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Country Profile **POLAND**

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Country profile: Poland

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
Priority 1	Adjusted Research Excellence Indicator (AREI)	2016	18.7	3	-58	45.0	2013-16	4.2%	1.0	3.2%	
	GBARD as share of GDP	2017	0.36%	3	-42	0.63%	2014-17	-5.6%	-4.0	-1.7%	
	EIS Summary Innovation Index (SII)	2017	0.270	4	-46	0.504	2015-17	4.7%	2.8	1.9%	
Priority 2	A - GBARD to transnatl coop (EUR/researcher)	2016	1,086	3	-71	3,739	2014-16	68.8%	64.9	3.9%	
	A - Collab papers w/ERA per 1 000 researchers	2016	34	4	-52	71	2014-16	3.3%	0.0	3.3%	
	A - Public-to-public partnerships (EUR/researcher)	2016	310	3	-45	558	2014-16	-8.3%	-8.9	0.7%	
	B - Roadmap for ESFRI projects	National roadmap implemented in 2014, ESFRI projects identified									
	B - Participation in ESFRI Projects and Landmarks (combined)	2018	36%	2	5	35%	2016-18	6.6%	-8.4	15.0%	
	B - Participation in developing ESFRI Projects	2018	28%	2	-5	29%	2016-18	-8.7%	-27.3	18.6%	
B - Participation in operational ESFRI Landmarks	2018	41%	2	9	37%	2016-18	14.3%	3.0	11.3%		
Priority 3	EURAXESS job ads per 1 000 researchers	2016	155.3	1	269	42.1	2014-16	1.7%	6.7	-5.0%	
	Open, transparent, merit-based hiring process	2016	72%	2	10	65%	2012-16	5.5%	-2.0	7.5%	
	Share of doctoral students from EU countries	2016	0.3%	3	-96	7.1%	2013-16	0.7%	-3.2	3.9%	
Priority 4	Share of women among Grade A in HES	2016	24%	3	2	24%	2014-16	3.0%	2.0	1.0%	
	Gender dimension in research content	2014-17 ^(R)	1.01	3	-3	1.05	2011-14 to 2014-17 ^(R)	-9.3%	-11.8	2.5%	
	Share of female PhD graduates	2016	54%	2	13	48%	2013-16	-0.7%	-1.2	0.4%	
Priority 5	A - Firms coop with univ, gov, res inst	2014	14.6%	2	-3	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	7.3%	3.3	4.0%		
	A - Share of public R&D funded privately	2015	3.6%	3	-48	7.0%	2013-15	-4.6%	-3.4	-1.2%	
	A - Public-private collab papers per capita	2017	5.4	3	-87	40.9	2014-17	-1.8%	-2.3	0.4%	
	B - Share of papers in Open Access (Total)	2016	45.1%	3	-9	49.3%	Not computed				
	B - Share of papers in Open Access (Gold)	2016	33.1%	2	10	30.2%	Not computed				
	B - Share of papers in Open Access (Green)	2016	21.7%	3	-33	32.5%	Not computed				
	B - Share life science papers with OA dataset(s)	2017	2.2%	2	-15	2.6%	2013-17	28.1%	25.5	2.6%	
Priority 6	Collab papers w/non-ERA per 1 000 researchers	2016	18	3	-67	54	2014-16	2.4%	-2.0	4.4%	
	Share of doctoral students from outside EU	2016	1.7%	4	-88	13.9%	2013-16	8.3%	4.5	3.8%	
	Share med & high tech product export	2017	49%	2	-14	57%	2015-17	-0.5%	-0.9	0.4%	
	Share Knowledge intensive service export	2016	40%	3	-42	69%	2014-16	2.7%	2.1	0.6%	

Note: (:) = missing data, more notes and 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

At the time this study was conducted Polish national ERA roadmap was not available and it was not possible to assess the country's progress in implementing its NAP. The analysis of the recent policy developments revealed that over the last years Poland made a substantial progress and adopted a number of important reforms and initiatives in most of the ERA priorities, including making more effective national research systems, making optimal use of public investments in research infrastructures, open labour market for researchers, optimal circulation, access to and transfer of scientific knowledge including via digital ERA and international cooperation.

