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Smart Specialisation at work: Assessing investment priorities

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Smart Specialisation at work: Assessing investment priorities

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Abstract

This paper provides a methodology to assess how national and regional authorities define their research and innovation investment priorities for smart specialisation. It then tests the methodology empirically, based on a significant sample of research and innovation strategies for smart specialisation from Italy and Poland.

The paper helps to fill a gap in the emerging literature on smart specialisation regarding the definition of investment priority areas, while providing useful analytical elements to orient policy impact evaluation exercises.

We found that research and innovation priorities in Italy and Poland are defined in line with a multi-level, tree-like structure whose higher hierarchical level usually contains a few broad dimensions, and whose branches cover several specific activities. When considered individually, most of those activities represent suitable smart specialisation priorities. Yet, some of the examined strategies contain priorities that do not fully reflect the smart specialisation logic. Several strategies encompass tens or even hundreds of activities.

It is beyond the scope of the present study to evaluate the appropriateness of a certain set of investment priorities in relation to the characteristics of a region or country. However, our analysis raises an important question about the capacity of the strategy management bodies to effectively support the development of huge sets of activities each of which potentially requires specific competences and dedicated administrative and technical resources. Also, large sets of priorities may *de facto* circumvent the smart specialisation principle of selective intervention, as the strategies ultimately cover broad economic areas.

Keywords: Regional innovation policy; smart specialisation; investment priorities; selective intervention

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1 Motivation and objectives

This paper provides a methodology to assess how national and regional authorities define their research and innovation investment priorities for smart specialisation. It then tests the methodology empirically, based on a significant sample of national and regional research innovation strategies for smart specialisation (RIS3s).

The existence of a national or regional RIS3 is a precondition for accessing European Regional Development Fund (ERDF) resources for research and innovation support under Thematic Objective 1 (TO1) in the framework of the EU Cohesion policy programming period 2014-2020. Over the past few years, EU Member States and regions have been gradually finalising their RIS3s and moving to the implementation stage. First evidence on actual policy choices is now available against which to assess how and to what extent the principles of smart specialisation have been applied and what impact they are producing.

An intervention logic based on the identification of *vertical* priority areas for public investment is a distinctive feature of smart specialisation (European Union, 2013) ([1]). More specifically, public intervention must be focused on "particular fields and technologies as well as particular sets or networks of actors" (Foray, 2015, p.6). Horizontal priorities aimed, for example, at improving the framework conditions for economic exchange and entrepreneurship, could complement the smart specialisation approach, but do not represent a direct target for such policy ([2]). Understanding how investment priorities have been defined in practice, thus represents a first key step in the assessment of the smart specialisation policy.

To the best of our knowledge, the existing academic literature and policy reports provide very little relevant evidence in this respect, and are based almost entirely on qualitative assessments or surveys of policy makers perceptions ([3]). The present paper aims to fill this gap in two steps: (i) providing a transparent, theory-based analytical framework to evaluate the consistency of actual policy priorities with the smart specialisation approach, based on the smart specialisation literature and EU policy regulations and guidance, and (ii) conducting an empirical analysis based on all regional and national RIS3s available for Italy and Poland.

2 Methodology

The European legislation explicitly mentions the notion of smart specialisation priorities. In the legislative act laying down the European Union Common Provision Regulation 1303/2013 for Cohesion policy in the 2014-2020 period, RIS3s are meant to "concentrate resources on a limited set of research and innovation priorities" (European Union, 2013, p. 438). Note that the text of the regulation does not provide specific indications about the expected nature of such priorities, nor does it identify a particular scale or "granularity" for the intervention.

([1]) For a detail account of the main theoretical underpinnings, ideas and guidance of the smart specialisation policy concept refer to European Commission (2012a) and to Foray and Goenaga (2013).

([2]) According to Foray (2015, p. 6), smart specialisation policy requires "setting priorities – not horizontal priorities such as improving human capital, developing good universities or building an effective intellectual property rights system – but vertical ones regarding particular fields and technologies as well as particular sets or networks of actors".

([3]) An exception is represented by Gianelle et al. (2017) who examine actual policy measures implemented under ERDF-TO1 and assess their alignment with RIS3s using a formal analytical framework.

