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Implementing Smart Specialisation Strategies

Analysis of the Role of Regional Strategies in National Innovation Strategies

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Contents

Abstract

The report analyses the progress of Member States in the implementation of national and regional smart specialisation strategies (RIS3) in 2017 through an assessment of policy developments, progress in implementation of the different strategies, monitoring mechanisms and observed impacts. Using publicly available data as well as an expert survey, the analysis shows that in most countries RIS3 processes have been conducted at both national and regional levels. The use of thematic priorities for research and innovation, engaging stakeholders and opening up to bottom-up initiatives often implied a radical change to previous policymaking practices. An analysis of RIS3 indicators suggests that a proper 'priority taxonomy' is lacking, raising doubts whether countries and regions are truly selective in setting priorities, whether they align the priority setting process between the national and regional level and whether the resulting set of priorities is really a factor of differentiation for countries and regions. The impact of RIS3 as a policy paradigm appears more pronounced among the moderate and modest innovators. The report concludes by highlighting the need for more granular indicators to analyse RIS3 priorities as well as their implementation and impact.

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Executive summary

Policy context

Smart specialisation (RIS3) is a placed-based policy approach aiming to boost Europe's innovative potential by enabling each region to identify and develop its own competitive advantages. It is based on an entrepreneurial discovery process and the selection of a limited number of thematic priorities, allowing policy makers to address emerging opportunities and market developments in a coherent manner, while avoiding duplication and fragmentation of efforts across regions. The Smart Specialisation Strategies may take the form of, or be included in, a national or regional research and innovation (R&I) strategic policy framework. The adoption of national and/or regional Smart Specialisation Strategies was a formal requirement for allocating R&I budgets from the European Structural and Investment Funds.

The objective of the present report is to analyse the progress of Member States in the implementation of national and regional smart specialisation strategies, in particular by means of an assessment of new policy developments, the progress of implementation of the different strategies, the monitoring mechanisms and observed impacts. This assessment mainly relied on the information contained in the Research and Innovation Observatory (RIO) country reports 2017 and through a survey conducted among the RIO network experts. This input was complemented by data gathered through the Eye@RIS3 platform, the European Innovation Scoreboard 2017 and the Regional Innovation Scoreboard (2017).

Main findings

The analysis of governance and coordination mechanisms shows that in most countries, RIS3 processes have been conducted at both national and regional levels. The setting-up of thematic priorities for research and innovation, engaging stakeholders and opening to bottom-up initiatives has often meant radical change comparing to previous policymaking practices. In many countries, RIS3 processes have initiated the discussions about the role of regional or even lower levels of governance in research and innovation policy as well as relations between them and national level. However, cutting across the different analyses of RIS3 indicators, it appears that a proper 'priority taxonomy' is lacking in order to assess whether countries and regions are truly selective in setting priorities, whether they align the priority setting process between the national and regional level and whether the resulting set of priorities is really a factor of differentiation for countries and regions. The available evidence does suggest a weak differentiation of priorities across Member States, although the lack of fine-grained indicators does not allow drawing clear conclusions. Taking stock of the effect of RIS3 on innovation policy in different member states, a fairly clear pattern emerges. The impact both at regional and national level has been fairly low among innovation leaders and strong innovators. The impact of RIS3 as a policy paradigm is much more pronounced among the moderate modest innovators. In most countries, it appears that publicly funded interventions based on RIS3 are designed as a series of individual projects rather than as a coherent portfolio of related and complementary projects generating critical mass and synergy effects. A shift towards a mission-oriented policy addressing specific challenges may help to overcome R&I fragmentation and build EU-wide capacity in related R&I areas.

Related and future JRC work

The present report suggests several venues for future research. The data analysed indicates innovation leaders, both at national and regional level, are the most selective in setting priorities in terms of sectors, scientific fields and policy objectives. Differently, moderate and modest innovators focus on average on a higher number of RIS3 priorities. Building a comparative advantage is not a mechanistic process, so countries and regions may want to keep their options open by not focusing on a relatively narrow set of priorities and by allowing for the exploitation of complementarities between priorities. Despite the plausibility of the aforementioned arguments, future research will have to confirm these results on selectivity of priorities and the underlying mechanisms in the development of RIS3.

In addition, a recommendation that manifestly comes forward from the analysis presented in this report relies on the need to develop more granular indicators to analyse RIS3 priorities and the progress in their implementation as well as to measure their impacts. With such an improved indicator set, more accurate analyses of genuine regional competitive advantages could be carried out.

1 Introduction

The Smart Specialisation approach, based on the Entrepreneurial Discovery Process (EDP) and the selection of a limited number of thematic priorities, allows policy makers to address emerging opportunities and market developments in a coherent manner, while avoiding duplication and fragmentation of efforts. The Smart Specialisation Strategy may take the form of, or be included in, a national or regional research and innovation (R&I) strategic policy framework. The adoption of national and/or regional Research & Innovation Smart Specialisation Strategies (RIS3)[1] was a formal requirement (the so called *ex-ante* conditionality) for allocating R&I budgets from the European Structural and Investment Funds (ESI Funds) (EC, 2014).

The RIS3 should be implemented through a roadmap, with an effective action plan including pilot projects that allow for a degree of experimentation. The progress of implementation should be monitored and evaluated. The goal of monitoring is to verify that activities are planned, funds are correctly used and spent on delivering planned outputs and that result indicators evolve in the desired direction. The goal of evaluation is to assess effects of the actions undertaken and to understand why and how the effects are being achieved. Formulating and implementing national or regional smart specialisation strategies is a continuous process, which should take advantage of information and insights gathered during the implementation phase (EC, 2012).

The objective of the present report is to analyse the progress of Member States in the implementation of national and regional smart specialisation strategies (as captured in "RIS3 documents", the term used in the remainder of the report), in particular by means of an assessment of new policy developments, the progress of implementation of the different strategies, the monitoring mechanisms and observed impacts**.** The report uses the term "RIS3 documents", because in some countries RIS3 are part of broader strategies or documented elsewhere. The report approaches RIS3 mainly from the national perspective of RIS3 in order to better understand how the national and regional governance level not only differ, but also how they may complement each other. In order to address the state of affairs regarding EU Member States' progress in implementing RIS3 documents, the report relies on several data sources, primarily the RIO (EU Research and Innovation Observatory) Country Reports and a survey conducted among the RIO Network Experts in December 2017. These data are complemented with additional sources, such as the Eye@RIS3 platform and innovation performance metrics drawn from the European Innovation Scoreboard (EIS 2017) and Regional Innovation Scoreboard (RIS 2017). Detailed information about the data sources, data collection and analysis procedures is presented in Annex 2.

The report is organised as follows. The present Section offers an introduction, explaining the objective and structure of the document. Sections 2 to 4 present the results of analyses concerning governance and coordination, priority-setting processes (i.e. the EDP) and funding. Sections 5 to 7 discuss new policy developments, progress of implementation, monitoring mechanisms and evidence of impact. Section 8 summarises the main results from the analyses and challenges related to the implementation of RIS3 documents.

[1] In the report we use the term RIS3, which is the most popular in relevant literature. Nevertheless, RIS3 refers to national and/or regional Smart Specialisation Strategies.

2 Governance and coordination

2.1 Level of governance for RIS3

A RIS3 could be designed, implemented and monitored at national and/or regional levels. The role of the regional level in designing and implementing the RIS3 is broadly discussed and acknowledged by most EU documents, guidelines and research papers. In some countries, the design and implementation of the RIS3 documents have focused on the regional level, but in most countries these processes have been conducted at both national and regional levels. In order to analyse Member States' heterogeneous approaches to RIS3, this report disentangles Member States by the level at which they have implemented RIS3 (national level only, regional level only, or combination of both) and by their innovation performance (based on the EIS 2017). The distribution is shown in Table 1, which includes the 28 Member States that were included in the RIO Network Experts' survey. Note that it is not always straightforward to unambiguously classify a country in terms of the level(s) at which it has RIS3 documents. For example, some countries have only one national Operational Programme (and are thus subjected to the thematic smart specialization ex-ante conditionalities), but develop their RIS3 documents at both the national and/or regional levels. The classification in Table 1 is an assessment that takes into account multiple sources, namely the RIO Network Experts' survey used as part of this report, the report on the implementation of ex-ante conditionalities (European Commission, 2016) and the Eye@RIS3 database[2].

Table 1. *Distribution of countries by the level of their RIS3 strategy and innovation performance*

	Country innovation performance (EIS 2017)				
Level of RIS3 strategy	Innovation Leader	Strong Innovator	Moderate Innovator	Modest Innovator	Total
Primarily or only at national level	0	3 (IE, LU, SI)	9 (CY, CZ, EE, HR, HU, LT, LV, MT, SK)	2 (BG, RO)	14
National and regional level	3 (DK, FI, SE)	1 (AT)	5 (EL, ES, IT, PL, PT)	0	9
Primarily or only at regional level	3 (DE, NL, UK)	2 (BE, FR)	0	0	5
Total	6	6	14	2	28

Sources:
- RIO Experts Survey 2018, European Innovation Scoreboard (EIS) 2017, Eye@RIS3 database (September 2017 version).
- *The implementation of the provisions in relation to the ex-ante conditionalities during the programming phase of the European Structural and Investment (ESI) Funds. Final Report.* Directorate-General Regional and Urban Policy. European Commission, 2016.

Several EU Member States did not define RIS3 documents at regional level, even though the country is divided into more than one NUTS2 entity: BG (6 NUTS2 regions), HR (2), HU (7), IE (2), SK (4) and SI (2). The design and implementation of RIS3 documents on the national level only in relatively larger countries such as BG, HU and SK, might indicate the centralisation of governance, comparably lower capacity or lack of involvement of regional authorities in R&I policy processes. Nevertheless, some regions from these countries are registered in the Eye@RIS3 platform (2 regions from BG, 7 from HU and 1 from SK), but without detailed data or supplementing regional documents. Countries that are comprised of only one NUTS2 region did not develop separate regional strategies (CY, EE, LV, LT, LU, MT). Only 5 Member States have RIS3 documents primarily or exclusively

[2] Besides taking account multiple data sources, some discretionary judgment was applied in classifying the countries in order to allow for fruitful analysis. For example, DE is included in the „primarily regional RIS3" group given that the *Länder* enjoy a fairly large degree of budgetary autonomy when it comes to ESI Funds. Naturally, this classification does not mean that there is no alignment of regional smart specialisation goals with national programmes and national priorities, but the overall process is arguably distinct compared to countries which have a more centralised approach.

at the regional level - among which 2 are classified as "*strong innovators*" and 3 as "*innovation leaders*", as measured in the EIS 2017. Altogether, 23 Member States have national RIS3 documents, 9 of which combine the national documents with regional ones. None of the modest innovators (RO, BG) or moderate innovators (CY, CZ, EE, EL, ES, HR, HU, IT, LT, LV, MT, PL, PT, SK) have RIS3 documents only at the regional level.

Cross-country comparisons are further complicated by the fact that while most RIS3 documents focused on NUTS2 level (AT, FR, EL, IT, PL, PT, RO, ES, UK), some countries engaged in the development of RIS3 documents on the levels of NUTS1 (BE, DE, NL) or NUTS3 (FI, SE).

The regional decomposition was in most cases directly linked to existing administrative structures, with some notable exceptions. In SE, authorities of several NUTS3 regions embarked on joint efforts to develop regional RIS3 for NUTS2 regions that do not have separate administrative structures (North-Middle Sweden, consisting of Värmland, Dalarna and Gävleborg; East-Middle Sweden with Östergötland, Sörmland, Örebro, Västmanland and Uppland), with the definition, implementation and monitoring of RIS3 requiring further cross-regional coordination efforts. In DE, authorities of Baden-Wurttemberg organised an interregional competition (RegioWIN) for areas "located in an inter-municipal context such as a municipal grouping, a county, two counties, a city and its surrounding area or a region according to regional planning" (Häberle, 2016). This approach created opportunities to abandon traditional administrative structures and favour real existing regional interconnections on the basis of development strategies related to smart specialisation. In BG, regions have no administrative or financial autonomy, but the capital city of Sofia developed a RIS3 document at the municipal level and the North Central Region. Severen Tsentralen is involved in a pilot project intended to develop regional RIS3 through a JRC-managed project "RIS3 Support in Lagging Regions", with the lead roles played by municipalities of Ruse and Gabrovo. FI experimented with thematic priorities on municipal levels through the "INKA Innovative City Programme", which was terminated in 2017, and targeted the largest Finnish cities supporting R&I themes identified with the involvement of multiple local stakeholders, albeit not entirely aligned with the recommended RIS3 approach (Business Tampere, 2016).

In some countries there is a tendency to disperse the idea of RIS3 at lower levels of governance than the regional one. The EDP has also been conducted by city councils, provincial governments or county administrations. The tendency of decentralization of RIS3 approach is observed in BE, FI, FR, SE, UK, but also in BG and HU. The last two examples indicate that formal government centralization is confronted with some bottom-up approaches not reflected in centrally managed RIS3 processes and operational programs. Cities and in particular metropolitan areas could play an important role in the processes of designing RIS3 and embedding the EDP into local communities (Rivas, 2016). On the other hand, such activities run the risk of increasing disparities between cities and rural areas. Moreover, policy intervention at multiple levels would require substantial coordination efforts in the R&I system.

While the preceding discussion indicates that a clear-cut division of countries based on RIS3 governance levels is not always possible, the remainder of the report focuses on three distinctive models of RIS3 design and governance[3]:

- Primarily or only regional (BE, DE, FR, NL, UK),
- Primarily or only national (BG, CY, CZ, EE, HR, HU, IE, LT, LV, LU, MT, RO, SK, SI),
- Mixed (AT, DK, EL, ES, FI, IT, PL, PT, SE).

These models tend to correspond to the levels of the implementation of ESI Funds for Research, Technological Development and Innovation (Thematic Objective 1, further referred to as: TO1) in the analysed countries. Generally, regional RIS3 documents are implemented through the dedicated regional operational programs (in the regional and

[3] Classification based on the RIO Network Experts' survey.

mixed models), and national RIS3 documents are enacted by national-level operational programs (in the mixed and national models). Nevertheless, in AT and FI (mixed model), ESI Funds are implemented only through national operational programs. This situation also concerns larger beneficiaries of ESI Funds such as BG, CZ[4], HU[5], RO and SK. The examples of those countries raise the question: what are the implementation mechanisms of the RIS3 documents elaborated at regional or lower levels?

In countries with both national and regional RIS3 documents and operational programs (i.e. IT, PL, PT), the effective introduction of a multi-level governance system remains a challenge, and authorities may face challenges while striving to ensure effective coordination, complementarities and synergies between activities carried out at national and regional levels i.e. find it difficult to establish mechanisms to limit or eliminate unnecessary duplication and fragmentation as well as to strengthen cooperation on common thematic priorities and synergies between policy instruments implemented at different levels. The issue of multi-level governance and alignment of priorities between governance levels is further addressed in sections 2.1, 2.2 and 3.1.

EXAMPLES: Multi-level governance in research and innovation policies among European countries

In BG and HU, the RIS3 documents have only been developed at national levels, despite the fact that BG consists of 6 regions and HU of 7 regions at NUTS2 level. According to the Innovation Strategy for Smart Specialisation of the Republic of Bulgaria 2014-2020 (p. 12): "*During this planning period it is not provided for the development of innovative strategies for smart specialization on regional level (classification NUTS 2), however the needs and challenges at regional level are the basis of this document and a key element in the strategy implementation*". In BG and HU, regional stakeholders were engaged in entrepreneurial development activities, but it's not clear how the centrally (or nationally)-managed policy instruments support their entrepreneurial activities (e.g. the eligibility criteria based on the definition of innovation limited to the new, world-class solutions could be difficult to match by some regional beneficiaries). A similar challenge has been identified in SK, where the R&I system is highly centralized. No explicit regional R&I programs and/or policy measures have been developed in SK and all policy measures to support R&I are designed and implemented by the Slovak government or its agencies.

In some countries with centrally-managed operational programs, dedicated instruments were introduced to enable the creation and reinforcement of appropriate institutional capacity in the regions for the EDP. One such example is the "*Smart Accelerator*", launched in CZ and supported by the Operational Program for Research, Development and Education. The aim of the scheme is to create administrative structures for the RIS3 implementation and EDP management in all Czech regions. The scheme should enable the tailoring of the nationally designed and implemented operational programs to different regional needs and thus strengthen the potential of regional institutions responsible for R&I policy (EC, 2016b). Regional activities in some countries are also supported by EU initiatives such as the "*RIS3 Support in Lagging Regions*"[6] or through the activities of the S3 Platform.

In IT, PL and PT, the RIS3 documents and operational programs have been developed at national and regional levels (NUTS2). Each region has its own RIS3 documents and an operational program with instruments dedicated to the support of prioritized research and innovation domains.

[4] CZ has also an operational program for Prague, which is classified as a more developed region (other Czech regions are classified as less developed regions in accordance with ESI Funds methodology).

[5] HU has a dedicated operational program for Central Hungary, which is classified as a more developed region (other Hungarian regions are classified as less developed regions in accordance with ESI Funds methodology).

[6] http://s3platform.jrc.ec.europa.eu/ris3-in-lagging-regions

Table 2 presents the role of regions within broader government arrangements, strengths and weaknesses of different approaches.

Table 2. *Differences between national and mixed models of RIS3 design and governance (national vs. regional perspectives)*

Region as…	**Passive actor**	**Implementor**	**Active partner**	**Independent policymakers**
Role of regional level from national perspective	The passive stage for policy action taken within a nationally defined framework	The role in the implementation of nationally defined priorities and targets	The active role as partners in defining and formulating national priorities for science and innovation, co-funding national scientific programs, including research infrastructures	The role as more or less independent policy makers, devoting significant resources of their own to funding regionally significant scientific investments or projects
Link between thematic priorities and policy instruments	Regional thematic priorities indicated in national strategies, no specific instruments and budgets for regions	Regional thematic priorities indicated in national strategies, dedicated instruments with relatively low budgets for regions	Regional strategies with own thematic priorities, but limited portfolio of own instruments and budgets	Regional strategies with own thematic priorities, portfolio of own instruments and budgets
Engagement of regional actors	Regional actors engaged in design, implementation and monitoring of national innovation policies	Regional actors engaged in design of national innovation policies, but benefiting from some regionally implemented instruments	Regional actors engaged in design of regional innovation policies as well as implementation and monitoring of regional instruments targeting specific groups/problems	Regional actors engaged in design, implementation and monitoring of regional innovation policies
Example	BG	CZ, PL (2004-2006; 2007-2013)	PL (2014-2020)	ES

Source: own elaboration based on Perry and May (2007).

