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Progress Report 2018

Country Profile

SLOVAKIA

Research and Innovation

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Directorate-General for Research and Innovation
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COUNTRY SNAPSHOT

	Indicator	Performance					Progress since ERA monitoring 2016				
	Name	Reference year	Score	Cluster	Lead/Gap (Δ %)	EU-28	Reference Period	CAGR	Lead/Gap (Δ % pt)	EU-28	Trend (2007-18)
Priority 1	**Adjusted Research Excellence Indicator (AREI)**	**2016**	**19.5**	**3**	**-57**	**45.0**	**2013-16**	**5.6%**	**2.4**	**3.2%**	
	GBARD as share of GDP	2017	0.35%	3	-44	0.63%	2014-17	-2.7%	-1.0	-1.7%	
	EIS Summary Innovation Index (SII)	2017	0.323	3	-36	0.504	2015-17	-0.6%	-2.5	1.9%	
Priority 2	**A - GBARD to transnatl coop (EUR/researcher)**	**2016**	**263**	**3**	**-93**	**3,739**	**2014-16**	**125.8%**	**121.9**	**3.9%**	
	A - Collab papers w/ERA per 1 000 researchers	2016	42	3	-40	71	2014-16	5.6%	2.3	3.3%	
	A - Public-to-public partnerships (EUR/researcher)	2016	153	4	-73	558	2014-16	-6.4%	-7.0	0.7%	
	B - Roadmap for ESFRI projects	**No national roadmap in place**									
	B - Participation in ESFRI Projects and Landmarks (combined)	**2018**	**22%**	**3**	**-37**	**35%**	**2016-18**	**65.1%**	**50.1**	**15.0%**	
	B - Participation in developing ESFRI Projects	2018	22%	2	-24	29%	2016-18	52.8%	34.2	18.6%	
	B - Participation in operational ESFRI Landmarks	2018	22%	3	-42	37%	2016-18	77.1%	65.8	11.3%	
Priority 3	**EURAXESS job ads per 1 000 researchers**	**2016**	**1.2**	**3**	**-97**	**42.1**	**2014-16**	**-9.3%**	**-4.3**	**-5.0%**	
	Open, transparent, merit-based hiring process	2016	47%	4	-28	65%	2012-16	5.9%	-1.6	7.5%	
	Share of doctoral students from EU countries	2016	7.0%	3	-2	7.1%	2013-16	0.6%	-3.3	3.9%	
Priority 4	**Share of women among Grade A in HES**	**2016**	**25%**	**3**	**7**	**24%**	**2014-16**	**0.1%**	**-0.9**	**1.0%**	
	Gender dimension in research content	2014-17[R]	1.65	1	57	1.05	2011-14 to 2014-17[R]	-17.3%	-19.8	2.5%	
	Share of female PhD graduates	2016	52%	2	9	48%	2013-16	0.6%	0.2	0.4%	
Priority 5	**A - Firms coop with univ, gov, res inst**	**2014**	**13.9%**	**3**	**-7**	**15.0%**	*Not computed*				
	A - Firms coop with univ	**2014**	*Not computed*				**2012-14**	**0.2%**	**-0.5**	**0.7%**	
	A - Firms coop with gov, res inst	**2014**	*Not computed*				**2012-14**	**6.1%**	**2.1**	**4.0%**	
	A - Share of public R&D funded privately	2015	4.4%	3	-36	7.0%	2013-15	-5.3%	-4.0	-1.2%	
	A - Public-private collab papers per capita	2017	10.3	3	-75	40.9	2014-17	-6.4%	-6.9	0.4%	
	B - Share of papers in Open Access (Total)	**2016**	**38.4%**	**3**	**-22**	**49.3%**	*Not computed*				
	B - Share of papers in Open Access (Gold)	**2016**	**24.3%**	**3**	**-19**	**30.2%**	*Not computed*				
	B - Share of papers in Open Access (Green)	**2016**	**21.0%**	**3**	**-35**	**32.5%**	*Not computed*				
	B - Share life science papers with OA dataset(s)	2017	1.6%	3	-36	2.6%	2013-17	8.3%	5.8	2.6%	
Priority 6	**Collab papers w/non-ERA per 1 000 researchers**	**2016**	**12**	**4**	**-77**	**54**	**2014-16**	**9.0%**	**4.6**	**4.4%**	
	Share of doctoral students from outside EU	2016	2.1%	4	-85	13.9%	2013-16	5.4%	1.5	3.8%	
	Share med & high tech product export	2017	66%	1	17	57%	2015-17	-0.1%	-0.5	0.4%	
	Share Knowledge intensive service export	2016	33%	4	-52	69%	2014-16	-3.0%	-3.6	0.6%	