According to the analysis of quantitative indicators, Poland's best performances were observed in Priority 2b (Make optimal use of public investments in research infrastructures) and Priority 3 (An open labour market for researchers). Scores here mostly positioned the country above the ERA average (Cluster 2), with some scores well above (Cluster 1) and below it (Cluster 3). No clear pattern in score changes was identified here.

The second group of priorities was made up of an even mix of scores above (Cluster 2) or below the ERA average (Cluster 3). It included Priority 4 (Gender equality and gender mainstreaming in research), Priority 5a (Knowledge transfer), Priority 5b (Open access) and Priority 6 (International collaboration). Trends in score changes here steered close to the EU-28 trajectories, counter-punctuated by more pronounced shifts on two indicators.

Poland had its weakest performances on Priority 1 (More effective national research systems) and Priority 2a (Transnational cooperation). Scores here were consistently below (Cluster 3) or well below (Cluster 4) the ERA average.

1. More effective national research systems

Poland's scores across indicators on this priority were between 40 and 60% less than the EU-28 benchmark. It positioned itself in Cluster 3 on the headline indicator, the Adjusted Research Excellence Indicator (AREI) and on one of the complementary indicators, the GBARD as a share of GDP. Poland's score in the EIS Summary Innovation Index (SII) placed the country in Cluster 4.

Poland's trends in the AREI and the SII since the last ERA monitoring exercise have been slightly positive and have marginally outpaced the EU-28 trajectories. These trends have enabled the country to reduce its gap to other Member States on the AREI and the SII. A widening gap with the EU-28 average since the last ERA monitoring exercise was observed for the GBARD as a share of GDP, its CAGR was 4 percentage points behind the Member States' CAGR.

Qualitative research also found that a number of actions were taken recently to improve the effectiveness of Poland's research system. According to the interview data, although international peer review method in allocating research funds was introduced in Poland before 2015, between 2012 and 2018 the use of this method in allocating research funds became much broader and more prevalent among the Polish research funding institutions. The main reason for this development was the position of the national authorities in Poland, which considered international peer review as one of the key guarantors of excellence in science and encouraged RFOs to use this method more broadly. The effectiveness of research and higher education funding system was also improved by the Ordinance on distributing public subsidies for public and non-public HEIs issued in 2016. This ordinance envisaged a new funding algorithm, which relies on an indicator of student-faculty ratio, penalising HEIs that have higher numbers of students per each academic employee.¹ Similarly, in 2017 funding mechanisms of ESIF support measures for R&I were streamlined: generic, repetitive calls supporting innovative research programmes, internships and doctoral studies, with relatively simple, standardized rules, instead of multiple small and focused calls were introduced for National Centre for Research and Development (NCBR)-managed ESIF-funded calls.²

A number of other measures aimed at improving the effectiveness of higher education and research system in Poland have been implemented over the last few years. In 2017, Poland

¹ Krzysztof Klincewicz, Katarzyna Szkuta, Magdalena Marczevska, RIO Country Report 2016: Poland, 2017.

² K. Klincewicz, M. Marczevska, K. Szkuta, RIO Country Report 2017: Poland, 2018.

hosted the peer-review of its higher education and research co-ordinated by the H2020 Policy Support Facility: the independent experts and international peers provided insights into the bottlenecks of the R&I system, commented on the alternative proposals of the HE draft prepared by the national expert teams, shared good practices from other countries and weighed in on the effectiveness and efficiency of planned policies and measures.³ Similarly, in 2017 the country-wide institutional assessment of 993 scientific units was concluded in Poland, involving 180 peer-reviewers working in 20 thematic evaluation teams. As a result of this exercise, all the institutions were ranked into four categories according to their excellence (A+, A, B and C). Based on the draft of the Higher Education and Science Act, units ranked as „B” or „C” would not be allowed to award habilitations and have restricted access to public funding.⁴

In addition, in 2016 Strategy for Scientific Excellence, Modern Higher Education, Partnership with Business and Responsible Research was issued in Poland. The strategy summarised recently adopted regulations and announced plans for new changes (incl. the planned summoning of the National Congress for Science and the creation of the National Agency for Academic Cooperation).⁵

