European Commission

EUROPEAN RESEARCH AREA

Progress Report 2018

Country Profile

SERBIA

Research and Innovation

EUROPEAN COMMISSION

Directorate-General for Research and Innovation
Directorate A — Policy Development and Coordination
Unit A2 — Research and Innovation Strategy

Contact: *Arie Van Der Zwan*
E-mail: *Arie.VAN-DER-ZWAN@ec.europa.eu*
RTD-PUBLICATIONS@ec.europa.eu

European Commission
B-1049 Brussels

Luxembourg: Publications Office of the European Union, 2019.

PDF ISBN 978-92-79-99816-4 doi:10.2777/153273 KI-01-19-109-EN-N

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**	**15.2**	**3**	**-66**	**45.0**	**2013-16**	**2.6%**	**-0.6**	**3.2%**	
	GBARD as share of GDP	2017	0.40%	3	-36	0.63%	2014-17	-1.1%	0.5	-1.7%	
	EIS Summary Innovation Index (SII)	2017	0.335	3	-34	0.504	2015-17	-3.0%	-4.9	1.9%	
Priority 2	**A - GBARD to transnatl coop (EUR/researcher)**	**2016**	***101***	**4**	**-97**	**3,739**	**2014-16**	**:**	**:**	**3.9%**	
	A - Collab papers w/ERA per 1 000 researchers	2016	35	4	-51	71	2014-16	-2.0%	-5.3	3.3%	
	A - Public-to-public partnerships (EUR/researcher)	2016	:	:	:	558	2014-16	:	:	0.7%	
	B - Roadmap for ESFRI projects	**No national roadmap in place**									
	B - Participation in ESFRI Projects and Landmarks (combined)	**2018**	**7%**	**3**	**-79**	**35%**	**2016-18**	**34.8%**	**19.8**	**15.0%**	
	B - Participation in developing ESFRI Projects	2018	6%	3	-81	29%	2016-18	:	:	18.6%	
	B - Participation in operational ESFRI Landmarks	2018	8%	3	-78	37%	2016-18	8.4%	-2.8	11.3%	
Priority 3	**EURAXESS job ads per 1 000 researchers**	**2016**	**0.2**	**3**	**-100**	**42.1**	**2014-16**	**-49.5%**	**-44.5**	**-5.0%**	
	Open, transparent, merit-based hiring process	2016	:	:	:	65%	2012-16	:	:	7.5%	
	Share of doctoral students from EU countries	2016	*0.4%*	3	-94	7.1%	2013-16	*30.9%*	27.0	3.9%	
Priority 4	**Share of women among Grade A in HES**	**2016**	**:**	**:**	**:**	**24%**	**2014-16**	**:**	**:**	**1.0%**	
	Gender dimension in research content	2014-17(R)	0.81	3	-23	1.05	2011-14 to 2014-17(R)	-17.0%	-19.5	2.5%	
	Share of female PhD graduates	2016	55%	2	15	48%	2013-16	*6.9%*	6.4	0.4%	
Priority 5	**A - Firms coop with univ, gov, res inst**	**2014**	**13.2%**	**3**	**-12**	**15.0%**	*Not computed*				
	A - Firms coop with univ	**2014**	*Not computed*				**2012-14**	**138.8%**	**138.2**	**0.7%**	
	A - Firms coop with gov, res inst	**2014**	*Not computed*				**2012-14**	**:**	**:**	**4.0%**	
	A - Share of public R&D funded privately	2015	6.1%	3	-12	7.0%	2013-15	-12.3%	-11.1	-1.2%	
	A - Public-private collab papers per capita	2017	4.5	3	-89	40.9	2014-17	*-21.3%*	-21.8	0.4%	
	B - Share of papers in Open Access (Total)	**2016**	**43.0%**	**3**	**-13**	**49.3%**	*Not computed*				
	B - Share of papers in Open Access (Gold)	**2016**	**32.9%**	**2**	**9**	**30.2%**	*Not computed*				
	B - Share of papers in Open Access (Green)	**2016**	**21.9%**	**3**	**-33**	**32.5%**	*Not computed*				
	B - Share life science papers with OA dataset(s)	2017	1.0%	4	-62	2.6%	2013-17	31.3%	28.7	2.6%	
Priority 6	**Collab papers w/non-ERA per 1 000 researchers**	**2016**	**16**	**4**	**-71**	**54**	**2014-16**	**-1.0%**	**-5.3**	**4.4%**	
	Share of doctoral students from outside EU	2016	*6.1%*	3	-56	13.9%	2013-16	*14.2%*	10.4	3.8%	
	Share med & high tech product export	2017	*45%*	3	-21	57%	2015-17	*0.1%*	-0.4	0.4%	
	Share Knowledge intensive service export	2016	*48%*	3	-31	69%	2014-16	*3.6%*	2.9	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

Serbia saw its best performances on Priority 4 (Gender equality and gender mainstreaming in research), with scores above (Cluster 2) and below (Cluster 3) the ERA average.