Note: (:) = missing data, more notes ang flags can be found in the "Annex: Methodological notes".
[R] = rolling averages (e.g. average scores across 2007–2010, 2008–2011… 2014–2017) have been used to measure performance and growth due to pronounced short-term fluctuations.
Refer to the "Annex: Guide to reading the quantitative results tables (country snapshots)" for guidance in interpreting the data presented above. Further information on the presented indicators is available in the 2018 ERA Monitoring Handbook.

COUNTRY NARRATIVE

Summary

Slovakia achieved its best performances in Priority 4 (Gender equality and gender mainstreaming in research). Scores in this priority were dispersed in country groups well above (Cluster 1), above (Cluster 2) and below (Cluster 3) the ERA average. Trends in score changes since the last ERA monitoring exercise generally steered close to the EU-28 trend, though the country was notably outpaced by the EU-28 on one indicator here.

Slovakia's scores were generally below the ERA average (Cluster 3) in a large group of priorities, made up of Priority 1 (More effective national research systems); Priority 2a (Transnational cooperation); Priority 2b (Make optimal use of public investments in research infrastructures); Priority 3 (An open labour market for researchers); Priority 5a (Knowledge transfer) and Priority 5b (Open access). Slovakia made notable progress on Priority 2b, but otherwise did not close notable ground to catch up to the Member States overall in these priorities.

On Priority 6 (International collaboration), Slovakia's scores were not only split, they were polarized. One score placed the country well above the ERA average (Cluster 1), whereas the three others put it well below the ERA average (Cluster 4). These scores have generally seen only slight changes in position relative to the EU-28 trends since the last ERA monitoring exercise.

Overall, the Slovak Republic showed mixed progress in achieving ERA priorities. While the ambition and endeavour to enhance the effectiveness of national research system and promote knowledge transfer policies should be noted, international cooperation, joint programming initiatives and open labour market areas should be addressed more thoroughly in the future.

1. More effective national research systems

Slovakia performed below the EU-28 benchmarks (35 % to 45 % under) and the ERA average (placing in Cluster 3) on the two complementary indicators in this priority, GBARD as a share of GDP and EIS Summary Innovation Index (SII). For the headline indicator, the Adjusted Research Excellence Indicator (AREI), Slovakia's score was well below the EU-28 benchmark (by almost 60 %) and below the ERA average (in Cluster 3).

Since the last ERA monitoring exercise, Slovakia has slowly reduced its gap to EU-28 performance on the AREI, with yearly average increases of 6 %, two percentage points above the EU-28 trend. The country's trend in the indicator GBARD as a share of GDP was similar to the EU-28 trajectory, therefore, the country maintained its position relative to its fellow Member States. For the SII score, the country saw its gap to the EU-28 performance slightly widen, with a CAGR almost three percentage points below the Member States' annual increases, which were small on average.

The Regional Innovation Strategy for Smart Specialisation of the Slovak Republic (RIS3SK) is currently the main strategy for stimulating innovation and excellence in research. One of the strategy objectives is to enhance the quality of Slovak research system and translate it to economic growth[1].

The effectiveness of Slovak national research system was enhanced as the Slovak government adopted a decision in 2016 to launch three new programmes with a budget of EUR 92 million. The programmes are linked to the national smart specialisation strategy and the Horizon 2020 programme. They aim to provide support to business R&D, motivate cooperation with public research organisations, and to support projects which received high scores in the Horizon 2020 evaluation but did not received funding[2].