2. Optimal transnational co-operation and competition

a. Transnational cooperation

Poland’s scores on this set of indicators were below (Cluster 3) or well below (Cluster 4) the ERA average, amounting to half the EU-28 benchmarks or less. The country has made considerable progress and notably reduced its performance gap for the headline indicator, GBARD to transnational cooperation. Its CAGR here was 65 percentage points above the EU-28 trend. If trends were sustained for both the country and its fellow Member States, Poland could fully catch up to EU-28 performance within five years, although year-to-year fluctuations for Poland raise the question of how likely it would be for these trends to remain stable over such a timeframe. A growing gap to EU-28 performance for public-to-public partnerships was also observed, with a Polish CAGR almost nine percentage points below the flat EU-28 trend. Poland strictly followed the EU-28 trend on the remaining indicator, the propensity to publish collaborative papers with researchers from other ERA countries.

b. Make optimal use of public investments in research infrastructures

Poland has made sustained contributions to ESFRI infrastructure initiatives. Its rates of participation are for all intents and purposes equivalent to the EU-28 benchmarks, consistently placing the country in Cluster 2. Poland participated in several developing Projects that have since evolved to the active landmark stage: landmarks participation for the country has gone from 31% in 2016 to 41% in 2018. Its rate of participation in developing projects has gone from 33% to 28% over the same period. Taken together, these findings result in a net proportionate increase since the last ERA monitoring, but Poland’s rate of growth did not keep up with the EU-28 pace, challenging Poland’s current slight lead over the Member States as a whole.

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.

In 2018 a new national RI roadmap of Poland is being prepared and it is expected to be finished and published by the end of the year.

3. An open labour market for researchers

Poland obtained the second highest ranking among ERA countries for this priority’s headline indicator, the usage of EURAXESS academic job ads. With 155 ads per 1 000 researchers, the country’s score was more than threefold the EU-28 benchmark and positioned the country in Cluster 1. Polish researchers were satisfied that academic hiring processes were open,

³ Peer Review of Poland’s Higher Education and Science System, <https://rio.jrc.ec.europa.eu/en/library/peer-review-poland%E2%80%99s-higher-education-and-science-system>.

⁴ K. Klincewicz, M. Marczevska, K. Szkuta, RIO Country Report 2017: Poland, 2018.

⁵ Krzysztof Klincewicz, Katarzyna Szkuta, Magdalena Marczevska, RIO Country Report 2016: Poland, 2017.

transparent and merit-based to a greater proportion than researchers across the Member States overall (72% versus 65%). This score placed the country in Cluster 2. Doctoral students from other EU countries accounted for only a fraction of the country's graduate enrolments. At 0.3%, this score was about one twentieth of the EU-28 benchmark and positioned the country in Cluster 3.

Poland's performance on EURAXESS use was the outcome of slight yearly increases that trended higher than the EU-28 CAGR, by almost seven percentage points. The country was weakly outpaced by the Member States average on the complementary indicators, by two percentage points for researcher satisfaction with hiring processes and by three percentage points for the share of doctoral students from other EU countries.

Qualitative analysis showed that since 2014 a large number of Polish research and higher education institutions have endorsed the European Charter & Code for Researchers – the number of institutions with HR excellence in Research label has increased around tenfold. This was a direct consequence of systemic efforts by national authorities in this area as the Polish Ministry of Science and Higher Education has encouraged country's research and higher education institutions to adopt the principles of the Charter and Code. In 2017 "Industrial PhD" scheme, which supports intersectoral collaboration and mobility of researchers has been introduced in Poland.⁶ Under this scheme a PhD candidate is conducting the research in a research organisation or university but at the same time is employed by a private company. Moreover, by the end of 2018 a reform of PhD training system in Poland is planned to be implemented in accordance to the new Polish Law on Higher Education and Science (so called "Law 2.0")⁷: under the new system only the top-quality research and higher education institutions having the necessary evaluation category will be able to organise PhD education. In addition, the reform will enable establishment of doctoral schools that will now use and combine the resources of multiple and not just one research/higher education organisation. This should encourage interdisciplinarity in PhD education and thereby foster the excellence.

4. Gender equality and gender mainstreaming in research

Poland's share of female PhD graduates was 54%, above the EU-28 benchmark and gave the country a position within Cluster 2. On the headline indicator, the share of women among Grade A positions in the higher education system, its score was the same as for Member States overall. This performance placed the country in Cluster 3. The country's performance was situated close to but below the EU-28 score and below the ERA average for its inclusion of gender dimension in research content.