A more precise indication of how priorities should be defined can be found in the European Commission guidance on RIS3, which explains and exemplifies how to put into practice the smart specialisation approach. In particular, "priorities could be framed in terms of knowledge fields or activities (not only science-based, but also social, cultural and creative ones), sub-systems within a sector or cutting across sectors and corresponding to specific market niches, clusters, technologies, or ranges of application of technologies to specific societal and environmental challenges or health and security of citizens (e.g. ICT for active ageing, mobility solutions to reduce traffic congestion, innovative material solutions for eco-construction, etc.)" (European Commission, 2012b).

Notably, in the official guidance, priorities are not defined according to a unique dimension (e.g. industry or technology). Rather, the approach followed by the European Commission, building on recent advances in development economics (Hausmann and Rodrik, 2003, 2006; Rodrik 2007) and the early smart specialisation literature (Foray et al., 2009; Foray and Goenaga, 2013), identifies candidate activities for policy interventions at the intersection of different dimensions. In particular, priorities shall result from the application of technologies or innovative processes to certain industries characterised, possibly, by the utilisation of specific natural or cultural assets, with the aim of pursuing specific societal goals.

We follow this line of thinking and propose the definition of the archetypal smart specialisation priority as a *distinctive combination* of up to four dimensions:

(A) Sectors or value chains of primary interest for the intervention;

(B) Transformative processes to be activated (technology applications);

(C) Societal challenges to be addressed;

(D) Natural and/or cultural resources to be used (e.g. maritime ecosystem, alpine ecosystem, cultural heritage).

The intersection of those dimensions determines the activities to be prioritised and the nature of the policy interventions. In practical terms, since the interaction among all four dimensions may represent a too-binding constraint on innovation support measures, which require some scope for experimentation, we consider suitable smart specialisation priorities those intervention areas defined as a combination of *at least two* of the four dimensions. Table 1 presents a brief description and exemplification of the four smart specialisation priority dimensions.

Table 1 – Dimensions of smart specialisation priorities

Dimension	Description	Examples
(A) Sector or value chain	Economic sectors or industries commonly defined according to standard statistical classifications of economic activities, as e.g. the NACE classification in use in the European Union. This dimension may also encompass areas defined as value chains linking together different sectors concurring to the realisation of a common family of products or services.	Sectors: agriculture, food industry, energy production and distribution, chemicals, construction, machines and robots, textiles. Value chains: automotive, aerospace, agri-food.
(B) Technology	Key enabling technologies, general purpose technologies, innovative materials, innovative processes in general, including organisational innovation.	Nanotechnology, photonics, biotechnology, ICT, new materials.
(C) Societal challenge	Challenges or problems the European society will have to face; they may regard the dynamics of the population, human interaction and migrations, as well as the sustainability of economic activities and environment protection.	Demographic change, land protection, environmental sustainability, security of citizens.
(D) Natural and/or cultural resource	Built and/or natural environment, natural ecosystems that can be specifically characterised.	Cultural heritage, maritime environment, alpine environment.

The criterion we propose above is primarily meant to check whether the RIS3 logic of intervention goes effectively beyond a merely sectoral or horizontal policy approach while taking into account economic, social, environmental and technological interactions which may be relevant for a given territory.

The reader should be aware that, even when individual priorities are identified according to the above criterion, it remains difficult to tell whether they represent a real effort to concentrate resources through preferential support. A "broad" innovation area can indeed be divided in a large number of "narrow" or highly specific activities ([4]). The European regulations state that the number of priorities should be limited, but give no further indication on how to assess it; in this way, there is a real risk of circumventing

([4]) On this specific aspect, Foray and Goenaga (2013, p. 3) claim that "[…] intervention at too detailed a level would transform smart specialisation into a horizontal policy via which all micro-projects of some merit would be supported (a task usually done by R&D tax credit systems or programmes of R&D subsidies targeting the whole population of firms)".

de facto the smart specialisation selectivity (prioritisation) principle by identifying many narrow activities.

