The new Smart specialization strategy of Veneto Region: an innovation system to thrive in complexity

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Introduction[1]

Before the Smart Specialization Strategy (S3) was conceived, the goal of regional development was addressed by theories such as industrial districts, clusters, innovative milieux, regional innovation systems and learning regions, all of which have underscored the importance of regions as key drivers of innovation (Asheim and Cooke, 2007).
The concept of S3 has then been initially proposed by a group of academic experts in 2008[2] and quickly captured the attention of European policy makers becoming a pillar of the 2014 reform of the EU Cohesion Policy (Di Cotaldo, 2020). Indeed, "smart specialisation has a strategic and central function within the new Cohesion Policy being a key vehicle for ensuring Cohesion Policy's contribution to the Europe 2020 jobs and growth agenda" (European Commission, 2012). But the "phenomenon of smart specialisation is not all new, what is new is the analytical description of the phenomenon which generates a few insights and directions concerning policy making" (Foray et al, 2011). In this sense "innovation activity is no longer associated with R&D expenditure; a large variety of innovation types that are not merely product innovation are taken into consideration, insisting that entrepreneurial discovery does not find its roots only in high-tech industry activities. With this statement, the one-size-fits-all policy of the Lisbon and Europe 2020 agenda has been overcome" (Capello and Kroll, 2016).
Smart specialisation represents a strategy aiming at identifying "the areas of intervention of greatest strategic potential in every territory". In other words, "each territory should concentrate development intervention in certain areas of specialisation where it holds significant potential and/or competitive advantage in order to sustain productivity growth" (Foray et al, 2009; Asheim et al, 2017).
As such, it represents a place-based development strategy that includes not only identifying, through what is known as the entrepreneurial discovery process, where the potential of every territory lies, but also developing a system of governance involving multi-stakeholder mechanisms in order to set strategic priorities and systems of intervention" (Midtkandal and Sörvik, 2012). The S3 strategy has been implemented for the first time at a large scale in Europe with the programming period 2014-2020 (Iacobucci and Guzzini, 2016; McCann and Ortega Argilés, 2016; Crescenzi et al, 2018; Gianelle et al, 2019).
With the programming period of the European Structural Funds underway, 2021-2027, the challenge for the S3 is twofold, on the one hand, to definitely move from theory to practice, on the other hand, to carry out a systematic effort of evaluation the S3 projects, in order to face "emerging bottlenecks (e.g. the lack of local pre-conditions in the local economy and limits of governance) as well as design possible future trajectories to overcome such bottlenecks, like the shift from a compulsory to a

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[2] The Group of Experts "Knowledge for Growth" was an advisory body of European Commissioner Potočnik.

voluntary RIS, and from an industry-focused to a territorial development strategies" (Capello and Kroll, 2016).

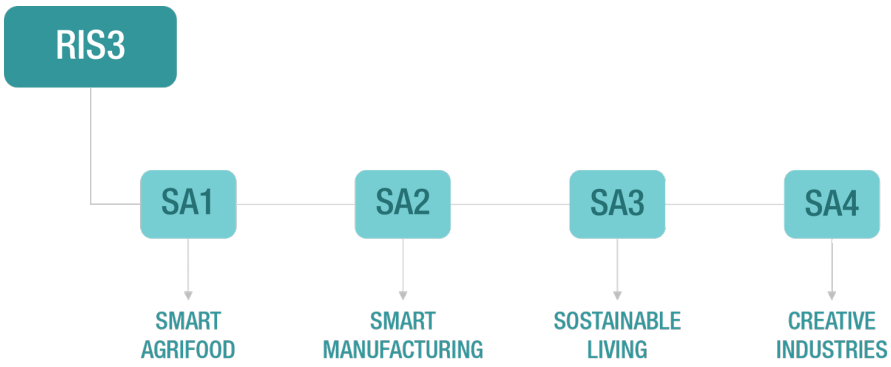
1 The smart specialisation strategy of the Veneto Region

