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Mapping Innovation Priorities and Specialisation Patterns in Europe

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Abstract

Mapping public innovation priorities is important for policy makers and stakeholders, allowing them to explore the potential for collaboration and to better understand innovation dynamics. This working paper presents original data on innovation strategies for smart specialisation (RIS3) in European Union (EU) regions and Member States, obtained from the Eye@RIS3 open data tool for sharing information on the areas identified as priority areas by 198 innovation strategies. It also contextualises these priorities and specialisation patterns with regard to the concept of ‘smart specialisation’. The most common RIS3 priority areas in the EU are energy, health, information and communication technologies, food, advanced materials, services, tourism, sustainable innovation, advanced manufacturing systems, and the cultural and creative industries. The paper also explores the degree to which policy makers are creating unique portfolios of priorities or, in contrast, are imitating one another. We find that few regions have developed similar combinations of priorities. However, there are groupings around a number of popular categories and connected to prioritised EU objectives. Finally, we compare the main areas of planned investment with sectoral data on firms, employment and patents, with the conclusion that the connection between priorities and the economic and innovation structures is weak.

Keywords: smart specialisation, prioritisation, innovation policy, open data, structural funds

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1. Introduction

This working paper presents the first comprehensive mapping of innovation priorities and specialisation patterns in Europe. It is based on an analysis of the current generation of innovation strategies for smart specialisation (RIS3), which are a cornerstone of the reformed European Union (EU) Cohesion Policy. For visualising this information, the European Commission's S3 Platform has developed Eye@RIS3, an open data tool for gathering and diffusing information on the envisaged regional and national areas of smart specialisation ⁽¹⁾.

RIS3 are central to the European Commission's effort to foster smart and sustainable growth (European Commission, 2010a). During the current programming period (2014–2020) of the European Regional Development Fund (ERDF), regional and national authorities should develop RIS3 in order to ensure effective and efficient investments in research and innovation (R&I) (European Commission, 2010b). One essential feature of RIS3 is the concentration of funding on a limited number of R&I priorities ⁽²⁾. The Eye@RIS3 tool provides information on these prioritised areas with the aim of facilitating searching for potential cooperation partners, making potential partners aware of one's priorities and helping regions and countries to identify unique activity niches. We use these data to give an overview of the most common priority areas and to explore the extent to which policy makers develop unique niches and combine priorities in their RIS3. We also explore the extent to which different regions' and countries' priorities relate to existing innovation.

2. Analytical background: why priorities matter for smart specialisation

As part of the Europe 2020 Strategy, the European Commission aims to foster smart sustainable growth within the European Union. RIS3 have emerged as key processes for structural change towards more knowledge-intensive and higher added value activities, and were announced in the Innovation Union flagship (European Commission, 2010a). For the current programming period (2014–2020), regional and national policy makers are required to develop RIS3 before investing ERDF resources in R&I (European Commission, 2010b). The objective of developing RIS3 is mainly to leverage public and private funds towards smart specialisation priorities, which should be identified through an entrepreneurial discovery processes ⁽³⁾.

According to Dominique Foray who coined the term, smart specialisation is 'the capacity of an economic system (a region for example) to generate new specialities through the discovery of new domains of opportunity and the local concentration and agglomeration of resources and competences in these domains' (Foray, 2015). These are then codified in RIS3. According to the

⁽¹⁾ <http://s3platform.jrc.ec.europa.eu/map>.

⁽²⁾ Smart specialisation priorities are areas 'to build competitive advantage by developing and matching research and innovation own strengths to business needs in order to address emerging opportunities and market developments in a coherent manner, while avoiding duplication and fragmentation of efforts'; see Article 2(3) of the Common Provisions Regulation for the European Structural and Investment Funds (Regulation (EU) No 1303/2013 of 17 December 2013).

⁽³⁾ A process whereby national or regional managing authorities, together with stakeholders such as research institutions, industry and social partners, identify and produce information about new activities and develop roadmaps to realise the potential.

Common Provisions Regulation for the European Structural and Investment Funds (ESIF), smart specialisation strategies are national or regional R&I strategic policy frameworks (or part of such frameworks). These strategies define priorities in order to build competitive advantage by developing and matching regions' or countries' strengths in R&I with business needs; this should allow emerging opportunities and market developments to be addressed in a coherent manner, while avoiding duplication and fragmentation of efforts. RIS3 should be developed in an entrepreneurial discovery process and should include 'up-stream actions', to prepare regional R&I organisations for participation in Horizon 2020, and 'down-stream actions', to provide the means of exploiting and diffusing R&I results. Furthermore, RIS3 have to comply with the features of well-performing national or regional R&I systems with regard to the Innovation Union flagship (European Commission, 2010a).

The concept of smart specialisation builds on knowledge accumulated from different Commission services as regards innovation policy development and implementation: the analysis of technological and scientific strengths and how to use them for growth by the Directorate-General Research and Innovation (DG RTD); DG Enterprise and Industry's experiences with cluster policies, sector-specific innovation policies and the Lead Market Initiative (European Commission, 2009); and the work of DG Regional and Urban Policy (DG REGIO) and regional policy makers on regional innovation strategies (RIS) and regional innovation and technology transfer strategies and infrastructures (RITTS) in the early 1990s and continuing until 2006.

It also builds on academic developments within the areas of regional and innovation policies, including regional innovation systems, economic geography, institutional economics and evolutionary geography (e.g. Asheim et al., 2007; Frenken and Boschma, 2007; Asheim et al., 2011; Boschma and Frenken, 2011). One of the conclusions derived from these theories is that innovation is systemic. The primary agents for innovation are companies, but their potential to innovate is affected by policies, which can make innovation more or less likely. The public sector can support innovation through many different measures, such as fostering skills, altering incentive structures through legislation, supporting research and development through subsidies, acting as lead customers for innovative solutions, etc. However, most innovation results from existing regional capabilities that transform into new industries in different forms.

The creation of new industries is influenced by the concept of 'lead markets'. These are countries and regions in which innovation designs are first widely used and demanded by consumers before they diffuse globally (Jänicke and Jacob, 2004; Beise, 2006). The concept of lead markets is related to the idea of choosing specialisation areas. Their starting point is, however, not research and technology or sectoral structures, but demand in certain product markets (which can be influenced by market access, legal frameworks impacting on private and public demand for innovative solutions, etc.). The Lead Market Initiative brought demand-driven innovation policy instruments into EU innovation policy thinking (Aho et al., 2006). In its report on reindustrialising Europe to promote competitiveness and sustainability, the European Parliament stressed again the need to develop lead markets "which aim to promote the market uptake of new products and services living up to societal needs" (European Parliament, 2013: 14-15).

This concept of market creation is also important in the context of RIS3 and should not primarily aim to identify and support single innovations produced by projects, but should ideally aim to (co-) create new domains of activities where innovations can be developed and used to modernise traditional sectors or to stimulate the emergence of new market areas (Foray, 2015). Identifying

existing strengths in R&I, while considering their potential contribution to new domains and lead markets, is an important step in designing RIS3. Although, by definition, not all regions and states can become lead markets, prioritised areas should be considered in the context of EU-wide and global developments and market potentials. For this outward-looking perspective prioritisation is crucial. One of the main challenges when collecting data on these domains or prioritised areas is their multi-dimensional nature. They cover both existing capabilities, address specific target markets and are often related to more abstract EU policy objectives. In the next section, we describe how we dealt with this challenge when developing the Eye@RIS3 tool.

However, from historical experience with growth and regional and sectoral policies, we have learnt that policy makers are not well positioned to pick winners, whether companies/sectors or technologies. Therefore, R&I strategies should be developed jointly with entrepreneurs, academics and users/civil society to develop a better understanding of both future and private investment potential. This is something that has been emphasised in the context of smart specialisation through the concept of entrepreneurial discovery (Foray et al., 2009), which builds on the idea of entrepreneurial self-discovery processes in developing countries (Hausmann and Rodrik, 2003).