To the best of our knowledge, very few studies analyse the priorities identified by regions and countries in their smart specialisation strategies. No existing works provide clear assessment criteria that are consistent with the theoretical foundations of smart specialisation and the official regulations of Cohesion policy and the European Commission guidance. Iacobucci and Guzzini (2016) analyse the priorities indicated by Italian regions and conclude that they corresponded, in general, to rather broad domains, identified as either sectors or technologies, and often split into more specific sub-domains. However, they do not provide an analytical framework to evaluate the scope and articulation of domains and sub-domains. Also, they argue that regions, apparently, have not adopted a common classification or labelling criterion for defining smart specialisation priorities. Sorvik and Kleibrink (2015) and McCann and Ortega-Argilés (2016) compare priority patterns across European countries based on information obtained from the European Commission open data repository, Eye@RIS3. This information provides only a reclassification of priorities according to NACE codes, obtained from multiple, sometimes not official sources, and, for these reasons, is not suitable for evaluating the actual intervention areas. Kroll (2015) collects information about smart specialisation priorities from policy makers through telephone interviews, but he does not provide a framework for their analysis.

3 Data

We analysed 39 RIS3s, corresponding to the total number of strategies currently being implemented in Italy and Poland (21 regional strategies and one national strategy in Italy; 16 regional strategies and one national strategy in Poland). The RIS3 documents considered for the analysis are those officially adopted by the respective regions and/or Member states in fulfilment of the ERDF ex-ante condition on smart specialisation.

The two countries represent 28.8% of the ERDF-TO1 budget available for the entire European Union – with Poland accounting for 20.3% and Italy for 8.5% – and have decentralised administrative structures that allow regional authorities to design and implement regional RIS3s with a dedicated budget.

4 Results

When looking at how priorities are defined, we first noticed that in virtually all the RIS3 documents examined, priorities are specified through a nested, multi-level scheme, where the higher levels comprise a number of items each of which is matched with several items defined at a lower level, giving rise to a tree-like structure. This structure is generally presented in the form of a table or a set of coordinated tables. Only in the strategy of the Italian region of Umbria priorities are presented in a single-level fashion. In 14 strategies, the priority trees include two levels; in 24 strategies they include three levels.

The 39 strategies examined comprise a total of 198 items in the highest hierarchical level of the priority structure, which we denote level one, with an average of around five, a maximum of eight and a minimum of three items per strategy; 92% (183) of level-one

items are matched to one or more level-two items; 43.2% (86) are further matched to a third level; only 8% (16) of the items listed at level one are not matched further.

The items listed for each level in the priority structure can be categorized according to one or more of the four dimensions presented in Table 1. Notice that, in some cases, different levels can be characterised according to the same dimension, the only difference being the granularity of the description.

Table 2 – Combinations of dimensions in the definition of smart specialisation priorities

Dimensions (*)	N. of level-one items; combinations evaluated considering information provided only in level one (column %)			N. of level-one items; combinations evaluated considering information provided in all levels (column %)		
	Italy	Poland	Total	Italy	Poland	Total
A	57 (51.8)	43 (48.9)	100 (50.5)	7 (6.4)	4 (4.5)	11 (5.6)
B	5 (4.5)	9 (10.2)	14 (7.1)	2 (1.8)	3 (3.4)	5 (2.5)
C	16 (14.5)	8 (9.1)	24 (12.1)	1 (0.9)	-	1 (0.5)
D	1 (0.9)	1 (1.1)	2 (1.0)	-	-	-
A+B	10 (9.1)	11 (12.5)	21 (10.6)	58 (52.7)	21 (23.9)	79 (39.9)
A+C	11 (10.0)	11 (12.5)	22 (11.1)	4 (3.6)	2 (2.3)	6 (3.0)
A+D	3 (2.7)	1 (1.1)	4 (2.0)	-	-	-
B+C	1 (0.9)	-	1 (0.5)	11 (10.0)	2 (2.3)	13 (6.6)
B+D	4 (3.6)	-	4 (2.0)	2 (1.8)	-	2 (1.0)
C+D	-	-	-	-	-	-
A+B+C	1 (0.9)	4 (4.5)	5 (2.5)	18 (16.4)	54 (61.4)	72 (36.4)
A+B+D	-	-	-	5 (4.5)	1 (1.1)	6 (3.0)
A+C+D	1 (0.9)	-	1 (0.5)	-	1 (1.1)	1 (0.5)
B+C+D	-	-	-	-	-	-
A+B+C+D	-	-	-	2 (1.8)	-	2 (1.0)
TOTAL	**110**	**88**	**198**	**110**	**88**	**198**

(*) The four dimensions are defined as follows: sectors/value chains of primary interest for the intervention (A); technologies or processes (B); societal challenges (C); natural or cultural resources (D).