1.1 The former RIS3 of the Veneto region

When was launched by the European Commission, the Research and Innovation Strategy for Smart Specialization (RIS3) was originally considered as part of the Europe 2020 Strategy (European Commission, 2010) which aims to address our structural weaknesses through progress in three mutually reinforcing priorities such as smart growth (based on knowledge and innovation), sustainable growth (through the promotion of a more resource efficient, greener and more competitive economy) and inclusive growth (through the promotion of a high employment rate ensuring economic, social and territorial cohesion) (European Commission, 2012).
In this context the RIS3 should be built by following several practical steps to design a national/regional RIS3 (European Commission, 2012), namely:

a) the analysis of the national/regional context and potential for innovation;
b) the set-up of a sound and inclusive governance structure;
c) the production of a shared vision about the future of the country/region;
d) the selection of a limited number of priorities for national/regional development;
e) the establishment of suitable policy mixes;
f) the integration of monitoring and evaluation mechanisms.

Figure 1 - The structure of the Regional Innovation Strategy 2014-2020



Source: elaboration by the authors, 2022

During the previous programming period, 2014-2020, the Veneto Region launched its RIS3, which consisted of four priority areas, namely smart agrifood, smart manufacturing, sustainable living and creative industries. The RIS3 design process defined, in total, 39 trajectories mainly related to the priority of smart manufacturing (one third of the total trajectories), as the industry represented a relevant regional specialisation.

Table 1 - The RIS3 2014-2020

	Specialisation ambits	**Trajectories**	
SA1	Smart agrifood	10	25,6%
SA2	Smart manufacturing	13	33,3%
SA3	Creative industries	9	23,1%
SA4	Sustainable living	7	17,9%
	Total	**39**	**100,0%**

Source: elaboration by the Department of Research, Innovation and Energy – Veneto Region

The analysis of the first experience of the RIS of the Veneto region showed good results compared to the 2014-2020 period. However, being mainly focused on a traditional definition of the development of sectors, it has shown just as many weaknesses and has proved incapable of grasping the significant transformation that has affected the region.
The structure essentially responded to the old industrial districts and above all, as already mentioned, to the manufacturing sector of the regional economy. It has not paid enough attention to the service sector, especially innovative services, and, above all, has not adequately grasped the growing and cross-cutting relationships of the complexity we are facing.

1.2 The new smart specialization strategy (S3)

The new smart specialisation strategy has been approved by the Veneto Regional Council[3] in 2022 and subsequently confirmed by the European Commission[4]. It represents an important step for the development of the regional innovation system and, more generally, of the socio-economic and environmental context, in which the innovation becomes a sort of transversal leverage effect.
The construction of the new S3 was based on an application of the so-called "Calvino method", i.e. that of the tension between opposites. Hence the need to ensure a certain degree of continuity, both in content and in method, with respect to the past, but at the same time, the need, partly also "disruptive", to explore new methodological trajectories for the future, to insert elements of discontinuity to grasp the essential elements of the transformations in progress.
The choice was, therefore, to build the new S3 both in terms of content and methodology. In terms of content, account was taken of the profound transformations that have characterized the regional territory in recent years but also of those that we expect will influence the future. Instead, in terms of methodology, a matrix model was introduced capable of better understanding the transversal relationships.

1.3 The entrepreneurial discovery process and the quadruple helix approach

The review of the S3 took place by involving the local stakeholders and by reviewing the areas of specialisation and specific trajectories, as well as by identifying several transversal drivers and some strategic missions.
The S3 has been then built through an entrepreneurial discovery process (EDP), which involved a total of over a thousand people, including representatives of the Regional Innovative Networks (RINs) and industrial districts, and led to the definition of possible new priority areas of intervention and the development trajectories to be include in the new smart specialisation strategy of the Veneto Region.
The public consultation, which took place through several thematic forums, the administration of questionnaires and the activation of a platform on the "Innoveneto" web portal[5] as well as the consultation and discussion with the main players in the Veneto ecosystem of research and innovation[6] led, starting from the smart specialisation strategy 2014-2020, to an update of the same based also on the evolution of the regional socio-economic system and above all of the challenges

