, transparent and merit based recruitment (OTM-R) practices with regard to research positions." though the text refers more generally to an open labour market for researchers.

Proposed indicator

Proportion of doctoral candidates with citizenship of another EU Member State as a percentage of all doctoral candidates (possibly also the share of doctoral candidates from non EU countries)

Description of the indicator

Fairly self-explanatory; dividing the number of doctoral candidates in each Member State by the number of doctoral candidates with citizenship of another MS

Justification

- Pros:
    - Based on robust and easily comparable national data
    - Serves as a proxy for the overall attractiveness and openness of national research systems
    - It is based on the plausible assumption that if we remove barriers to mobility, implement Innovative Doctoral Training principles, etc that more people will move within the EU [however, see Con below]
- Cons:
    - Covers university-based researchers only thereby excluding other public sector research organisations
    - Not particularly well aligned with the action priority (recruitment issues usually affect researchers at a later stage in their career than doctoral level, where obtaining funding may be more of a barrier to mobility).
    - MS may attract non-EU doctoral candidates rather than those from other EU countries
    - For some countries the % share is close to zero and unlikely to change as basically their salaries are simply not competitive. Also, it is not just about attractiveness but also about language, cultural & historical ties, etc.
    - Possible country size bias, language and geographic location bias

Source, frequency and coverage

Source:, Eurostat data (the share of *non-EU* doctoral candidates is also included in the Innovation Union Scoreboard)

Frequency: Updated annually

Scope: All EU-28 countries (the availability for all ERA countries still has to investigated).

Other indicators considered

[these are used in the Researchers' Report 2014]

- Stock: Researchers (Full Time Equivalent) per thousand labour force
- Open recruitment: Researcher posts advertised through the EURAXESS Jobs portal per thousand researchers in the public sector
- Percentage of researchers expressing satisfaction that the procedures in their institution are Open, Transparent and Merit based
- Education and Training: New doctoral graduates (ISCED 6) per thousand population aged 25-34
- Working conditions: Researchers employed on fixed-term contracts
- Mobility and international attractiveness:

  - Non-EU doctoral candidates as a percentage of all doctoral candidates

  - Doctoral candidates (ISCED 6) with a citizenship of another EU Member State

  - Researchers having spent a period of at least three months as a researcher in another country in the last 10 years

  - International scientific co-publications per million population

  - Scientific publications in the top 10% most-cited publications worldwide as a percentage of total scientific publications

Annex: example of the indicator (will be calculated for the most recent years for the Vienna meeting)

Table 25: Scorecard: Doctoral candidates (ISCED 6) with a citizenship of another EU Member State, Europe, 2010 and 2011 (%)

Country	2010	2011	Progress/2010 (%)	
Liechtenstein	88.9	89.7	↑	1
Luxembourg	:	67.9	n/a	n/a
Switzerland	36.3	36.6	↑	1
Netherlands	:	20.4	n/a	n/a
Austria	18.2	18.5	↑	2
Ireland	16.0	16.9	↑	5
United Kingdom	16.4	16.2	↓	-1

Country	2010	2011	Progress/2010 (%)	
Iceland	13.7	14.9	↑	8
Belgium	13.6	14.2	↑	5
Norway	12.9	13.9	↑	7
Denmark	12.4	13.8	↑	12
Sweden	10.0	10.9	↑	9
Cyprus	7.8	9.0	↑	15
Czech Republic	8.4	9.0	↑	7
France	8.0	8.3	↑	3
Slovenia	6.7	7.2	↑	8
Slovakia	6.3	6.7	↑	6
Finland	5.8	6.4	↑	11
Hungary	5.7	6.3	↑	10
Estonia	5.2	5.6	↑	8
Germany	:	5.3	n/a	n/a
Spain	5.7	5.1	↓	-10
Italy	3.3	3.6	↑	9
Portugal	3.0	3.2	↑	7
Bulgaria	3.3	3.1	↓	-7
Croatia	2.2	2.5	↑	13
Poland	1.8	1.7	↓	-2
Romania	1.7	1.6	↓	-6
Latvia	0.8	0.4	↓	-56
Lithuania	0.3	0.2	↓	-51
FYROM	6.3	:	n/a	n/a

Source: Deloitte
Data: Eurostat
*No information available for 2010 and 2011 for BiH, EL, IL, ME, MT and SR, and for 2010 for LU, NL, and DE, and for 2011 for FYROM

ERA PRIORITY 4 (Gender Equality and Gender Mainstreaming in Research)

Text from roadmap (description top priority)
Top Action Priority identified is "Translating national equality legislation into effective action to address gender imbalances in research institutions and decision making bodies and integrating the gender dimension better into R&D policies, programmes and projects."