Source: Authors' elaboration based on information reported by national and regional RIS3s documents.

The left-hand side of Table 2 reports the type and frequency of the combinations of dimensions we observe at level one in the priority tree. We can see that half of the items denote sectors or value chains (A), while 70% are categorised as A, B, or C. In Italy, the most represented dimension at level one is A, with 51.8% of the items, followed by C with 14.5%; in Poland, 48.9% of level one items are A, 12.5% are A+B and A+C, which are combinations respectively of sectors/value chains with technologies, and sectors/value chains with societal challenges, and 10.2% are B. In general, Poland shows a slightly higher tendency for level-one items to be described in terms of

combinations of two or more dimensions (30.7%) compared to Italy (28.2%). Annex Tables A1 and A2 present descriptions of the level-one priorities for each RIS3 in Italy and Poland respectively.

Level-one items are important, but are only part of the picture since the precise description of priorities is provided by the complete nested structure of the priority tree. More interesting, in the context of this paper, is the analysis of the information provided across the different levels of the priority tree. On the right-hand side of Table 2, level-one items are categorised based on the information provided in all levels of the priority tree, identifying the combinations of dimensions that can be encountered by moving along the tree starting from level one "trunk" to the tip of the priority "branches" at levels two and three. The results are quite different from those on the left-hand side of Table 2. Only 5.6% of level-one items (6.4% in Italy, 4.5% in Poland) denote areas defined only in terms of sectors/value chains, while in only 8.6% of cases (9.1% in Italy, 7.9% in Poland) areas are defined according to a single dimension A, B or C.

In contrast, half of level one items (68.2% in Italy, 28.4% in Poland) lead to a combination of two dimensions, 40% (20.9% in Italy, 63.6% in Poland) lead to a combination of three dimensions, while 1% combine all four dimensions. The most frequent combinations are A+B (40% in total, 52.7% in Italy, 23.9% in Poland), and A+B+C (36.4% in total, 16.4% in Italy, 61.4% in Poland), with the former appreciably more frequent in Italy and the latter more frequent in Poland.

The above analysis shows that most of the policy intervention areas identified in the 39 strategies examined appear to be suitable smart specialisation priorities since they are defined as a combination of at least two of the four basic dimensions identified in Section 2. Although more than 90% of level-one items lead to suitable smart specialisation priorities, six regional strategies in Italy and five in Poland contain priorities that do not fully reflect the intervention logic of the smart specialisation approach.

The multi-level structure of priorities is an emerging feature of the smart specialisation strategies that was not explicitly provided for or discussed in the European Commission's guidance (European Commission, 2012b) and has a fundamental implication. The number of priorities defined by a region or country is not given by the number of items defined at level one, or at the highest level in the priority tree; instead, it is more correctly represented by the number of items at the lowest hierarchical level.

If we apply this line of reasoning, the total number of priorities in Italy and Poland, obtained by considering the items at the lowest possible level of the priority tree, appears to be in the hundreds or even in the thousands. Note for instance, that the Italian region Campania identifies six items at the first level of the priority tree and 126 items at the third level, while the Polish region Łódzkie identifies six items at level one and 459 distinct items at the third level. Tables 3 and 4 report the number of items at each level of the priority trees for each RIS3 in Italy and Poland respectively.

Table 3 – Number of items at different levels of the priority trees, Italy

	Priorities, number of items		
	Level 1	**Level 2**	**Level 3**
Puglia	3	13	28
Calabria	8	28	23
Campania	6	27	126
Sicilia	6	22	-
Toscana	3	33	-
Emilia Romagna	5	19	50
Piemonte	6	56	-
Lazio	7	24	125
Lombardia	7	42	-
Sardegna	6	15	-
Basilicata	5	26	15
Veneto	4	19	39
Marche	4	27	-
Liguria	3	10	57
Friuli Venezia Giulia	5	21	11
Valle d'Aosta	3	12	-
P.A. Trento	4	18	114
P.A. Bolzano	6	22	19
Umbria	5	-	-
Abruzzo	5	19	8
Molise	4	8	-
National strategy	5	31	-
TOTAL	**110**	**492**	**615**

Source: Authors' elaboration based on information reported by national and regional RIS3s documents.

