

A composite indicator to measure regional investment policies on R&D and innovation

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1. Introduction

This work illustrates the results of the Smart Specialisation Italian enterprises classification process, aimed to support the Territorial Cohesion Agency in Italy, which is in charge of the monitoring and implementation of the European Smart Specialisation Strategy (S3).

This information policy requirement, which emphasizes the role of research and innovation as a leading factor for territorial growth and competitiveness, has resulted in the preparation of the “Statistic territorial and sectorial information for the cohesion policies 2014-2020” project from ACT, DpCoe and Istat, in which Istat has defined the enterprises S3 classification and the delimitation of national and regional areas of intelligent specialisation.

The traditional systems of classification for economic activities are often inadequate if compared to the shift from “horizontal” policies to “selective” policies (see for example place based, priority setting), and the willingness is to not turn back to traditional industrial and sectorial policies.

The potential enterprises classification S3 overcome this limit and allows to give directions on technological domains, developmental trajectories for businesses and territories.

The conceptualisation of the S3 components, derived from the original theory, aims to define a flexible and repeatable theoretical model, which could be easily adapted to different contexts.

Consequently, both the classification and its derived monitoring indicators are applicable to different domains pertaining to Smart Specialisation areas: although Smart Specialisation Strategies are not explicitly mentioned or linked in the PNRR, strong links are shown between the S3 priority areas and the Italian plan initiatives as defined, such as “Digitisation, Innovation and Competitiveness component of the productive system” and “From Research to Business”.

2. Composite indicator definition for regional investment policies measurement

The conceptual framework for the S3 theoretical definition recognized the Smart Specialisation Strategy as a policy guideline which emphasizes the role of research and innovation as a leading factor for territories development and competitiveness.

Furthermore, the S3 additions required to find specialization areas in order to maximize the results from research and development investments and to translate these results into new products and services.

In this scenario, the conceptual framework refers to 5 specific factors to represent the S3 enterprise general concept: “Research and Development”, “Innovation”, “Human Capital”, “the ability to foster local development” and “economic performances”¹.

Based on the theoretical framework definition, the operativization of the concepts brought to the connection between elementary indicators (built by previously selected elementary variables) and sub-factors. The guidelines from the Handbook on constructing composite indicators – OECD

¹ For a complete understanding of the methodology used to build the Smart Specialisation classification, the composite indexes and the monitoring indicators, the guidelines are published at the following link: https://www.agenziacoesione.gov.it/wp-content/uploads/2022/03/Guida-alla-lettura-degli-indicatori-S3_notam Metodologica-4.pdf.

The statistical tables with indicators on specialization areas divided by region are at the following link: <https://www.agenziacoesione.gov.it/lacoesione/dati-statistici-sulla-politica-di-coesione/indicatori-regionali-classificazione-s3/>

2008 were applied to build the composite index.

The major data source is the 2019 Enterprises Census Survey, together with Istat statistical registries on enterprises, which allowed to give consolidated directions on about a million enterprises.

S3 theoretical framework is based on a multidimensional concept, and the S3 enterprise concept is a theoretical construct. That's why a composite index was chosen: the complexity is represented by the S3 construct multidimensionality, that requires for its measurement to overcome conceptual and definitional obstacles.

A composite index is a mathematical combination of a set of elementary indicators, which could represent the different dimensions of the examined construct.

We build a composite index for each specific enterprise, used to select the potential S3 enterprises not only based on the major economic activity but taking into account the intangible assets that represent the Smart Specialisation Strategy dimensions.

The five S3 factors described above are composed of 10 specific dimensions and 35 elementary indicators.

After numerous experiments with different methods to summarize a set of elementary indicators, two different methodologies were identified:

- a) the elementary indicators were synthesized in specific dimensions through the Wrocław taxonomic method;
- b) the Mazziotta–Pareto Index, a non-compensatory composite index, was used to summarize specific dimensions in general dimensions;
- c) the last step for the potential S3 enterprises composite index calculation was obtained by extrapolating the enterprises with scores above the median line in each one of the 5 S3 factors.