The use of the term ‘smart specialisation’ to describe a policy concept emerged in the Knowledge for Growth expert group. It was established in March 2005 by DG RTD to contribute to the Lisbon Strategy process for providing high-level advice on the contribution of knowledge to sustainable growth and prosperity. This expert group was chaired by Commissioner Potočník, and Dominique Foray was the Vice-Chairman. It argued that research investments in Europe have been overly fragmented, have lacked critical mass and have been plagued by a ‘me too’ syndrome, which manifested as regions making investments in very similar and fashionable areas such as information and communication technologies (ICT), and nano- and biotechnologies. These areas of investment were often disconnected from actual local capabilities, and, in many cases, based on hopes of developing future industries. Also DG REGIO observed this challenge in its work with RIS and RITTS, as well as DG Enterprise and Industry in the context of politically driven cluster initiatives. The lack of connections between these investments and existing capabilities was probably one of the greatest problems; recent related research underlines this issue by showing that regional innovation, in many cases, begins with a set of existing capabilities (Neffke et al., 2011).

The Barca Report contributed to the development of the concept through recommendations for the post-2013 regional development programmes. It emphasised the need to focus on fewer priorities, to be more transparent, to make sure that programme success is verifiable and to better coordinate place-based policies (Barca, 2009). This transformed smart specialisation from a technology and research concept to a place-based concept attuned to regional policy (McCann and Ortega-Argilés, 2011). The innate message of this report was that, if regions opt for similar types of innovation priorities, the outcome will be fragmentation and lack of critical mass, which will prevent regions from developing economies of agglomeration and positive spill-overs. In order to overcome these problems of fragmentation, mimesis and lack of critical mass, great importance has been given to urging regions to foster new activity sectors or industries, by investing in R&I in a limited number of areas with the greatest strategic potential.

Because smart specialisation was a challenging new concept for R&I policy, and because investments in R&I were expected to increase considerably in ESIF, DG REGIO and the Joint Research Centre set up the Smart Specialisation Platform at the Institute for Prospective

Technologies (IPTS) in 2012 to provide regions and Member States with guidance and hands-on support for the development of their RIS3. This guidance material, contains many suggestions as to how regions or Member States can identify the unique characteristics, challenges and assets that will help them achieve competitive advantage and fulfil their potential for excellence ⁽⁴⁾. However, at the same time, it emphasises alignment with other EU objectives and the development of priorities that take into account some of these goals as well as synergies between different funding sources. These suggestions may foster herd behaviour once again. As smart specialisation is part of the *ex ante* conditionalities which must be fulfilled in order to qualify for ESIF, European regions and Member States are, as of 2012, identifying priorities for their RIS3 investments.

3. Developing an open data tool for mapping innovation priorities

Eye@RIS3 is an interactive open data tool that gives an overview of the envisaged RIS3 priorities of regions and countries in Europe. The tool gives regional and national innovation communities visibility and an opportunity to be recognised by potential counterparts looking for collaboration in a particular area. The tool also allows comparisons of innovation specialisations across Europe to give a better understanding of emerging competitive niches. Eye@RIS3 has been developed as an open data tool to help strategy development and to facilitate inter-regional and trans-national cooperation, rather than as a source of statistical data. The majority of data have been added by S3 Platform staff and a minority by policy makers themselves.

To have priorities listed in the Eye@RIS3 database does not mean that the particular strategy or priorities have been approved by the Commission as meeting the RIS3 *ex ante* conditionality criteria. Furthermore, the listed priorities have not been verified as being areas of strength. Rather, listed priorities are areas that regions and Member States have identified as domains on which they will concentrate in the upcoming programming period. Many of the activities indicated by the regions and Member States in the innovation strategies are still too generic, as they are not orientated towards economic transformation and have not been developed in an entrepreneurial discovery process. Therefore, more than 60 regional and national governments have to implement Action Plans to fulfil the RIS3 *ex ante* conditionalities. The listed priorities might therefore still change in a substantial number of cases.

Currently, the data consist of 1 307 priorities from 20 EU countries, 174 EU regions, 6 non-EU countries and 18 non-EU regions. On average, the 218 regions or countries have six priorities each, with the largest number of priorities for any region or country being 17 ⁽⁵⁾. Our sample covers around 65 % of the EU's 271 NUTS2 regions, which is the main level at which RIS3 are adopted. In countries without regional RIS3, national data have been added. In total, the sample covers almost all of the EU-28 territory, with the exception of three Italian regions.

The database contains data at NUTS1, 2 and 3 levels, since there are large variations in our sample in terms of regional powers and administrative responsibilities for innovation and development policies. However, NUTS2 is by far the most common level at which RIS3 have been adopted.

⁽⁴⁾ IPTS (2011), The RIS3 Guide ().

⁽⁵⁾ The data used in this paper were retrieved on 5 December 2014, at which time there was almost full coverage across EU Member States. Since then, additional data have been added.

Regional and national innovation priorities are at the heart of the database. For each priority, we have information on four main categories, as follows: (1) a free-text description of the priority, (2) the R&I capability, (3) the business area and target market and (4) the connection to EU priorities.

The first category is a text field that contains a description of the priority area. This field is possibly the most important, since it reflects the wording and description used by the policy makers who wrote the strategies.

Many regional and national priorities are not confined to a single traditional sector, but merge cross-sectoral activities and specialised niches. Furthermore, many priorities connect certain regional and national capabilities with broader EU objectives. In order to take this into account, each priority is further described through three *main categories* (with *sub-categories* for more specificity). The idea behind these three categories is to capture the R&I capabilities, the business areas and target markets, and the EU's prioritised policy objectives. Our approach cannot perfectly address each aspect of the priorities, but it ensures a user-friendly tool that indicates in which directions regions and states want to develop their R&I priorities. A comprehensive list of these categories can be found in Appendices 1 and 2.

The development of the categories 'research and innovation capability' and 'business areas and target markets' is based on NACE 1 and NACE 2 codes and OECD categories, with some modifications. For the category 'EU objectives', the S3 Platform has created a list of 10 main objectives with around six sub-categories based on the themes emphasised in the Europe 2020 Strategy and the Innovation Union. These cover grand challenges and prioritised policy areas, such as creative and cultural industries, key enabling technologies (KETs)⁽⁶⁾, social innovation and the Digital Agenda. The database also contains information on the source of each entry.

With regard to data quality, there are a number of caveats. First of all, the data are not yet suitable for econometric analyses, since all entries must be confirmed and double-checked against the final versions of strategies. However, the database is continuously being updated with the aim of having up-to-date information. When the negotiations of Operational Programmes and the implementation of Action Plans are finalised, the data can be fully validated. It must be kept in mind that, originally, the main rationale for developing the tool was to increase transparency and to stimulate contacts between regions and Member States in the field of R&I.

4. Mapping of priority areas

In this final section, we map the R&I priorities of 20 EU countries, 174 EU regions, 6 non-EU countries and 18 non-EU regions. We first give an overview of the major areas in which policy makers want to invest and identify patterns. In the second part, we analyse the degree to which regions are planning to invest in the same type of categories. Finally, we compare these priorities with the underlying economic structure in order to explore the extent to which regional priorities reflect actual regional capabilities.

⁽⁶⁾ These are constituted of the six categories of Advanced manufacturing, Advanced materials, Industrial biotechnology, Micro/Nano-electronics, Nanotechnology and Photonics.

4.1 Most common categories of priorities

In this section, we discuss the 10 most common priority categories, as well as their share of the total number of priorities. In general, we observe that priorities in the *main categories* are more common than any of the priorities in the *sub-categories*. There are two main reasons for this. First, it is difficult to encode multi-faceted innovation priorities at more finely grained levels. Second, when policy makers encode their priorities, they often resort to broader categories but provide more details in the free-text description.