Proposed indicator of impact
Proportion of women A grade in Higher Education Sector (HES)

Description of the indicator
- This indicator is available from the She Figures 2015 (expected e-publication in December 2015) and previous releases. The She Figures 2018 should yield new data in 2018 (reference year 2016).
- Numerator: Number of women grade A in HES
- Denominator: Sum of number of men and women grade A in HES

Justification
- Pros:
  - Corresponds well with the roadmap top priority of addressing gender imbalances, with a focus on senior level positions.
  - Data are based on a methodology refined over more than a decade.
- Cons:
  - Covers HES-based researchers only, thereby excluding other public sector research organisations.
  - Data are currently provided only every three years. The possibility to gather yearly data using ETER (European Tertiary Education Registry) as data source will be explored.
  - Indicators are easier to use and understand if higher means better, but what is the optimum here? 50%? How to assess countries: if they exceed 50%, is this a worse performance than countries below but nearer to 50%?
  - A high share of females could not only mean that jobs are attractive for women, but they that they are unattractive for men, for example because of low pay (as could be observed in the Baltics and some SE European countries in the recent past)

Source, frequency and coverage
Source: She Figures Study (managed by DG RTD)
Frequency: Every 3 years. Possibility to gather yearly data using ETER Database as source will be explored.
Scope: All EU-28 countries, depending on contributions sent by the Helsinki Group Statistical Correspondents.

Other indicators considered
These indicators, although relevant, are for the moment less feasible having considered their characteristics (i.e. availability, frequency, cost or administrative burden…).
- Gender balance in decision making: Proportion of women heads of RPOs (SHE Figures)
- Gender balance in decision making: Proportion of women on research boards of RO at national level (SHE Figures)

- Institutional change: Percentage of RPOs implementing a Gender Equality Plan (GEP) or equivalent (ERA Survey)

Annex: example of the indicator will be calculated and send out before the Vienna meeting

PRIORITY 5 a (Scientific knowledge transfer)

Text from road map (description top priority)

Fully implement knowledge transfer policies at national level in order to maximize the exploitation of scientific results. RPOs and RFOs should make knowledge transfer second nature by integrating it in their everyday work.

Proposed indicator

Public-private co-publication per million of the population

Description of the indicator

- This indicator is published by Eurostat and is part of the Innovation Union Scoreboard (indicator 2.2.3.). It captures public-private research linkages and active collaboration activities between business sector researchers and public sector researchers which give rise to academic publications.
- Numerator: Number of public-private co-authored research publications. The definition of the "private sector" excludes the private medical and health sector. Publications are assigned to the country/countries in which the business companies or other private sector organisations are located
- Denominator: Total population

Justification

- Pro:
  - Addresses effective knowledge transfer, which is expected to contribute towards open innovation
  - Readily available indicator
- Con:
  - The definition of private sector used in this context does not include private medical and health sector
  - Publications are assigned to the place in which the private sector organisations are located and not where the public sector organisation is located

- o The indicator just covers one aspect of the priority (collaborations whose end product is a paper published in in academic journal) and leaves out other forms of collaboration (e.g. patenting).
- o The figure might be rather stable over a long period and not reacting promptly on policy changes.
- o There have been some data changes in the Innovation Union Scoreboard (where it is copied from) in the recent past and the normalization procedure in the IUS is complex; the source of IUS might switch to Elsevier/Scopus/SciVal in the future.

Source, frequency and coverage

Source: University of Leiden (CWTS/Reuters) and Eurostat

Frequency: 2-years averages, yearly updates (?)

Scope: All EU-28 countries (should be available for all ERA countries).