The innovation in the methodology used for the composite index definition described in this work consists in the information synthesis for each single unit of analysis, i.e. for each enterprise, and in the aggregation of qualitative and often dicotomic elementary indicators. Having a score for each enterprise allows to flexibly differentiate between economic areas of interest.

Furthermore, the composite index covers the need to be *transparent* in the calculation (compared to black box machine learning methods), *replicability* and *modularity*.

2. Output and results visualization

The output of the present work is composed by a set of indicators for each specialisation area, built from the potential S3 enterprises classification, both nationally and regionally.

The indicators defined through the Census data allowed the construction of 34 tables by specialization areas and are composed of: structural and economic indicators (enterprises, employees, added value, export etc.); indicators on intangible assets strategic investments (R&D, technology and digitalization, human capital, internationalisation, social and environmental responsibility); on enterprises relationships through agreements with universities, public and private research centers, Public Administration; indicators on environmental sustainability.

The output allows regional or national policy makers to compare the 12 Smart Specialisation areas as illustrated in Figure 1, which shows 2 of the 34 regional tables by specialisation area.

Figure 1 – Regional tables for specialization area, Abruzzo Region

Tavola 2 - Imprese per area di specializzazione. Regione Abruzzo - Anno 2018
(Valori assoluti e percentuali)

Aree di specializzazione	Imprese	% imprese sul totale imprese specializzate della regione	% imprese sul totale imprese della regione
Aerospazio	542	7,6	2,5
Agroalimentare	3.331	46,6	15,3
Economia del mare	780	10,9	3,6
Chimica Verde	612	8,6	2,8
Design Creatività e Made in Italy	1.458	20,4	6,7
Energia e Ambiente	1.521	21,3	7,0
Fabbrica Intelligente	941	13,2	4,3
Mobilità sostenibile	940	13,2	4,3
Salute	1.279	17,9	5,9
Comunità intelligenti sicure e inclusive	740	10,3	3,4
Tecnologie per gli ambienti di vita	1.228	17,2	5,6
Tecnologie per il patrimonio culturale	839	11,7	3,9
Totale imprese specializzate della Regione	7.151	100,0	32,9
Totale imprese della regione	21.756	100,0	100,0

Tavola 7 - Valore delle esportazioni per area di specializzazione. Regione Abruzzo - Anno 2018
(Valori assoluti e percentuali)

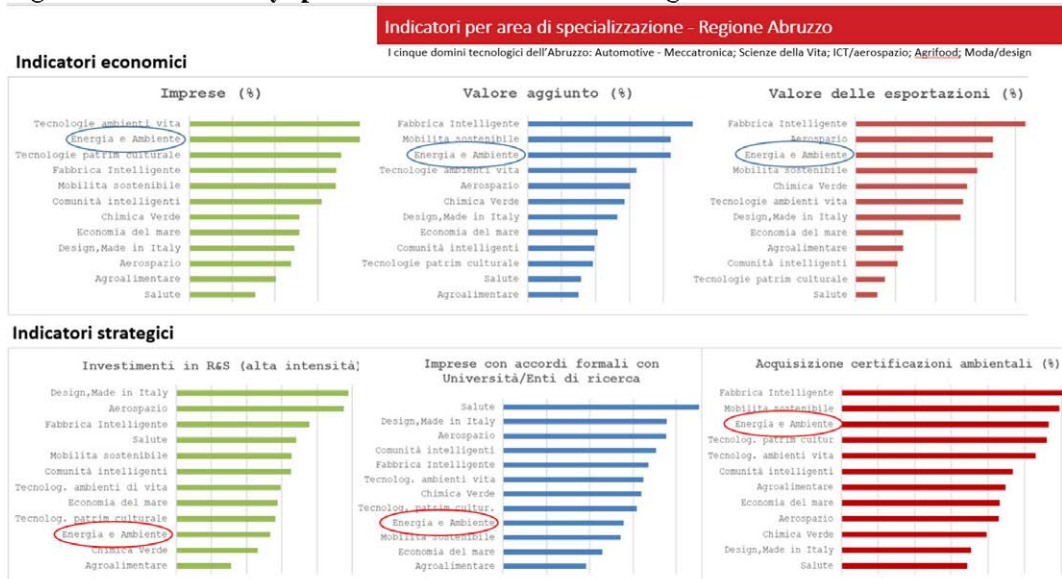
Aree di specializzazione	Valore delle esportazioni (€)	% esportazioni sul totale esportazioni delle imprese specializzate della regione	% esportazioni sul totale esportazioni delle imprese della regione
Aerospazio	1.999.104.704	59,9	34,5
Agroalimentare	815.784.124	24,4	14,1
Economia del mare	694.756.773	20,8	12,0
Chimica Verde	1.673.290.177	50,1	28,9
Design Creatività e Made in Italy	1.638.894.790	49,1	28,3
Energia e Ambiente	2.035.527.208	61,0	35,1
Fabbrica Intelligente	2.481.622.041	74,3	42,8
Mobilità sostenibile	1.772.466.786	53,1	30,6
Salute	319.283.057	9,6	5,5
Comunità intelligenti sicure e inclusive	610.439.014	18,3	10,5
Tecnologie per gli ambienti di vita	1.559.897.756	46,7	26,9
Tecnologie per il patrimonio culturale	423.095.313	12,7	7,3
Totale imprese specializzate della Regione	3.339.547.140	100,0	57,6
Totale imprese della regione	5.797.853.062	100,0	100,0