Poland's gap in performance, compared to other Member States, for inclusion of a gender dimension in research content has only appeared since the last ERA monitoring exercise and was brought about by yearly decreases in scores almost 12 percentage points below the EU-28 trend. Changes on the headline indicator and the other complimentary indicator have been small and have not substantially changed Poland's position relative to other Member States (differences in CAGR of two and one percentage points, respectively).

Similarly, no major changes in this area have been found during the qualitative research.

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

a. Knowledge transfer

Poland's share of firms cooperating with either universities or higher education institutions, or with governmental, public or private research institutes – the headline indicator – was roughly the same (14.6%) as the average for Member States (15.0%). This score placed the country within Cluster 2. The country's share of public R&D funded privately was 3.6%, just over half the EU-28 benchmark. Its gap compared to the EU-28 overall performance was much more pronounced on the final indicator, the number of public-private collaborative papers per capita.

⁶ K. Klincewicz, M. Marczevska, K. Szkuta, RIO Country Report 2017: Poland, 2018.

⁷ https://eacea.ec.europa.eu/national-policies/eurydice/content/national-reforms-higher-education-50_en.

Poland's score here was a fraction of the EU-28 score. On the two complementary indicators, Poland positioned itself in Cluster 3.

The propensity of Polish firms to cooperate with governmental, public or private research institutions has increased since the last ERA monitoring exercise, outpacing by about three percentage points the growth among fellow Member States overall. Collaboration between the private sector and universities or other higher education institutions has basically remained unchanged in recent years, as was the case for the EU-28. Poland's scores on complementary indicators decreased in recent years, within roughly three percentage points of the trend across Member States.

Qualitative analysis also revealed that a number of important policy developments and actions were taken in Poland over the last years in the area of knowledge transfer. In 2016 the first Polish law of Innovation⁸ and in 2017 the second law of Innovation⁹ have been adopted in Poland: both regulations implemented series of changes that stimulate cooperation between science and business sectors. One of the key changes brought by these laws were the tax benefits for R&D expenditures, which made Poland a country with some of the highest tax benefits for research and innovation activities conducted by enterprises (100% and in some cases 150% of tax benefits for R&D expenditures). In addition, technology transfer procedures were simplified at the level of public research organisations, which made it easier for scientists and entrepreneurs to cooperate on technology transfer.

In 2017, the two main Polish research funding organisations NCBR and PARP introduced funding instruments targeted at applicants of Horizon 2020 SME Instrument, who earlier received "Seal of Excellence" (passed the threshold but did not received the H2020 funding in this call).¹⁰ These instruments should contribute to the expansion of innovative companies and knowledge transfer in the country. An important contribution towards knowledge transfer is also the Draft Act on Research Network: Łukasiewicz, which was adopted in 2017 and which intends the introduction of a wide-ranging reform of public research institutes in Poland¹¹. The new network will be a quasi-holding structure, with 36 PROs and about 8000 employees. According to this reform, PROs in the network will no longer be supervised by sectoral ministries: central management, optimisation of administrative resources and research infrastructures will likely facilitate the pursuit of cross-institute projects and increase knowledge transfer, including that between PROs and industry.

b. Open access

Poland obtained its best performances on the OA indicators for its share of Gold OA papers, which was 33 %. This score compared to 30 % for the EU-28 benchmark and it positioned the country in Cluster 2. Gaps in performance were found for Total OA papers (the headline indicator) and Green OA papers, with scores that placed the country below the ERA average (Cluster 3). On the last indicator, the share of life science papers with OA datasets, the country scored below the EU-28 benchmark but above the ERA average (Cluster 2). On this last indicator, Poland has seen stark yearly average increases in scores that are more than 25 percentage points above the EU-28 trend. If trends for the country and the 28 Member States remain stable, Poland will close its gap in performance compared to the EU-28 level in the very short term.

In 2015 a document has been published in Poland encouraging research organisations to adopt open access measures ("the Directions for Developing Open Access to Scientific Contents"). The document contained recommendations to ensure open access to publications based on public R&D funding, with the main research funding agencies including relevant provisions in their funding agreements and tracking their implementation by beneficiaries. The document encouraged HEIs and research organisations to establish institutional repositories, preserving scientific publications

⁸ "The president signed the law on innovation", <http://scienceinpoland.pap.pl/en/news/news%2C412153%2Cthe-president-signed-the-law-on-innovation.html>.