In a second group of priorities, Serbia saw scores that either placed the country below ERA average (Cluster 3) or a combination of scores above (Cluster 2), below (Cluster 3) and well below (Cluster 4) the average. Priority 1 (More effective national research systems), Priority 2b (Make optimal use of public investments in research infrastructures), Priority 3 (An open labour market for researchers), Priority 5a (Knowledge transfer), Priority 5b (Open access) and Priority 6 (International collaboration) fell under this description.

Serbia's comparatively weakest performances were observed on Priority 2a (Transnational cooperation). Its scores here were well below the ERA average (Cluster 4).

Serbian national research and innovation strategies are aligned with European level policies and goals. Usually most of the national documents are structured according to six ERA priorities. Nevertheless, the implementation of national objectives that are aligned with European level policies and goals is not smooth. For a successful implementation new legislative and policy initiative are needed. Thus, qualitative data shows that concurrently progress is in a stalemate.

1. More effective national research systems

Serbia's GBARD as a share of GDP was 0.40 %, compared to the EU-28 benchmark of 0.63 %. Put differently, Serbia's score was 36 % less than the EU-28 benchmark. Serbia was similarly about 35 % behind the EU-28 level on the EIS Summary Innovation Index (SII), and further behind that level on the headline indicator, the Adjusted Research Excellence Indicator (AREI). Scores across the indicators here positioned the country in Cluster 3.

Small annual increases in AREI scores saw Serbia's trajectory follow its EU-28 counterpart since the last ERA monitoring exercise. On GBARD as a share of GDP, Serbia's annual decrease was on average 1 %, slightly flatter than the downwards EU-28 trend (-1.7%). For the SII, the country's CAGR was a -3 %, almost five percentage points below the small annual increases at the EU-28 level.

Serbia has progressed in enhancing excellence and relevance of its national scientific research system. Strategy on Scientific and Technological Development of the Republic of Serbia for the period 2016 – 2020 was adopted and a new system of funds allocation for project financing will be introduced[1]. Of the total funds at least 20% will be allocated to finance direct material costs of research. It is expected that due to this measure the quality of research will be enhanced.

Serbia demonstrates willingness to adopt various funding mechanisms to enhance the quality of its research system. In the new Strategy for Research and Innovation[2] there is an objective to apply international peer review mechanism. The mechanism was already used in allocating research funds in two calls for proposals at national level. In addition, in the Strategy for Research and Innovation the principle of competitive funding through institutional assessment is mentioned as one of key objectives as well. In the meantime, at the end of 2018 the Law on Science Fund has been adopted and establishes new institutions in Serbian Research and Innovation sector that will run competitive funding.

2. Optimal transnational co-operation and competition

[1] Strategy on Scientific and Technological Development of The Republic of Serbia for the Period 2016 – 2020 – Research for Innovation. Accessed: http://www.mpn.gov.rs/wp-content/uploads/2015/08/Strategija-engleski-jezik.pdf.

[2] Ministry of Education, Science and Technological Development (2016) Research for Innovation: Strategy on Scientific and Technological Development of the Republic of Serbia for the period 2016 – 2020.

a. Transnational cooperation

This priority is where Serbia obtained its weakest performances. A total of 35 collaborative papers produced together with researchers from other ERA countries (per 1 000 researchers) were found for the country in 2016, half the EU-28 benchmark. This score placed the country well below the EU-28 average (Cluster 4). Performance on the headline indicator, GBARD allocated to transnational cooperation, was more than an order of magnitude below the EU-28 benchmark, again positioning the country in Cluster 4.

Trends on yearly changes in score could only be computed for the propensity to publish collaborative papers with researchers from other ERA countries. Serbia's gap to EU-28 performance on this indicator grew slightly since the last ERA monitoring exercise, with a CAGR five percentage points below the Member States' overall trend.