Other possible indicators

- Firms collaborating with HEI's and PRO's
- Public research (in universities and public research centres) financed by the private sector

Example of the indicator (2011)

Public-private co-publications

Values by country (left to right): DK 13.1, SE 12.1, NL 11.3, BE 9.9, FI 9.9, AT 9.3, SI 9.2, UK 8.9, DE 8.7, EU27 7.3, FR 7.0, LU 6.0, IE 5.9, CZ 5.8, IT 5.8, HU 5.6, ES 5.4, HR 5.2, CY 5.2, EE 5.0, PT 4.1, EL 4.0, SK 4.0, LT 3.1, MT 2.9, RO 2.9, PL 2.3, BG 2.0, LV 1.5.
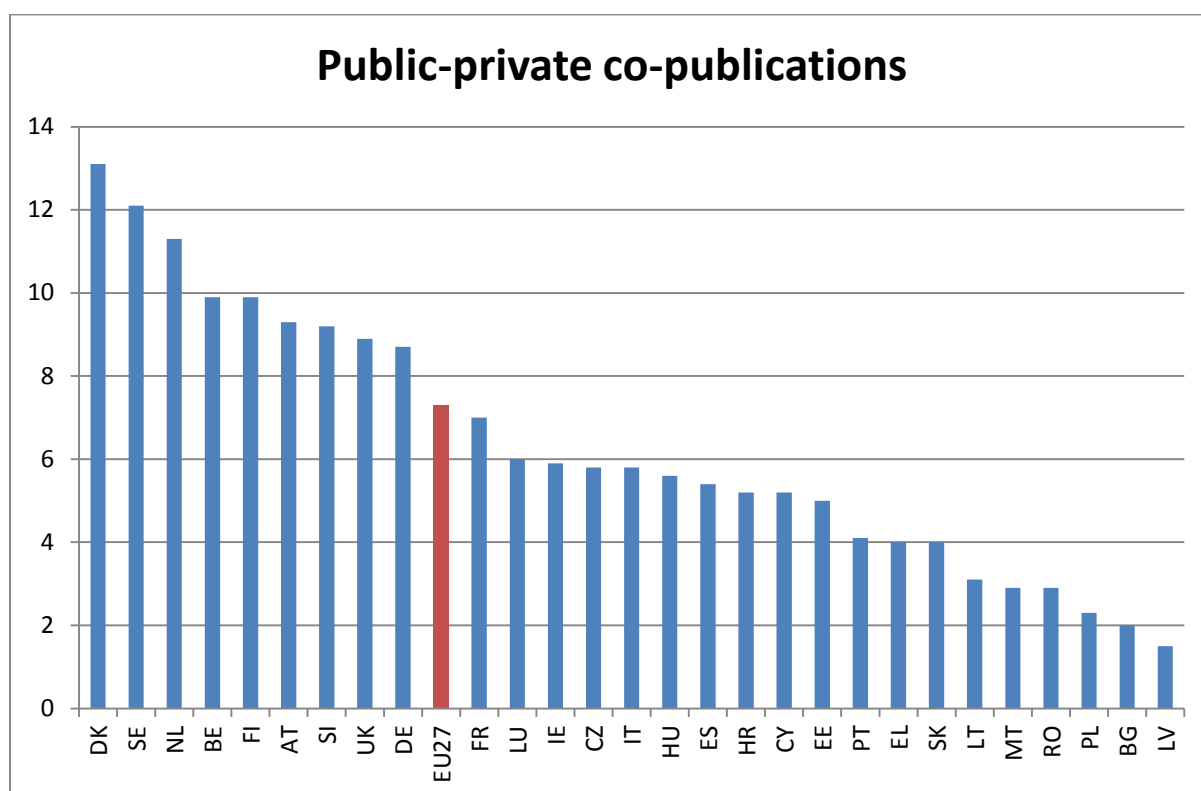
Source: Innovation Union Scoreboard

PRIORITY 5b (Promoting Open Access to scientific publications)

Text from road map (description top priority)

At National level Member States and Associated Countries should promote Gold and/or Green Open Access in line with the Commission's 2012 Recommendation on access to and preservation of scientific information (covering both scientific publications and research data). In particular, they should ensure the further implementation of open access to scientific publications by the most appropriate means in their own research environment.