The most common priority in the *main categories* of ‘research and innovation capability’ and ‘business areas and target markets’, is manufacturing and industry (see Tables 1 and 2), probably because this sector encompasses large parts of the economy. Moreover, an important goal of smart specialisation is to stimulate R&I activities linking industry and research, in order to create structural change. With regard to the *sub-categories*, food, power generation/renewable sources, health, biotechnology and motor vehicles are the most common priorities (see Tables 4 and 5).

Some of the more top-down policies within the *main category* ‘EU objectives’, such as sustainable innovation, public health and security, KETs ⁽⁷⁾ and Digital Agenda, are much more common than others (see Table 3). Thematic objectives, from Operational Programmes, set the targets for these broader EU objectives, which also influence planned investments.

Table 1: Number of priorities within the *main category* ‘research and innovation capability’

Name of priority category	No of observations	% of total priorities
Manufacturing and industry	452	34.6 %
Information and communication technologies (ICT)	157	12.0 %
Energy production and distribution	138	10.6 %
Agriculture, forestry and fishing	112	8.6 %
Human health and social work activities	100	7.7 %
Services	93	7.1 %
Creative and cultural arts and entertainment	60	4.6 %
Tourism, restaurants and recreation	51	3.9 %
Transporting and storage	40	3.1 %
Construction	38	2.9 %
Grand total	1 299	99.4 %

⁽⁷⁾ This is a top-level domain that brings together the six key enabling technology domains of Advanced manufacturing systems, Advanced materials, Industrial biotechnology, Micro/Nano-electronics, Nanotechnology and Photonics as sub-categories.

Table 2: Most common priorities within the *main category* ‘business areas and target markets’

Name of priority category	No of observations	% of total priorities
Manufacturing and industry	462	35.3 %
Human health and social work activities	154	11.8 %
Energy production and distribution	128	9.8 %
Information and communication technologies (ICT)	98	7.5 %
Tourism, restaurants and recreation	74	5.7 %
Transporting and storage	73	5.6 %
Services	69	5.3 %
Agriculture, forestry and fishing	65	5.0 %
Creative and cultural arts and entertainment	52	4.0 %
Construction	42	3.2 %
Grand total	1 287	98.5 %

Table 3: Most common priorities within the *main category* ‘EU objectives’

Name of priority category	No of observations	% of total priorities
Sustainable innovation	284	21.7 %
KETs	267	20.4 %
Public health and security	192	14.7 %
Digital Agenda	152	11.6 %
Cultural and creative industries	81	6.2 %
Blue growth	53	4.1 %
Service innovation	49	3.7 %
Specific local policy priority	46	3.5 %
Social innovation	24	1.8 %
Aeronautics and space	21	1.6 %
Nature and biodiversity	15	1.1 %
Grand total	1 184	90.6 %

By comparing the three *main categories* detailed in Tables 1 to 3, differences in how the priorities are described can be observed. For example, ICT, services, creative industries, and agriculture, forestry and fishing are most frequently described as R&I capabilities, whereas health-, tourism- and transport-related priorities are more frequently described as target markets. These observations could be interpreted to emphasise the importance of support for economic areas that, in turn, could function as a means of renewal for other sectors, whereby the knowledge from these sectors would stimulate renewal in more traditional sectors (with the possible exception of agriculture).

Food production is the most common priority of the *sub-category* of ‘business areas and target markets’ and is related to agriculture (see Table 5). With regard to priorities within the *sub-category* of EU-objectives, these also partly reflect the ambition to invest in sustainable innovation, KETs, health and ICT (see Table 6).

Table 4: Most common priorities within the *sub-category* of ‘research and innovation capability’

Name of priority category	No	% of total priorities
Power generation/renewable sources	83	6.4 %
Biotechnology	56	4.3 %
Motor vehicles and other transport equipment	55	4.2 %
Human health activities (medical services)	47	3.6 %
Machinery and equipment	41	3.1 %
Basic pharmaceutical products and pharmaceutical preparations	35	2.7 %
Food, beverage and tobacco products	33	2.5 %
Crop and animal production, hunting and related service activities	30	2.3 %
Computer, electronic and optical products	28	2.1 %
Nanotechnology and engineering	26	2.0 %
Grand total	805	61.6 %

Table 5: Most common priorities within the *sub-category* of ‘business areas and target markets’

Name of priority category	No	% of total priorities
Food, beverage and tobacco products	88	6.7 %
Human health activities (medical services)	71	5.4 %
Energy distribution	46	3.5 %
Power generation/renewable sources	43	3.3 %
Machinery and equipment n.e.c.	38	2.9 %
Motor vehicles and other transport equipment	36	2.8 %
Basic pharmaceutical products and pharmaceutical preparations	28	2.1 %
Biotechnology	25	1.9 %
Other manufacturing	24	1.8 %
Computer, electronic and optical products	23	1.8 %
Grand total	742	56.8 %

Table 6: Most common priorities within the *sub-category* of ‘EU-objectives’

Name of priority category	No	% of all priorities
Public health and well-being	98	7.5 %
Sustainable energy and renewables	92	7.0 %
Advanced manufacturing systems	90	6.9 %
Advanced materials	79	6.0 %
Industrial biotechnology	54	4.1 %
Eco-innovations	45	3.4 %
Smart green and integrated transport systems	31	2.4 %
Resource efficiency	26	2.0 %
Food security and safety	25	1.9 %
Development of regional cultural and creative industries	24	1.8 %
Sustainable agriculture	24	1.8 %
Grand total	837	64.0 %

The most common priorities are similar for the *sub-categories* ‘research and innovation capabilities’ and ‘business areas and target markets’ and are as follows: energy, biotechnology, health and food. However, their roles seem to differ (see Tables 4 and 5). Power generation, biotechnology and

motor vehicles are more often described as capabilities, whereas food, health and energy distribution are more important as markets. They seem to be related to the *sub-categories* of EU-objectives of health, sustainable energy and advanced manufacturing and materials.

As part of this review, we have also performed a search of the priority *names/descriptive text fields* in order to identify the most common themes and their frequency (see Table 7). The most common themes that emerged were energy, health, food, ICT and materials. This is very similar to the categories identified above, but with an increased importance of food and tourism.

Table 7: Most common names/descriptions

Name	No	% of all priorities
Energy	160	12.2 %
Health	147	11.2 %
Food	119	9.1 %
Materials	109	8.3 %
Information and communications technologies (ICT)	107	8.2 %
Tourism	93	7.1 %
Service	97	7.4 %
Sustainability	92	7.0 %
Creative sectors	67	5.1 %
Manufacturing	58	4.4 %

Overall, the most commonly cited priority categories are energy, health, food, materials and ICT.

4.2 Distribution of different priority combinations

We have also explored the extent to which regions have the same combinations of priorities and whether or not these combinations follow a standardised set of choices. Initially, to attain a more detailed picture, we analysed the commonalities among *sub-categories*. In order to carry out this analysis, we created a search scheme consisting of the six most common *sub-categories*. Some overlaps exist between the ‘capabilities’ and ‘markets’ categories, since these use the same category names in the Eye@RIS3 database; we have merged these in a umbrella terms. The most common sub-categories are summarised in Table 8.