The advantage of the roles of passive actor and implementor lies mainly in a standardized approach to R&D support and monitoring (lower costs, no duplication and no double-funding). The main disadvantage of these roles are the lack of instruments addressing specific regional/local needs as well as limited involvement of regional stakeholders in the EDP. The roles of active partner or independent policy-maker enable to better adjust policy intervention to regional needs, empower regional stakeholders and actively engage them in design and implementation of regional innovation policies. The weaknesses of these roles are: the proliferation of policy instruments (large number of instruments, different eligibility rules), possible duplication of some instruments and bureaucracy related to monitoring activities. In PL, regions prepared their first innovation strategies together with the Polish accession to the EU (2001-2004), but for many years they did not have dedicated budgets for research and innovation to implement these strategies. This situation has changed in 2014 and in the currently implemented regional operational programs, Polish regions have dedicated financial allocations for R&I. The case of PL indicates that the role of regions can change over time (implementors in 2004-2006, 2007-2013 and active partners in 2014-2020).

2.2 Coordination mechanisms for RIS3 implementation on regional levels

All countries with regional-level RIS3 documents have also national coordination mechanisms, supporting the alignment of regional approaches, experience sharing and dialogue among regions and with national government stakeholders, but these mechanisms display variable levels of maturity and sophistication. The most frequent form of coordination is the establishment of committees or fora connecting regional and national stakeholders, in particular administrative authorities in charge of RIS3 and structural policies. In some countries, national agencies are also tasked with dedicated support for regional authorities in matters related to the implementation of RIS3, e.g. the Italian Agency of Territorial Cohesion or the Polish Ministry of Regional Development (later transformed into the Ministry of Economic Development) or the Swedish Agency for Economic and Regional Growth. Regional authorities were able to benefit from targeted support for RIS3 development and implementation, offered through capacity building projects launched on the national level. Examples include the "Smart Specialisation Hub" in the UK and the "Smart Accelerator" initiative in CZ. Some national governments offered regions access to shared methodologies, mapping of identified regional strengths and datasets, which could be used in the development of RIS3. In RO, a shared methodology was developed in the "SIPOCA 27" project and used to increase cross-regional compatibility, but regional strategies remain rather heterogeneous and are used in combination with an operational programme implemented on the national level. The Italian government provided a common analytical framework with data concerning individual regions as part of the National Smart Specialisation Strategy (Ministerio dello Sviluppo Economico, 2014), and it also carried out an extensive analysis of 12 thematic specialisations, outlining respective regional strengths with a view to contribute to the regional planning efforts (L'Agenzia per la Coesione Territoriale - Invitalia, 2016).

In Austria, the process of developing and amending RIS3 is regarded as an opportunity to develop new collaborative approaches involving the federal government and regions, going beyond the programming of ESI Funds, as confirmed by a report of the Austrian Conference for Spatial Planning (de. Österreichische Raumordnungskonferenz) (ÖROK, 2016). The RIS3 efforts on regional levels are not fully aligned with federal-level R&I strategies, but the Conference considers this "asynchronous processing" to promote co-operation and mutual learning even though it makes systematic implementation and monitoring efforts difficult (ÖROK, 2016).

Some governments prepared or commissioned cross-regional comparisons of RIS3 that were carried out after the official adoption of strategic documents by regions[7]. They were not used as inputs into the RIS3 development, but could inspire further amendments and promote policy learning. In FR, a report issued by government agency reviewed regional strategies and compared their contents to nationally identified priorities, thus attempting to combine the regional smart specialisations into a coherent country-wide framework (Commissariat Général a l'Égalité des Territoires, 2015). Such efforts may result in increased alignment of RIS3 priorities at the national and regional levels (see also section 3.1, which addresses the alignment of priorities in greater detail). In DE, the Prognos (2017) report offered structured comparisons between highly heterogeneous strategies of 15 regions, which differed in methodological approach and were developed in different years, not always adhering to RIS3 standards (Prognos, 2017). Countries without regional RIS3 might still identify thematic strengths and areas with technological critical mass. Hungarian regions do not have autonomy in administration or R&I funding, but its "National Smart Specialisation Strategy" includes information about specialisations identified in a top-down manner for individual counties (NIH, 2014).

PL offers a comprehensive example of coordination between the national and regional RIS3. The country included R&I support measures in operational programmes implemented both on the national and regional levels and most Polish regions engaged in the development of regional R&I policies for the first time in 2012-2014. The government authority coordinating the RIS3 planning processes initially imposed "demarcation lines" dividing the possible types of R&I support measures between regions and central agencies. These divisions were subsequently blurred through strategic dialogues between 16 Polish regions, the central government and the European Commission. In 2013, the government commissioned the World Bank to strengthen regional competences and evaluate RIS3 planning efforts to ensure that all regions meet the formal requirements of the European Commission and benefit from good practice examples (Piątkowski, Szuba & Wolszczak, 2014). Regional authorities established a consultative structure of the Regional Smart Specialisations Forum (pl. *Regionalne Forum Inteligentnych Specjalizacji*), attached to the Union of the Voivodeships of the Republic of Poland. In 2016, the national R&I funding agency NCBR (National Centre for Research and Development) also launched a dedicated support measure intended to ensure cross-regional alignment of RIS3: "*RANB*", Regional Scientific Agendas (pl. *Regionalne Agendy Naukowo-Badawcze*) (NCBR, 2016). The Polish R&I system includes support measures offered in parallel on the national and regional levels, and RANB was bridging these levels by aligning their thematic priorities. RANB followed a process of identifying R&I topics covered by several regional RIS3, involving submissions from regional authorities and extensive stakeholder consultations. The resulting themes were consistent with national-level specialisations but also overlapped with interest areas identified by several regions. This exercise made regional authorities realize the synergies, overlaps, similarities and differences between approaches of each region, and can inspire the EDP in the future.

[7] See also the analysis of within-country RIS3 priorities in section 3.1 of this report.

2.3 Embeddedness of RIS3 in policy documents

The analysed countries differ in terms of the relation between the RIS3 documents and other national and regional documents concerning R&I policy.

Two main approaches can be distinguished at national level (see Tables 3 and 4):

- RIS3 as part of broader national or regional R&I strategies, illustrated below by examples from AT,
- RIS3 embodied in separate strategic documents, illustrated below by means of the LT example.

Table 3. *Characteristics of national RIS3 strategies (part 1)*

	Country innovation performance (EIS 2017)				
Variable	Innovation Leader	Strong Innovator	Moderate Innovator	Modest Innovator	Total
Documentation of national RIS3					
separate document	0	1	8	0	9
part of broader national strategy	3	3	5	2	13
documented elsewhere	0	0	1	0	1
Regional needs in national RIS3					
no separate thematic priorities	0	3	8	0	11
separate thematic priorities	3	1	5	1	10
other solution	0	0	1	1	2
Introduction of thematic priorities					
also used before 2010, same approach	2	0	2	0	4
also used before 2010, different approach	0	2	6	1	9
not used before 2010	1	2	6	1	10
Novelty of RIS3/EDP for policy making					
no significant difference	2	1	1	0	4
new approach	0	0	7	2	9
modified approach	0	2	3	0	5
parallel exercise	1	1	3	0	5
State of implementation					
delayed, deviation from roadmap	0	1	1	0	2
delayed, but in line with roadmap	0	1	7	2	10
on schedule	1	0	3	0	4
embedded in broader national innovation strategy	2	2	3	0	7
Mechanism linking H2020 and ESI funds					
no	2	2	6	1	11
yes	0	2	8	1	11
Mechanism of 15% used					
no	1	3	10	2	16
yes	1	1	4	0	6
Total	3	4	14	2	23

Sources: RIO Experts Survey 2018, European Innovation Scoreboard (EIS) 2017. Numbers indicate counts of countries.

Table 4. *Characteristics of national RIS3 strategies (part 2)*

	Country innovation performance (EIS 2017)				
Variable	Innovation Leader	Strong Innovator	Moderate Innovator	Modest Innovator	Total
Definition of thematic priorities					
industrial sectors	0	0	3	0	3
scientific fields	0	1	2	0	3
technology domains	0	0	1	0	1
societal challenges	1	2	8	1	12
combination of sectors/fields/scientific domains	3	3	13	2	21
other classification	0	0	1	0	1
Identification of thematic priorities					
bibliometric /technometric analysis	1	1	11	2	15
analysis of economic data	2	3	12	2	19
foresight exercises	1	2	7	2	12
public consultations	2	3	11	2	18
workshops or working groups with stakeholders	3	4	12	2	21
support from foreign experts	0	2	6	2	10
other methods	0	0	3	1	4
Leaders for defining thematic priorities					
business	2	2	9	2	15
academia	1	3	8	2	14
government	3	3	11	2	19
citizens, NGOs	0	0	0	0	0
other entities	0	0	0	0	0
Funding instruments					
subsidies and grants	0	1	13	2	16
tax instruments	0	0	4	0	4
equity instruments	0	0	2	0	2
repayable financial instruments	0	1	5	0	6
public procurement	0	0	3	0	3
other instruments	0	0	1	0	1
Contribution of monitoring and evaluation					
modification of policy instruments	1	1	2	1	5
no impact so far	1	3	10	1	15
modification of thematic priorities	1	0	1	0	2
modification of overall approach	0	1	0	0	1
other actions	0	0	1	0	1
Timing of evaluations					
ex-ante evaluation of selected priorities	1	0	5	0	6
ex-ante evaluation of EDP process	1	0	4	0	5
mid-term/ongoing evaluation	1	1	4	1	7
other evaluation	0	0	1	0	1
no evaluation so far	2	3	8	1	14
Nr of countries[♣]	3	4	14	2	23

Sources: RIO Experts Survey 2018, European Innovation Scoreboard (EIS) 2017. Numbers indicate counts of countries.

[♣] Note that each of the questions in this table allows multiple answers so countries may appear more than once for each question.

At the regional level, the RIS3 strategies are mainly embodied in separate documents, but in some countries such as BE, FI and DE (example below), the RIS3 strategies are part of broader national or regional strategies (see Tables 5 and 6).

Table 5. *Characteristics of regional RIS3 strategies (part 1)*

	Country innovation performance (EIS 2017)				
Variable	Innovation Leader	Strong Innovator	Moderate Innovator	Modest Innovator	Total
RIS3 at sub-regional level					
no	3	1	5	-	9
yes	3	2	0	-	5
Documentation of regional RIS3					
separate document	2	0	5	-	7
part of broader national or regional strategy	3	1	0	-	4
documented elsewhere	1	2	0	-	3
Introduction of thematic priorities					
also used before 2010, same approach	2	0	1	-	3
also used before 2010, different approach	3	3	2	-	8
not used before 2010	1	0	2	-	3
Novelty of RIS3/EDP for policy making					
no significant difference	3	2	0	-	5
new approach	2	0	4	-	6
modified approach	0	1	1	-	2
parallel exercise	1	0	0	-	1
Mechanism linking H2020 and ESI funds					
no	4	1	2	-	7
yes	1	2	3	-	6
Mechanism of 15% used					
no	3	3	3	-	9
yes	2	0	2	-	4
Total	6	3	5	0	14

Sources: RIO Experts Survey 2018, European Innovation Scoreboard (EIS) 2017. Numbers indicate counts of *countries*.

Table 6. *Characteristics of regional RIS3 strategies (part 2)*

Variable	Country innovation performance (EIS 2017)				Total
	Innovation Leader	Strong Innovator	Moderate Innovator	Modest Innovator	
State of implementation[♣]					
delayed, but in line with roadmap	0	2	3	-	5
delayed, deviation from roadmap	0	0	2	-	2
on schedule	3	1	2	-	6
embedded in broader national innovation strategy	4	1	1	-	5
Definition of thematic priorities					
industrial sectors	4	1	1	-	6
scientific fields	3	1	0	-	4
technology domains	3	1	1	-	5
societal challenges	5	2	3	-	10
combination of sectors/fields/scientific domains	4	3	5	-	11
other classification	2	0	0	-	2
Identification of thematic priorities					
bibliometric /technometric analysis	3	1	4	-	8
analysis of economic data	6	3	5	-	13
foresight exercises	2	2	3	-	7
public consultations	5	0	4	-	9
workshops or working groups with stakeholders	6	3	5	-	13
support from foreign experts	2	2	3	-	6
other methods	2	2	1	-	5
Interregional coordination mechanisms					
dedicated governmental committees or councils	0	2	4	-	6
governmental bodies w/ with regional representatives	4	3	2	-	8
inter-regional and non-governmental bodies	1	0	0	-	1
other mechanisms	1	1	0	-	2
none	1	0	1	-	2
Leaders for defining thematic priorities					
business	6	3	3	-	11
academia	5	2	3	-	10
government	5	3	5	-	12
citizens, NGOs	0	0	0	-	0
other entities	1	1	0	-	2
Funding instruments					
subsidies and grants	3	3	5	-	11
tax instruments	0	1	1	-	2
equity instruments	1	1	1	-	3
repayable financial instruments	2	1	4	-	7
public procurement	1	1	1	-	3
other instruments	2	1	0	-	3
Contribution of monitoring and evaluation					
modification of policy instruments	2	1	0	-	3
no impact so far	2	1	3	-	6
modification of thematic priorities	3	0	1	-	3
modification of overall approach	2	1	1	-	4
other actions	1	0	0	-	1
Timing of evaluations					
ex-ante evaluation of selected priorities	2	1	2	-	5
ex-ante evaluation of EDP process	3	1	3	-	7
mid-term/ongoing evaluation	5	2	2	-	9
other evaluation	2	1	0	-	3
no evaluation so far	2	0	3	-	4
Nr of countries[♦]	6	3	5	0	14

Sources: RIO Experts Survey 2018, European Innovation Scoreboard (EIS) 2017.

♦ Note that each of the questions in this table allows multiple answers so countries may appear more than once for each question.

♣ Different possibilities may apply to a single country due to between-region differences in the status of implementation of regional RIS3 strategies (i.e. also for this question, countries may appear more than once in a given column).

EXAMPLE: RIS3 IN AUSTRIA

The core document for RIS3 in AT is the research, technology and innovation (RTI) strategy of the federal government "*Becoming an Innovation Leader – strategy for research, technology and innovation of the Austrian Federal Government*" (original version from 2011). The strategy presents challenges for the Austrian R&I system, mission, horizontal objectives, policy instruments and budgetary issues. The term "smart specialisation" is not included in the document, but the strategy describes thematic priorities and the priority setting process as well as previous Austrian experiences in this field. The RIS3 processes have also been carried out at regional level. Austrian regions have autonomous, elected political representatives and budgets. The autonomy is also reflected in separate regional strategies and their thematic priorities. Each region has prepared its own, relevant RTI strategies, budgets for financial assistance schemes and the mechanisms of implementation of the strategies. The federal government and regions coordinate their activities as well as cooperate in monitoring and reporting mechanisms. The regional innovation strategies are not available as standalone RIS3 documents.

The strategy "*Becoming an Innovation Leader – strategy for research, technology and innovation of the Austrian Federal Government*" was approved by the European Commission as the National Smart Specialisation Strategy, but it is worth to note that this document has been included in the broader framework of Austrian RIS3 processes (national and regional ones) and referenced by the "*Policy Framework for Smart Specialisation in Austria*", which indicates that "*although the concept of Smart Specialisation was not yet public at the time [2011], the federal government produced the RTI strategy which already anticipated key elements of the Smart Specialisation strategy such as the broadly-based creation and implementation process and the monitoring of implementation*" (ÖROK, 2016, p. 31). In Austria, the RIS3 approach has not significantly modified previous policy planning activities reflected in strategic documents, but might open up opportunities for further improvements in areas such as priority setting for R&I or mobilisation of stakeholders.

EXAMPLE: RIS3 IN LITHUANIA

The introduction of strategic planning and priority setting to the policy discourse in LT was associated with the accession to the European Union in 2004. Nevertheless, the programming period of 2007-2013 was characterized by a lack of coordination – the innovation policy was managed by two ministries - and scattering of R&I funding. In this context, "*RIS3 was seen as a solution to this poorly-managed approach to innovation strategy*" (Mosta, 2016). LT began RIS3 process in 2012 with the resolution "*The Concept of the Establishment and Development of Integrated Science, Studies and Business Centres (Valleys)*". The document describes the main rules related to the selection of priority areas in research and (socio-cultural) development and innovation development (i.e. smart specialisation). The list of six research, development and innovation priorities was approved by the Lithuanian government in 2013. In 2014, The government adopted "*The programme of the implementation of the Priority Areas of Research (Socio-Cultural) Development and Innovation (Smart Specialisation) and their priorities*"[8]. As a result, the Lithuanian RIS3 strategy is embodied in a separate strategic document, formally accepted by the government.

[8] http://ukmin.lrv.lt/en/sector-activities/innovation/smart-specialisation

EXAMPLE: RIS3 IN GERMANY

In DE, the RIS3 strategies are built on cluster activities and two distinctive approaches can be identified. German regions with already high levels of research, innovation and technological development and numerous existing and well-recognised clusters, have focused more on improvement of cluster management, as well as intra- and inter-cluster network effects (e.g. "*Innovation Strategy Baden-Wurttemberg*" from 2013). On the other hand, regions with a lower research and innovation intensity have focused more on enhancing R&I activities within the developing clusters (e.g. the regional innovation strategy in Berlin-Brandenburg: "*Joint Innovation Strategy of the States Berlin and Brandenburg (innoBB)*" from 2011 (Land Brandenburg, 2011), complemented by "*Innovation Strategy of the States Brandenburg (InnoBB plus)*" from 2014 (Land Brandenburg, 2014)).