The creation of the strategy for smart specialisation of the Slovak Republic is based on essential EU8 documents and on the practical experience of processing strategic documents gained during the recent period in the SR10. All key relevant stakeholders were involved in the process of drafting the strategy. The overall result is a document that is a consensus-created and

[1] OECD (2016) "Slovak Republic", in OECD Science, Technology and Innovation Outlook 2016, OECD Publishing, Paris.
[2] European Commission (2017) European Semester Country Reports: Slovakia.

encompasses participation of scientists, entrepreneurs (including SMEs), business clusters, academic sector, regional government structures, civil society structures and systematic consolation of foreign European Commission experts.

2. Optimal transnational co-operation and competition

a. Transnational cooperation

Slovakia's propensity to publish collaborative papers with researchers from elsewhere within the ERA was measured at 42 papers per 1 000 researchers, compared to the 71 such papers for Member States overall. This score placed the country below ERA average as well (in Cluster 3). Slovakia's level of investment in public-to-public partnerships was 153 €per researcher, roughly a quarter of the EU-28 benchmark. The country placed in Cluster 4 here. On the headline indicator, GBARD allocated to transnational cooperation, the country obtained a score below the ERA average (Cluster 3), an order of magnitude below the EU-28 benchmark. This performance was based on a datapoint for 2016 that may have been an outlier, as it was much higher than in previous years, a level that Slovakia will hopefully sustain and even improve moving forward.

The marked yearly average increases in Slovakia's GBARD to transnational cooperation should be repeated in coming years before this observation of stark growth can be considered reliable. Slovakia has slightly reduced its gap in performance to Member States overall for its propensity to publish collaborative papers with researchers in other ERA countries, with a CAGR two percentage points above the EU-28 trend. It lost further ground to fellow Member States for its participation in public-to-public partnerships. Yearly average decreases of more than 6 % were below a basically flat EU-28 trend, although here again some degree of yearly fluctuation in scores should elicit caution when considering this trend.

Slovakia is weakly involved in joint programming initiatives. The Agency responsible for the support of research and development (APVV) did not participate in either one of the ERA-NETs.

Slovakia participates in a total of 18 of the 36 European Technology Platforms (ETP) and 2 of 5 Joint Technology Initiatives (ENIAC and ARTEMIS), which are based just on ETP. Both initiatives have a significant impact on defining the guidelines of the research support in the EU. Slovak participation in these activities should be systematically supported by the state. Additionally, the participation of Slovak entities in other EU programs supporting innovation (CIP) is very low.[3]

b. Make optimal use of public investments in research infrastructures

Slovakia participated in 22 % of ESFRI developing Projects, and in the same share of Landmarks. These scores placed the country in Cluster 2 and 3, respectively, and below the EU-28 benchmarks, which were 29 % and 37 %. In 2016, Slovakia achieved rates of participation of 10 % in developing Projects and 7 % in Landmarks. Slovakian increases in ESFRI participation since the last ERA monitoring exercise have therefore been appreciable. They were also much more pronounced than those witnessed for the Member States overall. In other words, the country reduced its gap to other Member States across the three indicators in this priority. In fact, Slovakia's progress in Priority 2a clearly represents its most notable increases of any priority, both in absolute terms and in terms of closing performance gaps to the Member States overall.

Note that large countries are generally advantaged on this priority since the indicators are not normalised to account for differences in the size of countries.

The Slovak Centre of Scientific and Technical Information approved the National ESFRI Roadmap in 2016. The document defines: (a) key types of the research infrastructures (national, central, unique); (b) provisions for selecting and financing important research infrastructures in 2014-2020; (c) evaluation procedures for infrastructures; (d) Slovakia's membership in the European infrastructures; and (e) long-term plans for development and financing research infrastructure in 2016-2023 (SGCSTI, 2016)[4]. In the roadmap it is indicated that Slovakia will continue to participate in the ESFRI Roadmap projects, in which it is currently involved, i.e. European XFEL, ESRF, ILL 20/20 ESSurvey, FAIR a PRACE.

[3] Research and Innovation Strategy for Smart Specialisation of the Slovak Republic 2013.
[4] Baláž, V.; Frank, K.; Ojala, T. (2018) RIO Country Report 2017: Slovak Republic, Luxembourg.