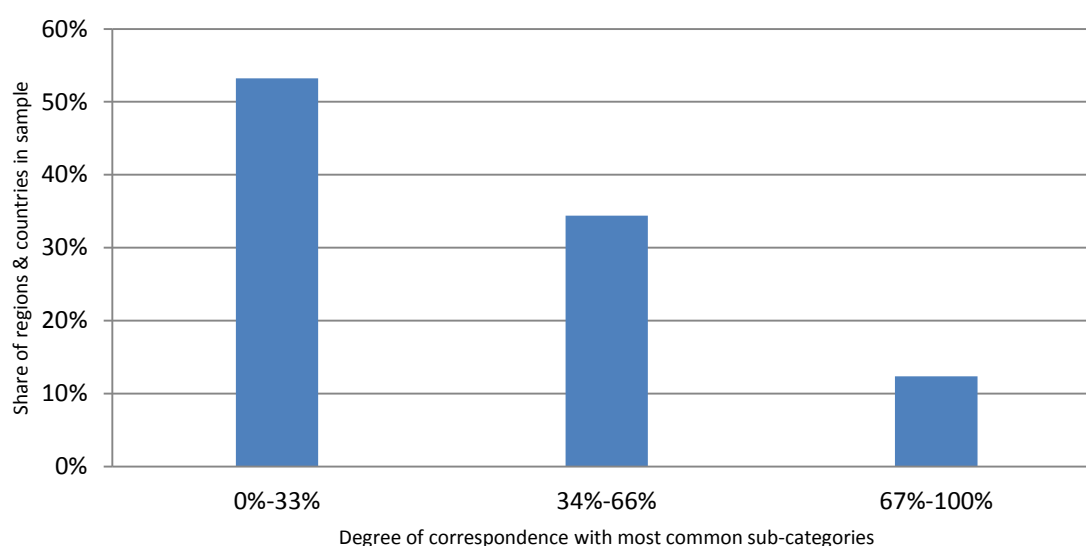
Table 8: Most common priority sub-categories

Name	No	% of total priorities
Public health and well-being	98	7.5 %
Sustainable energy and renewables	92	7.0 %
Advanced manufacturing systems	90	6.9 %
Food, beverage and tobacco products	88	6.7 %
Power generation/renewable sources	83	6.4 %
Advanced materials	79	6.0 %

We use this scheme of the most common priority *sub-categories* to explore how many of the regions have chosen these priorities and the extent to which their priorities belong to *any* of these categories. Figure 1 illustrates the distribution of regions and countries according to their share of priorities related to the most common priority sub-categories.

A typical pattern is to have 30-39% of priorities connected to any of the six *most common sub-categories*, which is true for around 23% of the regions and countries in our sample. A value of 0 indicates regions and countries have no priorities related to the most common *sub-categories*. This subset includes many regions that may have only encoded priorities at the broader category level. At the other end of the spectrum all of the priorities in five regions are related to the most common *sub-categories*. Out of these, four have either one or two priorities. There is one region with 4 priorities of which all are connected to the most common ones. When reviewing this region more closely, the priority mix seems to be fairly broad in its definitions.

Figure 1: Share of regions and countries and degree of correspondence with most common sub-categories



Note: This figure is based on data from 218 regions and countries from the Eye@RIS3 database. The y-axis is the share of all regions and countries in the database (n = 198). The x-axis depicts the degree of correspondence of regional and national priorities with the most common sub-categories.

While some priority categories are more popular than others, we do not find that every region and country intends to invest in the same categories. In order to check the robustness of this finding, we conducted an additional two-step analysis as follows: (1) we calculated the frequency of the most common combinations of *sub-categories* among all priorities; and (2) we counted the number of regions and countries whose priorities are among these most common combinations.

With regard to the frequency of the most common combinations, we find a total of 480 combinations that were used by the regions and countries for 1 076 priorities, with at least one

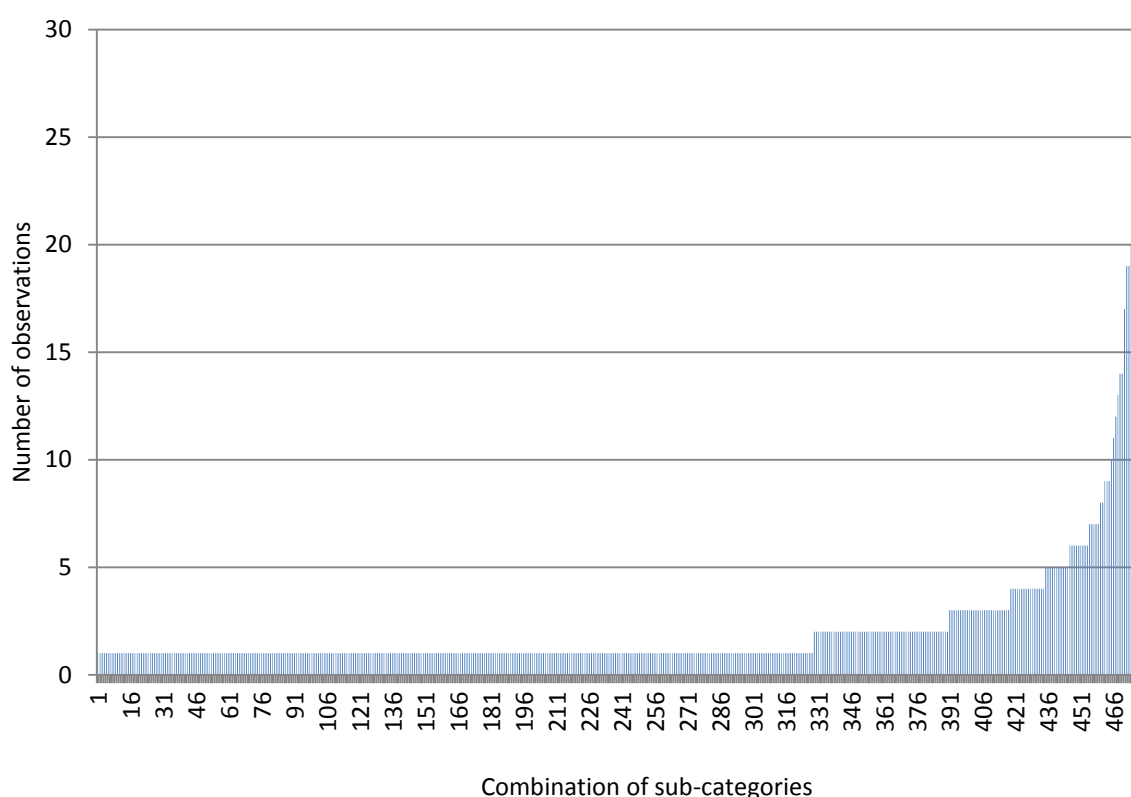
data entry among the *sub-categories*. The most common combinations of the subcategories are listed in Table 9.

Table 9: Most common combinations of sub-categories

EU objectives	Capabilities	Target market	Occurrences
Sustainable energy and renewables	Power generation/renewable sources	Energy distribution	5.4%
Public health and well-being	Human health activities	Human health activities	5.2%
Advanced manufacturing			5%
Sustainable energy and renewables			4.8%

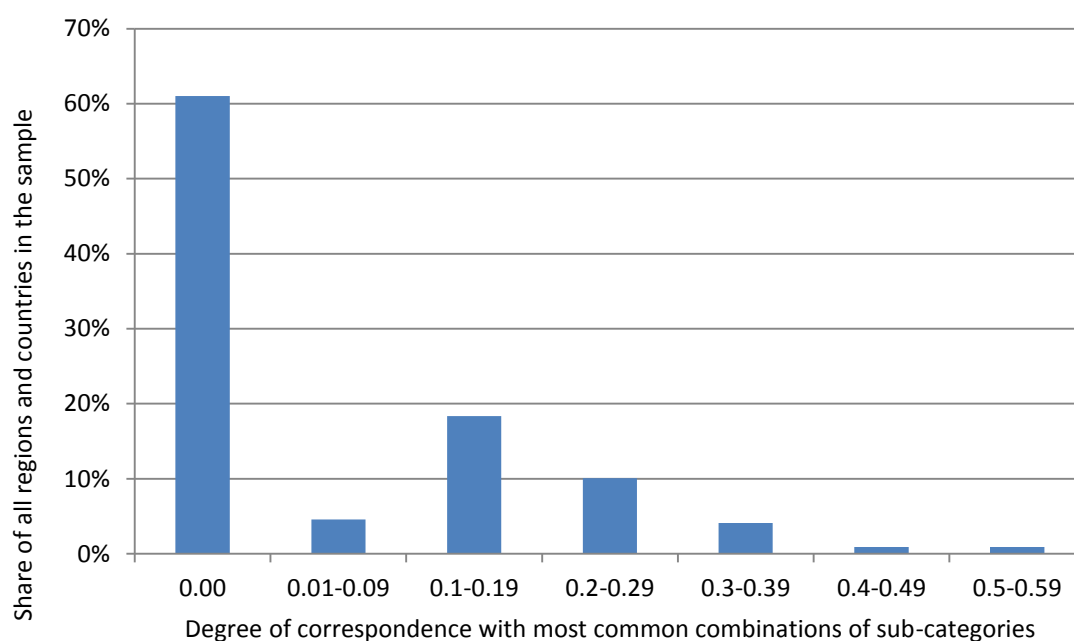
The distribution of the most common combinations of the subcategories is illustrated in Figure 2.