Generally, according to information delivered by the RIO Network Experts, countries such as BE, DK, FR, DE and NL have a long tradition of RIS3-like policies, initiated decades before the RIS3 framework became widespread, with particularly active cluster policies from the mid-1990s. In these cases, RIS3 strategies became a natural continuation of existing approaches to regional development as well as previous R&I policies.

3 Thematic priority setting and the EDP

3.1 Operationalization of priorities

A central tenet of RIS3 is that it is crucial to set priorities such that resources are "concentrated in specially selected domains dealing with particular kinds of technology, field, disciplines, sub-systems within a sector or at the interstices of different sectors" (Foray & Goenaga, 2009). This principle suggests that a combination of perspectives is called for when defining priorities rather than relying on a single lens, such as industrial sectors. Thematic priorities in national RIS3 documents tend to be defined using a combination of industrial sectors, technology classes and scientific fields (see Table 4 - 21 out of 23 Member States with national RIS3), based on the RIO Network Expert survey. Such a combined approach is also frequently used for regional RIS3 (11 out of 14 Member States, Table 6)

Selectivity of priorities

Foray and Goenaga (2009) emphasize the importance of sufficient granularity in defining priorities to avoid a mere sectoral prioritisation. Besides the level at which priorities are defined, selectivity is another premise of the smart specialisation approach: "[Smart specialization strategies] help regions to concentrate resources on few key priorities rather than spreading investment thinly across areas and business sectors" (EC, 2010). In order to create a comparative advantage, countries and regions should identify those domains where new projects will complement their existing productive assets. Thus, lack of selectivity is an important threat for a successful smart specialisation strategy (Foray, David & Hall, 2011)[9].

To assess Member States' and regions' selectivity in terms of their RIS3 priorities, the September 2017 version of the Eye@RIS3 database was analysed. Eye@RIS3 contains the RIS3 priorities as indicated by EU Member States and regional administrations, and was set up to help strategy development and implementation. Given this purpose, it serves as a relevant data source to analyse Member States' and regions' priorities, and the differences in selectivity of the resulting priority sets. It should be noted however that the priorities were registered based on input of representatives of the respective countries and regions without an extensive cross-validation and/or content analysis vis-à-vis corresponding RIS3 documents. This implies that the representation of priorities in terms of sectors and scientific fields is an approximation, but nevertheless provides tractability for analysing RIS3 priorities given that the same approach has been used across countries and regions.[10] Furthermore, coverage for some countries in terms of regions is only partial, as indicated in the tables. To allow for easy comparisons, priorities that are registered in Eye@RIS3 are classified using standardized nomenclatures, namely the Statistical Classification of Economic Activities in the European Community (NACE rev. 2) and the Nomenclature for the Analysis and Comparison of Scientific Programmes and Budgets (NABS 2007). In addition, Eye@RIS3 contains an indication of 'policy objectives', a typology that has been developed based on selected EU strategy documents. Policy objectives are recorded at two aggregation levels, which are labelled as 'level 1' (most aggregate) and 'level 2' (most detailed) in the results. Finally, note that the report's objective is to analyse RIS3 priorities in terms of countries' and regions' selectivity, the alignment between the national and regional level, and the between-country differentiation of priorities rather than analyse the content of RIS3 priorities in terms of their

[9] A test for whether the entrepreneurial discovery process is successful at identifying exploitation opportunities, but out of scope for this report, is the observation of prompt entry of new firms into a newly identified domain in which the region could become a leader.

[10] Note that sectoral prioritization is generally not considered a good starting point for smart specialization since priorities should in principle be selected at a finer level of aggregation (e.g. Foray, 2016). However, sectoral and scientific lenses are informative as a means for *ex post analysis* of RIS3 strategic priorities. In fact, considering priorities in terms of, for example, NACE2 sectors provides a conservative test of aspects like a country or region's selectivity of priorities: if a priority can be linked to a wide variety of sectors, it is unlikely that it is truly selective as intended by the RIS3 rationale.

appropriability or other characteristics. The analysis will also allow drawing more general conclusions with respect to development of improved indicators.

Table 7 provides an analysis of RIS3 priorities at the country level i.e. national RIS3. The indicators in rows 2-7 show on average 29 priorities in terms of industrial sectors, 8 scientific fields, 6 high-level policy objectives and 23 low-level policy objectives[11]. There is substantial heterogeneity though, as indicated by the high standard deviations and maxima for each of these indicators. For example, the number of priorities in terms of NACE2 industries ranges from 9 (BG) to 67 (PT).

[11] The indicators in rows 5 and 7 are discussed below.

Table 7. *Analysis of RIS3 priorities at the country level*

	Variable	mean	s.d.	min	max	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)
(1)	EIS 2017 performance*	82,4	30,0	33,1	140,9	1,00																		
(2)	Industry sectors (NACE 2-digit)	29,3	16,6	9,0	67,0	0,26	1,00																	
(3)	Scientific fields (NABS)	7,9	1,9	3,0	11,0	-0,14	0,47	1,00																
(4)	Policy objectives (level 1)	5,8	1,7	3,0	10,0	0,39	0,33	0,27	1,00															
(5)	Policy objectives (level 1, excl GPT)	3,9	1,6	2,0	8,0	0,34	0,37	0,32	0,98	1,00														
(6)	Policy objectives (level 2)	22,5	12,0	10,0	55,0	0,13	0,58	0,64	0,82	0,84	1,00													
(7)	Policy objectives (level 2, excl GPT)	13,4	8,7	4,0	33,0	0,12	0,63	0,66	0,78	0,82	0,93	1,00												
(8)	Industry sectors (NACE 2-digit) / population	12,0	18,2	0,3	65,2	0,16	0,13	0,14	0,23	0,21	0,22	0,16	1,00											
(9)	Scientific fields (NABS) / population	3,3	5,2	0,1	19,6	0,10	0,04	0,13	0,16	0,13	0,14	0,08	0,99	1,00										
(10)	Policy objectives (level 1) / population	2,5	4,0	0,1	15,2	0,13	0,06	0,11	0,26	0,24	0,22	0,16	0,99	0,99	1,00									
(11)	Policy objectives (level 1, excl GPT) / population	1,7	2,8	0,1	10,9	0,13	0,08	0,13	0,31	0,30	0,27	0,21	0,98	0,98	1,00	1,00								
(12)	Policy objectives (level 2) / population	9,8	16,3	0,4	63,0	0,11	0,11	0,17	0,34	0,33	0,33	0,25	0,97	0,96	0,99	0,99	1,00							
(13)	Policy objectives (level 2, excl GPT) / population	5,6	10,2	0,2	39,1	0,12	0,13	0,19	0,36	0,36	0,34	0,30	0,96	0,95	0,98	0,99	0,99	1,00						
(14)	Industry sectors (NACE 2-digit) / GERD	23,6	15,0	5,5	57,0	-0,32	0,67	0,51	-0,09	-0,05	0,36	0,36	0,24	0,22	0,21	0,21	0,24	0,24	1,00					
(15)	Scientific fields (NABS) / GERD	7,1	4,8	1,8	22,4	-0,67	-0,11	0,57	-0,08	-0,06	0,21	0,22	0,10	0,15	0,12	0,12	0,14	0,14	0,48	1,00				
(16)	Policy objectives (level 1) / GERD	4,9	2,9	1,5	14,3	-0,54	-0,19	0,39	0,23	0,21	0,33	0,30	0,23	0,27	0,28	0,29	0,30	0,30	0,34	0,90	1,00			
(17)	Policy objectives (level 1, excl GPT) / GERD	3,3	2,1	0,9	10,2	-0,47	-0,12	0,45	0,34	0,35	0,43	0,41	0,24	0,27	0,30	0,32	0,33	0,34	0,32	0,86	0,98	1,00		
(18)	Policy objectives (level 2) / GERD	19,5	15,6	3,7	69,4	-0,48	0,08	0,62	0,30	0,30	0,54	0,51	0,19	0,21	0,22	0,24	0,27	0,27	0,51	0,91	0,94	0,94	1,00	
(19)	Policy objectives (level 2, excl GPT) / GERD	11,5	10,8	2,1	46,9	-0,43	0,14	0,67	0,33	0,35	0,56	0,62	0,15	0,16	0,18	0,20	0,22	0,25	0,49	0,87	0,88	0,91	0,96	1,00

Numbers are average number of priorities at the national level (as registered in thr september 2017 version of Eye@RIS3), split by EIS 2017 performance group. The 18 countries covered in this table include 2 innovation leaders (DE, SE), 4 strong innovators (AT, IE, LU, SI), 10 moderate innovators (CZ, EE, HR, HU, LT, LV, MT, PL, PT, SK) and 2 modest innovators (BG, RO), as defined in the EIS 2017. Population is measured in 2017 (Eurostat); GERD is measured in 2015 as % of GDP (Eurostat). The right panel of the table shows the pairwise correlation coefficients.

* EIS performance in 2016 relative to EU performance in 2016.

Country size

The large differences between Member States in terms of priority counts may to a large extent be explained by their size, so the different indicators are normalized by the country's population in 2017 (measured in millions of inhabitants, Eurostat data) and are shown in rows 8-13 of the table. Controlling for country size in this manner, a Member State on average has 12 priorities in terms of industrial sectors, 3 scientific fields, 3 high-level policy objectives and 10 low-level policy objectives. Importantly, the variation between countries remains very high and the selectivity in priority setting is therefore unlikely to be due to the country's size.

As a further corroboration of their robustness, the indicators are normalized by R&D intensity (GERD/GDP) in rows 14-19. While these numbers cannot be directly compared to the non-normalized values (rows 2-7) and the ones normalized by population (rows 8-13), the within-indicator variance remains high, which suggests big differences between countries in terms of selectivity, even after controlling for their R&D intensity.

The right panel of the table reports the correlation between the various indicators with each other and with the country's innovation performance as measured by the 2017 European Innovation Scoreboard. The population-normalized indicators (rows 8-13) show a weak positive correlation with innovation performance (column 1), suggesting that national RIS3 of the better performing countries contain slightly more priorities, on average. But variation remains high: as an illustration (not reported in the table), innovation leaders like DE and SE report 0.1 and 0.6 scientific fields per million inhabitants, while moderate innovators like LT and EE report 13.5 and 6.1 scientific priority fields also normalized by population, respectively. If we instead rely on R&D intensity to normalize priority counts - which arguably reflects better the R&I capabilities than a size control based on population - then the correlations in column 1 are systematically and substantially negative, suggesting *more* selectivity for the higher performing countries.

General Purpose Technologies

Of particular concern are priorities related to general purpose technologies (GPTs) as these may have a broad impact on the economy and a prioritization of GPTs by a country or region may explain less selectivity in terms of sectors or scientific fields. Although the theoretical literature on the growth effects of GPTs is well developed (see e.g. Helpman, 1998), the empirical evidence is rather scarce. Even the precise definition of what constitutes a GPT is not well established, although the economics literature refers to *originality* ('does the technology really constitute the genesis of a new approach?'), *longevity* ('does the technology exhibit a prolonged influence?') and *generality* ('does the technology affect a broad range of industries?') as criteria (Moser & Nicholas, 2004). Also the capacity of a technology to generate *complementarities in innovation* and hence increasing returns to scale is considered to be a defining characteristic (Bresnahan & Trajtenberg, 1995). Based on such considerations, technologies like the steam engine, the electric motor and semiconductors are considered examples of GPTs. Despite this conceptual clarity, the precise level of aggregation at which general purpose technologies should be defined is not very clear. For example, while the fairly intuitive notions of novelty and general applicability are commonly used in the literature to describe technologies like biotechnology, nanotechnology and ICT, they are also used to refer to more narrowly defined technologies. For example, within ICT, cryptography is considered a GPT, with applications in authentication, anti-virus software, firewalls, etc. (Gambardella & McGahan, 2010). The most commonly cited contemporary example of a GPT is ICT. While the empirical literature typically reports a positive labor productivity effect of ICT, the evidence for ICT as a GPT is mixed. For example, there is no convincing evidence to date of horizontal spillovers to other firms. Nevertheless, the 'circumstantial evidence' indicates that ICT display many characteristics of a GPT (Cardona *et al.*, 2013).

While an extensive analysis of references to technologies with GPT-characteristics in RIS3 priorities is beyond the scope of this report, we conduct a robustness check of countries'

selectivity in setting priorities, excluding those linked to GPTs. The reason is that, given the aforementioned characteristic of generality, one would expect GPT-focused priorities to necessarily affect a broad range of sectors and scientific fields, which argues in favor excluding them from an analysis of selectivity. While different selections could be made, the robustness check excludes priorities linked to *digital transformation* policy objectives and those related to *Key Enabling Technologies* (KETs). Both these categories relate to GPTs that may affect a wide range of sectors and/or be involved in many scientific fields i.e. they exhibit the 'generality' feature.

Table 13 in Appendix lists the detailed policy objectives contained in each of the excluded categories. Note that one cannot study the direct effect of excluding GPT-focused policy objectives on industry sectors or scientific fields since the Eye@RIS3 data does not contain a link between individual policy objectives on the one hand and sectors or fields on the other hand. However, it is possible to assess to what extent excluding GPT-focused policy objectives increases overall selectivity. In addition, it allows to see whether variation in selectivity between countries goes down once GPT technologies are (largely) removed from the analysis. The pure counts (i.e. non-normalized) of the 'GPT-free' versions of the policy objectives show that GPTs account for a sizeable share (30-40%) of policy objectives (comparing rows 4 & 6 with rows 5 & 7 in Table 7). Considering the 'GPT-free' versions of the population-normalized indicators (rows 11 & 13) and the rows normalized by GERD as a % of GDP (rows 19 & 21) shows that the earlier conclusions remain robust: variance between countries remains high i.e. some countries are more selective than others in setting priorities, and – considering the GERD-normalized indicators – stronger innovators tend to specify fewer policy priorities.

Table 14 in Annex 2 contains a final robustness check in which the same indicators are analyzed, but only including those entries in Eye@RIS3 that are marked as "final RIS3 document"[12]. The results are entirely consistent with those based on the full Eye@RIS3 data.

Links with innovation performance and selectivity

Table 8 further explores Member States' selectivity in priority setting by disentangling the innovation performance groups, as defined in the EIS 2017. Looking at the bottom panel of the table with the GERD-normalized indicators, an interesting observation is that the innovation leaders are the most selective in setting priorities in terms of sectors (indicator value 7.5 versus 23.6 on average), scientific fields (2.5 versus 7.1) and policy objectives (2.0 versus 4.9 for level 1 objectives, 7.0 versus 19.5 for level 2 objectives). Also the strong innovators are slightly more selective than average. Thus, the negative correlation between innovation performance and GERD-normalized number of priorities observed in Table 7 is driven by the innovation leaders and to some extent the strong innovators while the moderate and modest innovators appear clearly less selective in setting priorities[13].

[12] 889 out of 1,389 entries in the Eye@RIS3 database have a "Final RIS3 document" as the source. The other entries are based on various sources containing information on countries' smart specialization strategies, such as "Draft RIS3 Document" (267 entries), "Peer Review" (89 entries) and other studies.

[13] Note that the population-normalized indicators show that also the modest innovators define fewer priorities than the average country. The comparison with the GERD-normalized indicators clarifies that this pattern is due to their (on average) larger size but lower R&D intensity.

Table 8. *Analysis of RIS3 priorities at the country level by innovation performance*

	Country innovation performance (EIS 2017)				
Variable	Innovation Leader	Strong Innovator	Moderate Innovator	Modest Innovator	Total
Industry sectors (NACE 2-digit)	23,0	40,5	29,7	11,5	29,3
Scientific fields (NABS)	7,5	8,3	7,6	9,5	7,9
Policy objectives (level 1)	6,0	7,5	5,2	5,5	5,8
Policy objectives (level 1, excl GPT)	4,0	5,5	3,3	4,0	3,9
Policy objectives (level 2)	21,0	30,5	19,6	22,5	22,5
Policy objectives (level 2, excl GPT)	12,5	19,0	11,1	15,0	13,4
Industry sectors (NACE 2-digit) / population	1,1	21,6	12,6	1,0	12,0
Scientific fields (NABS) / population	0,4	5,1	3,7	0,8	3,3
Policy objectives (level 1) / population	0,3	4,3	2,6	0,5	2,5
Policy objectives (level 1, excl GPT) / population	0,2	3,0	1,7	0,3	1,7
Policy objectives (level 2) / population	0,8	17,3	10,2	1,6	9,8
Policy objectives (level 2, excl GPT) / population	0,5	10,6	5,6	1,1	5,6
Industry sectors (NACE 2-digit) / GERD	7,5	22,3	28,3	19,0	23,6
Scientific fields (NABS) / GERD	2,5	4,9	7,3	15,4	7,1
Policy objectives (level 1) / GERD	2,0	4,2	4,9	9,2	4,9
Policy objectives (level 1, excl GPT) / GERD	1,3	3,0	3,1	6,7	3,3
Policy objectives (level 2) / GERD	7,0	16,7	19,0	40,4	19,5
Policy objectives (level 2, excl GPT) / GERD	4,2	10,0	10,5	27,1	11,5
Nr of countries	2	4	10	2	18

Numbers are average number of priorities at the national level (as registered in thr september 2017 version of Eye@RIS3), split by EIS 2017 performance group. The 18 countries covered in this table include 2 innovation leaders (DE, SE), 4 strong innovators (AT, IE, LU, SI), 10 moderate innovators (CZ, EE, HR, HU, LT, LV, MT, PL, PT, SK) and 2 modest innovators (BG, RO), as defined in the EIS 2017. Population is measured in 2017 (Eurostat); GERD is measured in 2015 as % of GDP (Eurostat).