The Action plan for building R&D in Slovakia is consistent with the priorities of Smart specialization strategy of the Slovak Republic. It creates conditions to achieve stated tangible priorities in building and maintaining domestic Slovak R & D infrastructure. According to the roadmap the participation of Slovakia will be more efficient in the research infrastructure projects and the new priorities will be set for the participation in the other projects[5]. The potential participation opportunities will be assessed considering the consistency of the priority areas of RIS3 and the economic efficiency of the infrastructure investments.

3. An open labour market for researchers

Almost half (47 %) of Slovakian researchers who participated in the MORE3 survey were satisfied that academic hiring processes were open, transparent and merit-based. This performance compared to a score of 65 % for the Member States overall. Slovakia posted 1 EURAXESS academic job ad per 1 000 researchers (the headline indicator) in 2016, a fraction of the EU-28 benchmark of 42 ads. Of the country's population of doctoral students, 7 % came from other EU countries, a performance identical to the score obtained for Member States overall. Slovakia was positioned in Cluster 4 for researcher views on hiring fairness, and in Cluster 3 for the other two indicators.

Trends in annual score changes for Slovakia were all slightly outpaced by their EU-28 counterparts (by one to four percentage points). These decreases have slowly widened gaps to EU-28 performance on the headline indicator and for researcher satisfaction with hiring processes. EURAXESS use, however, as seen some degree of yearly fluctuations, and upcoming datapoints should be used to substantiate the observation made here. For its share of doctoral students hailing from other EU countries, Slovakia's previous lead has eroded away.

The requirement practices in RPOs in Slovakia are open, transparent and merit-based. Some of Slovakian universities recruitment policies are in line with Charter and Code principles.

Even though, efforts are taken to attract foreign students (for instance, the National Scholarship Programme of the Slovak Republic supports mobility of PhD students, university teachers, researchers of any nationality except Slovak (EU and non-EU) for stays of 1-10 months in a Slovak higher education institution (incoming grant))[6] the number of international students is low. In addition, the country is experiencing brain drain as the main flow of Slovakian researchers moves towards Czech Republic.

The government has sought to enhance the international mobility of researchers and linkages with global research networks. The Phoenix Strategy, approved in 2011, is a package of policy measures to support the international mobility of human capital in public research sector. It supports cooperation with foreign institutions, specifically by establishing joint study programmes in Slovakia. In addition, the Phoenix Strategy aims to increase the participation by Slovak research teams in relevant EU programmes (the EURAXESS Network of European mobility portals and the Marie Curie mobility support framework programme)[7].

4. Gender equality and gender mainstreaming in research

Slovakian researchers included a gender dimension in their research content to a comparatively high degree. The country obtained a score more than 50 % above the EU-28 benchmark and well above the ERA average (Cluster 1). The country had a 52 % share of female PhD graduates, above the 48 % score found for Member States overall. Here also, Slovakia positioned itself above the ERA average (Cluster 2). The country achieved a 25 % share of women among Grade A positions in the higher education system, above both the EU-28 benchmark (of 24 %) and the ERA average (placing in Cluster 2).

Despite a very strong score on inclusion of gender dimension in research content, Slovakia's performance had been even stronger in the previous ERA monitoring exercise. The country has

[5] Research and Innovation Strategy for Smart Specialisation of the Slovak Republic 2013.
[6] Claire Nauwelaers (2018) Mutual Learning Exercise on national practices in widening participation and strengthening synergies. Topic report Attracting qualified R&D staff in the public and private sectors.
[7] OECD (2016), "Slovak Republic", in OECD Science, Technology and Innovation Outlook 2016, OECD Publishing, Paris.

seen annual decreases at an average almost 20 percentage points below the EU-28 trend on this indicator. By contrast, the country's trends were flat and close to their EU-28 counterparts on the headline indicator and for the share of female PhD graduates.

Available statistical data indicates the presence of gender imbalances in terms of academic careers as well as in management and decision-making. The proportion of women and men at different stages of a typical academic career in a public university shows that the higher the level of academic ranking, the lower the women's representation. Recently significant steps have been made in terms of building the knowledge base and research on gender equality. These will further serve as building blocks for future measures. For instance, the Summary Report on the State of Gender Equality in the Slovak Republic is compiled annually. This measure is fundamental for designing a systematic approach to understanding the mechanisms and displays of inequalities and discrimination in both public and private life.[8]

5. Optimal circulation, access to and transfer of scientific knowledge including via digital ERA

a. Knowledge transfer

Examining this priority's headline indicator, 14 % of Slovakian firms cooperated either with universities or higher education institutions, or with governmental, public or private research institutes. This score was slightly below the EU-28 benchmark of 15 % and below the ERA average (Cluster 3). A share of 4 % of public R&D was funded privately in the country, again below both EU-28 benchmark (7 %) and ERA average (Cluster 3). Scholars and scientists in the country contributed to 10 public-private collaborative papers per 1 000 researchers, about one quarter of the EU-28 score of 41 papers and below the ERA average (Cluster 3).