Figure 2: The number of priorities with the same type of sub-category combinations



Let us now examine the distribution of regions and countries according to their share of priorities related to the most common combinations of *sub-categories*, as mentioned above. The majority of regions and states do not have any of these combinations (see Figure 3), while in 22.5 % of regions and states up to one-fifth of the priorities are related to the most common combinations.

Figure 3: Distribution of regions and countries and their share of priorities among the most common sub-category combinations



Note: This figure is based on data from 218 regions and countries from the Eye@RIS3 database. The x-axis is the share of all regions and countries in the dataset ($n = 198$). The x-axis depicts the degree of correspondence of regional and national priorities with the most common sub-categories.

Looking at *sub-category* data, we found that, *grosso modo*, regions and countries have not chosen the same sets of priorities, but rather have more individual priority combinations.

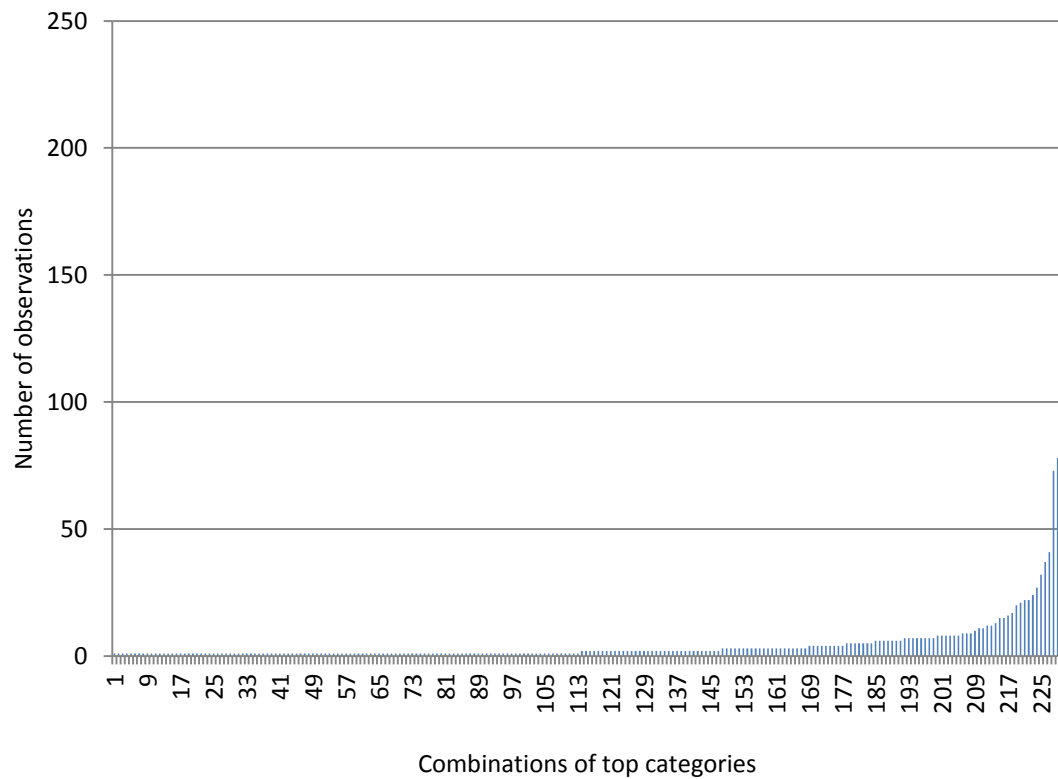
To complete this robustness check, we carried out the same type of analysis for *main category* data. In total, there were 231 combinations of 1 307 encoded priorities. The by far most common combinations of *main categories* are illustrated in Table 10.

Table 10: Most common combinations of *main categories*

EU objectives	Capabilities	Target market	Occurrences
KETs	Manufacturing and industry	Manufacturing and industry	16%
Sustainable innovation	Energy production and distribution	Energy production and distribution	6.2 %
Digital Agenda	Information and communication technologies	Information and communication technologies	6%
Public health and security	Human health		5.6%

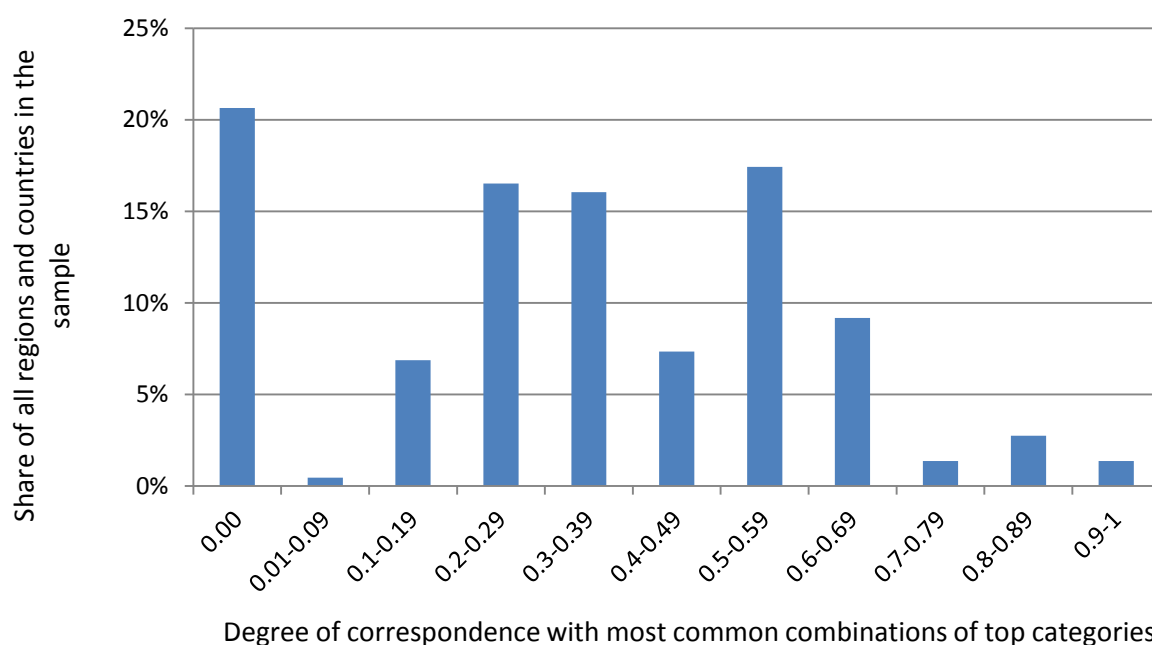
As expected, there is a higher frequency in the priority combinations based on these *main categories* than based on the *sub-categories*. Among these *main category* combinations, there are fewer combinations and more priorities belonging to each of these combinations, as illustrated in Figure 4.

Figure 4: The number of priorities with the same type of category combinations



In Figure 5, we also examine the distribution of regions and countries according to their share of priorities among the most common combinations of *main categories*. Once more, the commonalities are greater than they are in the *sub-category* combinations. In slightly more than 30 % of the 218 regions and countries more than half of the priorities are related to the most common combinations of *main categories*. However, when looking at individual regions which have a large proportion of their priorities related to the most common category combinations, they are actually also quite elaborate, which indicates that regions and countries have developed rather individual sets of priorities.

Figure 5: Distribution of regions and countries and their share of priorities among the most common top category combinations



Note: This figure is based data from 218 regions and countries from the Eye@RIS3 database. The y-axis is the share of all regions and countries in the database (n = 198). The x-axis depicts the degree of correspondence of regional and national priorities with the most common top categories.