[3] Regional Council Resolution n. 474 of 29 April 2022. Approval of the document "Smart Specialization Strategy (S3) of the Veneto Region 2021 - 2027". Art. 15 and Annex IV Reg. (EU) n. 1060 of 24 June 2021.
[4] The European Commission, having analysed the updated documents on the Smart Specialization Strategy of the Veneto Region and the self-assessment report, with note Ref. ARES (2022) 4435516 of 16 June 2022 "Commission's observations on the Veneto ERDF RP program 2021-2027 - CCI 2021IT16RFPR020", in section 4 Enablement conditions - point 137, declared the thematic enabling condition 1.1 "Good governance of national or regional smart specialization strategy" fulfilled.
[5] The Innoveneto web portal can be visited at the following address: https://www.innoveneto.org.
[6] In details, the EDP involved 603 participants in 4 thematic forums, 320 between questionnaires and contributions. It also collected 324 expressions of interest in participating collected during the activities promoted in October 2021.

that the territory is called to face in terms of green and industrial transition for sustainable development.
As stated in the PRI Playbook, EDP "has evolved from being just an activity performed during the design phase of S3, to an ongoing activity, which continues throughout the implementation of S3" (Pontikakis et al, 2022a).
Not only that, but EDP has increasingly become a process in which stakeholders have been involved in the co-creation of the S3 strategy through meetings and the organization of thematic workshops and also in the construction of the monitoring and evaluation system. In this sense, the initial EDP has been transformed into an open discovery process (ODP) model through which to discover new opportunities, verify the results of the projects. As stated in the PRI Playbook, "the key futures of an ODP include openness, directionalities focused on long-term societal wellbeing, working backwards from goals, and a distinction between control and influence" (Pontikakis et al, 2022a).
Furthermore, civil society has been involved in the EDP, moving, therefore, from a triple-helix model (Etzkowitz and Leydesdorff, 1995) of the former S3 framework to a quadruple helix model of governance (Cai and Lattu, 2022). Thanks to the transition to the quadruple helix model, EDP was able to pay more attention to the real needs of the territory and build a real place-based innovation strategy. In this context the effort of Veneto Region has also been to try to combine the bottom-up approach with the top-down one. In fact, this "familiar top-down versus bottom-up dichotomy is itself the source of crippling policy constraints. (…). Policy programs fostering smart specialisation need to be more sophisticated than thinking within the confines of this dichotomy will allow; they call for a bi-directional iterative dynamic." (Foray at al, 2011)

1.4 Objective and rationale of the new S3

The objective of the new S3 is twofold: on the one hand to improve the regional innovation policy, make it work better, in the face of continuous changes in the factors of economic competitiveness, sector specializations, network relations, on the other to enable the double transition, digital and green, and link the smart specialization strategy to the National Recovery and Resilience Plan (NRRP), in order to achieve smart, sustainable and inclusive growth. The overall and indirect objective is to go beyond the concept of resilience and strengthen the level of antifragility[7] of the economic, social, and environmental system by place-based innovation policies. With the new S3 Veneto Region aims at developing an environment able to react and thrive in the current complexity paradigm as well. So, in the end, the purpose of new S3 is to face the challenge of complexity through the creation of a place-based innovation system capable of accompanying the social and economic transformation of the Veneto region.
As already stated, the new S3 has radically innovated the rationale of regional intervention by adopting a matrix model and replacing the former one, that was more focused on a traditional and vertical framework. The main innovation lies indeed in its method, by shifting towards a framework able to identify new paths opportunities between continuity and discontinuity and, above all, to address the challenge of the transformational change in the context of a transformative innovation approach. The new S3 model, with its priority areas, horizontal drivers and strategic missions, introduces a sharp improvement in the capability to capture the growing connections among all the elements of the S3 and the ongoing economic transformations. Further, with the new S3, the Veneto region aims to overcome the "one-size fits all" model of intervention by improving the ability to identify new development areas and, above all, to diversify the regional specializations, avoiding being trapped in lock-in phenomena, as partially happened with the previous S3 model. In this context, it is believed that the new S3 becomes a strategy capable of promoting further spillovers of intersectoral knowledge by following a "doing-using-interacting" (DUI) model of innovation which, integrating with the "science-technology-innovation" (STI), allows for better adaptation to the entrepreneurial context, mainly made up of MSMEs, of the Veneto.