Slovakian firms have stepped up their cooperation with governmental, public or private research institutes since the last ERA monitoring exercise, with a CAGR of 6 % found on this indicator. This increase put the country's trend two percentage points above the trajectory found for Member States overall. Trends were flat at both the country level and the EU-28 level on the other component of the headline indicator. Slovakia slightly lost ground to fellow Member States on the complementary indicators, with downward trends that were four to seven percentage points under the EU-28 trajectories.

While the country has implemented several measures to stimulate knowledge transfers, these have mainly been focused on the enhancement of physical infrastructure. There has been less emphasis on improving framework conditions to create incentives for cooperation between academia and industry, or on providing support for the creation and development of spin-off companies[9].

The Slovak Government earmarked significant resources to strengthen the synergies between science and industry in the OPRI budget. The Government also designed a national programme of the SRDA for the cooperation between the academia and industry in the period 2016-2020. Yet, none of these initiatives has been implemented yet[10]. The Smart Industry Concept for Slovakia provides guidance for interconnecting academia and industry sector in specific research agendas[11].

The MINERVA 2.0 strategy (2011) contains the main tools for promoting cooperation between academic and business sector organisations. The strategy envisages the implementation of a unified national system for technology transfer (TT) to support and manage the commercialisation of intellectual property generated in academia. The strategy also considers measures to promote collaborative R&D (Joint R&D Programmes) and to improve research infrastructure (World Class Infrastructure for Top Research)[12]. Additionally, poor links between the public sector, research

[8] Ministry of Labour, Social Affairs and Family of the Slovak Republic (2014) National Strategy for Gender Equality in the Slovak Republic.
[9] European Commission (2016) European Semester Country Reports: Slovakia.
[10] Vladimír Baláž, Karol Frank, Jana Zifciakova (2017) RIO Country Report 2016: Slovakia.
[11] Baláž, V.; Frank, K.; Ojala, T. (2018) RIO Country Report 2017: Slovak Republic, Luxembourg.
[12] OECD (2016) "Slovak Republic", in OECD Science, Technology and Innovation Outlook 2016, OECD Publishing, Paris.

institutions and businesses are evident from the low number of public-private co-publications per million inhabitants[13].

b. Open access

Slovakian scientific papers made available in some form of OA (Total OA – the headline indicator) represented a 38 % share of the country's output in 2016. This compared to a 49 % EU-28 benchmark and placed the country below the ERA average (in Cluster 3). The country's score was similarly about 20 % below the EU-28 for the share of papers available in Gold OA specifically, whereas for Green OA and for the share of life sciences papers with an OA dataset, Slovakia was more than 30 % below the Member State level, positioning the country in Cluster 3 here also. Yearly trends in score change could only be calculated on the last indicator, the share of life science papers with OA datasets. Here Slovakia saw annual increases at an average of 8 %, almost six percentage points above the EU-28 trend. Given the exceptionally high score recorded on this indicator in 2017, upcoming datapoints will ideally be used substantiate this observation.

The Slovak Centre of Scientific and Technical Information is the main body responsible for open access policy in Slovakia. The activities of the centre include organising conferences and workshops related to open access. For instance, in 2018 a three-day course about the basics of open access was organised. In addition, The Slovak Centre of Scientific and Technical Information (SCSTI) is a partner in the OpenAIRE2020 project (Open Access Infrastructure for Research in Europe) and a key organization in PASTEUR4OA project (Open Access Policy Alignment Strategies for European Union Research).