Qualitative data reveals that Serbia's performance regarding transnational cooperation is increasing. Serbia continues to be active and successful in the EU research programme Horizon 2020 as well as in EUREKA, COST and the NATO Science and Peace for Security programmes. The number of early-stage or experienced researchers participating in Marie Skłodowska-Curie Actions has increased steadily over the last years, counting a total of 126 funded talented researchers since 2014[3]. However, research and innovation sector in Serbia is not fully integrated into the European Research Area and there is lack of national researchers' participation in international projects.

b. Make optimal use of public investments in research infrastructures

In 2018, Serbia participated in 8 % of ESFRI Landmarks and 6 % of developing Projects. Both scores placed the country in Cluster 3 and were roughly a fifth of their respective EU-28 benchmarks. Looking at results for 2016, Serbia's participation rates were null for developing Projects and 7 % for Landmarks. On the combined indicator, Serbia registered growth that exceeded the EU-28 trend. Put differently, the country's annual increases in ESFRI participation have outpaced those at the EU-28 level, and it has therefore reduced some of its previous gaps in performance to Member States.

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.

Serbia has adopted national ESFRI Research Infrastructure Roadmap in December 2018. In its current form the National roadmap for research infrastructure is aligned with ESFRI roadmap. Additionally, Serbia has compiled a partial inventory of existing equipment[4].

3. An open labour market for researchers

Serbia's scores in this priority were fractions of the EU-28 benchmark, putting the country in Cluster 3 for EURAXESS usage and for doctoral students from other EU countries (with Cluster 3 being the bottom clusters for both indicators, as no Cluster 4 was defined for either one). Serbia's score on the headline indicator, the number of EURAXESS academic job ads per 1 000 researchers, fluctuated very strongly from year to year, with a sharp annual decrease of almost 50 % computed as the average change; as a result, Serbia's gap to the Member States overall grew since the last ERA monitoring exercise. This indicator has seen strong yearly fluctuations in scores, however, and the trend observation should therefore be substantiated with upcoming datapoints. For its share of doctoral students coming from other EU countries, Serbia saw sustained annual increases in score, measured at 27 percentage above the EU-28 trend, helping to start addressing its notable gap to the level of the Member States overall. No data was available on the views of Serbian researchers regarding the fairness of hiring practices.

[3] Commission Staff Working Document (2018) Serbia Report Accompanying the document Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions 2018 Communication on EU Enlargement Policy.
[4] Western Balkans agree to step up the work on research infrastructure http://www.gov.me/en/search/193172/Western-Balkans-agree-to-step-up-the-work-on-research-infrastructure.html?AccessibilityFontSize=150.

The Ministry of Education, Science and Technological Development, together with the Bridgehead Organisation, organised 'info days' to promote the Charter and Code[5]. Research institutions are motivated to develop their own Human Resource strategy. In Serbia since 2014, four institutions had signed declarations of endorsement of the Charter and Code. Moreover, the job ads are regularly published on EURAXESS job portal, throughout four years there has not been a major increase or decrease in in the number of adds.

There is no information regarding the implementation of Mobility for Better Learning strategy and no data was available regarding the measure to increase the number of PhD students in non-academic sector and the number of foreign students in doctoral and other academic studies

4. Gender equality and gender mainstreaming in research

Serbia displayed a share of 55 % of female PhD graduates, well above the EU-28 score of 48 %. This performance positioned Serbia in Cluster 2 and represented Serbia's greatest strength relative to EU-28 levels. The country obtained a score below the EU-28 benchmark for its inclusion of gender dimension in research content, placing the country in Cluster 3. Performance and progress since the last ERA monitoring exercise on the headline indicator, the share of women in Grade A positions in the higher education system, could not be computed for Serbia.

Serbia has increased its lead in performance to Member States when it comes to shares of female PhD graduates. Annual average increases were close to 7 % for the country, more than six percentage points above the almost flat EU-28 trend. Yearly decreases in scores were seen for inclusion of gender dimension in research content, measured at 17 % on average. This CAGR was almost 20 percentage points below the moderate, upward trajectory recorded for the EU-28, causing Serbia to trail even further behind the Member States since the last ERA monitoring exercise.

Minor progress has been made regarding gender equality in research. The government of Serbia adopted the new National Strategy for Gender Equality for the period 2016-2020[6]. In the strategy budgeting at the national level will be implemented in accordance with the Gender Budgeting Guidelines. Furthermore, the strategy indicates that the gender and minority rights will be improved at all levels of decision-making bodies by adopting a new set of law. However, no further specifications are provided.

Overall, Serbia does not have concrete measures to support women in top-level positions in research, technology and innovation sector. However, the government supports advancement of women in the economy through the National Strategy for the Advancement of Women and Promoting Gender Equality adopted in 2009 and its Action Plan to implement the National Strategy for the Advancement of Women and Gender[7].