Proposed indicator

Proportion of Open Access papers per country, 2008-2013;

Description of the indicator

The indicator shows the proportion of Open Access papers published in peer reviewed Journals at the European and World levels over the period 2008 -2013 based on data from the Scopus database. Also a Composite indicator has been developed to measure the growth of Open Access over the years 2011-2013 vs. 2008-2010. (based on a study by Science Metrix RTD B6-PP-2011-2: Study to develop a set of indicators to measure Open Access).

Justification

- **Pro:**
    - A relative simple indicator to measure the proportion of Open Access papers per Country

- **Con:**
    - Still many statistical problems and shortcomings. Future research is needed on seeking additional sources of robust data to provide a more reliable appreciation of the OA landscape.
    - Might have to be normalised to take into account relative importance of different research fields in countries, or only selected fields might be considered. Openness tends to differ between fields
    - A systematic update depends on a contract by the Commission

Source, frequency and coverage

Source: Science-Metrix

Frequency : one-time study 2008-2013, periodical update needed

Scope: 44 countries including all EU-28 countries

Alternatives:

- Institutional perception of OA strategies
- Stakeholders perception to of access to digital resources
- Existing funder mandates for open access publishing
- Number of Open Access Journal in a certain year
- Number of Open Access repositories

(See EC, Analytical report on the dimension of Open Access, forthcoming)

Annex : presentation will be (hopefully) improved for the Vienna meeting; table below is a PDF-file that could not edited.

Data on OA study by Science Metrix:

Total OA 2008-2013 computed as sum of Gold, Green and other OA, adjusted for retrieval precision and recall