6. International cooperation

Slovakia's share of medium and high technology products in product exports was 66 %, above the EU-28 benchmark of 57 % and well above the ERA average (Cluster 1). Conversely, the country's performances on the other indicators in this priority were all measured at 50 % to 90 % less than the EU-28 scores and were well below the ERA averages (Cluster 4).

Since the last ERA monitoring exercise, Slovakia has slightly reduced its gap to EU-28 performances for its propensity to publish collaborative papers with partners from countries outside the ERA—the headline indicator—for which the country outpaced EU-28 trajectory by nearly five percentage points. Slovakia also gained ground for its share of doctoral students from outside the EU, with the country nearly two percentage points ahead of the trend among its fellow Member States overall. The country's position relative to its fellow Member States remained unchanged on the share of medium and high technology products as part of product exports. Lastly, it was trailing slightly further behind other Member States for its share of knowledge-intensive service exports, with stability among the Member States contrasted to slow decreases for Slovakia.

Slovak Research and Development Agency (SRDA) is responsible for research and development promotion in all research fields, including international research cooperation. Regarding international cooperation there are some measures in place, but the whole all-encompassing strategy or approach has not been designed yet. Rather several separate initiatives exist. For instance, National grant agency has some programmes to support researchers preparing proposals for H2020. There are also bilateral programmes for researcher's mobility and in 2018 two bilateral calls were launched for Slovakia cooperation with Israel and China.

[13] European Commission (2016) European Semester Country Reports: Slovakia.

References

Baláž, V.; Frank, K.; Ojala, T. (2018) RIO Country Report 2017: Slovak Republic, Luxembourg.

Claire Nauwelaers (2018) Mutual Learning Exercise on national practices in widening participation and strengthening synergies. Topic report Attracting qualified R&D staff in the public and private sectors.

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Vladimír Baláž, Karol Frank, Jana Zifciakova (2017) RIO Country Report 2016: Slovakia.

ANNEX: METHODOLOGICAL NOTES

	Indicator	Data availability	Flag							
	Name		**Exception to ref. year**	**Exception to ref. period**	**Break in time series**	**Definition differs**	**Estimated**	**Provisional**	**Potential outlier**	**Confidential**
Priority 1	**Adjusted Research Excellence Indicator (AREI)**	Available								
	GBARD as share of GDP	Available						2017		
	EIS Summary Innovation Index (SII)	Available								
Priority 2	**A - GBARD to transnatl coop (EUR/researcher)**	Available				2007-14	2007		2016	
	A - Collab papers w/ERA per 1 000 researchers	Available				2007-14				
	A - Public-to-public partnerships (EUR/researcher)	Available				2012-14				
	B - Roadmap for ESFRI projects									
	B - Participation in ESFRI projects and landmarks (combined)	Available								
	B - Participation in developing ESFRI projects	Available								
	B - Participation in operational ESFRI landmarks	Available								
Priority 3	**EURAXESS job ads per 1 000 researchers**	Available				2012-14				
	Open, transparent, merit-based hiring process	Available								
	Share of doctoral students from EU countries	Available								
Priority 4	**Share of women among Grade A in HES**	Available								
	Gender dimension in research content	Available								
	Share of female PhD graduates	Available								
Priority 5	**A - Firms coop with univ, gov, res inst**	Available								
	A - Firms coop with univ	Available								
	A - Firms coop with gov, res inst	Available				2012				
	A - Share of public R&D funded privately	Available				2007-14				
	A - Public-private collab papers per capita	Available								
	B - Share of papers in Open Access (Total)	Available								
	B - Share of papers in Open Access (Gold)	Available								
	B - Share of papers in Open Access (Green)	Available								
	B - Share life science papers with OA dataset(s)	Available								
Priority 6	**Collab papers w/non-ERA per 1 000 researchers**	Available				2007-14				
	Share of doctoral students from outside EU	Available								
	Share med & high tech product export	Available								
	Share Knowledge intensive service export	Available								

Additional note: For the indicator *Share of women among Grade A in HES* the definition differs for 2014 and 2016 (reference population = Academic staff)

ANNEX: GUIDE TO READING THE QUANTITATIVE RESULTS TABLES (COUNTRY SNAPSHOTS)