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

a. Knowledge transfer

On the headline indicator for this priority, the share of firms cooperating with either universities or higher education institutions, or with governmental, public or private institutions, a score of 13 % was found for Serbia, below the EU-28 benchmark of 15 %. The country had a 6 % share of public R&D funded privately, again below the EU-28 score of 7 %. Public-private collaborative papers per capita numbered nearly 5 units in 2017, compared to 41 for the 28 Member States taken together. These performances consistently placed the country in Cluster 3.

Serbia has seen strong annual increases in firm cooperation with universities and higher education institutions since the last ERA monitoring exercise. Caution may be warranted with yearly average increases of almost 140 %; although no formal warning has been found for this

[5] Deloitte (2013) Researchers' Report Country Profile: Serbia.
[6] National Gender Equality Strategy for the period from 2016 to 2020 With action plan for the period from 2016 to 2018: https://www.rodnaravnopravnost.gov.rs/sites/default/files/2016-12/Nacionalna%20strategija%20za%20rodnu%20ravnopravnost%20%282016-2020%29%20sa%20Akcionim%20planom_1.doc.
[7] Deloitte (2014) Researchers Report Country profile: Serbia.

dataset, even if correct such a level of increase is unlikely to be sustainable over an extended timeframe. Serbia's gaps to EU-28 performance on the two complementary indicators have widened over the same period, however. Here, Serbia's CAGRs were both negative, in addition to being 10 to 20 percentage points below the EU-28 trends, which were close to flat.

Regarding the monitoring system the Strategy for Research and Innovation addresses the need for it, nevertheless, no significant actions to establish the system are visible today.

Qualitative data reveals that key bottleneck of Serbian research system is the detachment of industry and academia. However, during the period 2016-2018 some progress has been made to enhance business academia collaboration. One of the objectives mentioned in Strategy on Scientific and Technological Development of the Republic of Serbia for the period 2016 – 2020 is to strengthen the links between science, economy and society with an overall aim to encourage innovation. Currently, there are several national policies aimed at facilitating collaboration between public and private sectors. For instance, in order to strengthen the links, joint innovation projects of the private sector and science research organisations were established. In addition, Collaborative Grant Scheme Program aims to incentivise private-sector companies and public-sector R&D organizations to engage in joint scientific research and development projects with the goal of creating new commercially viable products and services, as well as innovative precompetitive technologies with significant future impact and market potential. Within the Innovation Fund (functioning since 2016) operates a specialized unit - the Technology Transfer Facility with an objective to help local TTOs and R&D organizations to identify research with commercial potential and focus on the transactional aspect of technology transfer. Overall, several new instruments have been introduced to boost business-academia collaboration since the last assessment. Some initiatives were made at the grass-root organisation level as well. For instance, Belgrade Science and Technology Park that was established by the Serbian government, city of Belgrade and University of Belgrade. More than attracting investments of foreign companies, the Belgrade Science and Technology Park provides attractive conditions for domestic innovative companies and hosts a successful business and technology incubator.

b. Open access

Serbia's 33 % share of scientific papers published in 2016 and available in Gold OA was above the EU-28 benchmark of 30 %. This score placed the country in Cluster 2. The country had a score of 43 % on the headline indicator: share of papers available in Total OA – that is, irrespective of the access modality. This level was below the EU-28 score of 49 % and below the ERA average (Cluster 3). Much the same pattern was found for Green OA. For its share of life science papers with an OA dataset, Serbia scored 60 % lower than the EU-28 benchmark, placing well below the ERA average (Cluster 4). On this last indicator, however, the country has substantially reduced its gap to EU-28 performance since the last ERA monitoring exercise, with a CAGR of 31 % that was well above the EU-28 trend.

In 2018 Serbia has adopted a national science policy 'Open Science Platform'. According to the document universities and research institutes shall define and adopt their open science platforms within six months, in accordance with this platform. Progress and compliance will be monitored by the ministry.

Another example of Serbia's performance regarding open access priority is BE-OPEN (Boosting Engagement of Serbian Universities in Open Science) project funded under the Erasmus+ Capacity Building in Higher Education action. The project is coordinated by the University of Novi Sad. The main objective of the project is to develop conditions for the implementation of the core principles of Open Science at universities in Serbia[8].

6. International cooperation

Serbia achieved a 45 % share of medium and high technology products as part of product exports, below the EU-28 benchmark of 57 %. Its share of knowledge-intensive services exports was 48 %, compared to an EU-28 score of 69 %. In both cases, Serbia placed in Cluster 3. The country's share of doctoral students from outside the EU was nearly half that of the 28 Member States, at 6 % (compared to 14 %). Here again, the country positioned itself in Cluster 3. On the

[8] Boosting engagement of Serbian universities in open science, see http://www.beopen.uns.ac.rs/project.php.

headline indicator, the propensity to publish papers with researchers from countries outside the ERA, Serbia recorded 16 such papers per 1 000 researchers. This score was about a quarter of the EU-28 benchmark and placed the country in Cluster 4.