Selectivity in setting regional priorities is analysed in Table 9, revealing similar patterns. First, the average number of priorities per region is roughly comparable to what was observed at country level with, population-normalized, 17 industries, 6 scientific fields, 4 high-level and 13 low-level policy objectives (rows 8-13). Also at regional level there are big differences in terms of selectivity: for example, the (non-normalized) number of low-level policy objectives in the Madrid region (ES30) is 46 while for the Lazio region (ITI4) it is 7. With respect to the relation with innovation performance (measured using the 2017 Regional Innovation Scoreboard), both the population- (rows 8-13) and GERD-normalized (rows 14-19) indicators show a negative correlation (column 1), indicating that the better performing regions on average select fewer priorities. This is confirmed by the split of the selectivity indicators according to the innovation performance groups in Table 10: regions that are innovation leaders – and to a lesser degree also the strong innovators - specify clearly lower numbers of priorities (as measured by both population- and GERD-normalized indicators) than the other regions. While these regions have strong innovative capabilities and therefore in principle could be more comprehensive in setting RIS3 priorities, they instead seem more selective and 'pick their targets'. Analogous to the analysis of priorities at the national level, Table 15 in Annex 1 reports the indicators based on final RIS3 documents in Eye@RIS3, and results are again robust.

Table 9. *Analysis of RIS3 priorities at regional level*

Analysis of RIS3 priorities at the regional level																								
	Variable	mean	s.d.	min	max	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)
(1)	RIS 2017 performance[♣]	68,6	23,2	23,0	165,1	1,00																		
(2)	Industry sectors (NACE 2-digit)	19,6	10,7	1,0	51,0	0,06	1,00																	
(3)	Scientific fields (NABS)	6,9	2,0	2,0	11,0	0,10	0,45	1,00																
(4)	Policy objectives (level 1)	5,2	2,0	1,0	10,0	0,02	0,36	0,45	1,00															
(5)	Policy objectives (level 1, excl GPT)	3,7	1,8	0,0	8,0	0,03	0,31	0,45	0,94	1,00														
(6)	Policy objectives (level 2)	15,5	9,5	1,0	48,0	0,09	0,45	0,46	0,70	0,63	1,00													
(7)	Policy objectives (level 2, excl GPT)	9,3	5,9	0,0	26,0	-0,01	0,39	0,51	0,72	0,76	0,85	1,00												
(8)	Industry sectors (NACE 2-digit) / population	17,3	24,3	0,4	220,7	-0,09	0,24	-0,09	-0,08	-0,06	-0,03	0,02	1,00											
(9)	Scientific fields (NABS) / population	5,5	6,1	0,4	47,3	-0,13	0,03	-0,03	-0,10	-0,07	-0,08	-0,01	0,92	1,00										
(10)	Policy objectives (level 1) / population	4,2	4,7	0,3	31,5	-0,15	0,00	-0,17	0,10	0,13	0,01	0,06	0,85	0,91	1,00									
(11)	Policy objectives (level 1, excl GPT) / population	3,0	3,4	0,0	15,9	-0,14	0,02	-0,13	0,17	0,25	0,04	0,15	0,76	0,83	0,95	1,00								
(12)	Policy objectives (level 2) / population	12,9	16,6	0,4	110,3	-0,13	0,06	-0,13	0,05	0,07	0,21	0,23	0,82	0,84	0,87	0,82	1,00							
(13)	Policy objectives (level 2, excl GPT) / population	7,9	10,9	0,0	82,4	-0,15	0,07	-0,08	0,06	0,13	0,18	0,34	0,76	0,78	0,78	0,81	0,92	1,00						
(14)	Industry sectors (NACE 2-digit) / GERD	24,4	21,2	1,1	104,1	-0,49	0,49	0,16	0,15	0,17	0,29	0,31	0,32	0,25	0,24	0,29	0,32	0,37	1,00					
(15)	Scientific fields (NABS) / GERD	7,8	5,7	0,8	31,8	-0,60	0,10	0,24	0,08	0,13	0,14	0,26	0,18	0,25	0,20	0,26	0,25	0,33	0,86	1,00				
(16)	Policy objectives (level 1) / GERD	5,8	5,0	0,6	24,2	-0,53	0,09	0,04	0,35	0,38	0,25	0,36	0,16	0,19	0,28	0,35	0,28	0,33	0,80	0,88	1,00			
(17)	Policy objectives (level 1, excl GPT) / GERD	4,2	4,1	0,0	21,1	-0,47	0,07	0,05	0,36	0,45	0,23	0,42	0,16	0,19	0,30	0,42	0,27	0,37	0,75	0,83	0,97	1,00		
(18)	Policy objectives (level 2) / GERD	17,9	17,3	0,6	100,0	-0,46	0,23	0,12	0,30	0,29	0,54	0,55	0,25	0,25	0,30	0,34	0,48	0,51	0,82	0,80	0,85	0,80	1,00	
(19)	Policy objectives (level 2, excl GPT) / GERD	11,2	12,7	0,0	67,6	-0,43	0,14	0,12	0,28	0,36	0,40	0,62	0,25	0,28	0,31	0,41	0,45	0,60	0,76	0,80	0,84	0,87	0,92	1,00

Source: Eye@RIS3 database, RIS 2017, Eurostat. The table includes those regions for which priorities have been defined in the Eye@RIS3 database and for which performance data is available in the Regional Innovation Scoreboard 2017. The included regions belong to the following countries: BE, CZ, DE, EL, ES, IT, NL, PL, PT, RO, SE, UK. Population is measured in 2017 (Eurostat); GERD is measured in 2015 as % of GDP (Eurostat). The right panel of the table shows the pairwise correlation coefficients.

[♣] RIS 2017 score relative to EU 2017 (available for 81 regions). Indicators (2)-(7) are calculated using data for all 187 regions that are registered in the eye@RIS3 platform i.e. 26 NUTS 1 level regions in BE, DE, NL, UK; 124 NUTS 2 level regions in AT, CZ, DE, EL, ES, FR, IT, NL, PL, PT, RO, UK; and 37 NUTS 3 level in FI, SE, UK. Indicators (8)-(13) are calculated using 135 regions given the availability of population data. Indicators (14)-(19) are calculated using 112 regions given the availability of GERD data.

Table 10. *Analysis of RIS3 priorities at regional level by innovation performance*

Variable	Regional innovation performance (RIS 2017)♦				Total
	Innovation Leader	Strong Innovator	Moderate Innovator♣	Modest Innovator	
Industry sectors (NACE 2-digit)	24,0	26,7	24,6	20,9	24,1
Scientific fields (NABS)	6,7	8,4	7,8	6,8	7,6
Policy objectives (level 1)	6,7	5,1	5,1	5,3	5,2
Policy objectives (level 1, excl GPT)	5,3	3,9	3,7	3,9	3,8
Policy objectives (level 2)	19,0	18,9	17,6	13,9	17,1
Policy objectives (level 2, excl GPT)	11,0	11,9	10,5	9,5	10,4
Industry sectors (NACE 2-digit) / population	5,6	21,2	23,6	14,9	21,1
Scientific fields (NABS) / population	1,7	5,8	7,2	4,7	6,4
Policy objectives (level 1) / population	1,8	3,4	4,9	3,7	4,5
Policy objectives (level 1, excl GPT) / population	1,4	2,8	3,4	3,0	3,2
Policy objectives (level 2) / population	5,7	11,2	17,4	9,2	14,9
Policy objectives (level 2, excl GPT) / population	2,9	7,5	10,5	7,1	9,3
Industry sectors (NACE 2-digit) / GERD	10,5	17,6	27,5	48,9	30,0
Scientific fields (NABS) / GERD	3,1	6,0	8,4	16,2	9,5
Policy objectives (level 1) / GERD	3,1	3,5	6,0	12,7	6,9
Policy objectives (level 1, excl GPT) / GERD	2,6	2,7	4,3	9,6	5,1
Policy objectives (level 2) / GERD	7,1	11,0	21,6	32,8	22,3
Policy objectives (level 2, excl GPT) / GERD	4,6	7,2	13,0	23,2	14,1
Nr of regions	3	7	56	15	81

Source: Eye@RIS3 database, RIS 2017, Eurostat. Numbers are average number of priorities by RIS 2017 performance group. The table includes NUTS regions for which priorities have been defined in the Eye@RIS3 database and for which performance data is available in the Regional Innovation Scoreboard 2017. The included regions belong to the following countries: BE, CZ, DE, EL, ES, IT, NL, PL, PT, RO, SE, UK. Population is measured in 2017 (Eurostat); GERD is measured in 2015 as % of GDP (Eurostat).

♦ This table is based on the 81 regions for which RIS performance data (2017) and priorities in the eye@RIS3 database are available.

♣ For 2 of the 56 moderate innovator NUTS2 regions there is no GERD data available.

While the data does not allow pinpointing the underlying reasons for the seemingly greater specialization for the stronger innovators relative to the weaker performing countries, one may conjecture that several factors are at play. First, the innovation policy literature has reported (mixed) evidence for the tendency for administrators and policy makers to 'pick the winners' when they have to make choices to allocate scarce resources (see e.g. Wallsten, 2000; Cantner & Kösters, 2012). Thus, if there is consensus within a country or region about where its strengths lie in terms of innovative capabilities, this may steer the definition of priorities to be linked primarily to those areas. Note that even though the 'picking the winners' concept has a rather negative connotation in the literature on the evaluation of innovation support mechanisms, this is not necessarily the case in the context of RIS3 as this concerns a more aggregate level of policy making compared to granting public support to individual firms. In other words, from the perspective of specialization – and differentiation, discussed later in this report - it may be a perfectly valid strategy to build on one's strengths rather than pursuing a broad variety of priorities. Second, extending the previous argument, *uncertainty* arguably plays a role in weaker performing countries' strategies to place more (informed) bets in terms of RIS3 priorities since they have fewer established areas of excellence. Building a comparative advantage is not a mechanistic process, so countries and regions may want to keep their options open by not focusing on a relatively narrow set of priorities and by allowing for the exploitation of complementarities between priorities. Such strategies are also observed in turbulent or nascent industries where firms engage in activities like 'patent flooding' because they don't know what will turn out to be the most valuable technologies in the future (see e.g. Granstrand, 1999). Foray, Morgan and Radosevic (2018) discuss also the difficulty of defining and implementing thematically focused public interventions, as they require

superior skills and capabilities of national or regional authorities compared with the implementation of horizontal policies. Despite the plausibility of the aforementioned arguments, future research will have to confirm these results on selectivity of priorities and the underlying mechanisms in the development of RIS3.

Alignment of priorities within countries

If RIS3 priorities are specified at both the country and regional level, the extent to which they are aligned is informative with respect to coordination between RIS3 governance levels. More specifically, if RIS3 are formulated at both levels, one would expect that priorities at the national level are not entirely disconnected from those pursued at the regional level. While perfect alignment is not required or even desirable – because a different focus at each level is possible or because certain priorities may complement each other[14] – national and regional priorities for RIS3 ultimately build on the same pool of resources and capabilities in the country and they may be expected to overlap to a considerable degree. In particular, if both the national and regional level are committed to RIS3 approach then the same or related priorities can be expected to surface from the EDP. Further, alignment between governance levels helps to exploit complementarities, avoid wasteful duplication of efforts, ensure critical mass, etc.

Table 11. *Alignment of RIS3 priorities within countries (% of priorities defined at both national and regional level)*

	All countries (N=8)				Country innovation performance (EIS 2017)			
Variable	mean	s.d.	min	max	Innovation Leader (N=3)	Strong Innovator (N=1)	Moderate Innovator (N=3)	Modest Innovator (N=1)
Industry sectors (NACE 2-digit)	49,8%	22,6%	25,0%	85,1%	41,0%	70,0%	59,0%	29,0%
Scientific fields (NABS)	68,8%	18,0%	41,7%	90,9%	69,0%	70,0%	69,0%	67,0%
Policy objectives (level 1)	60,2%	18,1%	27,3%	88,9%	56,0%	89,0%	51,0%	70,0%
Policy objectives (level 1, excl GPT)	52,9%	18,3%	22,2%	85,7%	49,0%	86,0%	42,0%	63,0%
Policy objectives (level 2)	38,9%	17,0%	15,5%	66,0%	32,0%	44,0%	38,0%	56,0%
Policy objectives (level 2, excl GPT)	40,6%	19,0%	11,8%	62,5%	36,0%	63,0%	36,0%	45,0%

Source: Eye@RIS3 database, EIS 2017. Numbers are the % of priorities that is defined at both the national and regional level. The countries included in this table are the ones with RIS3 strategies at both the national and regional level and which have data in the eye@RIS3 platform for more than 1 region (AT, CZ, DE, DK, PL, PT, RO, SE). Note that a national priority is considered to be present at regional level if it has been defined for *at least one* region in the country.

There is no established way to analyze alignment of priorities within countries across governance levels, so we follow an explorative approach in which we use the available data to construct indicators that allow assessing to what extent priorities are 'shared' i.e. whether they occur at both the national and regional level within a given country. The analysis is per definition restricted to those countries for which the Eye@RIS3 database contains RIS3 priorities at both the country and regional level[15]. Table 11 shows that, relative to the total set of priorities - i.e. all unique priorities defined at national and regional level combined – only half of industry sectors that is flagged as a priority occurs at both governance levels within the same country. The variance is high however, ranging from 25% (SE, with 72 unique NACE2 sectors flagged at national and/or regional level) to an overlap of 85% (PT, with 74 unique NACE2 sectors). Scientific priorities using the NABS classification are fewer in number and hence per definition overlap more on average (69%), but again with high variance, ranging from 42% (SE and SK, with 12 and 7 NABS chapters flagged as priorities, respectively) to 91% (PT, with 11 unique NABS chapters). With respect to GPTs - operationalized here as digital transformation technologies and Key

[14] As the AT example from section 0 shows, "asynchronous processing" of the federal and regional levels may also constitute a learning opportunity.

[15] The analyzed set of countries was restricted further to those that list regional priorities for more than 1 region. Since the resulting set contains only 8 countries (AT, CZ, DE, DK, PL, PT, RO, SE) and the Eye@RIS3 platform may not provide a fully accurate or up to date representation of priorities, the results have to be interpreted with caution as they merely provide an indication of countries' alignment of smart specialization priorities.

Enabling Technologies, as contained in the policy objectives – a baseline hypothesis is that they increase the alignment of priorities between the national and regional level due to their generality. The results show that alignment of high-level policy objectives indeed decreases once GPTs are excluded, but only by about 7 percentage points, while at a more disaggregate level alignment less than half % of policy objectives occurs at both the national and the regional level. The right panel of the table splits the results according to innovation performance (EIS 2017) and is merely provided for illustrative purposes given the small number of countries in the different categories. One noteworthy observation is that the three innovation leaders included in the table show a below-average overlap in priorities between the national and regional level. Results based on an analysis of final RIS3 documents only are not reported here but show similar results.

Note that the interpretability of the reported alignment indicators is largely limited to checking for outliers, in terms of their absolute value and deviation from the average across countries. The indicators would warrant closer inspection in case of very low values as these are indicative of very little coordination and exploitation of complementarities. Analogously, very high values may suggest that priorities are simply transposed between governance levels. Future exercises could also use updated data for comparisons over time for a given country, which would be helpful to follow up on coordination between governance levels. Finally, note that the reported numbers indicate *exact* matches between priorities i.e. they do not take into account *relatedness* between priorities. Thus, while alignment of priorities between the national and regional level may generally be considered fairly low, some of the non-matching priorities may effectively be closely related and/or complementary[16]. With respect to guiding further development of RIS3, these results do suggest that within-country alignment of priorities is an attention point and that some countries may improve on developing their R&I capacities by more judiciously assessing whether priorities that the national level has committed to are tying into the focal areas at the regional level, and *vice versa*.

Differentiation of priorities between countries

No two countries are the same in terms of socio-economic conditions or capacities and potential for R&I. As a consequence, 'smart' specialization should aim to capitalize on the specific strengths of the country or region. In other words, countries' and regions' RIS3 documents should not only aim for specialization but should also be differentiated from those of other countries regions (Foray *et al.*, 2018). While the notion of differentiation is central to the concept of RIS3, it is not straightforward to operationalize in terms of specific indicators.

[16] For example, sectors C.26 (computer, electronic and optical products) and C.27 (electrical equipment) do not produce a match in the data presented in the table but may in practice correspond to related activities.

Table 12. *Differentiation of RIS3 priorities across countries*

Variable	Share of priorities selected by: less than 5 other countries	more than 5 but less than 10 other countries	more than 10 but less than 20 other countries	more than 20 other countries
	All countries			
Industry sectors (NACE 2-digit)	0,8%	2,4%	43,0%	53,8%
Scientific fields (NABS)	0,0%	2,6%	14,6%	82,8%
Policy objectives (level 1)	0,0%	0,0%	19,6%	80,4%
Policy objectives (level 1, excl GPT)	0,0%	0,0%	25,5%	74,5%
Policy objectives (level 2)	0,4%	6,8%	46,8%	46,0%
Policy objectives (level 2, excl GPT)	0,4%	8,7%	56,6%	34,3%
	Innovation leaders			
Industry sectors (NACE 2-digit)	1,2%	2,9%	51,7%	44,2%
Scientific fields (NABS)	0,0%	2,8%	21,1%	76,1%
Policy objectives (level 1)	0,0%	0,0%	26,8%	73,2%
Policy objectives (level 1, excl GPT)	0,0%	0,0%	33,7%	66,3%
Policy objectives (level 2)	0,3%	7,8%	54,4%	37,5%
Policy objectives (level 2, excl GPT)	0,6%	9,1%	63,3%	27,0%
	Strong innovators			
Industry sectors (NACE 2-digit)	0,6%	3,2%	49,3%	46,9%
Scientific fields (NABS)	0,0%	1,2%	13,3%	85,6%
Policy objectives (level 1)	0,0%	0,0%	17,7%	82,3%
Policy objectives (level 1, excl GPT)	0,0%	0,0%	23,1%	76,9%
Policy objectives (level 2)	0,7%	5,6%	46,5%	47,2%
Policy objectives (level 2, excl GPT)	0,8%	6,6%	58,0%	34,6%
	Moderate innovators			
Industry sectors (NACE 2-digit)	1,3%	3,6%	42,9%	52,1%
Scientific fields (NABS)	0,0%	3,5%	14,4%	82,1%
Policy objectives (level 1)	0,0%	0,0%	18,3%	81,7%
Policy objectives (level 1, excl GPT)	0,0%	0,0%	24,2%	75,8%
Policy objectives (level 2)	0,7%	8,5%	42,2%	48,6%
Policy objectives (level 2, excl GPT)	0,1%	11,5%	49,0%	39,4%
	Modest innovators			
Industry sectors (NACE 2-digit)	0,0%	0,0%	28,3%	71,7%
Scientific fields (NABS)	0,0%	2,8%	9,7%	87,5%
Policy objectives (level 1)	0,0%	0,0%	15,6%	84,4%
Policy objectives (level 1, excl GPT)	0,0%	0,0%	20,8%	79,2%
Policy objectives (level 2)	0,0%	5,2%	44,0%	50,8%
Policy objectives (level 2, excl GPT)	0,0%	7,5%	56,3%	36,2%

Source: Eye@RIS3 database, EIS 2017.