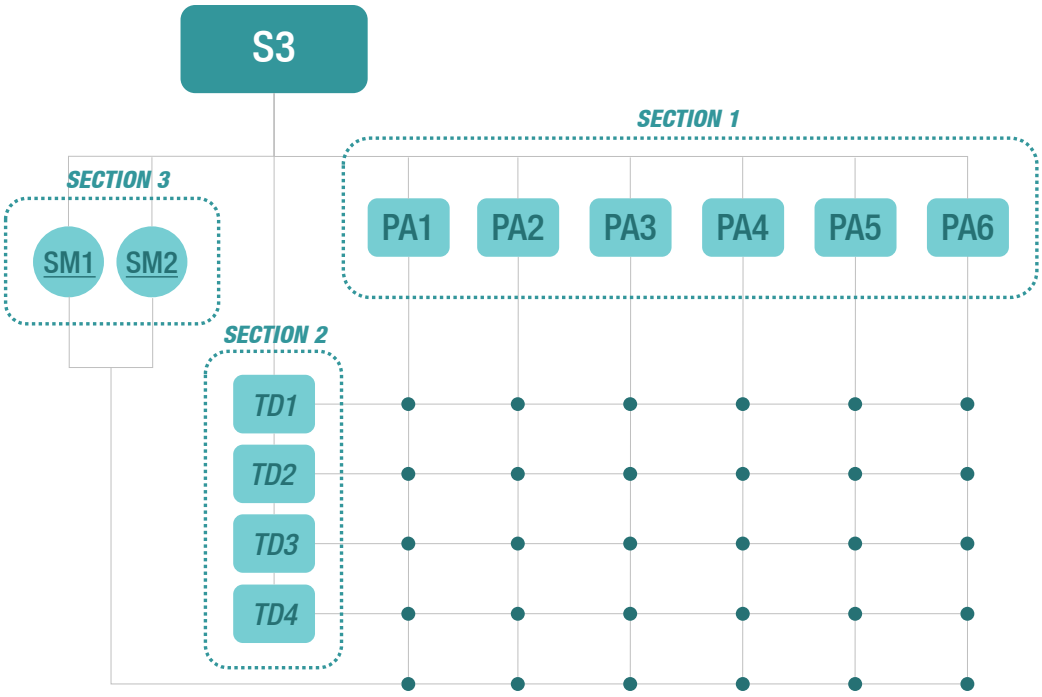
[7] Regarding the concept of antifragility and the difference with respect to resilience you can see the works of Taleb.

Indeed, drawing on the results of several international analyses, it can be stated that “firms combining the two modes (STI and DUI models) are more likely to innovate new products or services than those relying primarily on one mode or the other” (Jensen et al, 2007; Alhusen et al, 2021).

1.5 Framework and contents of the new S3

Overall, the new S3 has marked a sharp transition through a change both in the framework of the model and in the content of the areas subject to intervention. In terms of framework, the model shifts from a fundamentally vertical system to a matrix system of priority areas with the inclusion of transversal drivers and strategic missions as well. It has marked the transition from a linear system to a reticular one, in which areas, drivers and missions intersect to give greater effectiveness to the innovation strategy.

Figure 2 - The new S3 matrix



Source: elaboration by the authors, 2022

The new S3 was built by innovating the contents of old areas of specialization as well as introducing new ones. Next to these "vertical" areas, intersections have been made, four through the drivers, which act transversally as activators. Finally, two strategic missions have been foreseen as new explorations of the future. Six priority areas of intervention have been identified by introducing the new areas of "Smart health" and "Smart destination" with respect to the previous strategy and by redefining the areas of Culture and Creativity (previously called "Creative industries") and Smart Living and Energy (previously called "Sustainable living).
The new priority areas are the following:

1. Smart agrifood;
2. Smart manufacturing;
3. Smart health;
4. Culture and creativity;
5. Smart living and energy;
6. Smart Destination.