Table VI Proportion of OA per country, 2008–2013

Group	Country	Sample size	Green OA Found	Green OA %	Gold OA journals Found	Gold OA journals %	Other OA Found	Other OA %	Total OA Found	Total OA %	Adjusted OA %
	Austria	8,764	821	9.4 ± 0.6	775	8.8 ± 0.6	3,450	39.4 ± 1.0	4,855	55.4 ± 1.0	63.5 ± 4.6
	Belgium	13,147	1,813	13.8 ± 0.6	968	7.4 ± 0.4	5,210	39.6 ± 0.8	7,841	59.6 ± 0.8	68.4 ± 4.6
	Bulgaria	1,707	161	9.4 ± 1.3	126	7.4 ± 1.2	558	33 ± 2	829	49 ± 2	56 ± 5
	Croatia	2,954	153	5.2 ± 0.8	687	23 ± 1.5	1,149	38.9 ± 1.7	1,876	63.5 ± 1.7	72.8 ± 4.8
	Cyprus	584	72	12 ± 3	43	7 ± 2	223	38 ± 4	329	56 ± 4	65 ± 6
	Czech Republic	7,637	521	6.8 ± 0.5	736	9.6 ± 0.6	2,598	34.0 ± 1.0	3,718	48.7 ± 1.1	55.3 ± 4.6
	Denmark	9,097	871	9.6 ± 0.6	819	9.0 ± 0.6	3,539	38.9 ± 1.0	5,127	56.4 ± 1.0	64.6 ± 4.6
	Estonia	932	81	8.7 ± 1.8	123	13 ± 2	390	42 ± 3	577	62 ± 3	71 ± 5
	Finland	7,414	659	8.9 ± 0.6	690	9.3 ± 0.6	2,838	38.3 ± 1.0	4,102	55.3 ± 1.1	63.4 ± 4.6
	France	48,991	6,881	14.0 ± 0.3	3,255	6.6 ± 0.2	16,560	33.8 ± 0.4	25,915	52.9 ± 0.4	60.6 ± 4.5
	Germany	66,268	7,575	11.4 ± 0.2	5,065	7.6 ± 0.2	21,993	33.2 ± 0.3	33,735	50.9 ± 0.4	58.4 ± 4.5
	Greece	8,043	525	6.5 ± 0.5	773	9.6 ± 0.6	3,067	38.1 ± 1.0	4,246	52.8 ± 1.0	60.5 ± 4.6
	Hungary	4,559	454	10.0 ± 0.8	356	7.8 ± 0.7	2,023	44 ± 1.4	2,782	61.0 ± 1.3	69.9 ± 4.7
	Ireland	5,150	815	15.8 ± 0.9	472	9.2 ± 0.8	1,839	36 ± 1.2	3,018	58.6 ± 1.3	67.2 ± 4.7
EU28	Italy	39,117	3,691	9.4 ± 0.3	3,112	8.0 ± 0.3	14,594	37.3 ± 0.5	21,021	53.7 ± 0.5	61.6 ± 4.5
&	Latvia	387	21	5.4 ± 2.3	57	15 ± 3	156	40 ± 5	232	60 ± 5	69 ± 7
ERA	Lithuania	1,434	65	4.5 ± 1.0	183	12.8 ± 1.7	593	41 ± 2	811	57 ± 2	65 ± 5
	Luxembourg	417	46	11.0 ± 3.0	36	9 ± 3	174	42 ± 5	253	61 ± 5	70 ± 6
	Malta	140	7	5.0 ± 3.8	30	21 ± 7	41	29 ± 7	78	54 ± 8	61 ± 9
	Netherlands	23,564	2,863	12.1 ± 0.4	1,883	8.0 ± 0.3	10,707	45.4 ± 0.6	15,177	64.4 ± 0.6	73.8 ± 4.5
	Poland	15,628	1,112	7.1 ± 0.4	2,099	13.4 ± 0.5	4,698	30.0 ± 0.7	7,416	47.5 ± 0.7	54.4 ± 4.5
	Portugal	7,190	1,169	16.3 ± 0.8	747	10.4 ± 0.7	2,636	36.7 ± 1.1	4,422	61.5 ± 1.1	70.5 ± 4.6
	Romania	5,105	271	5.3 ± 0.6	487	9.5 ± 0.8	1,994	39.1 ± 1.3	2,647	51.9 ± 1.3	59.4 ± 4.7