♦ This table includes 36 countries (and their regions) for which EIS performance data (2017) and priorities in the eye@RIS3 database are available.

We take the following approach in order to empirically assess the degree of uniqueness of priorities across countries, as demonstrated by Table 12. All unique RIS3 priorities defined at national or regional level within a country - as registered in the Eye@RIS3 database - are used to determine to what extent that country's set of priorities overlaps with other countries' priorities. Of course, the analysis is restricted by the amount of detail that the information can provide, where in particular the potential for differentiation in the scientific domain is limited due to the limited number of scientific fields in the NABS classification[17]. Considering all previously used indicator types (sectors, scientific fields, policy objectives), we find that, unsurprisingly, highly differentiated priorities – in the sense that less than 5

[17] For NACE2 sectors, there are 88 possible values, compared to only 14 possible scientific fields.

other countries also selected them – occur very rarely. Only 1% of priority sectors falls into this category, while scientific priorities and (high-level) policy objectives are never selected by such a small set of countries (see the top panel in Table 12). More than half of focal sectors and more than 80% of focal scientific fields have also been flagged as priorities by more than 20 other countries. Rather than suggesting that differentiation in priorities between countries is (too) low, these numbers first and foremost indicate that we need more granular indicators to measure RIS3 priorities if one wants to properly track whether countries indeed aim to build a comparative advantage by not doing what other Member States do. The comparison of policy level 1 and level 2 priorities – with 21 and 72 possible values, respectively - illustrates this point: for the more detailed level 2 indicator less than half of priorities are broadly used elsewhere i.e. by more than 20 other countries. This further decreases to 34% if GPTs – which are arguably valid priorities for most if not all countries - are excluded. When comparing countries by innovation performance (see the bottom 4 panels in Table 12) then no major differences between the performance groups arise in terms of pursuing priorities that are unique or rarely chosen by other countries. When it comes to scientific fields, innovation leaders do seem to commit comparatively more to scientific domains that are not 'crowded' by many other countries with 24% of their scientific priorities pursued by less than 20 other countries, compared to 16% on average. Innovation leaders also seem more differentiated from other countries in terms of detailed policy objectives, excluding GPTs. An example of such a policy objective that is flagged by less than 5 countries is *"A.04 - Remotely piloted aircrafts"* within the aeronautics domain. A robustness check where the analysis is done using only final RIS3 documents, reported in Table 16 in Annex 1, shows stronger indications of differentiation: for policy objectives at the disaggregate level (excl. GPTs) on average 23.6% of priorities appears in fewer than 10 countries' final smart specialization documents, compared to 9.1% if all RIS3 sources in Eye@RIS3 are considered. Whether this is the result of deliberate actions during the RIS3 process cannot be concluded with certainty from this data and constitutes an avenue for further analysis.

3.2 Time of introduction in innovation policy

Setting thematic priorities in R&I policies has long tradition in some countries and regions, but for quite a few this process was absent before 2010, the year of the pertaining European Commission Communication (EC, 2010). Based on the RIO Network Experts' survey, thematic priority setting was indeed not used before 2010 in *national* R&I strategies for 10 out of 23 Member States that have a RIS3 at the country level (see Table 3). For *regional* RIS3, thematic priorities were more commonly used prior to 2010 i.e. by 11 out of 14 Member States (see Table 5), although the precise approach of defining them has typically changed since then.

3.3 Methods for identification

As mentioned in section 3.1, countries in general do rely on multiple ways to define thematic priorities for their national (see Table 4) and regional RIS3 (see Table 6), referring to industrial sectors, scientific fields, technology domains and societal challenges. In terms of the process leading up to the definition of priorities, the vast majority of countries engaged in workshops with stakeholders (21 out of 23 Member States with national RIS3, 13 out of 14 Member States with regional RIS3) and public consultations (18/23 and 9/14 Member States, respectively), combined with economic analysis (19/23 and 13/14 Member States, respectively).

EXAMPLE: NATIONAL RIS3 STRATEGY IN POLAND

The following methods were used to identify priorities in the national RIS3 strategy (Klincewicz & Szkuta, 2016):

- foresight activities: National Foresight Poland 2020 and Technology Foresight for Polish Industry - Insight 2030 (2009-2011) – identification of key research areas and technologies with brainstorming, Delphi and scenario building methods, STEEP and SWOT analyses, cross-analysis of influences, panels of experts and public consultations with stakeholders,
- pilot programs dedicated to support sectoral research programmes designed and proposed by industries i.e. aviation and medical industries (since 2011),
- pilot study conducted by the World Bank among more than 1000 companies in 4 regions and aimed at identifying the indigenous potential and the demand of companies for public intervention (2014-2016),
- workshops and consultations organised by three Ministries (Economy, Regional Development, Science and Higher Education) with among others representatives of industries (14 sectoral meetings), entrepreneurs and scientists (2012-2014),
- consultations with stakeholders and establishment of 20 working groups dedicated to selected areas of specialisation and a consultative group to monitor and analyse emerging specialisations (since 2014),
- participation in the Regional Forum for Smart Specialisation (since 2013) – a dialog platform grouping representatives of all regional authorities responsible for regional smart specialisation strategies.

3.4 Entities leading the RIS3 development process

While it was mentioned in section 3.3 that many countries set up public consultation processes involving various stakeholders, none of the surveyed countries assigned a leading role to citizens or other entities such as NGOs, neither for national (Table 4) nor for regional RIS3 (Table 6). While innovation users need not necessarily take the lead in setting thematic priorities, a more open and co-creational 'Quadruple Helix' model should cater for that possibility, besides a process orchestrated by the classical Triple Helix entities (Carayannis *et al.*, 2018).

EXAMPLE: POMERANIAN REGION IN POLAND

At the beginning of the RIS3 process, the regional authorities identified the regional strengths and weaknesses as well as the most promising areas for regional development through intensive data analyses. Then regional authorities organized an open and competitive call to identify regional smart specialisations and invited stakeholders to present initial proposals of regional smart specialisations and activities aimed at strengthening the innovativeness and competitiveness of regional economy (first phase of selection process). Stakeholders representing business, academia and other interested groups communicated with each other and formulated thematically-oriented partnerships in a bottom-up manner. The partnerships prepared the initial proposals of R&I priorities in selected areas and submitted them to regional authorities. The most advanced proposals were invited to the second phase of selection process (some partnerships were asked to join their activities) and prepared final proposals, which were negotiated with regional authorities. The process engaged 434 stakeholders, including 292 companies, 43 schools and universities, 38 intermediary and technology transfer organisations, 12 municipalities, 6 hospitals and many non-government organisations. Finally, four agreements were signed between stakeholders' partnerships and regional authorities[18]:

[18] https://drg.pomorskie.eu/documents/102005/836126/Porozumienie+na+rzecz+ISP+2_B0F%261%26%2605M.pdf/a9e5dfee-bf97-4937-9205-cd279c7c37be

- offshore, port and logistics technologies (75 partners signed an agreement with a regional authority),
- interactive technologies in an information-saturated environment (68 partners signed an agreement with a regional authority),
- eco-effective technology in generation, transmission, distribution and consumption of energy and fuels, and in construction (108 partners signed an agreement with a regional authority),
- medical technologies in the area of civilization and ageing-associated diseases (93 partners signed an agreement with a regional authority).

The partnerships consist of SMEs, start-ups, large enterprises, universities and research organisations, NGOs, clusters and intermediary organisations. The partnerships are open to new members interested in cooperation with their areas of specialisation. Each partnership developed in a bottom-up manner the rules concerning the elaboration of a common vision and research agenda, communication, cooperation and participation in common R&D projects. The members of partnerships could apply for R&I funding from the Regional Operational Programme for 2014-2020. Submitted applications could gain extra points for compliance with research agendas. Nevertheless, some partners indicated that this incentive and their engagement in creating and maintaining partnerships were incommensurable. In practice, some initially planned projects did not pass to the submission phase (especially projects with relatively high budgets and many partners), but cooperation between partners is still very active and has led to new project proposals. In effect, the partnerships create the foundations for closer and continuous interaction between partners, but the main challenge remains how to maintain the cooperation of partners in the long term.

3.5 RIS3 / EDP as a new policy paradigm

Based on the RIO Network Experts survey, RIS3 represented an entirely novel approach to policy making for only a minority of member states. For national RIS3, it concerns only modest or moderate innovators (Table 3). National RIS3 strategies of innovation leaders were either not significantly affected by the introduction of the RIS3 approach or were even developed as a parallel exercise to an existing strategy. At the regional level, 6 Member States acknowledge that RIS3 constituted a novel approach, of which 2 innovation leaders (Table 5).

EXAMPLE: RIS3 IN BELGIUM

BE is an illustration of a Member State where the advent of RIS3 approach did not represent a major shift in policy making. In particular the Walloon and Flemish Region had already in place governance structures that, in effect, focus on specialisations in selected priority areas. A cornerstone of the implementation of the RIS3 principle in Flanders is its cluster policy, where the 'spearhead clusters' aim for long-term, large-scale triple-helix collaboration in domains that are considered strategic for the region. The Walloon Region follows a different approach in which the so-called Competence Poles act as the centrepiece of the region's cluster strategy (Kelchtermans & Robledo-Bottcher, 2018). Like Wallonia, Flanders participates in the Vanguard Initiative, aimed at interregional cooperation for supporting clusters and regional eco-systems. These regions try to assimilate the principles from RIS3 approach rather than supplanting existing governance structures.

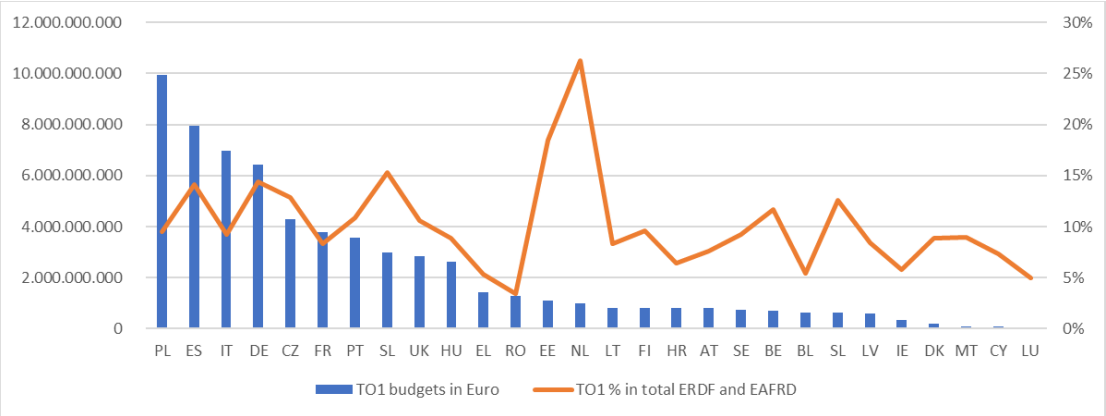
4 Funding

4.1 Budgets and instruments

This section addresses the questions concerning budgetary sources and policy instruments dedicated to support R&I activities. According to the "Guide for Research and Innovation Strategies for Smart Specialisations (RIS 3)", the RIS3 strategies should identify among others the funding sources, delivery mechanisms and projects, timeframes as well as measurable targets to assess results and impact of actions (EC, 2012).

The RIS3 documents mention many sources of funding but in most countries the main source of public funding are ESI Funds, both at national and regional levels. All funding from ESI Funds - Thematic Objective 1 (Research, Technological Development and Innovation) should be dedicated to support projects, which are in line with RIS3 documents (possibly with a small allocation for pilot projects and emerging specialisations). In DE, NL and ES, ESI Funds are used to implement the RIS3 strategies at regional levels. Total budgets for TO1 and their percentages in total ERDF/EAFRD budgets in 2014-2020 are presented in Figure 1.

Figure 1. *Total budgets for Thematic Objective 1 and their percentages in total ERDF and EAFRD budgets in 2014-2020*



- Source: own elaboration based on https://cohesiondata.ec.europa.eu/

In 2014-2020 the total budget for TO1 is about 66 billion Euro. Countries with the largest budgets for TO1 are PL (9.95 billion Euro), ES (7.94 billion Euro), Italy (6.98 billion Euro), DE (6.43 billion Euro) and CZ (4.3 billion Euro). The largest shares of budgets for TO1 in total budgets are in NL, EE, SL, DE and ES, the lowest in RO. In some countries, projects in line with thematic priorities indicated in national and regional RIS documents could also benefit from preferences in selection criteria in instruments funded from Thematic Objective 3 (SME Competitiveness), but it's rather an exception than a rule. It's worth nothing the total funding for TO3 in 2014-2020 is 96.5 billion Euro.

In countries with dedicated budgets for RIS3, the most popular policy instruments are subsidies and grants, which are used in 16 of 23 Member States for national RIS3 (see Table 4), and 11 out of 14 Member States for regional RIS3 (see Table 6). Less popular are the use of repayable financial instruments and public procurement in areas identified as smart specialisations, which are used respectively in 6 and 3 out of 23 Member States for national RIS3. At regional level, repayable financial instruments are used in 7 and public procurement in 3 out of 14 Member States.

The implementation of RIS3 in most countries and regions is deeply integrated in the implementation of operational programs and is limited to instruments included in such programs. It's worth noting that the use of private funding to support RIS3 activities is also directly linked to ESI Funds i.a. owing to the mandatory co-funding in projects. The RIS3 could also benefit from instruments and funds used to support research and innovation activities in general, e.g. tax instruments to support research, development and innovation activities.

In most of the analysed cases, organizational units (teams, persons) responsible for the design, update and monitoring/evaluation of the RIS3 strategies were not directly responsible for the implementation of ESI Funds operational programs. Often, the priorities were not adequately communicated, organizational units had diverse goals and were faced with different challenges, which complicate the development of RIS3 strategies but also the implementation of operational programs (Piątkowski, Szuba & Wolszczak, 2014).

4.2 Complementarities in multi-level governance

It's expected that RIS3 induces synergies between different policies and funding sources and aligns EU, national and regional policies in the identified areas of current and potential future strengths. In particular, the RIS3 strategies should include "upstream actions" to prepare regional R&I players to participate in Horizon 2020 ("stairways to excellence") and "downstream actions" to provide the means to exploit and diffuse R&I results, stemming from Horizon 2020 and preceding framework programmes (EC, 2013, p. 94; EC, 2012, p. 118). These recommendations address the multi-level nature of R&I policy in European countries, in which R&I activities can be supported by many instruments, implemented at different levels (i.e. European, national and regional) and funded from different sources, including national funding or ESI Funds. To increase complementarities between R&I policy instruments, mechanisms have been proposed that link intervention at various levels (e.g. vertical measures such as "the Seal of Excellence" in the H2020 SME Instrument, MSCA Individual Fellowship and "Teaming for Excellence") as well as frameworks that link the implementation of projects in different countries and regions. Examples of the latter are horizontal mechanisms such as the possibility of using up to 15% of ESI Funds allocations of a given country or region to finance project activities carried out in other countries or regions (art. 70 of Regulation (EU) No. 1303/2013).

The "Seal of Excellence" is the high-quality label awarded to the projects submitted to Horizon 2020 that received a positive assessment (i.e. above the quality threshold), but did not receive funding due to budget limits. National or regional authorities could support the projects with the "Seal of Excellence Certificate" from their own sources or ESI Funds as well as could design and implement these support schemes in line with their specific needs and expectations (i.e. eligible costs, state aid schemes, types of R&I activities). Projects with the "Seal of Excellence" certificate funded from ESI Funds (Thematic Objective 1) need to be in line with thematic priorities identified in smart specialisation strategies. From the perspective of the RIS3 strategies, these projects offer interesting information about activities of innovative companies in countries or regions, especially they could confirm the niches identified in the RIS3 strategies or help to identify new niches and emerging areas of specialisations.

In HR, CZ, EL, HU, LV, IE, PL, PT, RO, ES and SE, mechanisms linking H2020 and national funding, such as the "Seal of Excellence", have been implemented. In countries like CZ or PL, projects with the "Seal of Excellence" certificate are funded from ESI Funds. At the regional level, such instruments have been implemented in BE, FR, EL, PT, ES and SE. The lack of such instruments in other countries might indicate a missed opportunity to better exploit synergies with H2020 instruments, although it cannot be ruled out that the positive "Seal of Excellence" signal translates into national or regional funding.

There is generally low usage among European countries of mechanisms such as the "15% rule" or the "Seal of Excellence". According to the RIO Network Experts' survey, such

mechanisms are used by up to 11 of 23 Member States at national level (see Table 3) and by up to 6 of Member States at regional level (see Table 5).

An important role in stimulating cooperation between regions from different countries is played by initiatives such as the Vanguard Initiative[19] (see also section 3.5), S3 Thematic Platforms[20] or Interreg projects. They could improve knowledge exchange and networking, stimulate cooperation and help to build intra-regional critical mass for research activities in the same areas identified in RIS3 by different countries and regions. In most of those initiatives the most active regions are from Western and South countries as opposed to relatively lower engagement of regions from Central and Eastern Europe.