Alongside the six priority areas, the new S3 contains 52 trajectories[8]. The trajectories identification took a long time and involved many local stakeholders. It was implemented in four phases: listening, analyzing, prioritizing and validating. The process from the first listening phase to the last validation phase, thanks also to the intervention of the Regional Economic Observatory, has made it possible to reduce the number of trajectories which have gone from the initial 187 to 72 and then to 52, with a reduction 72.2% compared to those initially emerging from the territory.

Table 2 - The S3 2021-2027

	Priority areas	**Trajectories**	
PA1	Smart agrifood	11	21,2%
PA2	Smart manufaturing	11	21,2%
PA3	Smart health	6	11,5%
PA4	Culture and creativity	7	13,5%
PA5	Smart living and energy	12	23,0%
PA6	Smart Destination	5	9,6%
	Total	**52**	**100,0%**

Source: elaboration by the Department of Research, Innovation and Energy – Veneto Region

Compared to the previous one, the new S3 has increased the number of priorities by 50% (from 4 to 6) and the number of trajectories by 33,3% (+13, from 39 to 52). It can be seen that the new distribution of trajectories is more articulated and homogeneous, i.e. more in line with the complexity of economic and social relations at the regional level. Furthermore, in a better portfolio of trajectories, the primacy now belongs to smart living and energy with 23% of the total trajectories.
Moreover, during the process of updating strategy S3, some cross-cutting issues emerged that can be qualified as needs de facto common to all areas of specialization which, in the description of the strategy, were traced back to the four "cross-cutting drivers" listed below:

1. Digital transformation;
2. Green transition;
3. Human capital;
4. Services for innovation and new business models.

Finally, in defining the strategy as a whole, the regional administration decided to highlight two specific topics of interest for the relaunch and positioning of the Veneto in the context of the implementation of the NRRP classified as strategic missions:

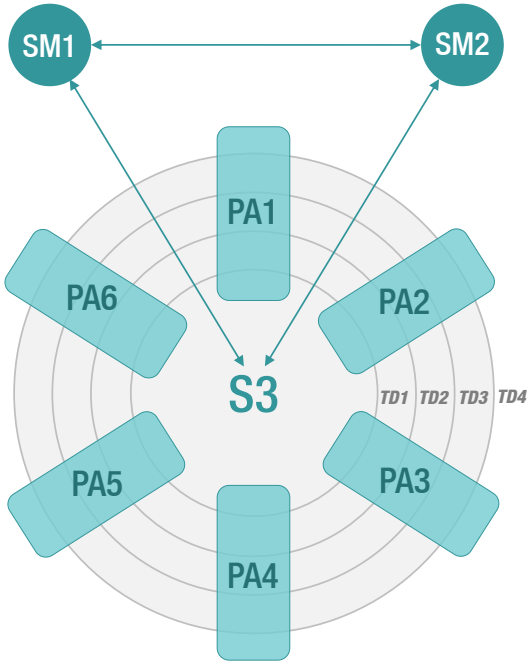
1. Bioeconomy (i.e. biotechnology, bioenergy, hydrogen);
2. Space Economy (i.e. artificial intelligence, quantum technologies, space technologies).

Overall, therefore, the smart specialisation strategy of the Veneto Region 2021-2027 is based on a matrix-type logic, which intertwines vertical elements (the six priority areas) with cross-cutting elements (the four drivers) also integrating a strategic dimension (the two strategic missions) which acts as a bridge between the NRRP and the S3 itself.
Returning, for a while, to the old model of the S3, it provided for a basic structure formed by four pillars, which however did not intersect, did not communicate directly with each other. Basically, each one contained a miscellany of elements and each pillar, even if it was functional to the realization of the S3, did not allow for the creation of adequate synergies between the same pillars and with the outside world. It was the period when across Europe the focus on policy intervention started to shift from "quantity" to "quality", as happened in cluster policy (Minello, 2009). Just the experience of cluster policies has represented numerous similarities with the nascent S3, namely drivers of performance, productivity and innovation as critical factors for sustained growth, multiple factors influencing productivity and innovation, importance of proximity and of local effects and critical role of the local context (European Commission, 2013).