Table 4 – Level-one priority items in national and regional RIS3, Poland

	Priorities, number of items		
	Level 1	**Level 2**	**Level 3**
Łódzkie	6	57	459
Dolnośląskie	6	54	11
Lubelskie	4	13	16
Lubuskie	3	15	32
Małopolskie	7	55	288
Mazowieckie	4	16	45
Opolskie	6	18	107
Podkarpackie	4	18	60
Podlaskie	4	27	-
Pomorskie	4	19	-
Świętokrzyskie	7	40	225
Warmińsko-Mazurskie	3	19	76
Wielkopolskie	6	22	30
Zachodniopomorskie	8	57	-
Śląskie	3	15	81
Kujawsko-Pomorskie	8	30	-
National strategy	5	20	125
TOTAL	**88**	**495**	**1555**

Source: Authors' elaboration based on information reported by national and regional RIS3s documents.

The number of reported items appears in some strategies excessively high, in light of both the need to concentrate public resources on a limited number of priorities, as required by the ERDF regulations, and the administrative and technical capacities needed to effectively follow the development of many distinct areas. However, a proper judgement about the suitability of a given priority tree should be formulated on a case by case basis, taking account of the specific socio-economic conditions of the country or region, the size of the policy programme and the technological characteristics of each production niche. This sort of analysis goes beyond the scope of the present paper.

We argue that the observed branching structure of priorities might counteract/neutralise the selectivity of the policy intervention advocated by the smart specialisation approach even in the presence of a formally correct combination of dimensions. This would be the case, for instance, if a certain technology branches into many application fields or sectors, or if a societal challenge is meant to be tackled by applications in multiple sectors. In other words, if the branches become bushy and dense, it may become difficult to distinguish whether the interventions depending on this priority structure differ from broad measures that apply across all areas of the economy. For a policy intervention to be selective, the priority tree needs to be sparse.

5 Final considerations

In this study, we propose a systematic criterion to collect and analyse evidence on the smart specialisation priorities defined by countries and regions in the framework of their RIS3. Based on the economic development and industrial policy literatures and the European Commission's guidelines on smart specialisation, we characterise smart specialisation priorities as unique combinations of at least two dimensions, among the following four: sectors/value chains, technologies/processes, societal challenges, cultural and/or natural resources.

Examining the national and regional RIS3 in Italy and Poland, we found that policy priorities are defined in line with a multi-level, tree-like structure whose higher hierarchical level usually contains a few broad dimensions, and whose branches cover several specific activities. Most of those activities represent suitable smart specialisation priorities. Yet, in 11 out of the 39 RIS3 examined, some of the innovation areas do not fulfil the criteria used in this analysis to define smart specialisation priorities.

Several strategies encompass tens or even hundreds of activities. It is beyond the scope of the present study to evaluate the appropriateness of the choice of a certain set of priorities; however, our analysis raises an important question about the capacity of the strategy management bodies to effectively support and monitor the development of huge sets of activities each of which potentially requires specific competences and dedicated administrative and technical resources. Also, very dense priority trees may de facto circumvent the principle of selective intervention, as the strategies would ultimately cover broad economic areas.

The results of our study are limited to two countries; nevertheless, we believe they provide a significant picture, since Poland and Italy considered together receive close to 29% of ERDF-TO1 funds available for the entire European Union.

The evidence we gathered seems, overall, to reveal an ongoing, partial transition from the "old" horizontal or sector-based industrial policy, characterising European regional policy prior to 2014, to a more vertical/targeted approach. There are indeed indications that the smart specialisation logic of intervention is being translated in practical terms, but, at the same time, there are tangible signs that some regions and countries have put in place mechanisms that might circumvent the selective intervention principle, which is another pillar of smart specialisation. This could be the result of lobbying activities, higher political return from widespread public support measures, risk-averse attitude of policy makers and lack of adequate institutional and administrative capacity that can be observed at national and regional level. However, an additional explanation may lie in the incentive structure established at EU level which did not fully support the selective intervention principle. For the next programming period, it would be then advisable to revise the incentive structure provided to national and regional authorities in order to better reconcile the experimentalist approach and selective intervention logic of smart specialisation with the requirements established by Cohesion Policy regulations (funding absorption, performance framework, etc.).