	Slovakia	2,372	156	6.6 ± 1.0	240	10.1 ± 1.2	798	33.6 ± 1.8	1,155	48.7 ± 1.9	55.8 ± 4.9
	Slovenia	2,586	181	7.0 ± 0.9	425	16.4 ± 1.4	871	33.7 ± 1.7	1,369	52.9 ± 1.8	60.7 ± 4.8
	Spain	35,557	3,517	9.9 ± 0.3	4,074	11.5 ± 0.3	12,119	34.1 ± 0.5	18,341	51.6 ± 0.5	59.1 ± 4.5
	Sweden	14,872	1,527	10.3 ± 0.5	1,460	9.8 ± 0.5	5,767	38.8 ± 0.7	8,587	57.7 ± 0.8	66.2 ± 4.5
	United Kingdom	73,621	8,506	11.6 ± 0.2	5,265	7.2 ± 0.2	28,173	38.3 ± 0.3	41,133	55.9 ± 0.3	64.0 ± 4.5
Total EU28		337,231	31,635	9.4 ± 0.1	29,165	8.6 ± 0.1	117,793	34.9 ± 0.2	172,956	51.3 ± 0.2	58.8 ± 4.5
	Albania	87	4	5 ± 5	16	18 ± 8	25	29 ± 10	43	49 ± 11	57 ± 11
	Bosnia and Herzegovina	362	3	0.8 ± 1.0	92	25 ± 4	139	38 ± 5	226	62 ± 5	72 ± 7
	Iceland	554	57	10.3 ± 2.5	37	7 ± 2	269	49 ± 4	354	64 ± 4	73 ± 6
	Israel	8,450	894	10.6 ± 0.6	502	5.9 ± 0.5	3,552	42.0 ± 1.0	4,882	57.8 ± 1.0	66.2 ± 4.6
ERA	Liechtenstein	40	5	13 ± 11			20	50 ± 16	25	63 ± 15	72 ± 16
Associated	FYR Macedonia	255	18	7 ± 3	75	29 ± 5	87	34 ± 6	173	68 ± 6	78 ± 7
Countries	Montenegro	104	6	6 ± 5	30	29 ± 9	38	37 ± 9	71	68 ± 9	78 ± 10
	Norway	7,280	629	8.6 ± 0.6	705	9.7 ± 0.6	2,907	39.9 ± 1.1	4,145	56.9 ± 1.1	65.3 ± 4.6
	Rep. of Moldova	160	14	9 ± 4	5	3 ± 3	52	33 ± 7	71	44 ± 8	51 ± 9
	Serbia	2,997	135	4.5 ± 0.7	906	30.2 ± 1.6	803	26.8 ± 1.5	1,786	59.6 ± 1.7	68.3 ± 4.8
	Switzerland	16,896	2,497	14.8 ± 0.5	1,547	9.2 ± 0.4	6,630	39.2 ± 0.7	10,369	61.4 ± 0.7	70.3 ± 4.5
	Turkey	17,420	475	2.7 ± 0.2	3,458	19.9 ± 0.6	4,853	27.9 ± 0.6	7,962	45.7 ± 0.7	52.4 ± 4.5
Total ERA		375,820	33,766	9.0 ± 0.1	34,932	9.3 ± 0.1	130,244	34.7 ± 0.1	192,202	51.1 ± 0.2	58.6 ± 4.5
Others	Brazil	26,158	1,626	6.2 ± 0.3	10,482	40.1 ± 0.6	6,515	24.9 ± 0.5	17,322	66.2 ± 0.5	75.9 ± 4.5
	Canada	41,114	2,895	7.0 ± 0.2	3,098	7.5 ± 0.2	17,430	42.4 ± 0.5	23,096	56.2 ± 0.5	64.4 ± 4.5
	Japan	58,527	4,170	7.1 ± 0.2	5,382	9.2 ± 0.2	16,883	28.8 ± 0.3	25,846	44.2 ± 0.4	50.6 ± 4.5
	United States	258,815	17,865	6.9 ± 0.1	17,709	6.8 ± 0.1	119,943	46.3 ± 0.2	153,416	59.3 ± 0.2	67.9 ± 4.5
World		1,000,000	60,271	6.0 ± 0.04	104,050	10.4 ± 0.1	324,637	32.5 ± 0.1	470,530	47.1 ± 0.1	53.9 ± 4.5