We found no evidence to substantiate our original hypothesis, which predicted copycat behaviour and similar priority combinations among regions and countries. A caveat of our analysis is the quality of the strategy documents encoding the priorities; our observations could have been affected by reviewing strategies that had not been finalised.

With this said, we do find priority clusters around a number of popular categories. This could, to a small extent, be an outcome of our coding and interpretation of data. However, in general, we do find a correlation between EU objectives and the chosen priorities. A relatively high proportion of priorities are related to renewable energies, sustainability, the Digital Agenda and KETs. This could reflect the fact that smart specialisation priorities are influenced by other types of activities funded by ESIF. The requirement for EU regions and Member States to allocate funding to the thematic objectives (TOs) of ‘strengthening R&I for regional growth’ (TO1), ‘enhancing the access to and use of ICT’ (TO2), ‘enhancing SME competitiveness’ (TO3) and ‘supporting the shift to a low carbon economy’ (TO4) could explain the popularity of sustainability, renewable energies and ICT. The intention to invest large amounts of money into health and healthy ageing could be explained by the major societal challenge of on-going demographic change, and the fact that many regions are service providers in this area and have significant public procurement potential for innovative solutions.

Another interesting finding is that tourism is a widely shared innovation priority. Although there are some good examples of service innovation related to tourism, the high popularity of this priority in the RIS3 context could also be explained by the desire of many regions and Member States to continue using ERDF to subsidise their existing tourism industries and infrastructures, despite

tourism (and culture) not figuring prominently among the ERDF Thematic Objectives. There is a risk that these investments stem from political priorities, rather than from a real discovery process and a realistic assessment of R&I and business potentials.

4.3 Comparing priorities to economic structure

Having examined the direction of change for regions and countries in their structural processes, we will now examine data on their actual economic structure. This helps us to better understand the extent to which regional and national priorities focus on areas where strong or growing capabilities already exist. For this, we have used Eurostat data on the number of organisations, employment data and patent applications in absolute terms, as well as growth figures in absolute and relative terms. We have compared these data with the most common RIS3 priorities to determine how the priorities relate to the economic structure. This analytical exercise does not allow regional matching but looks at EU totals.

Box: Most common R&I priorities in Europe

- *Energy*
- *Information and communication technologies (ICT)*
- *Health*
- *Food*
- *Advanced materials*
- *Services*
- *Tourism*
- *Sustainable innovation*
- *Advanced manufacturing systems*
- *Cultural and creative industries*

For this comparison, we have created a list of the 10 most common priorities (see Box), which is based on the mapping described in the previous sections. It is based on a combination of main categories, sub-categories and free-text descriptions. The reason for combining this information is that neither the broader main categories, such as manufacturing and industry, nor the sub-categories of KETs adequately separate the different sectors; alone, they do not capture the many priorities in the areas of ICT, creative industries, tourism and services.

When comparing the *absolute numbers of firms* by sector with RIS3 priority combinations, we see some overlap in food and beverage service activities and possibly in activities relating to services. However, few regions specifically mention any of the other major sectors—legal services, engineering or head offices—in the text descriptions of their priorities. Likewise, few regions mention priorities in retail trade, but some do mention transportation and construction. It seems as though the choices of RIS3 priorities are not strongly reflected in the data on local units in absolute numbers.

We also looked at the sectors that, in *absolute numbers*, grew the most between 2008 and 2010. Construction, real estate and related services are large sectors, but they do not correlate strongly with RIS3 priorities. The only sectors where we see a direct correlation between the growth of related businesses and RIS3 priorities are ICT and computer programming; this is possibly linked to other scientific activities since RIS3 deal with R&I.

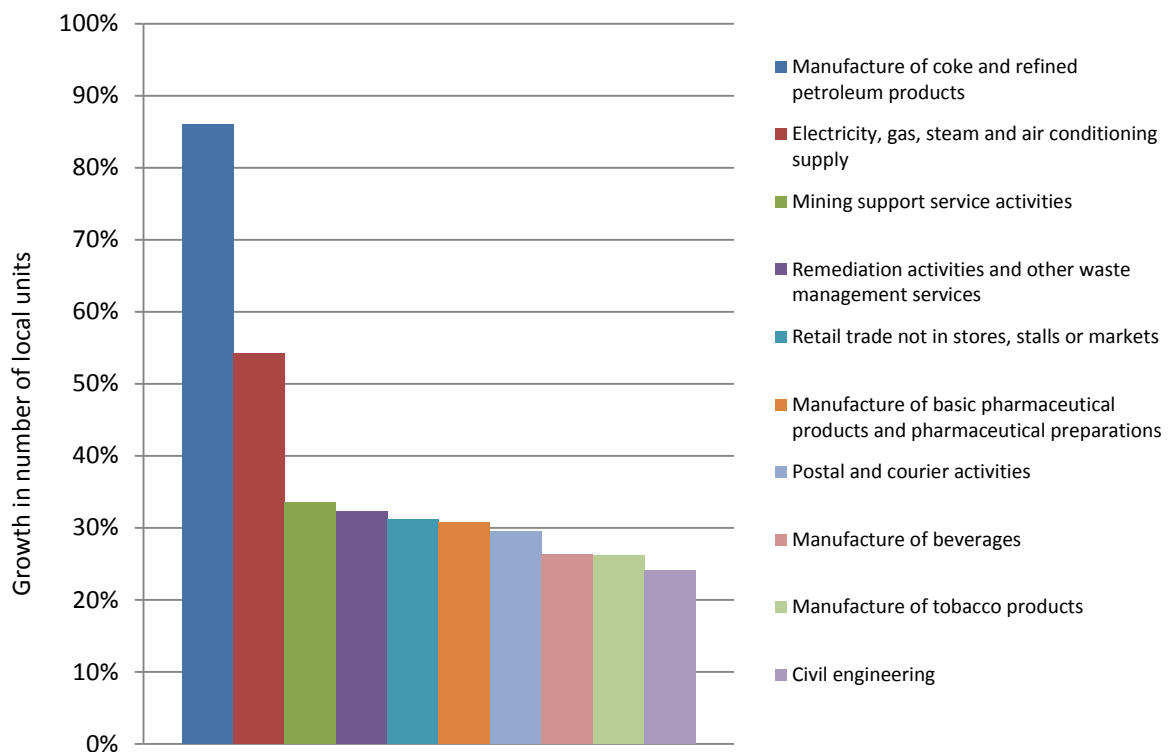
The greatest overlaps between *the relative growth of a sector* (i.e. how much it has grown in proportion to its original size) and RIS3 priorities are as follows:

- energy and the ‘manufacture of coke ...’ and ‘electricity, gas, steam and air conditioning supply’;
- sustainable innovation and ‘remediation and waste management ...’;
- health and ‘manufacturing of basic pharmaceuticals ...’;
- food and the ‘manufacture of beverages’;

- services (to some extent) and ‘civil engineering’.

After looking at the number of local units in absolute terms, growth in absolute terms and relative growth, we found that regional priorities overlap with the largest sectors mainly in terms of *relative growth* (see Figure 6).