More research is needed to complete the picture we have sketched and to provide a better understanding of the characteristics and causal mechanisms of one of the most ambitious industrial policy experiments ever attempted. We believe that the empirically testable criterion we propose for the assessment of priorities will contribute to understanding how to properly perform impact evaluation of the smart specialisation policy.

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Annex

Table A1 – Level-one priority items in national and regional RIS3, Italy

	Level-one priorities (as appear in the RIS3)	Areas/activities addressed	Attributed dimensions
Puglia	Sustainable manufacturing	Sustainable manufacturing industry	A+C
	Human and environmental health	Human and environmental health	C
	Digital creative and inclusive communities	Digital, creative and inclusive communities	C
Calabria	Agri-food	Agri-food value chain	A
	Tourism and culture	Tourism and cultural industries	A
	Sustainable construction	Sustainable construction sector	A+C
	Logistics	Logistic sector	A
	ICT and innovative services	ICT and service sectors	A
	Smart manufacturing	Smart factory / Industry 4.0	A+B
	Environment and risks	Environmental risk	C
	Life sciences	Life science value chain	A
Campania	Aerospace	Aerospace value chain	A
	Transport and advanced logistics	Transport and logistic sectors	A
	Health (biotechnology, human health, agri-food)	Biotechnology applications and agri-food production for human health	A+B+C
	Cultural heritage, tourism and sustainable construction	Cultural heritage, tourism and sustainable construction sector	A+C+D
	Energy and environment	Green energy production	A+C
	Advanced materials and nanothechnologies	Materials technologies and nanotechnologies	B
Sicilia	Life sciences	Life science value chain	A
	Energy	Energy sector	A
	Smart cities and communities	Smart cities and communities	C
	Culture and tourism	Cultural industries and tourism	A
	Blue economy	Blue economy	D
	Agri-food	Agri-food value chain	A
Toscana	ICT-Photonics	ICT applications and photonic technologies	B
	Smart factory	Smart factory / Industry 4.0	A+B
	Chemical and nanotechnologies	Technologies for the chemical industry and nanotechnologies	A+B
Emilia	Agri-food	Agri-food value chain	A

Romagna	Construction	Construction sector	A
	Mechatronics and engine	Mechatronics and engine manufacturing industry	A
	Health and well-being	Health and well-being	C
	Cultural and creative industries	Cultural and creative industries	A
Piemonte	Aerospace	Aerospace value chain	A
	Automotive	Automotive value chain	A
	Green chemistry/cleantech	Green chemistry	A+C
	Mechatronics	Mechatronics	A
	Made in Piemonte	Traditional manufacturing sectors of "made in Italy"	A
	Health and well-being	Healthcare industry	A
Lazio	Aerospace	Aerospace value chain	A
	Life sciences	Life science value chain	A
	Cultural heritage and technologies for culture	Technologies for cultural heritage	B+D
	Digital, creative industries	Digital and creative industries	A
	Agri-food	Agri-food value chain	A
	Green economy	Green economy	C
	Security	Citizen security	C
Lombardia	Aerospace	Aerospace value chain	A
	Agri-food	Agri-food value chain	A
	Green industry	Green industries (energy, construction, and chemical sectors)	A+C
	Health industry	Healthcare industry	A
	Creative and cultural industries	Creative and cultural industries	A
	Advanced manufacturing	Technologies for the manufacturing industry	A+B
	Sustainable mobility	Sustainable mobility	C
Sardegna	ICT	ICT sector	A
	Smart network for energy management	Network technologies for energy management	A+B
	Agri-food	Agri-food value chain	A
	Aerospace	Aerospace value chain	A
	Bio-med	Biomedical industry	A
	Tourism, cultural heritage and environment	Tourism, cultural and environmental heritage	A+D
Basilicata	Aerospace	Aerospace value chain	A