Source: Computed by Science-Metrix using DOAJ, PubMedCentral, and Scopus.

Table I   Growth of Open Access scientific literature based on various indicators, 2008–2013

Country	Share of Green OA Pubs (%)			Share of Pubs in Gold OA Journals (%)			Share of Other OA Pubs (%)			Share of Total OA Pubs (%)			No. of Gold OA Journals		
	2008-10	2011-13	% Change	2008-10	2011-13	% Change	2008-10	2011-13	% Change	2008-10	2011-13	% Change	2008-10	2011-13	% Change
Austria	9	10	6%	7	10	40%	40	39	-1%	53	57	7.3%	33	39	19%
Belgium	14	13	-9%	5	9	69%	41	38	-7%	60	59	-1.2%	18	24	31%
Brazil	5	7	33%	40	40	-1%	26	24	-7%	66	66	-1.1%	719	886	23%
Bulgaria	10	9	-7%	6	8	36%	32	33	2%	48	49	3.5%	24	39	63%
Canada	7	7	-4%	6	9	51%	45	40	-12%	57	55	-4.9%	167	250	50%
Croatia	5	6	20%	24	22	-7%	39	38	-3%	64	62	-3.2%	92	99	8%
Cyprus	15	10	-33%	6	8	34%	33	41	23%	53	58	n.c.	4	5	n.c.
Czech Republic	6	7	13%	8	11	27%	34	34	-1%	47	50	5.7%	54	77	42%
Denmark	9	10	9%	8	10	30%	40	37	-8%	56	56	-0.5%	24	35	49%
Estonia	8	9	17%	14	13	-7%	43	41	-4%	63	61	-2.7%	16	22	35%
Finland	8	10	16%	8	11	44%	40	37	-8%	54	56	3.7%	32	39	22%
France	14	15	8%	5	8	49%	35	32	-8%	53	53	0.8%	143	178	24%
Germany	11	12	10%	6	9	49%	35	32	-8%	50	51	2.0%	203	300	48%
Greece	6	7	8%	9	10	20%	39	37	-4%	52	53	1.3%	36	44	24%
Hungary	9	11	20%	5	10	97%	48	40	-16%	62	60	-2.4%	24	28	18%
Iceland	10	10	5%	7	6	-5%	51	46	n.c.	65	61	n.c.	3	4	n.c.
Ireland	15	16	10%	8	10	19%	37	34	-9%	58	58	0.5%	9	11	23%
Israel	10	11	16%	5	7	40%	44	40	-10%	58	57	-1.9%	13	15	16%
Italy	9	9	-1%	6	10	53%	39	36	-7%	53	54	1.1%	174	275	58%
Japan	7	7	-2%	8	11	45%	30	27	-8%	44	44	1.5%	91	97	6%
Latvia	7	4	-36%	11	17	53%	39	41	n.c.	57	63	n.c.	2	4	n.c.
Liechtenstein	n.c.	n.c.	n.c.	n.c.	n.c.	n.c.	49	50	n.c.	54	66	n.c.	n.a.	n.a.	n.c.
Lithuania	4	5	37%	13	12	-5%	42	40	-5%	57	56	-3.1%	22	31	39%
Luxembourg	n.c.	n.c.	n.c.	8	9	8%	44	42	n.c.	59	62	n.c.	1	1	n.c.
Macedonia	5	9	82%	34	23	n.c.	27	41	n.c.	65	69	n.c.	9	17	79%
Malta	n.c.	n.c.	n.c.	31	13	n.c.	27	32	n.c.	59	49	n.c.	3	5	n.c.
Netherlands	13	11	-13%	6	9	44%	48	43	-9%	66	63	-5.0%	43	64	50%
Norway	8	9	10%	9	10	19%	42	38	-11%	58	56	-4.1%	25	35	40%
Poland	7	8	15%	12	15	26%	28	32	11%	44	51	17.5%	118	157	34%
Portugal	17	16	-8%	9	12	35%	39	35	-10%	63	60	-3.7%	58	78	33%
Romania	5	6	34%	10	10	2%	39	39	-1%	51	53	3.0%	201	285	42%
Slovakia	5	8	56%	9	12	34%	35	32	-7%	47	51	8.4%	24	35	49%
Slovenia	6	8	23%	14	18	26%	35	33	-6%	51	54	6.3%	34	40	20%
Spain	10	10	1%	10	13	26%	36	32	-10%	52	51	-2.3%	412	502	22%
Sweden	9	11	17%	8	12	50%	40	38	-5%	56	59	6.0%	36	61	70%
Switzerland	14	15	6%	7	11	45%	41	37	-10%	61	61	0.5%	76	158	109%
Turkey	3	3	20%	18	21	18%	29	27	-7%	45	46	3.1%	165	246	49%
United Kingdom	12	11	-6%	6	9	49%	39	37	-5%	56	56	0.0%	401	568	42%
United States	7	7	-4%	5	8	51%	49	43	-12%	61	57	-5.4%	813	1,154	42%
World	**6**	**6**	**-5%**	**9**	**12**	**42%**	**34**	**31**	**-10%**	**47**	**47**	**-1.2%**	**6,373**	**9,112**	**43%**

Note: The scores for 2008-2010 and 2011-2013 are averages of the yearly scores. The % change = ((Score2008-2010/Score2011-2013) - 1) * 100; n.c. = not computed due to too small numbers (statistics would be unreliable due to potentially strong yearly fluctuations). For Green OA, papers in Gold OA journals, other OA and total OA, the % change was not computed when the average yearly margin of error was equal or greater than 10% in either period. For the number of Gold OA journals, the % change was not computed when the number of journals in 2013 was less than 10 (this threshold was established by looking at the yearly trends in the no. of gold OA journals with the goal to eliminate those where growth measures could be misleading). Source: Computed by Science-Metrix using Scopus and DOAJ data as well as data gathered by Science-Metrix on publications available in open access

PRIORITY 6 (International cooperation)

Text from road map (description top priority)

Top Action Priority identified is "Develop and implement joint strategic approaches and actions for international STI cooperation on the basis of Member States' national priorities."