Serbia made notable strides in reducing its gap to EU-28 performance for its share of doctoral students hailing from outside the EU. With a CAGR of 14 %, it was 10 percentage points above the Member States' overall trend. Slight growth above the EU-28 trajectory was also found on share of knowledge-intensive service exports. A flat CAGR aligned with a flat EU-28 trajectory for the share of medium and high technology products among product exports. On the headline indicator, Serbia witnessed an increase of its gap to EU-28 performance, with roughly stable scores on average resulting in a CAGR five percentage points below the Member States' combined progress.

The Republic of Serbia runs bilateral cooperation programmes with several countries (Belarus, China, Croatia, France, Germany, Hungary, Slovakia, Slovenia and Switzerland). This has resulted in the co-financing of R&D projects carried out by teams consisting of researchers from both countries.

Progress has been made regarding the further enhancement of international cooperation in the field of science and innovation. Even though, no data is available regarding the planed establishment of advisory body for better cooperation and policy implementation and no progress has been made in adopting Capacity Raising Program, currently there are some specific national level measures implemented that aim to enhance international cooperation. For instance, an intensive support campaign (info days, workshops, technical support, consultations with national contact points,) for researchers is running. Additionally, it is aimed to enhance the cooperation with the Joint Research Centre of the EC, especially in the development of smart specialisation strategy, exchange of information, access to databases and support to the process of accession to the EU[9].

References

Commission Staff Working Document (2018) Serbia Report Accompanying the document Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions 2018 Communication on EU Enlargement Policy.

Deloitte (2013) Researchers Report Country Profile: Serbia.

Deloitte (2014) Researchers Report Country profile: Serbia.

Boosting engagement of Serbian universities in open science http://www.beopen.uns.ac.rs/project.php.

Western Balkans agree to step up the work on research infrastructure: http://www.gov.me/en/search/193172/Western-Balkans-agree-to-step-up-the-work-on-research-infrastructure.html?AccessibilityFontSize=150.

National Gender Equality Strategy for the period from 2016 to 2020 With action plan for the period from 2016 to 2018 https://www.rodnaravnopravnost.gov.rs/sites/default/files/2016-12/Nacionalna%20strategija%20za%20rodnu%20ravnopravnost%20%282016-2020%29%20sa%20Akcionim%20planom_1.doc.

European Commission (2015) Screening report Republic of Serbian – Science and Research.

[9] Strategy on Scientific and Technological Development of The Republic of Serbia for the Period 2016 – 2020 – Research for Innovation, accessed: http://www.mpn.gov.rs/wp-content/uploads/2015/08/Strategija-engleski-jezik.pdf.

Strategy on Scientific and Technological Development of The Republic of Serbia for the Period 2016 – 2020 – Research For Innovation. Accessed: http://www.mpn.gov.rs/wp-content/uploads/2015/08/Strategija-engleski-jezik.pdf.

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	2014							
	A - Collab papers w/ERA per 1 000 researchers	Available								
	A - Public-to-public partnerships (EUR/researcher)	Unavailable								
	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								
	Open, transparent, merit-based hiring process	Unavailable								
	Share of doctoral students from EU countries	Available	2015	2013-15						
Priority 4	**Share of women among Grade A in HES**	Unavailable								
	Gender dimension in research content	Available								
	Share of female PhD graduates	Available		2014-16						
Priority 5	**A - Firms coop with univ, gov, res inst**	Available								
	A - Firms coop with univ	Available								
	A - Firms coop with gov, res inst	Unavailable								
	A - Share of public R&D funded privately	Available			2014					
	A - Public-private collab papers per capita	Available		2015-17						
	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								
	Share of doctoral students from outside EU	Available	2015	2013-15						
	Share med & high tech product export	Available	2016	2014-16						
	Share Knowledge intensive service export	Available	2015	2013-15						

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 ([10]). 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 ([11])), 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

[10] 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).

[11] Refer to the 2018 ERA Monitoring Handbook for the extraction dates of the presented data.

indicator where short-term fluctuations were particularly pronounced (gender dimension in 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 ([12]); 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

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

doctorate students (Priority 6). Additional modifications in the approach used in computing EU-28 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.

KI-01-19-109-EN-N

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.

Research & Innovation policy

Publications Office

ISBN 978-92-79-99816-4
doi:10.2777/153273