	Automotive	Automotive value chain	A
	Bio-economy	Biotechnology applications	B
	Energy	Energy sector	A
	Cultural and creative industries	Cultural and creative industries	A
Veneto	Smart agri-food	Agri-food value chain	A
	Smart manufacturing	Smart factory / Industry 4.0	A+B
	Sustainable living	Sustainable furniture industry	A+C
	Creative industries	Creative industries	A
Marche	Health and well-being	Health and well-being	C
	Home automation	Technologies for home automation	A+B
	Sustainable manufacturing	Sustainable manufacturing	A+C
	Mechatronics	Mechatronics	A
Liguria	Maritime technologies	Maritime technologies	B+D
	Health and life science	Health and life science	C
	Security and quality of life	Citizen security and quality of life	C
Friuli Venezia Giulia	Agri-food	Agri-food value chain	A
	Strategic filiere	Traditional manufacturing sectors of "made in Italy"	A
	Maritime technologies	Maritime technologies	B+D
	Smart health	Health	C
	Culture, creativity and tourism	Cultural and creative industries, tourism	A
Valle d'Aosta	Excellent Mountain (manufacturing, tourism, construction)	Manufacturing industry, construction and alpine tourism	A+D
	Smart Mountain	Technologies for smart cities and communities	B+C
	Green Mountain	Green economy	C
P.A. Trento	Agri-food	Agri-food value chain	A
	Quality of life	Quality of life	C
	Energy and environment	Green energy production	A+C
	Mechatronics	Mechatronics	A
P.A. Bolzano	Energy and environment	Green energy production	A+C
	Alpine technologies	Technologies for the Alpine environment	B+D
	Agri-food technologies	Technologies for the agri-food value chain	A+B
	ICT and automation	ICT applications and automation technologies	B

	Creative industries	Creative industries	A
	Medical technologies and health treatments	Technologies for the healthcare industry	A+B
Umbria	Agri-food	Agri-food value chain	A
	Life science	Life science value chain	A
	Green chemistry	Green chemistry	A+C
	Energy	Energy sector	A
	Smart factory	Smart factory / Industry 4.0	A+B
Abruzzo	Automotive/mechatronics	Automotive value chain and mechatronics	A
	Agri-food	Agri-food value chain	A
	Life sciences	Life science value chain	A
	ICT/Aerospace	ICT sector and aerospace value chain	A
	Fashion/design	Fashion and design industry	A
Molise	Agri-food	Agri-food value chain	A
	Creative, culture and tourism industries	Creative and cultural industries, tourism	A
	Life sciences	Life science value chain	A
	Innovation in the ICT system	ICT applications	B
National RIS3	Smart and sustainable industry, energy and environment	Sustainable manufacturing industry and energy production	A+C
	Health, food, quality of life	Health, nutrition and quality of life	C
	Digital agenda, smart communities, smart mobility	Digital agenda, smart communities, smart mobility	C
	Tourism, cultural heritage and creative industry	Tourism, cultural heritage and creative industries	A+D
	Aerospace and defence	Aerospace value chain and defence industry	A

Source: Authors' elaboration based on information reported by national and regional RIS3s documents.

Table A2 – Level-one priority items in national and regional RIS3, Poland

	Level-one priorities (as appear in the RIS3)	Areas/activities addressed	Attributed dimensions
Łódzkie	Modern textile and fashion industry	Textile and fashion industries	A
	Advanced construction materials	Materials technologies for the construction sector	A+B
	Medical industry, pharmaceuticals and cosmetics	Medical, pharmaceutical and cosmetic industries	A
	Energy (including energy efficiency, renewable energies)	Energy sector	A
	Innovative agriculture and agri-food industry	Agri-food value chain	A
	ICT	ICT sector	A
Dolnośląskie	Chemical and pharmaceutical industries	Chemical and pharmaceutical industries	A
	Spatial mobility	Spatial mobility	C
	High quality food	Food industry	A
	Natural resources and secondary raw materials	Extraction of natural resources, manufacture of secondary raw materials	A
	Production of machinery, equipment and materials processing	Machinery and materials processing industries	A
	ICT	ICT sector	A
Lubelskie	Bio-economy	Biotechnology applications	B
	Medicine and health	Healthcare industry	A
	Low-carbon emission energy	Green energy production	A+C
	ICT and automation	ICT applications and automation technologies	B
Lubuskie	Green economy - eco-innovation	Green economy	C
	Health and quality of life (eco-development)	Health and quality of life	C
	Innovative industry (eco-development)	Sustainable manufacturing	A+C