Proposed indicator

International scientific co-publications with non-EU countries per million of the population

Description of the indicator

- International co-publications are an outcome of international STI cooperation. International scientific co-publications can also be a proxy for the quality of scientific research as collaboration tends to lead to higher quality research as measured in terms of citations .
- Numerator: Number of scientific publications with at least one co-author based outside of the EU
- Denominator: Total population (in million)

Justification

- Pros
  - Good proxy for assessing international activity and cooperation between countries, which is the main challenge in this area
- Cons
  - The indicator does not show the positive effects of national cooperation strategies per se, it just shows how institutions collaborate (which can be the result of many factors)
  - The number of publications depends on the scientific field
  - The impact of the publications is not measured (a more sophisticated approach based on most-cited papers might do this)
  - A certain country size bias (small countries tend to be more international)
  - Linguistic and location bias (countries with non-EU countries as neighbours or English speaking countries might have an advantage)

Source, frequency and coverage

Source: This indicator is not available from Eurostat but can be produced through the existing bibliometric databases
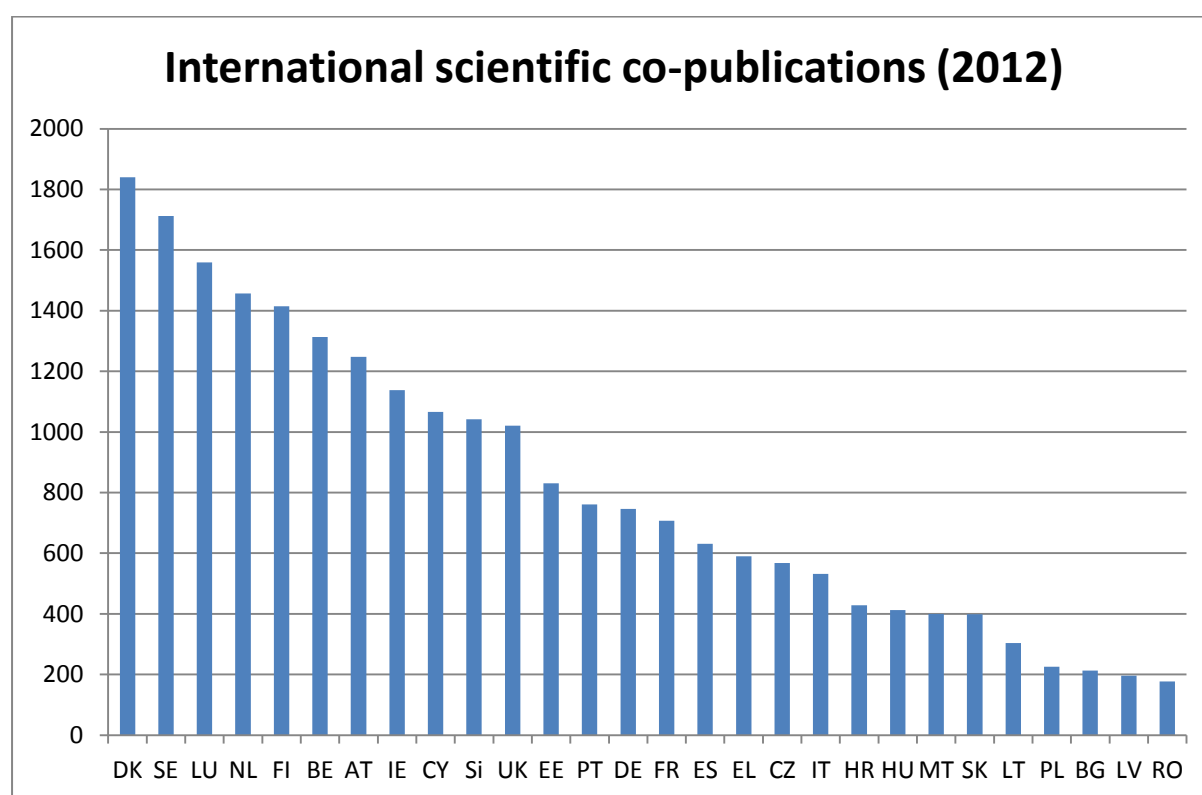
Other indicators considered in the ICF report

Other possible indicators are:

- Citations
- Percentage patents with foreign co-inventors
- Licence and patent revenues from abroad, as a % of GDP
- % patents with foreign co-inventors

Annex : snapshot of a similar indicator used in the Innovation Union Scoreboard

The indicator presented here is drawn from the Innovation Union Scoreboard but it is not the one being proposed. This one presents the number of publications with at least one co-author based abroad (including the other European countries).

International scientific co-publications (2012)

Source: Innovation Union Scoreboard, indicator 1.2.1.