Despite the promotion of mechanisms based on complementarities and intra-regional cooperation by the EC, many countries and regions have not yet implemented such mechanisms, mainly due to difficulties in defining, implementing and monitoring them. For some national and regional authorities, "silo"-based approaches are still present and hamper investments from national or regional operational programmes in other countries or regions (EC, 2016c). According to the opinions of RIO Network experts, interregional cooperation is considered among national and regional authorities, but through other dedicated programmes such as Interreg.

[19] http://www.s3vanguardinitiative.eu/
[20] http://s3platform.jrc.ec.europa.eu/s3-thematic-platforms

5 Progress in implementation

Timely progress in the implementation of RIS3 is the exception rather than the rule. For national RIS3, the RIO Network Experts of 4 out of 23 Member States report that RIS3 implementation is on schedule, while it is facing delays in 12 Member States (see Table 3). In 7 cases, the national RIS3 cannot be clearly separated from the broader national innovation strategies and there is no dedicated roadmap/action plan for RIS3 documents, which complicates the assessment of progress in implementation of those strategies.

From a regional perspective, the answer to the question concerning the progress in implementation of the RIS3 is more complicated, due to the fact that regions within a single country may differ in their advancement of the implementation of RIS3. In 6 of 14 Member States with regional RIS3, implementation is considered on schedule in all or at least some regions (see Table 6). In 7 Member States, the execution of regional RIS3 faces delays in one or more regions, but in 5 of these countries implementation is still in line with the initial roadmap. Also at the regional level, it is not always possible to assess the state of affairs due to the lack of a dedicated RIS3 strategy with a separate roadmap.

In some countries, the delays in the implementation of the RIS3 strategy were caused by the problems concerning the fulfilment of ex-ante conditionalities for ESI Funds (PT and SK) or the approval of RIS3 documents at national or regional levels. RIO Network Experts indicated that the RIS3 processes had not been straightforward in some cases, notwithstanding the support put in place by the European Commission (including through the S3 Platform and through the mobilisation of appointed experts) and also by national administrations, which organised workshops and seminars and disseminated guidelines to support the regions and the state representatives in the regions in the process. As a result, the monitoring of the progress of the implementation of RIS3 documents, especially at regional level is difficult because the start-dates of the different regional strategies differ considerably.

Many RIO Network Experts made attempts to explain the potential motivations behind the development and implementation of RIS3, indicating that the strategies were mainly drafted to address the ex-ante conditionalities related to the use of ESI Funds for Thematic Objective 1 (Research, Technological Development and Innovation).

In ES, the implementation of RIS3 documents was "delayed" due to the long approval process of the new operational programs. The delays in the implementation of the RIS3 documents caused by the problems related to the implementation of operational programs are also indicated by experts from BG, HR, CZ, LT, PL and RO. Other problems concerning the implementation of the RIS3 are:

- complicated governance system: operational programs are often governed by individual ministries that remain out of direct reach of the RIS3 governance structure,
- lack of experience in the implementation of operational programs by governmental structures (ministries and agencies),
- insufficient budgets and bureaucratic difficulties,
- technicalities regarding the compliance to state aid rules,
- novelty of some policy instruments like innovative procurement and applied R&D and hence relatively slow absorption of funds at the beginning of the implementation of RIS3.

Some experts indicated also the existence of political constraints hindering the progress of RIS3 strategy implementation. In LT, the government change in autumn 2016 resulted in the review of some programs. For example, major R&D infrastructure investments were reviewed and updated aiming at higher effectiveness, which caused additional delay. In IE, the delay is caused by the lack of clarity on the RIS3 national policy and commitment of the Irish government to RIS3 as a policy framework. In EL, calls for proposals were deferred due to the delay in setting up the Regional Council for R&I (the previous institution was replaced by this newly established Council following the change of respective laws),

the reluctance of the Development Directorates of the Regions to assume responsibility which left the Managing Authorities in an understaffed position to deal with the whole process and problems with the Central Information System that had to specify the features of the calls for each different region.

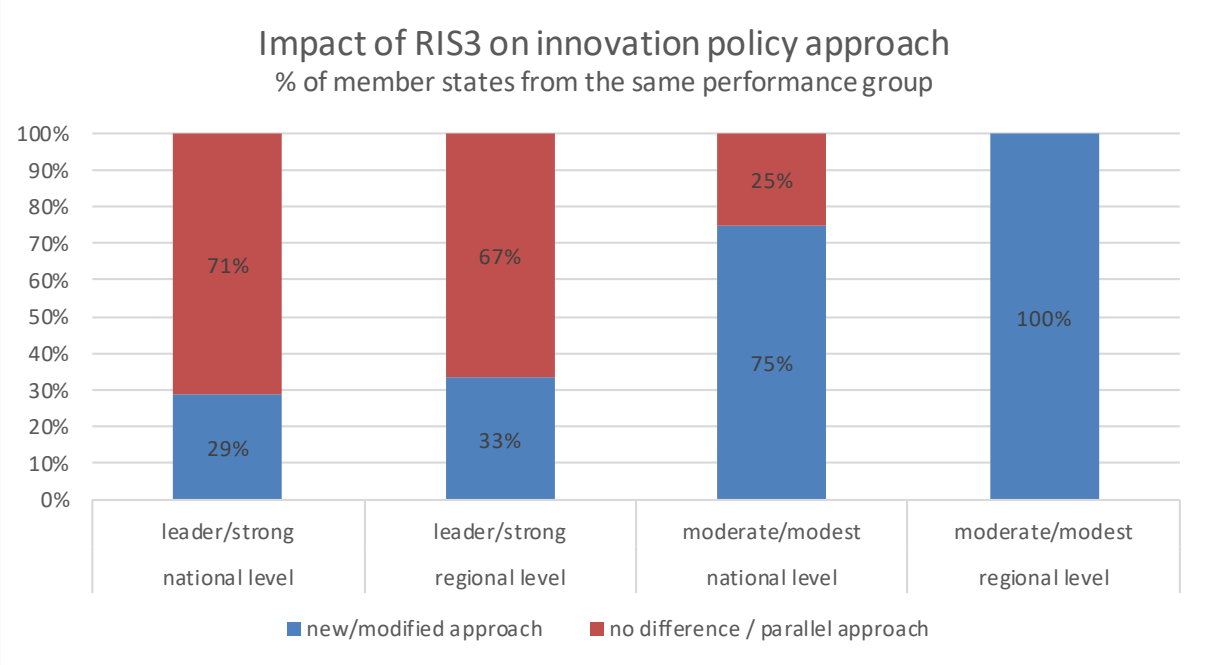
6 Monitoring mechanisms, feedback loops and evidence of impact

Monitoring efforts for a RIS3 strategy should "measure the changes of the regional productive structure towards activities that are globally competitive and have a greater potential for value added" (EC, 2012). While the RIO Network Experts' survey did not address implementation details of monitoring systems such as precise types of indicators, it focused on the contribution of RIS3 monitoring and evaluation on the approach to policy making and on Member States' progress in carrying out evaluations.

In most countries, monitoring of RIS3 documents has not started or was at the beginning phase by the time when the RIO Network Experts participated in the survey. As a result, for national RIS3, a clear majority of experts indicated that RIS3 monitoring and evaluation activities have yet to register a significant impact on thematic priorities, policy instruments or the overall approach to policy making (15 out of 23 Member States, see Table 4).

For regional RIS3, for 6 out of 14 Member States no significant impact has been observed so far, although there are instances of modifications to thematic priorities and/or policy instruments (3 Member States) or even the overall approach (4 Member States, see Table 6 and Figure 2).

Figure 2. Summary of RIS3 impact on innovation policies



In terms of progress with carrying out evaluations of national RIS3 strategies, there is substantial heterogeneity between Member States. Several countries with national RIS3 strategies have performed ex-ante evaluations of the selected priorities (6 Member States), process evaluations of EDP (5 Member States, see Table 4) and/or have undertaken a mid-term/ongoing evaluation (7 Member States, see Table 4).

At the regional level, there is comparatively more evaluation activity, as indicated by the results of the RIO Network Experts' survey in Table 6. Ex-ante evaluations of selected priorities and/or the EDP process have been carried out in regions of respectively 5 and 7 out of 14 Member States while regions in 9 Member States are engaged in an ongoing evaluation.

EXAMPLE: RIS3 MONITORING IN LITHUANIA

In 2017, the first RIS3 monitoring report prepared by the Lithuanian Research and Higher Education Monitoring and Analysis Centre (MOSTA) was presented. The monitoring system of the Lithuanian RIS3 strategy is based on three types of data (and indicators):

- economic sectors (added value created, number of people employed, material investments from 2010-2014),
- research potential (scientific publications from 2014-2015 and patents from 2014-2017,
- research and innovation activities (participation in projects funded by Horizon 2020 (European) from 2014-2016 and "Intelect" programme (national) from 2016).

The analysed data represented different time horizons and did not directly reflect the RIS3 strategy since many instruments were not implemented in 2014-2016. Additionally, according to the monitoring report (MOSTA, 2017, p. 7) "The S3 priorities are of an horizontal nature and do not directly correspond with economic activities, fields of research or other classification groups. That made linking the monitored priorities to economy and research complicated… the findings of this report should be interpreted cautiously and regarded as indicative. The report should not be used for policy decision making and/or amending the S3."

Taking into account opinions of the RIO Network Experts and analyses of reports concerning RIS3 monitoring, the following problems related to monitoring of RIS3 activities could be identified, in line with the observations made in section 3.1:

- lack of common classification concerning RIS3 activities: there are different classifications of R&D, economic activities and research output (publications, patents), such as industry sectors (NACE), fields of science (NABS), technology domains (IPC), etc. These classifications do not precisely reflect the activities and priorities mentioned in RIS3 documents,
- lack of comparable data, which makes it difficult to use many indicators (economic, technometric and bibliometric) across EU Member States for measuring progress of RIS3,
- bureaucracy related to gathering and classifying data: additional efforts to public statistics and monitoring of operational programs are necessary to collect data concerning RIS3 strategies.

To allow for better monitoring of RIS3, both the validity and sophistication of indicators need to be addressed. For some activities (e.g. software development), certain indicators (e.g. patents) are not valid measures, and alternatives need to be developed. Second, simple indicators such as publication and patent counts cannot be expected to give an accurate picture of the rich context in which RIS3 takes place. Therefore, besides improving the granularity of existing science and technology indicators, the toolbox as such needs to be innovated, building on recent advances in measuring technological and scientific novelty (Verhoeven *et al.*, 2016; Wang *et al.*, 2017).

7 New policy developments

EU Member States with previous experiences of regional R&I policy and countries that were used to setting R&I thematic priorities and enforcing them through dedicated public funding programmes, are still struggling how to reconcile the previously developed approaches with the RIS3 framework. R&I policies on the national and regional levels are gradually incorporating elements of the RIS3 framework but these countries and/or regions still face the challenges of carrying out the EDP. Among new Member States, PL belongs to those countries that also had an elaborate R&I policy setting process before the introduction of smart specialization, involving large-scale foresight exercises and stakeholder consultations. The existing approach was initially difficult to align with the smaller-scale, time-limited EDP efforts that had to be implemented as an ex-ante conditionality of ESI Funds. More generally, the RIS3 framework may prove difficult to reconcile with existing cluster policies, research infrastructure support schemes and other R&I policy frameworks adopted prior to the 2014-2020 EU programming period if the previous approach is considered more comprehensive, inclusive and evidence-based by policy makers. While RIS3 seems to have limited appeal for EU Member States with strong traditions of R&I policy making, the Smart Specialisation approach contributed to notable changes in countries that previously did not engage in R&I priority setting and/or extensive stakeholder dialogues. Countries which seemed to benefit from the adoption of RIS3 approach included CZ, HU, LT and RO, due to radical changes in approaches to and contents of R&I policies owing to the identification of thematic priorities with the involvement of stakeholders.

The requirement to carry out EDP and document its outcomes in the Smart Specialisation Strategy document was imposed on EU Member States as ex-ante conditionality for ESI Funds, 2014-2020. Policy makers had relatively short periods of time to complete these efforts and identify priorities that would be supported by RIS3, even though a genuine EDP would actually require substantially more time. This time pressure led to some Member States relabelling their previous R&I policy planning processes to suggest alignment with RIS3 requirements even though these processes originated in different methodological frameworks. For example, BE, DE and NL had long-standing traditions of R&I policy planning with dedicated tools and planning techniques. PL embarked on two nation-wide foresight projects in 2006-2012, expecting to use the technological foresight results to inform the national R&I policy. However, in 2013-2013 the country had to organise additional stakeholder dialogues to comply with formal requirements related to RIS3 and EDP, even though the foresight exercises were more insightful and ambitious than entrepreneurial discovery workshops, and they involved very large representation of stakeholders from various sectors and technological areas. Therefore, taking into consideration these realities of R&I programming, the analysis of RIS3 efforts could look beyond the formally submitted RIS3 documents. Following the acceptance of RIS3 by the European Commission, some governments embarked on alternative efforts that helped further refine the thematic priorities, formally communicated in strategic documents.

PL launched several calls for submission of proposals for "sectoral programmes" (Klincewicz *et al.*, 2018), R&I programmes defined by large, representative consortia of industrial and scientific stakeholders, who were supposed to identify specific R&D-related opportunities in global markets and propose coherent research agendas that could be implemented through calls open to all interested companies. This process resembled the original intentions of proponents of the EDP, as proposals for technological specialisations and research agendas were defined by stakeholder representatives in a bottom-up process, and subsequently contrasted with feedback from reviewers and R&D funding agency to align priorities and support measures. In consequence, Polish National Centre for Research and Development introduced a number of sectoral programmes, including programmes in fields overlapping with the previously adopted National Smart Specialisations, but it also targeted areas that were uncovered through stakeholder submissions and initially not covered by the RIS3. The process empowered stakeholders to analyse global markets and prior art in selected technological areas to draft feasibility studies, stimulated cycles of

interactions and yielded results that were probably even more aligned with specific needs of industrial R&I performers than the original Entrepreneurial Discovery Process, which was primarily motivated by the need to satisfy *ex-ante* conditionalities for ESI Funds. Moreover, in 2017-2018 the Polish government introduced stakeholder consultation processes to further refine national thematic priorities, reduce their number and select more specific focus areas for some particularly broad specialisations.

Taking stock of the effect of RIS3 on innovation policy in different member states, a fairly clear pattern emerges. The impact at the national level has been fairly low among innovation leaders and strong innovators with only 29% of these member states with RIS3 policies at this level classifying them as constituting a new or significantly different approach to policy making (RIO Experts survey; Figure 1). At the regional level, the picture looks very similar (33%). The impact of RIS3 as a policy paradigm is much more pronounced among the moderate modest innovators, with 75% of them classifying RIS3 as new or modified approach to innovation policy, and even all of them at the regional level.

Development, implementation and monitoring of RIS3 spurred a wave of further policy innovations and relevant initiatives across EU Member States and beyond. RIS3 became a relevant topic for numerous stakeholders, leading to analytical reports such as the ones on RIS3 priorities in AT, FR and DE, which compare RIS3 priority areas of regions and promote mutual dialogue and learning, useful for the next policy programming cycle). In addition, collaborative initiatives were started such as the "Vanguard Initiative", linking regions focused on industrial renewal, and research projects launched, such as the "ONLINES3" project, developing online tools supporting the development of RIS3. Thematic Smart Specialisation Platforms of the European Commission encourage benchmarking and cross-regional cooperation in several broad thematic fields. The Joint Research Centre of the European Commission maintains the Eye@RIS3 platform, where national and regional authorities can self-register their selected thematic priorities, and JRC implements the "RIS3 Support in Lagging Regions" projects, building relevant capacity in regions with low levels of innovation performance. There has also been increased interest of non-EU countries in the RIS3 efforts, with RIS3 documents prepared among others by Albania, Moldova, Montenegro, Serbia, Ukraine and selected regions of Turkey.

As indicated in section 3.1, RIS3 priorities selected in various parts of Europe remain overwhelmingly incommensurable, especially with respect to levels of detail and operationalisation. Lists of specialisations were implemented either as funding priority areas (topics shortlisted for ESI Funds financing) or as parts of fully-fledged strategies, with distinctive types of activities planned for each individual specialisation, depending on maturity levels and specific support requirements. Direct comparison of RIS3 of different regions and countries proves difficult, and no ready-to-use benchmarks exist. Many RIS3 approaches demonstrate insufficient focus, with broad RIS3 priorities or approaches that could not really be characterised as prioritisation. There is relatively little evidence of genuine "discovery" resulting from EDP processes, i.e. cases when the stakeholder dialogue yielded unexpected results: discovery of new thematic specialisations that have not been identified prior to the beginning of the process.

The involvement of stakeholders, particularly strong representation of industry, remains a key challenge for EDP in many parts of Europe. Interestingly, problems in reaching out to relevant stakeholders were not only experienced by government authorities orchestrating the development of RIS3, but also witnessed by stakeholder initiatives. For example, the Horizon 2020-funded project "ONLINES3" had difficulties in involving relevant stakeholder groups in RIS3-related discussions (Deakin, Reid and Mora, 2017: 15). For some regions participating in the JRC "RIS3 Support for Lagging Regions" project, workshops seemed to be the first attempts at conducting broad stakeholder consultations of R&I priorities even though the earlier EDP exercises were described in documents formally submitted to the European Commission to meet ex-ante conditionalities.

There is also anecdotal evidence of problems with RIS3 implementation: some funding calls that focused on specific specialisations, which had been selected through EDP with

the involvement of stakeholders, experienced problems with severely limited numbers of applications. This does not necessarily indicate mistakes in the selection of specialisations, but could also signal a mismatch between stakeholder expectations and the design of specific support measures (e.g. excluding certain types of beneficiaries, imposing prohibitive requirements of co-funding, targeting inadequate levels of technological maturity or stages of innovation development process). Moreover, regional operational programmes based on ESI Funds usually support only activities of R&I performers located in a given region, while many technology markets require inter-regional and international cooperation, thus making many innovative projects ineligible for ESI Funds financing, even though a regional, critical mass might already exist in a given technological area, as indicated by the RIS3.