Each profile table shows the given country's performance score and growth for all indicators used in this study. Given that specific targets were not established for each of the 24 ERA Monitoring Mechanism (EMM) indicators for each country, it is impossible to report on a country's level of compliance in achieving the ERA priorities, or the ERA policies/actions, that each of these indicators intends to measure ([14]). Instead, the level of performance in the country snapshots is compared to the EU-28 (lead/gap analysis) and ERA averages (performance clusters). These references might represent unrealistic targets for some countries, especially the smaller ones. However, care was taken to use normalised indicators (except for Priority 2b), usually by incorporating the size of a country's population or economy in the denominator of an indicator. Additionally, the EU-28 and ERA averages might in some cases be lower than the level of performance which would be optimal towards achieving the ERA; for instance, gender equality might not have been reached in all relevant aspects at the EU- and/or ERA-wide level. That said, the main goal of these comparative analyses is to help situate countries relative to the core of the EU and ERA, so as to inform decisions on the most appropriate targets and on how to achieve them.

In addition to a measurement of performance in 2017 (or the most recent reference year for which sufficient data were available at the time of producing this report ([15])), the profile table also reports on recent changes in national performance, computed as a Compound Annual Growth Rate (CAGR). The CAGR aims to assess progress made since the ERA Progress Report 2016. Accordingly, it compares the latest available year in the 2016 report to the latest available year in this report. Growth since the last monitoring exercise is also compared to the EU-28 (lead/gap analysis) to inform individual countries on the extent to which their gap with the EU-28 level of performance is closing or widening. This information is intended to help individual countries better assess the extent to which new actions are required to achieve their respective targets.

The profile table is divided in two parts: performance and growth. For performance, the reference year for each indicator is noted. If the reported year for a given country and indicator is different from the reference year, the performance score in the snapshot is highlighted using a grey font in italics. The specific year which is reported appears in the column "exception to ref. year" of the appendix table at the end of the country profile. The appendix table also lists the years for which a flag is applied to the data. The performance section of the snapshot table also provides the EU-28 scores across indicators upon which the country lead/gap, in percent difference to the EU-28 score, is computed. Furthermore, the performance clusters from the main report have also been presented here; recall that countries more than one standard deviation above the unweighted ERA average (i.e. average across member states and associated countries for which data is available for each indicator) are in Cluster 1, the strongest cluster; those at or above the unweighted ERA average but within one standard deviation are in Cluster 2; those below the unweighted average but within one standard deviation are in Cluster 3; those more than one standard deviation below the ERA unweighted average are in Cluster 4, the weakest cluster.

For growth, the reference period used in computing the Compound Annual Growth Rate (CAGR) is also presented, alongside the actual CAGR. Again, exceptions to the reference period are highlighted by using a grey font in italics to display the actual CAGRs of the corresponding country and EU-28. Information on the specific years used in these cases are again available in the appendix tables. The lead/gap analysis for growth shows the percentage point difference between the country's CAGR and the CAGR of the EU–28 average. The CAGR measures growth relative to the latest available year in the *2016 ERA Progress Report*. Since there were retrospective corrections to the scores of countries on some indicators, growth was computed based on the updated time series. Trend lines over the longest available period for a given indicator are provided to inform on longer-term patterns of progress towards realising the ERA. Empty lines in the trend indicate either that data was missing for that year, or that the country's score was zero. For one indicator where short-term fluctuations were particularly pronounced (gender dimension in

[14] A more in-depth assessment of progress of implementation of ERA policies was rather achieved in the text of country profiles (not the snapshot tables) accounting for quantitative (where available) and qualitative (especially) elements in relation to the objectives, baselines, targets, timelines and milestones established by individual countries in their National Action Plans (NAP).
[15] Refer to the 2018 ERA Monitoring Handbook for the extraction dates of the presented data.

research content in priority 4), rolling averages (e.g. average scores across 2007–2010, 2008–2011… 2014–2017) have been used to measure performance and growth. In such cases, the CAGR measures the year-by-year percent change in the rolling average of an indicator between the starting and ending periods (e.g. between 2011–2014 and 2014–2017). These cases are highlighted by the addition of the superscript (R) to the reference year (performance) and period (growth) of the concerned indicators.