		industry	
Małopolskie	Life sciences	Life science value chain	A
	Sustainable energy	Green energy production	A+C
	ICT including multimedia	ICT sector	A
	Chemical industry	Chemical industry	A
	Manufacture of metal products, except machinery and equipment	Manufacture of metal products, except machinery and equipment	A
	Electrotechnical and machinery industries	Electrotechnical and machinery industries	A
	Creative and leisure time industries	Creative and leisure industries	A
Mazowieckie	Food safety	Food safety	A+C
	Smart management systems	Innovative management processes	B
	Modern business services	Business services	A
	High quality of life	Quality of life	C
Opolskie	Chemical technologies	Technology for the chemical industry	A+B
	Construction and wood technologies	Technologies for the construction sector and wood processing industry	A+B
	Technologies for metal products and machinery industries	Technologies for metal products and machinery industries	A+B
	Energy technologies (including renewable energy)	Technologies for the energy sector	A+B
	Food and agriculture technologies	Technologies for the agri-food value chain	A+B
	Life and environmental science	Life and environmental sciences	A
Podkarpackie	Aerospace	Aerospace value chain	A
	Quality of Life	Quality of life	C
	Automotive	Automotive value chain	A
	ICT	ICT sector	A
Podlaskie	Value chains around agri-food	Agri-food value chain	A

	sector and related sectors		
	Value chains around metal, machinery sectors and related sectors	Metal products and machinery industries	A
	Value chains around the medical industry, life sciences and related sectors	Healthcare value chain	A
	Value chains around eco-innovation, environmental science and life sciences and related sectors	Green economy	C
Pomorskie	Offshore and port-logistic technologies	Technologies for the logistic sector	A+B
	Interactive technologies in digital environments	Digital technologies	B
	Eco-efficient technologies for the production, transmission, distribution and consumption of energy and fuels, and for construction	Green technologies for the energy and construction sectors	A+B+C
	Medical technologies in civilisation diseases and aging	Medical technologies for social diseases and population aging	A+B+C
Świętokrzyskie	Metal and Casting Industry	Metallurgy and metal products industries	A
	Modern agriculture and food processing	Agri-food value chain	A
	Resource-efficient construction industry	Sustainable construction sector	A+C
	Health and health-promoting tourism	Healthcare industry and health-promoting tourism	A+C
	Information and communication technologies	ICT applications	B
	Trade fair and congress industry	Trade fair and congress industries	A
	Sustainable power industry growth	Green energy production	A+C
Warmińsko-Mazurskie	Wood and furniture	Wood and furniture industries	A
	High quality food	Food industry	A
	Water economy	Water-based economy	D
Wielkopolskie	Bio-based raw materials and food for informed consumers	Materials and food for informed consumers derived from biotechnology	A+B+C

		applications	
	Interiors of the future	Furniture and interior design industries	A
	Industry of tomorrow	Smart factory / Industry 4.0	A+B
	Specialised logistics processes	Logistic sector	A
	ICT-based development	ICT applications	B
	Modern medical technologies	Technologies for the healthcare industry	A+B
Zachodniopomorskie	Large-scale water and land constructions	Construction sector	A
	Advanced metal products	Manufacturing of metal products	A
	Wood and furniture products	Wood and furniture industries	A
	Eco-friendly packaging	Green packaging industry	A+C
	Chemical and materials engineering products	Technologies for the chemical industry and materials engineering	A+B
	Modern agri-food processing	Agri-food value chain	A
	Multimodal transport and logistics	Logistic sector	A
	ICT-based products	ICT applications	B
Śląskie	ICT	ICT sector	A
	Medicine	Healthcare industry	A
	Energy	Energy sector	A
Kujawsko-Pomorskie	Healthy and safe food	Food safety and nutraceutics	A+C
	Health and health tourism	Healthcare industry and health-promoting tourism	A+C
	Advanced materials and equipment	Materials technologies	B
	Transport and mobility	Transport sector	A
	Cultural heritage and creative industries	Cultural heritage and creative industries	A+D
	ICT	ICT sector	A
	Eco-innovation	Green economy	C
	Industrial automation	Automation technologies	B
National RIS3	Healthy society	Health	C

Agri-food and forestry, environmental bioeconomy	Agri-food value chain, forestry industry and environmental biotechnology applications	A+B+C
Sustainable energy	Green energy production	A+C
Natural resources and waste management	Natural resource production and waste management	A
Innovative technologies and industrial processes	Technologies for the manufacturing sector	A+B

Source: Authors' elaboration based on information reported by national and regional RIS3s documents.

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