Modifications of RIS3 priorities in regions and countries imply learning-by-doing processes and form an integral part of the EDP, but were observed only in selected countries. Some EU Member States were relatively late with adopting RIS3 priorities altogether (LU and SK) or launching calls based on the selected priorities (HU).

It must also be noted that EU Member States display particular heterogeneity in their use of RIS3 priorities for ESIF-based R&I support measures: only some countries require strict compliance of all supported projects with RIS3 priorities, while others apply RIS3 criteria only to selected support measures or consider them optional. A possible indicator of impact of RIS3 programming on R&I policies would be the extent of using RIS3 priorities in various contexts, e.g. nationally or regionally funded programmes that do not rely on ESIF or R&I strategies of local stakeholders. Such evidence is still missing due to the limited availability of data.

8 Conclusions and lessons learned

Embeddedness of RIS3 in national and regional policies

Critics of smart specialization argue that this concept is "old wine in new bottles" and the popularity of the concept results mainly from the ex-ante conditionality (TO1). Additionally, the concept is still at the early stages of implementation and it's difficult to indicate measurable achievements of the concept on research and innovation performance in the Member States. On the other hand, the opinions of many experts dealing with innovation policy in less innovative countries and regions, especially in Central and Eastern Europe, indicate that RIS3 is not seen as a "fashion" but rather more comprehensive and systemic approach to defining, implementing and monitoring public intervention in research and innovation area. For many countries and regions, setting thematic priorities for research and innovation, engaging stakeholders and opening to bottom-up initiatives, mean radical change comparing to previous policymaking practices. Additionally, in many countries, RIS3 processes have initiated the discussions about the role of regional or even lower levels of governance in research and innovation policy as well as relations between them and national level.

> ***RIS3 processes should be continued in 2021-2027, but ex-ante conditionalities should put more emphasis on the long-term sustainability of RIS3, especially linking ESI Funds dedicated to the implementation of RIS3 (i.e. TO1, TO3 and TO4) with additional national/regional funding.***

International cooperation

International cooperation is growing in research and innovation, but in many countries and regions, the level of internationalisation of RIS3 activities seems unsatisfactory. They concentrate mainly on the implementation of ESI Funds within national or regional borders and many local stakeholders and policymakers perceive ESI Funds as strictly assigned to specific countries/regions, despite the fact that regulations concerning ESI Funds allow to use the funds outside the area of intervention. Additionally, bottom-up initiatives promoting international cooperation (i.e. the Vanguard initiative) are grouping mainly regions from more developed countries. It raises the risk of national/regional isolation and duplication of R&D efforts as well as limits the achievement of critical mass in some R&D areas.

> ***The problem of low international cooperation could be addressed by additional incentives stimulating international (cross-border) cooperation, such as dedicated part of ESI Funds for such activities.***

Mandatory nature of RIS3

In 2014-2020, the design and implementation of RIS3 strategies are mandatory (so called ex-ante conditionality) for countries and regions using ESI Funds for Thematic Objective 1 (TO1 – Strengthening research, technological development and innovation activities or research infrastructure). Nevertheless, a significant part of ESI Funds is dedicated to other TOs, like TO3 (Enhancing the competitiveness of SMEs) or TO10 (Investing in education, training and vocational training for skills and life-long learning), which are related to research, technological development and innovation activities, especially through the diffusion and deployment of the results of R&D activities.

> ***To ensure a more comprehensive approach to RIS3 implementation, it's worth considering to link RIS3 strategies with other R&I related TOs.***

Fine-grained indicators for RIS3

Cutting across the different analyses of RIS3 indicators, it is clear that a proper 'priority taxonomy' is lacking in order to assess whether countries and regions are truly selective in setting priorities, whether they align the priority setting process between the national and regional level and whether the resulting set of priorities is really a factor of differentiation for countries and regions. As a case in point, it is not possible to clearly identify the role of general purpose technologies in countries and regions' RIS3 documents as there is no clear distinction between the scientific, technological and application dimension in the formulation of RIS3 strategies.

> ***Thus, a recommendation that manifestly comes forward from the analysis presented in this report is that we need better, more granular indicators to analyse RIS3 priorities and the progress in their implementation as well as to measure their impacts. With such an improved indicator set, more accurate analyses of genuine regional competitive advantages could be carried out. Examples of such indicators include regionalized publication and patent statistics (Glänzel et al., 2012) for which a more systematic and regular provision would substantially facilitate the analysis of the implementation of RIS3 strategies.***

Alignment of priorities between governance levels

While the data do not allow for clear-cut conclusions, the analysis of RIS3 priorities suggests that their within-country alignment between governance levels is a point of attention. At least some countries may improve on developing their R&I capacities according to the guiding principles of RIS3 by more judiciously assessing whether priorities that have been committed to at the national level are tying into the focal areas at the regional level. Even in countries with a primarily regional focus on RIS3, the national level may and perhaps should take up a stronger coordinating role, within the bounds of the subsidiarity principle. As the example of AT illustrates, "asynchronous processing" of R&I policies by the federal and regional level makes systematic implementation and monitoring efforts difficult, although some level of misalignment also presents learning opportunities. Furthermore, while it is commendable that some Member States experiment with thematic priorities even at the subregional level, this may exacerbate coordination problems, potentially affecting the consistency of priorities defined at different governance levels.

> ***Thematic priorities defined in RIS3 documents could constitute a platform linking R&I activities implemented at different governance levels. The question of whether complementarities in a multi-level governance system are truly realized should be further investigated, taking into account examples of such multi-level activities presented in the report.***

Differentiation between countries ('smart' specialization)

The rationale of RIS3 concept argues that countries and regions should not only aim for specialization but also differentiation of their innovation capacities (Foray, Morgan & Radosevic, 2018). Given the lack of fine-grained indicators, the available evidence does not allow drawing clear conclusions, but does suggest weak differentiation across Member States, resulting in the attempts to establish "yet another centre of excellence" in popular fields such as biotechnologies or environmental technologies. While societal challenges cut across national borders, genuinely "smart" RIS3 require both specialization and differentiation, which can not be developed in isolation but require cross-country coordination.

> ***The issues of cross-country coordination and cooperation in RIS3 processes are not popular among Member States, but this topic seems to be crucial to manage the risk of potential weak differentiation across Member States.***

Communication and transparency

Despite a growing number of publicly available reports and websites dedicated to RIS3, easily accessible information, especially in English, is still lacking in most countries. EC's documents put particular emphasis on monitoring and evaluation issues as an important feedback information for stakeholders, but usually monitoring and evaluation activities are tailored to national/regional needs and they do not allow for comparisons and quantitative analyses. The data concerning ESI Funds (mainly financial) are presented with time delays, which makes difficult to analyze current trends. Nevertheless, the dissemination of information about RIS3, especially promotion of success stories, is of key importance for transparency and involvement of stakeholders. The observation of their engagement in RIS3 processes indicates that stakeholders are usually active in the design phase (i.e. consultations) and their role is lower in the implementation phase (i.e. governance and monitoring). The decrease of their involvement in the EDP could result in substitution of their roles by stakeholders representing the public sector (i.e. higher education, research organizations).

> ***The progress, achievements and benefits of RIS3 strategies could be more actively promoted, especially via social media and RIS3 communication activities to stakeholders should be strengthened. In many cases communication is not mentioned or only generally presented in RIS3 documents. Additionally, countries/regions should regularly (and mandatorily) update information and data, e.g. on platforms such as Eye@RIS3.***

Mission-oriented policies vs. thematic concentration

The RIS3 approach is aimed at concentrating financial resources on a limited number of priorities, based on national/regional strengths and international specialisations to avoid duplication and fragmentation in the European Research Area (EC, 2012). Nevertheless, publicly funded interventions based on RIS3 and TO1 are usually designed as a series of disjoint, individual projects, defined in a bottom-up manner by project applicants, but not as a coherent portfolio of related and complementary projects generating critical mass and synergy effects (Foray, Morgan & Radosevic, 2018). One of the ways to overcome these weaknesses may be a more mission-oriented policy. According to the draft framework programme Horizon Europe, a mission constitutes "a portfolio of actions intended to achieve a measurable goal within set timeframe and impact for science and technology and/or society and citizens that cannot be achieved through individual actions" (EC, 2018). The missions should be defined as economically feasible technical solutions related to particular societal challenges (Mazzucato, 2017). The mission-oriented policy is very similar in many respects to the main characteristics of the RIS3 and EDP process, such as the involvement of stakeholders in decentralised and bottom-up initiatives. The main differences are that missions put emphasis on solving critical problems addressing specific challenges on the basis of frontier knowledge, spearheading research, orchestrating excellence and concentrating on areas where added value to the European Union is higher. Aligning high-level missions with smart specialization strategies and the associated spending of ESI funds requires a balance between top-down direction of priorities versus their bottom-up discovery, with the latter allowing for specialization and differentiation across Member States. This challenge is reminiscent of the reconciliation of deliberate and emergent strategies in organizations. As Mintzberg & Waters (1985) already noted: "The more deliberate strategies tend to emphasize central direction and hierarchy, the more emergent ones open the way for collective action and convergent behaviour. All real-world strategies need to mix these in some way: to exercise control while fostering learning". They coined this interplay 'deliberately emergent strategy', which sets general boundaries but not the details, and argued it is the best choice when operating in uncertain environments. The interface between missions and the bottom-up processes characteristic of smart specialization should strive to embody this principle, with the missions setting the general boundaries, or as Mazzucato (2018) puts it: "the vertical aspect of missions picks the problem". The allocation of public funding should then be a process "that admits the

tension between the top-down direction setting and the bottom-up explorative approaches".

RIS3 processes, due to their thematic concentration, could contribute to mission-oriented policies, especially through increasing international exposure of excellent researchers from less innovative countries and regions. RIS3 communities should be actively engaged in the definition of missions funded from Horizon Europe and develop synergies/complementarities with them, which should help to overcome R&I fragmentation and build EU-wide critical mass in related R&I areas (thematic priorities identified in RIS3 documents). With respect to the design of funding schemes, this may call for better alignment of the ESIF funds' with the missions.

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Annex 1: Robustness checks for the analysis of RIS3 priorities

Table 13. *Policy objectives related to General Purpose Technologies (GPTs)*

D - Digital transformation

- D.18 - Advanced or High performance computing
- D.19 - Artificial intelligence, cognitive systems, augmented and virtual reality, visualization, simulation, gamification & interaction technologies
- D.20 - Big data, data mining, database management
- D.21 - Broadband, spectrum and other communication networks (e.g. 5G)
- D.22 - Cleaner environment & efficient energy networks and low energy computing
- D.23 - Cloud computing and software as a service and service architectures
- D.24 - Digitizing Industry (Industry 4.0, smart and additive manufacturing)
- D.25 - E-Commerce & SMEs online
- D.26 - e-Government (e.g. e-Procurement, open data & sharing of public sector information)
- D.27 - e-Health (e.g. healthy ageing)
- D.28 - e-Inclusion (e.g. e-Skills, e-Learning)
- D.29 - ICT trust, cyber security & network security
- D.30 - Intelligent inter-modal & sustainable urban areas (e.g. smart cities)
- D.31 - Internet of Things (e.g. connected devices, sensors and actuators networks)
- D.32 - Location based technologies (e.g. GPS, GIS, in-house localization)
- D.33 - New media & easier access to cultural contents (e.g. heritage)
- D.34 - Quantum computing
- D.35 - Robotics, autonomous and cyber physical systems (e.g. vehicles, embedded systems)
- D.36 - Smart system integration

E - KETs

- E.37 - Advanced manufacturing systems
- E.38 - Advanced materials
- E.39 - Industrial biotechnology
- E.40 - Micro/Nano-electronics
- E.41 - Nanotechnology
- E.42 - Photonics

Table 14. *Analysis of RIS3 priorities at the country level (including only "final RIS3" documents in Eye@RIS3)*

	Variable	mean	s.d.	min	max	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)
(1)	EIS 2017 performance[♣]	84,1	27,7	53,6	140,9	1,00																		
(2)	Industry sectors (NACE 2-digit)	24,3	21,0	0,0	67,0	0,09	1,00																	
(3)	Scientific fields (NABS)	5,9	3,8	0,0	11,0	0,03	0,83	1,00																
(4)	Policy objectives (level 1)	4,6	3,1	0,0	10,0	0,50	0,70	0,82	1,00															
(5)	Policy objectives (level 1, excl GPT)	3,1	2,3	0,0	8,0	0,48	0,71	0,77	0,99	1,00														
(6)	Policy objectives (level 2)	18,0	15,3	0,0	55,0	0,23	0,81	0,83	0,88	0,91	1,00													
(7)	Policy objectives (level 2, excl GPT)	10,9	10,2	0,0	33,0	0,27	0,86	0,80	0,83	0,87	0,95	1,00												
(8)	Industry sectors (NACE 2-digit) / population	10,4	17,6	0,3	65,2	-0,11	0,08	0,25	0,34	0,34	0,36	0,29	1,00											
(9)	Scientific fields (NABS) / population	2,8	5,2	0,1	19,6	-0,14	-0,02	0,22	0,24	0,23	0,24	0,18	0,99	1,00										
(10)	Policy objectives (level 1) / population	2,3	4,1	0,1	15,2	-0,11	0,00	0,20	0,33	0,32	0,31	0,24	1,00	0,99	1,00									
(11)	Policy objectives (level 1, excl GPT) / population	1,6	3,0	0,1	10,9	-0,08	0,03	0,22	0,37	0,37	0,35	0,28	0,99	0,98	1,00	1,00								
(12)	Policy objectives (level 2) / population	9,5	17,5	0,4	63,0	-0,09	0,06	0,26	0,39	0,39	0,40	0,32	0,99	0,98	0,99	1,00	1,00							
(13)	Policy objectives (level 2, excl GPT) / population	5,5	10,9	0,2	39,1	-0,07	0,09	0,28	0,40	0,41	0,41	0,36	0,99	0,97	0,99	0,99	0,99	1,00						
(14)	Industry sectors (NACE 2-digit) / GERD	24,4	17,2	5,5	57,0	-0,49	0,70	0,55	-0,20	-0,13	0,31	0,33	0,30	0,28	0,24	0,23	0,26	0,26	1,00					
(15)	Scientific fields (NABS) / GERD	6,1	3,4	1,8	11,7	-0,70	0,19	0,45	-0,36	-0,35	0,07	0,02	0,51	0,55	0,48	0,45	0,47	0,44	0,77	1,00				
(16)	Policy objectives (level 1) / GERD	4,4	2,0	1,5	9,1	-0,55	-0,02	0,13	0,09	0,06	0,21	0,09	0,77	0,78	0,76	0,74	0,75	0,71	0,47	0,74	1,00			
(17)	Policy objectives (level 1, excl GPT) / GERD	2,9	1,4	0,9	6,5	-0,38	0,14	0,24	0,33	0,32	0,41	0,30	0,84	0,83	0,84	0,83	0,84	0,81	0,46	0,62	0,95	1,00		
(18)	Policy objectives (level 2) / GERD	17,6	10,7	3,7	37,7	-0,40	0,43	0,56	0,20	0,22	0,57	0,46	0,70	0,67	0,65	0,65	0,69	0,66	0,75	0,80	0,84	0,86	1,00	
(19)	Policy objectives (level 2, excl GPT) / GERD	10,2	7,1	2,1	25,0	-0,28	0,61	0,69	0,28	0,31	0,62	0,68	0,63	0,59	0,59	0,59	0,62	0,64	0,74	0,68	0,65	0,73	0,87	1,00

Numbers are average number of priorities at the national level (as registered in thr september 2017 version of Eye@RIS3), split by EIS 2017 performance group. The 18 countries covered in this table include 2 innovation leaders (DE, SE), 4 strong innovators (AT, IE, LU, SI), 10 moderate innovators (CZ, EE, HR, HU, LT, LV, MT, PL, PT, SK) and 2 modest innovators (BG, RO), as defined in the EIS 2017. Population is measured in 2017 (Eurostat); GERD is measured in 2015 as % of GDP (Eurostat). The right panel of the table shows the pairwise correlation coefficients.

[♣] EIS performance in 2016 relative to EU performance in 2016.