⁹ Projekt ustawy o zmianie niektórych ustaw w celu poprawy otoczenia prawnego działalności innowacyjnej, <https://legislacja.rcl.gov.pl/projekt/12298150>

¹⁰ Granty dla Seal of Excellence, <https://poir.parp.gov.pl/granty-dla-seal-of-excellence/ogloszenie-o-konkursie-do-poddzialania-2-4-1-w-2017-r>.

¹¹ Projekt ustawy o Sieci Badawczej: Łukasiewicz (poprzednio: projekt ustawy o Narodowym Instytucie Technologicznym), <https://legislacja.rcl.gov.pl/projekt/12297460>.

and to grant open access to research data.¹² Since then a number of workshops and seminars have been conducted in the country to familiarise research organisations with OA. However, there is still no legal requirement to publish research results resulting from public funding in OA mode.

6. International cooperation

Poland's share of high & medium technology products among its product exports was 49%, below the EU-28 benchmark of 57% but above the ERA average (Cluster 2). The country fared less well on other indicators in this priority. Gaps in performance to the EU-28 benchmarks were measured between 40% and 90%. The country's propensity to publish collaborative papers with researchers from countries outside the ERA, as well as its share of knowledge-intensive service exports, placed it in Cluster 3. It fell in Cluster 4 for its share of doctoral students coming from outside the EU.

The stark gap in performance to the EU-28 reported for its share of doctoral students from outside the EU nonetheless amounted to an improvement over the findings obtained in the last ERA monitoring exercise. On this indicator, Poland saw yearly average increases of more than 8%, 4.5 percentage points above the EU-28 trend. Modest changes in scores on the other indicators were not far removed from the EU-28 trajectories (within two percentage points above or below), sustaining Poland's position relative to its fellow Member States.

In 2017 a National Agency for Academic Exchange (NAWA) has been established in Poland¹³: it is the governmental agency that deals with academic exchange and manages various programmes and actions aimed at stimulating this exchange. The new agency will offer inbound and outbound mobility scholarships and introduce measures stimulating international cooperation of Polish scientists. In general, interviews with key policy making stakeholders revealed that Poland's research cooperation with third countries has increased over the last years. One of the key reasons for this is that the criteria for evaluation of research institutions have been changed in 2015 and amended in 2017: having cooperation with third countries in terms of visiting professors, common projects and programmes are now much more emphasised and valued in the new institutional evaluation algorithm.

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Krzysztof Klincewicz, Katarzyna Szkuta, RIO Country Report 2015: Poland, 2016.

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¹² Krzysztof Klincewicz, Katarzyna Szkuta, RIO Country Report 2015: Poland, 2016.

¹³ http://orka.sejm.gov.pl/proc8.nsf/ustawy/1550_u.htm.

Country profile: Poland

ANNEX: METHODOLOGICAL NOTES

	Indicator		Flag							
	Name	Data availability	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			2012					
	EIS Summary Innovation Index (SII)	Available								
Priority 2	A - GBARD to transnatl coop (EUR/researcher)	Available	2015	2013-15						
	A - Collab papers w/ERA per 1 000 researchers	Available	2015	2013-15						
	A - Public-to-public partnerships (EUR/researcher)	Available	2015	2013-15						
	B - Roadmap for ESFRI projects									
	B - Participation in ESFRI projects and landmarks (combined)	Available								
	<i>B - Participation in developing ESFRI projects</i>	Available								
	<i>B - Participation in operational ESFRI landmarks</i>	Available								
Priority 3	EURAXESS job ads per 1 000 researchers	Available	2015	2013-15						
	Open, transparent, merit-based hiring process	Available								
	Share of doctoral students from EU countries	Available				2014				
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								
	<i>A - Firms coop with univ</i>	Available								
	<i>A - Firms coop with gov, res inst</i>	Available				2012				
	A - Share of public R&D funded privately	Available				2009-10			2007	2011, 2013-15
	A - Public-private collab papers per capita	Available								
	B - Share of papers in Open Access (Total)	Available								
	<i>B - Share of papers in Open Access (Gold)</i>	Available								
<i>B - Share of papers in Open Access (Green)</i>	Available									
	B - Share life science papers with OA dataset(s)	Available								
Priority 6	Collab papers w/non-ERA per 1 000 researchers	Available	2015	2013-15						
	Share of doctoral students from outside EU	Available				2014				
	Share med & high tech product export	Available								
	Share Knowledge intensive service export	Available								

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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