Dashboards such as the one shown in Figure 2 for Abruzzo region were built in order to simplify the learning and comparison between specialisation areas, looking at different indicators within the same territory.

The compared indicators have different nature, economic or strategic, to underline, as an example, that the specialisation area “Energia e Ambiente” in Abruzzo region performs well in economic indicators, being in the first three areas, but has some delays referring to some strategic indicators such as R&D investments, agreements with universities or environmental certifications.

At the top of the dashboard, the priority areas chosen by Abruzzo region are shown.

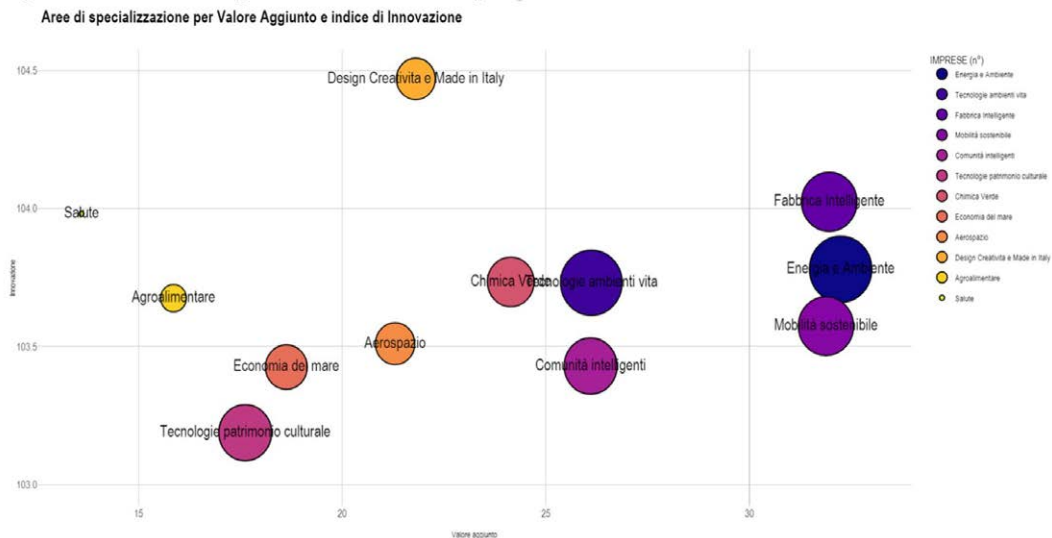
Figure 2 – Indicators by specialisation area – Abruzzo Region



Data visualization instruments provide an observable benchmark between areas at a national level too: Figure 3 shows the 12 areas positioning regarding to the relationship between added value and innovation composite index.

The areas “Fabbrica intelligente”, “Energia e Ambiente” and “Mobilità sostenibile” show the best relationship between these two dimensions; the area “Design, creatività e Made in Italy” has an intermediate position referring to enterprises added value although it has the highest innovation level.

Figure 3 – National specialisation areas, by added value and innovation index



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