Figure 6: Relative growth of top sectors, number of local units (2008–2010)



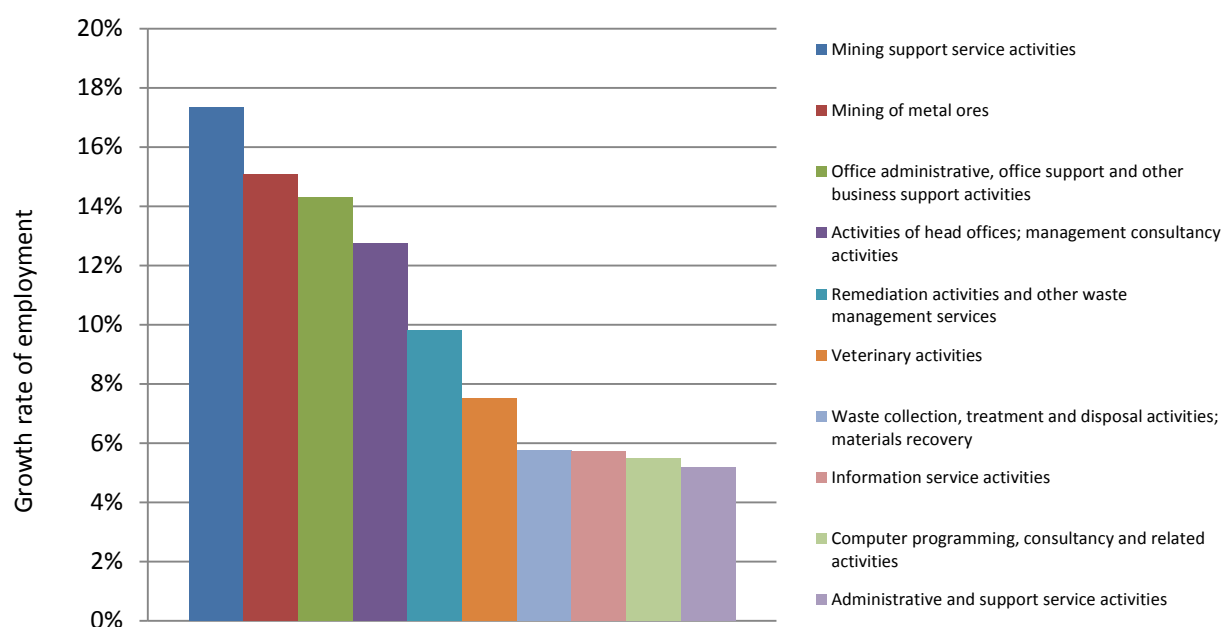
Source: SBS data by NUTS 2 regions and NACE Rev. 2 (from 2008 onwards), number of local units

However, the number of local units and their growth can be affected by sectoral structure. Therefore, we have also looked at the *number of employees per sector* (NACE code categories) and *growth of employment*. We found that there were some connections between the RIS3 priorities of food, services and advanced manufacturing and:

- ‘food and beverage service activities’;
- the ‘manufacture of food products’;
- ‘services to buildings and landscape activities’ (possibly);
- the ‘manufacture of fabricated metal products, except machinery and equipment’.

There was quite a strong link between regional priorities and the *sectors with the largest growth in employment* in 2010 (illustrated in Figure 7), there being overlaps in most sectors except for ‘mining support services actions’, ‘mining of metal ores’ and ‘veterinary activities’. The main overlaps were found to be with services, sustainable innovation and ICT priorities.

Figure 7: Sectors with highest average growth in 2010



Note: Eurostat employment data for 2010, SBS data by NACE Rev. 2 for the EU-28 (and Norway) with missing data for Croatia, Greece, France, Italy, the Netherlands and Slovakia. No data were available for the wholesale and retail sectors.

Finally, we examine Eurostat patent data covering patent applications to the European Patent Office (EPO), in terms of both absolute numbers and growth in absolute and relative numbers. There were relatively few connections between regional priorities and the growth of the number of patent applications. For *patent applications in absolute numbers* (Figure 8), we find overlaps between:

- health and ‘medical and veterinary science, hygiene’;
- ICT and ‘electric communication technique’ and ‘computing, calculating, counting’;
- energy and ‘generation, conversion or distribution of power’.

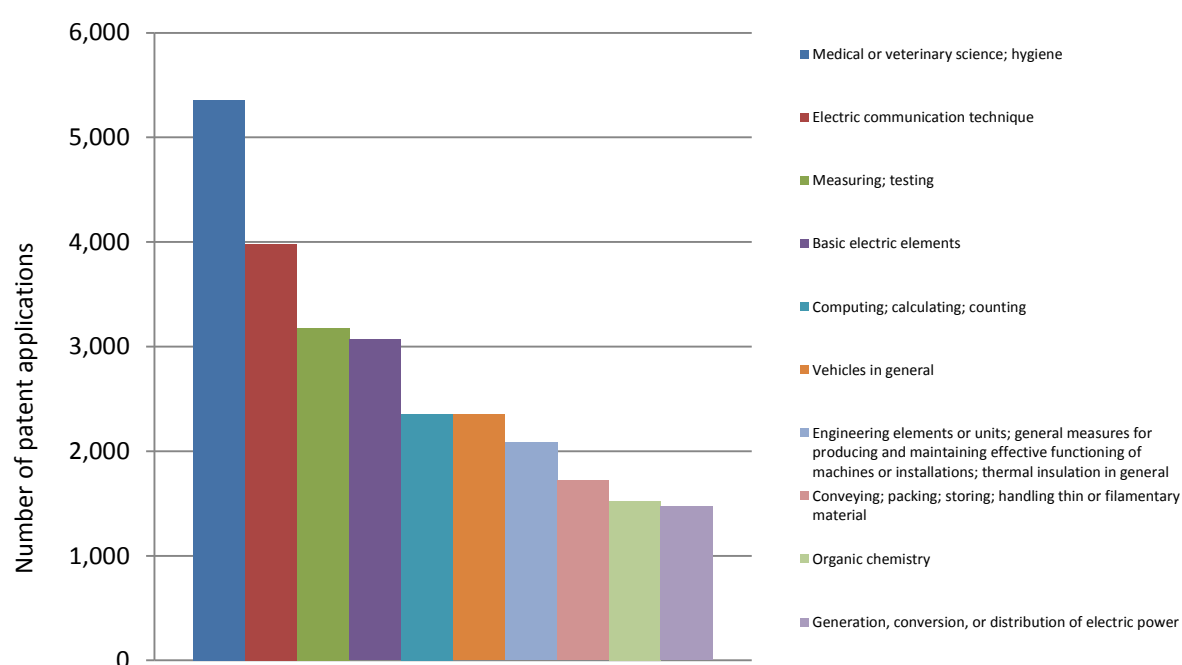
There are fewer connections between patents and regional and national priorities than there are with main sectors in terms of number of firms. This is not surprising, since patents are not highly relevant to some of the main priority areas, such as tourism, services, and the creative and food industries.

According to our analyses, priority choices correlate with existing specialisations mainly in terms of relative growth of the number of firms and employment, and the absolute number of patent applications. Nonetheless, the connections between priorities and economic and innovation structures seem weak overall. This may be a result of a mismatch in the statistical categories we compare or due to lacking patent data categories and lack of easily assignable NACE codes for sustainable innovation.

On the other hand, priority choices could simply be based more on future plans than on existing or growing areas of activity. The priorities may emphasise political ambitions and efforts towards structural change in the framework of EU objectives rather than reflecting the largest sectors of a particular region. In this optimistic view, regions could be investing in emerging and niche sectors, thus avoiding a lock-in in incumbent sectors.

To better understand the relationship between priorities and economic and innovation structures, we would have to perform more detailed comparative analyses of regional and national priorities and indicators of regional economic structure, such as labour, organisations, publications and patents.

Figure 8: Patent applications in absolute numbers (2010)



Source: Patent applications to EPO at the national level by IPC sections and classes (Eurostat).

5. Conclusion

EU regions and Member States have been required to develop smart specialisation strategies. For this, they had to select a limited number of investment priorities, via an entrepreneurial discovery process, that reflect regional capabilities, future market potentials and EU-prioritised policy areas, in order to overcome potential problems of fragmentation, imitation and lack of critical mass.

This working paper has presented data from the Eye@RIS3 database, an open data tool which gathers information on the innovation priorities of regions and states in the EU and in neighbouring countries. The purpose of this tool is to give an overview of specialisation patterns and to facilitate communication between countries and regions. Currently, the dataset covers 1 307 priorities from 20 EU countries, 174 EU regions, 6 non-EU countries and 18 non-EU regions; this constitutes around two-thirds of Europe's 271 NUTS2 regions. On average, each of the 218 regions and countries has six priorities. The most common priority areas are energy, health, ICT, food, advanced materials, services, tourism, sustainable innovation, advanced manufacturing systems, and the cultural and creative industries.