Table 15. Analysis of RIS3 priorities at the regional level (including only "final RIS3" documents in Eye@RIS3)

	Variable	mean	s.d.	min	max	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)
(1)	RIS 2017 performance[♣]	65,0	20,4	23,0	123,3	1,00																		
(2)	Industry sectors (NACE 2-digit)	20,1	10,3	4,0	48,0	0,24	1,00																	
(3)	Scientific fields (NABS)	6,7	2,0	1,0	11,0	0,28	0,40	1,00																
(4)	Policy objectives (level 1)	5,5	2,0	1,0	10,0	0,17	0,34	0,48	1,00															
(5)	Policy objectives (level 1, excl GPT)	3,9	1,8	0,0	8,0	0,16	0,28	0,52	0,95	1,00														
(6)	Policy objectives (level 2)	16,6	9,4	1,0	48,0	0,20	0,44	0,49	0,71	0,65	1,00													
(7)	Policy objectives (level 2, excl GPT)	9,7	5,7	0,0	26,0	0,17	0,35	0,57	0,75	0,78	0,85	1,00												
(8)	Industry sectors (NACE 2-digit) / population	16,3	25,0	0,7	220,7	-0,06	0,20	-0,13	-0,05	-0,07	0,00	-0,02	1,00											
(9)	Scientific fields (NABS) / population	4,9	6,0	0,4	47,3	-0,09	0,02	-0,04	-0,03	-0,04	-0,01	0,00	0,92	1,00										
(10)	Policy objectives (level 1) / population	4,2	4,9	0,3	31,5	-0,06	0,01	-0,14	0,14	0,13	0,06	0,07	0,87	0,93	1,00									
(11)	Policy objectives (level 1, excl GPT) / population	2,9	3,3	0,0	15,9	-0,05	0,01	-0,09	0,24	0,27	0,11	0,16	0,74	0,83	0,96	1,00								
(12)	Policy objectives (level 2) / population	13,2	17,3	0,6	110,3	-0,06	0,05	-0,10	0,08	0,07	0,21	0,17	0,85	0,90	0,92	0,85	1,00							
(13)	Policy objectives (level 2, excl GPT) / population	7,5	9,5	0,0	56,6	-0,08	0,04	-0,05	0,14	0,16	0,20	0,28	0,81	0,87	0,91	0,89	0,96	1,00						
(14)	Industry sectors (NACE 2-digit) / GERD	23,7	20,0	1,7	90,9	-0,47	0,44	0,13	0,10	0,08	0,34	0,28	0,27	0,23	0,20	0,22	0,31	0,34	1,00					
(15)	Scientific fields (NABS) / GERD	7,0	5,5	0,8	31,8	-0,60	0,08	0,24	0,05	0,07	0,19	0,24	0,15	0,23	0,16	0,18	0,26	0,31	0,86	1,00				
(16)	Policy objectives (level 1) / GERD	5,7	4,8	0,6	24,2	-0,53	0,07	0,07	0,29	0,28	0,30	0,35	0,15	0,20	0,24	0,29	0,31	0,36	0,85	0,90	1,00			
(17)	Policy objectives (level 1, excl GPT) / GERD	4,1	3,7	0,0	18,9	-0,48	0,08	0,13	0,35	0,40	0,32	0,43	0,13	0,17	0,24	0,34	0,28	0,38	0,80	0,84	0,97	1,00		
(18)	Policy objectives (level 2) / GERD	18,2	17,6	0,6	100,0	-0,41	0,20	0,12	0,22	0,20	0,55	0,47	0,22	0,25	0,28	0,31	0,46	0,49	0,86	0,83	0,88	0,85	1,00	
(19)	Policy objectives (level 2, excl GPT) / GERD	10,7	11,6	0,0	67,6	-0,37	0,13	0,16	0,26	0,30	0,44	0,59	0,19	0,24	0,27	0,33	0,40	0,51	0,80	0,81	0,88	0,90	0,92	1,00

Source: Eye@RIS3 database, RIS 2017, Eurostat. The table includes those regions for which priorities have been defined in the Eye@RIS3 database and for which performance data is available in the Regional Innovation Scoreboard 2017. The included regions belong to the following countries: BE, CZ, DE, EL, ES, IT, NL, PL, PT, RO, SE, UK. Population is measured in 2017 (Eurostat); GERD is measured in 2015 as % of GDP (Eurostat). The right panel of the table shows the pairwise correlation coefficients.

§ RIS 2017 score relative to EU 2017 (available for 81 regions). Indicators (2)-(7) are calculated using data for all 187 regions that are registered in the eye@RIS3 platform i.e. 26 NUTS 1 level regions in BE, DE, NL, UK; 124 NUTS 2 level regions in AT, CZ, DE, EL, ES, FR, IT, NL, PL, PT, RO, UK; and 37 NUTS 3 level in FI, SE, UK. Indicators (8)-(13) are calculated using 135 regions given the availability of population data. Indicators (14)-(19) are calculated using 112 regions given the availability of GERD data.

Table 16. Differentiation of RIS3 priorities across countries based on final RIS3 documents

Variable	Share of priorities selected by: less than 5 other countries	more than 5 but less than 10 other countries	more than 10 but less than 20 other countries	more than 20 other countries
	All countries			
Industry sectors (NACE 2-digit)	1,4%	13,7%	74,2%	10,7%
Scientific fields (NABS)	1,0%	2,7%	48,7%	47,7%
Policy objectives (level 1)	0,0%	0,0%	49,1%	50,9%
Policy objectives (level 1, excl GPT)	0,0%	0,0%	66,9%	33,1%
Policy objectives (level 2)	1,0%	14,6%	76,9%	7,6%
Policy objectives (level 2, excl GPT)	1,2%	22,4%	69,0%	7,4%
	Innovation leaders			
Industry sectors (NACE 2-digit)	1,3%	9,9%	77,8%	11,0%
Scientific fields (NABS)	1,4%	2,8%	55,9%	39,9%
Policy objectives (level 1)	0,0%	0,0%	47,0%	53,0%
Policy objectives (level 1, excl GPT)	0,0%	0,0%	59,9%	40,1%
Policy objectives (level 2)	0,7%	14,9%	78,0%	6,4%
Policy objectives (level 2, excl GPT)	1,1%	19,4%	72,3%	7,2%
	Strong innovators			
Industry sectors (NACE 2-digit)	1,0%	10,3%	84,2%	4,5%
Scientific fields (NABS)	1,7%	4,2%	50,6%	43,6%
Policy objectives (level 1)	0,0%	0,0%	60,1%	39,9%
Policy objectives (level 1, excl GPT)	0,0%	0,0%	77,6%	22,4%
Policy objectives (level 2)	1,2%	18,4%	74,6%	5,7%
Policy objectives (level 2, excl GPT)	1,5%	23,9%	71,8%	2,8%
	Moderate innovators			
Industry sectors (NACE 2-digit)	3,5%	12,3%	73,6%	10,6%
Scientific fields (NABS)	1,0%	3,7%	45,3%	50,0%
Policy objectives (level 1)	0,0%	0,0%	39,3%	60,7%
Policy objectives (level 1, excl GPT)	0,0%	0,0%	55,0%	45,0%
Policy objectives (level 2)	1,9%	15,8%	73,0%	9,3%
Policy objectives (level 2, excl GPT)	2,0%	21,4%	69,6%	7,1%
	Modest innovators			
Industry sectors (NACE 2-digit)	0,0%	22,2%	61,1%	16,7%
Scientific fields (NABS)	0,0%	0,0%	42,9%	57,1%
Policy objectives (level 1)	0,0%	0,0%	50,0%	50,0%
Policy objectives (level 1, excl GPT)	0,0%	0,0%	75,0%	25,0%
Policy objectives (level 2)	0,0%	9,1%	81,8%	9,1%
Policy objectives (level 2, excl GPT)	0,0%	25,0%	62,5%	12,5%

Source: Eye@RIS3 database, EIS 2017.

♦ This table includes 29 countries (and their regions) for which EIS performance data (2017) and priorities in the eye@RIS3 database (in final RIS3 documents) are available.

Annex 2: Methodology

The starting point to analyse the progress of Member States in the implementation of national and regional smart specialisation strategies were the ***reports prepared by RIO Network Experts*** in summer 2017. The country reports delivered by RIO network experts include generally four types of information: new policy developments, the progress of implementation of the different strategies, the monitoring mechanisms and evidence of impact. The country reports differ in terms of the details of presented information, so to get additional input and to systematize the information in the country reports, RIO network experts were asked in December 2017 to complete ***a survey*** with questions concerning the governance system for smart specialisation, funding sources and instruments, and monitoring and evaluation efforts. The survey has been complemented by information obtained from the S3 platform and EC's websites concerning mainly ***statistical data of governance systems and operational programmes***[21].

The use of the above mentioned data and information has some limitations. The RIO network experts' reports and the answers to the survey in many cases are very general, mainly due to the fact that the collection of information concerning the implementation of RIS3 is difficult (i.e. the delay of implementation of monitoring and evaluation mechanisms, the need to obtain data from many institutions, especially regional ones). The limitations are also related to the quality of data collected by the S3 platform i.e. not all countries and regions are registered on the S3 platform, information entered into the S3 platform is based on subjective assessments of national and regional experts, the available data are not standardised and complete for many countries and regions, etc. Finally, data from EC websites dedicated to the implementation of ESI Funds (especially Thematic Objective 1) are also limited because not all European regions use ESI Funds to implement smart specialisation strategies and in some countries operational programmes are implemented only at national level, which makes it difficult to use information related to OP's to analyse the regional dimension.

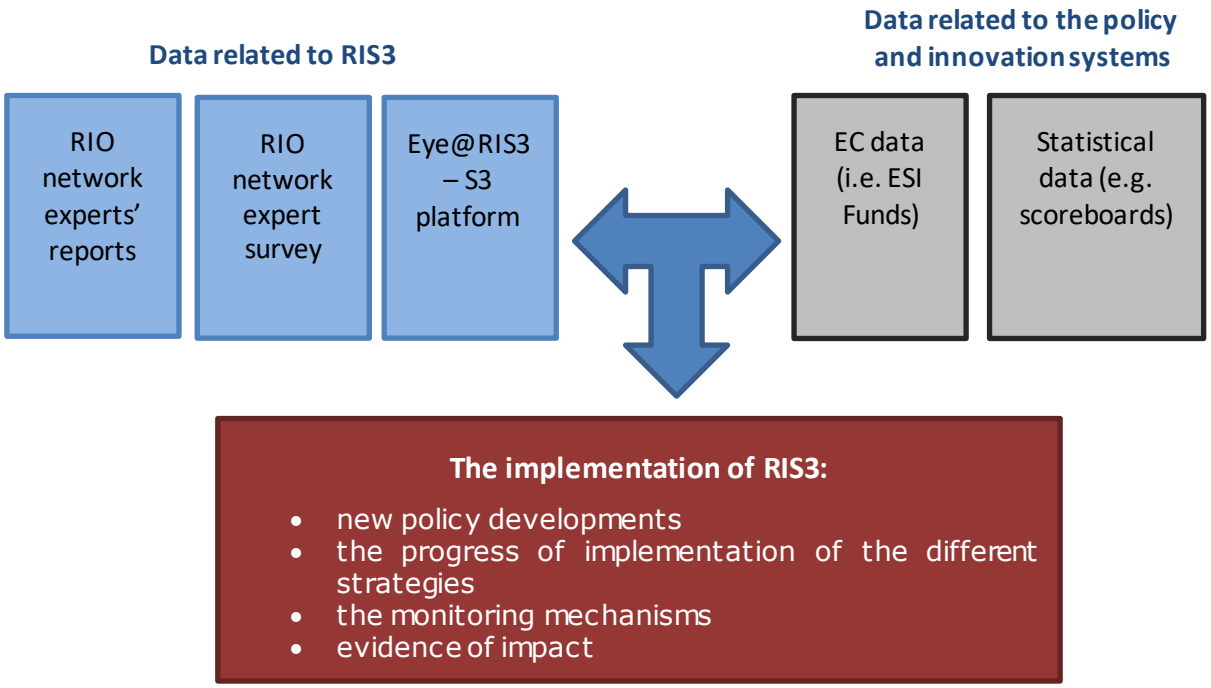
The aforementioned limitations do not allow taking advantage of extensive quantitative analyses or econometric models. Nevertheless, ***the collected data and information were compared with various inputs and outputs related to innovation systems/policies***. This approach allow to draw a comprehensive picture of the implementation of RIS3 documents taking into account the embeddedness of these strategies in the broader context of national and regional innovation systems. In our opinion, the following dimensions can be taken into account:

- country structure (e.g. number of regions and the level of decentralisation, the role of national/regional innovation strategies, the importance of ESI Funds, year of joining the European Union),
- size of economy (e.g. population, total R&D expenditures, number of business enterprises),
- research and innovation performance (e.g. scoreboard data),
- private investments in research and innovation (e.g. BERD, R&D intensive companies),
- public support for research and innovation (e.g. GBAORD statistics, ESIF allocations for Thematic Objective 1).

[21] I.e. http://ec.europa.eu/regional_policy/en/atlas/programmes/; http://ec.europa.eu/eurostat/web/nuts

Combining information derived from the above mentioned sources as well as data and information prepared by the RIO network experts' reports and the survey allow for conducting a multi-dimensional assessment of new policy developments, the progress of implementation of the different strategies, the monitoring mechanisms and evidence of impact. The proposed analytical framework is presented in Figure 3.

Figure 3. *The analytical approach of the implementation of smart specialisation strategies in 28 Member States*



Source: own elaboration.

The report presents descriptive analyses supported by examples of some national and regional practices related to the implementation of RIS3 documents. The examples indicate how countries and regions manage to overcome some problems and challenges related to the implementation of RIS3 documents. The report avoids the term „best practice" because given the current state of implementation of RIS3 it is not possible to select certain practices as optimal from a social welfare perspective. Moreover, the starting point of the analysis was that countries may be very heterogeneous in the way that they implement RIS3 and there is unlikely to be a "one size fits all" best practice. A key goal of the report is intended to highlight this heterogeneity in order to better understand the contingencies that determine countries' approaches to RIS3.

The last part of the report presents main recommendations derived from quantitative and quality analyses, including information presented in case studies. The links between background information (RIO expert reports, questionnaire, case studies, data analyses) and recommendations are presented in Table 17.

Table 17. *Background information related to recommendations*

	Recommendation	**Background information (RIO expert reports, questionnaire, case studies, data analyses)**
1	Embeddedness of RIS3 in national and regional policies	In many countries and regions RIS3 processes have initiated positive changes in national and regional innovation policies (i.e. example: RIS3 in LT (point 2.3), new policy developments in CZ, HU, LT and RO (point 7)), nevertheless in many countries the existence of RIS3 approach is too strongly (or only) related to TO1 and ex-ante conditionalities (i.e. the delays in the implementation of RIS3 due to the problems concerning the fulfilment of *ex-ante* conditionalities for ESI Funds in BG, ES, HR, CZ, LT, PL, PT, SK, RO (point 5)). On the other hand, RIO Network Experts from some countries, which benefiting in lower scale from ESI Funds (AT, IE, SE, UK), indicated that there is no dedicated budget for RIS3. Taking into account information gathered from questionnaire and RIO Network Experts' reports we cannot confirm the existence of dedicated funding schemes for RIS3 from national/regional sources not related to ESI Funds (only national or regional funds) - even if they are, the scale of them seems to rather low.
2	International cooperation	OPs based on ESI Funds usually support only activities of R&I performers located in a given region, while many technology markets require inter-regional and international cooperation, thus making many innovative projects ineligible for ESI Funds financing, even though a regional, critical mass might already exist in a given technological area, as indicated by the RIS3 (point 7). Such "silo"-based approaches hampering investments from national or regional OPs in other countries or regions. Many countries and regions have not yet implemented mechanisms based on multi-level complementarities and intra-regional cooperation (i.e. "Seal of Excellence, 15% rule), mainly due to difficulties in defining, implementing and monitoring them. According to the opinions of RIO Network Experts, interregional cooperation is considered among national and regional authorities, but mainly through other dedicated programmes such as Interreg (point 4.2). Nevertheless, the analysis of R&I thematic priorities indicated in RIS3 demonstrates that highly differentiated priorities occur very rarely (point 3.1), which constitute opportunities to strengthen international cooperation on the same or similar R&I thematic priorities.

3	Mandatory nature of RIS3	Many RIO Network Experts made attempts to explain the potential motivations behind the development and implementation of RIS3, indicating that the strategies were mainly drafted to address the *ex-ante* conditionalities related to the use of ESI Funds for TO1 (point 5). According to information delivered by RIO Network Experts and our analyses of RIS3 policy-mixes in some countries, projects in line with R&I thematic priorities indicated in national and regional RIS documents can also benefit from preferences in selection criteria in instruments funded from TO3 (enhancing the competitiveness of SMEs) and TO10 (Investing in education, training and vocational training for skills and lifelong learning). Nevertheless, it's rather an exception than a rule. From financial perspective, in 2014-2020 the total budget for TO1 is about 66 billion Euro, but the total funding for TO3 in 2014-2020 is 96.5 billion Euro and for TO10 49.2 billion Euro (point 4.1).
4	Fine-grained indicators for RIS3	The example: RIS3 monitoring in Lithuania (point 6), opinions of many RIO Network Experts as well as our analyses indicate on problems concerning common taxonomy related to R&I thematic priorities in RIS3, availability of data and set of indicators to analyse RIS3 priorities and the progress in their implementation as well as to measure their impact.
5	Alignment of R&I priorities between governance levels	The effective introduction of a multi-level governance system remains a challenge, especially from the perspective of ensuring effective coordination, complementarities and synergies between activities carried out at national and regional levels (which is presented by examples: Multi-level governance in research and innovation policies among European countries (point 2.1)). Authorities in many countries (i.e. IT, PL, PT) are facing challenges related to the establishment of mechanisms, which could limit or eliminate unnecessary duplication and fragmentation as well as to strengthen cooperation on common thematic priorities and synergies between policy instruments implemented at different levels (points 2.1, 2.2, 3.1). Our analyses indicate that within-country alignment of priorities is an attention point and that some countries may improve on developing their R&I capacities by more judiciously assessing whether priorities that the national level has committed to are tying into the focal areas at the regional level, and *vice versa* (point 3.1).
6	Differentiation between countries ('smart' specialization)	In many countries and regions RIS3 have positive impact on stakeholders engagement in policymaking processes (i.e. example: Pomeranian Region in Poland) or support former experiences in this area (i.e. examples: RIS3 in Austria, RIS3 in Belgium, RIS3 in Germany). Nevertheless, in many countries RIS3

		approaches demonstrate insufficient focus, with broad RIS3 priorities or approaches that could not really be characterised as prioritisation. There is relatively little evidence of genuine "discovery" resulting from EDP processes, i.e. cases when the stakeholder dialogue yielded unexpected results: discovery of new thematic specialisations that have not been identified prior to the beginning of the process. Our analyses identified also some concerns about the implementation of RIS3 (point 7).
7	Communication and transparency	National and regional authorities are facing the problem of long-term involvement of stakeholders in RIS3 processes. One of the reason could be the lack of "tangible" results of RIS3, which could demonstrate concrete benefits for entrepreneurs, researchers and citizens (i.e. examples: Pomeranian Region in Poland, RIS3 Monitoring in Lithuania). Additionally, the role of stakeholders could be particularly important in the design and modification of specific support measures better addressing their needs (point 7).
8	Mission-oriented policies vs. thematic concentration	RIO Network Experts and our analyses indicate on low engagement in international cooperation (discussed above in recommendation 2) and challenges related to the alignment of R&I priorities between government levels (discussed above in recommendation 5). The analysis of R&I thematic priorities indicates on many similarities between countries and regions, including GPTs accounting for a sizeable share of policy objectives (point 2).

Source: own elaboration.

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