The lead/gap analyses, both for performance and for growth, have been colour-coded to help visually elucidate patterns in the findings. The colour scheme for the country profiles ranges from dark blue (weakest scores) to dark orange (strongest scores), as was applied in the main report. There is, however, a key difference to note. In the main report, the colouring compared the results of different countries along a single indicator, in these country profile tables the colouring compares the results of one country along several indicators, to highlight its relative strengths and weaknesses across indicators. More specifically, in each profile, blue always indicates that a country is below the EU–28 average, and orange always indicates that it is above, but the shade of blue and orange (dark or light) is relative to the country's own performance across indicators, rather than relative to the performance of other countries.

Indicators in bold are the Headline indicators that were selected as being the most relevant in monitoring progress in achieving the ERA by the European Research Area and Innovation Committee (ERAC). Within each priority, the Headline is followed by the two complementary EMM indicators identified by ERAC. Lack of data is identified by using a symbol (:) within the table cells.

Due to changes and discontinuities in data collection, some indicators have been updated, modified or replaced. A first modification was introduced for the complementary EMM indicators of Priority 2b (Make optimal use of public investments in research infrastructures). Here, findings are now provided on a combined indicator that better illustrates how level of engagement in ESFRI developing Projects and Landmarks are connected rather than independent.

For the headline indicator of Priority 5a, the underlying data coming from Eurostat was for the first time aggregated in a manner that made it possible to present a single metric (in terms of performance) merging both of its underlying dimensions ([16]); that is the share of product and/or process innovative firms cooperating with 1) universities or higher education institutions, or 2) with government, public or private research institutes. For growth, these two dimensions still had to be kept separated in this edition.

The indicators on the share of a country's peer-reviewed scientific papers that are available in Open Access (i.e. Total, Gold and Green OA) in Priority 5b have all been impacted by a revised definition of what constitute Green Open Access papers (see Section 3.5.5 of the Main Report for a description of this change). The indicator on the inclusion of OA policies in RIO policy repositories was discontinued since the new reporting guidelines for RIO policy reports no longer ask the experts to report on OA specifically. It has been replaced by a qualitative assessment of the NAPs and other information sources. A new indicator was also added to Priority 5b to fill a data gap in the 2016 ERA Progress Report; no data was available in 2016 for the share of research performing organisations (RPOs) making their research data available in OA. The share of research performing organisations (RPOs) making their research data available in OA has been replaced by the share of life sciences papers to which a country contributed and that have at least one open dataset in Figshare.

Due to discontinued data, the indicator on "Licence and patent revenues from abroad as a share of GDP" in Priority 6 has been replaced by two new indicators: knowledge intensive services exports as percentage of total services exports and exports of medium and high technology products as a share of total product exports; this modification coincides with a similar replacement in the 2018 European Innovation Scoreboard (EIS). Changes in the data for some countries also led to changes in EU28 aggregate scores the following two indicators: the share of doctoral candidates with a citizenship of another EU Member State (Priority 3) and non-EU doctorate students as a share of all doctorate students (Priority 6). Additional modifications in the approach used in computing EU-28

[16] The new aggregation provided by Eurostat enabled this change by removing duplicated count of firms falling in both types of partnerships.

aggregate scores (e.g. imputation of missing data) led to some changes in the GBARD (EUR) allocated to Europe-wide transnational, as well as bilateral or multilateral, public R&D programmes per FTE researcher in the public sector (Priority 2a).

Finally, the composite indicators combining findings from headline and complementary indicators within and across ERA priorities have not be computed in the 2018 ERA monitoring exercise. The rationale for these changes is detailed in the 2018 ERA Monitoring Handbook.

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The 2018 ERA Progress Report assesses the current state of the European Research Area (ERA) and the progress made on ERA implementation in 2016-2018. It is the second time in a row that progress has been measured at country level using the ERA monitoring mechanism.

Based on the overall evolution of the headline indicators, progress on ERA implementation continues, albeit at a slower pace than before. This trend calls for a renewed commitment to (i) further strengthening shared efforts at all levels; (ii) reforming national research and innovation systems; and (iii) realising a well-functioning ERA. The Commission has anticipated this need by proposing a number of programmes for the next financing period 2021-2027: these include regional funds, a European reform delivery tool, and the EU's next research and innovation framework programme — Horizon Europe, which includes a dedicated pillar to help strengthen the ERA.

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