In order to explore the extent to which regions and countries are developing similar portfolios of priorities, we explored combinations of both main category and sub-category priority data. We found that very few regions and countries have developed similar combinations. Our evidence suggests that there is no significant 'copycat' behaviour among regions and countries.

Having said this, we do find clusters of popular priorities that resemble broader EU objectives. These clusters are renewable energy, sustainability, the Digital Agenda and KETs. In addition, many regions and countries seek to concentrate funding on (public) health and healthy ageing, thus addressing societal challenges. In devolved administrative systems, local and regional authorities often have health-related powers and spending responsibilities.

Finally, we compared Eye@RIS3 data with Eurostat data on numbers of local units in different sectors, employment and patent applications. The chosen innovation priorities somewhat reflect growth in employment, the relative growth of the number of local units and the absolute number of patent applications. However, the overall relationship between priorities and the economic and innovation structure seems weak. This could be explained by either a mismatch or a lack of relevant data or it might simply indicate that priorities are geared towards future potential rather than existing areas of activity. The regional priorities might also emphasise political ambitions and efforts towards structural change connected to EU objectives.

A potential risk of basing priority decisions mainly on future potential is that regional and national policy makers might opt for priorities that are not backed up by local capabilities. This will, however, depend on how priorities are aligned in subsequent steps and put into practice with the help of regional stakeholders engaged in an entrepreneurial process of discovery. In the coming years, priorities that are more broadly defined should be broken down, making them more specific and application oriented. This is the main thrust of the many Action Plans agreed for the fulfilment of the RIS3 *ex ante* conditionalities.

To better understand the relationship between priorities and economic and innovation structure, we need more studies aimed at comparing regional priorities with regional economic structure and performance indicated by regional data on labour, organisations, publications and patents.

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Appendix 1: Categories and sub-categories for ‘research and innovation capabilities’ and ‘business areas and target markets’

Agriculture, forestry and fishing
Agricultural services
Crop and animal production, hunting and related service activities
Fishing and aquaculture
Forestry and logging
Construction
Construction of buildings
Civil engineering
Specialised construction activities
Creative and cultural arts and entertainment
Amusement and recreation activities
Creative, arts and entertainment activities
Gambling and betting activities
Libraries, archives, museums and other cultural activities
Sports activities
Energy production and distribution
Energy distribution
Power generation/renewable sources
Human health and social work activities
Human health activities (medical services)
Residential care activities
Social work activities without accommodation
Information and communication technologies (ICT)
Computer programming, consultancy and related activities
Information service activities
Motion picture, video and television programme production, sound recording and music publishing activities
Programming and broadcasting activities
Publishing activities
Telecommunications
Manufacturing and industry
Basic metals and of fabricated metal products
Basic pharmaceutical products and pharmaceutical preparations
Biotechnology
Chemicals and chemical products
Coke and refined petroleum products
Computer, electronic and optical products
Electrical equipment
Food, beverage and tobacco products
Furniture
Handicrafts
Machinery and equipment n.e.c.
Motor vehicles and other transport equipment

Nanotechnology and engineering
Printing and reproduction of recorded media
Repair and installation of machinery and equipment
Rubber and plastic products
Textiles, wearing apparel and leather and related products
Wood and paper (except for furniture)
Other manufacturing
Other non-metallic mineral products
Mining and quarrying
Extraction of crude petroleum and natural gas
Mining of coal and lignite
Mining of metal ores
Mining support service activities
Other mining and quarrying
Public administration, security and defence
Defence
Public administration, justice, judicial, public order, fire service and safety activities
Services
Activities auxiliary to financial services and insurance activities
Activities of head offices and management consultancy activities
Advertising and market research
Architectural and engineering activities, technical testing and analysis
Education
Employment activities
Financial service activities, except insurance and pension funding
Insurance, re-insurance and pension funding, except compulsory social security
Legal and accounting activities
Office administrative, office support and other business support activities
Rental and leasing activities
Scientific research and development
Security and investigation activities
Services to buildings and landscape activities
Travel agency, tour operator and other reservation service and related activities
Other professional, scientific and technical activities
Tourism, restaurants and recreation
Accommodation (hotels, camping)
Rental and leasing activities
Restaurants and catering industry
Travel agency, tour operator and other reservation service and related activities
Transporting and storage
Air transport and related services
Postal and courier activities
Rail transport and related services
Road transport and related services

Warehousing and support activities for transportation (logistics storage)
Water transport and related services
Water supply, sewerage, waste management and remediation activities
Sewerage
Waste collection, treatment and disposal activities, materials recovery and remediation activities
Water collection, treatment and supply
Wholesale and retail trade
Retail trade
Wholesale trade

Appendix 2: Categories and sub-categories for EU priorities

Aeronautics and space
Aeronautics
Aeronautics and environment
Bio-fuels and energy efficiency
Remotely piloted aircrafts
Safety and security
Space
Transport and logistics
Blue growth
Aquaculture
Blue renewable energy
Coastal and maritime tourism
Fisheries
Marine biotechnology
Offshore mining, oil and gas
Shipbuilding and ship repair
Transport and logistics (including highways of the seas)
Cultural and creative industries
Development of regional cultural and creative industries
Support to link cultural and creative industries with traditional industries
Digital Agenda
Automated driverless vehicles
Basic broadband: coverage in rural areas
Cleaner environment and efficient energy networks (e.g. smart grids)
E-Commerce and SMEs online
e-Government (e.g. e-Procurement, e-Participation)
e-Health (e.g. healthy ageing)
e-Inclusion (e.g. e-Skills, e-Learning)
High speed broadband: last mile networks (>30Mbps)
High speed broadband: middle mile and backhaul
ICT trust, cyber security and network security
Intelligent inter-modal and sustainable urban areas (e.g. smart cities)
New media and easier access to cultural contents (e.g. heritage)
Open data and sharing of public sector information
KETs
Advanced manufacturing systems
Advanced materials
Industrial biotechnology
Micro-/nano-electronics
Nanotechnology
Photonics

Nature and biodiversity
Biodiversity
Ecotourism
Nature preservation
Public health and security
Ageing societies
Food security and safety
Public health and well-being
Public safety and pandemics
Service innovation
New or improved organisational models
New or improved service processes
New or improved service products (commodities or public services)
Social innovation
New organisational models and social relations that meet social needs
New products or services that meet social needs
Social innovation with regard to child care
Social innovation with regard to education, skills and training
Social innovation with regard to environmental issues
Social innovation with regard to health, well-being and elder care
Social innovation with regard to social inclusion
Sustainable innovation
Eco-innovations
High-speed rail-road transportation systems
Resource efficiency
Smart green and integrated transport systems
Sustainable agriculture
Sustainable energy and renewables
Sustainable land and water use
Sustainable production and consumption
Waste management
Specific local policy priority

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Abstract

Mapping public innovation priorities is important for policy makers and stakeholders, allowing them to explore the potential for collaboration and to better understand innovation dynamics. This working paper presents original data on innovation strategies for smart specialisation (RIS3) in European Union (EU) regions and Member States, obtained from the Eye@RIS3 open data tool for sharing information on the areas identified as priority areas by 198 innovation strategies. It also contextualises these priorities and specialisation patterns with regard to the concept of 'smart specialisation'. The most common RIS3 priority areas in the EU are energy, health, information and communication technologies, food, advanced materials, services, tourism, sustainable innovation, advanced manufacturing systems, and the cultural and creative industries. The paper also explores the degree to which policy makers are creating unique portfolios of priorities or, in contrast, are imitating one another. We find that few regions have developed similar combinations of priorities. However, there are groupings around a number of popular categories and connected to prioritised EU objectives. Finally, we compare the main areas of planned investment with sectoral data on firms, employment and patents, with the conclusion that the connection between priorities and the economic and innovation structures is weak.



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