[8] The considered trajectories are listed in the Annex I.

Starting from these considerations, it was deemed necessary to better structure the dimensional elements of the S3. The first step was to work on the tools-goals logic of the S3.
On the objective side, the new smart specialization is oriented towards promoting a smart, inclusive, sustainable development (in line with the Europe 2020 strategy), based on competitive advantage factors, within a place-based approach. Therefore, the objective is not the promotion of a specific sector (sectoral logic) but the development of the distinctive elements, even transversal ones, which can enable the evolution of the regional economic system and the overall development (enabling logic).
In terms of tools, it was considered essential to innovate the number and type of tools to address the complexity of the socio-economic reference context. The S3 must be made not so much more resilient but, above all, antifragile with respect to the transformations and emerging needs of companies, institutions, and stakeholders in general. Following Taleb, some "things benefit from shocks; they thrive and grow when exposed to volatility, randomness, disorder, and stressors and love adventure, risk, and uncertainty. Yet, in spite of the ubiquity of the phenomenon, there is no word for the exact opposite of fragile. Let us call it antifragile. Antifragility is beyond resilience or robustness. The resilient resists shocks and stays the same; the antifragile gets better." (Taleb, 2013).

Figure 3 - The relationships among the elements of the S3



Source: elaboration by the authors, 2022

Hence, the final goal is to become more antifragile, get better, designing a new set of tools that must be able to address complexity and increase the synergy and effectiveness of S3 interventions. The latter must be suitable for promoting an innovative contamination process that generates positive effects on all S3 units.
As in the "funnel" model, the tools that distinguish the new S3 must be inserted inside a container whose structure is modified by subsequent stimuli. In this sense, the structure of the new S3 will be the result of the processing and combination of the three-dimensional tools (areas of specialization, transversal drivers, and strategic missions) identified during the revision process.
Ultimately the structure of the new S3 of the Veneto can be represented by three sections:
1. Section one - Priority areas (PA);
2. Section two - Transversal Drivers (TD);
3. Section three - Strategic Missions (SM).

In this context, "section one" consists of 6 areas of specialization, "section two" includes 4 transversal drivers, while "section three" includes 2 strategic missions.
The development of the new S3 model can be represented through a circular diagram that includes all three sections of the structure. In fact, the logic of the new S3 is no longer sequential and linear but reticular and circular. In the development of relationships, the areas of specialisation are intersected and interconnected through transversal drivers, while in the previous S3 the areas were substantially separated as if they were watertight compartments.
The system of relations within the new S3 is represented in the figure 3. It can be observed that there is a direct dialogue between the three blocks of the S3: the priority areas are autonomous and at the same time part of a whole that sees them connected primarily through transversal drivers. While the strategic missions are connected to the S3 system with which they dialogue in a one-to-one sense, i.e. both drawing resources from the system and returning results to it.

Table 3 – The transversal connections in the S3

Drivers and Strategic missions	Connection to the trajectories
TD1 - Digital transformation	35
TD2 - Green transition	27
TD3 - Human capital	13
TD4 - Services for digital innovation and new business models	9
SM1 – Bioeconomy	3
SM2 - Space economy	4
Total	**91**

Source: elaboration by the authors, 2023

The relational scheme will then take concrete form on the basis of the activations that the Region will decide to carry out through the individual calls for projects. This is a crucial and distinctive element that gives new potential for adaptation to the S3 and, above all, allows you to know in advance the priority areas that the promotion of a given intervention will activate, therefore the synergies and greater effectiveness. If, for example, the Region decides to launch a call for one of the four transversal drivers, it would immediately know which priority areas will be activated. Considering the connections between trajectories, drivers and strategic missions, you can observe 91 connections between them. Mainly they refer to the digital transformation, but the connections related to the green transition and human capital are also relevant.

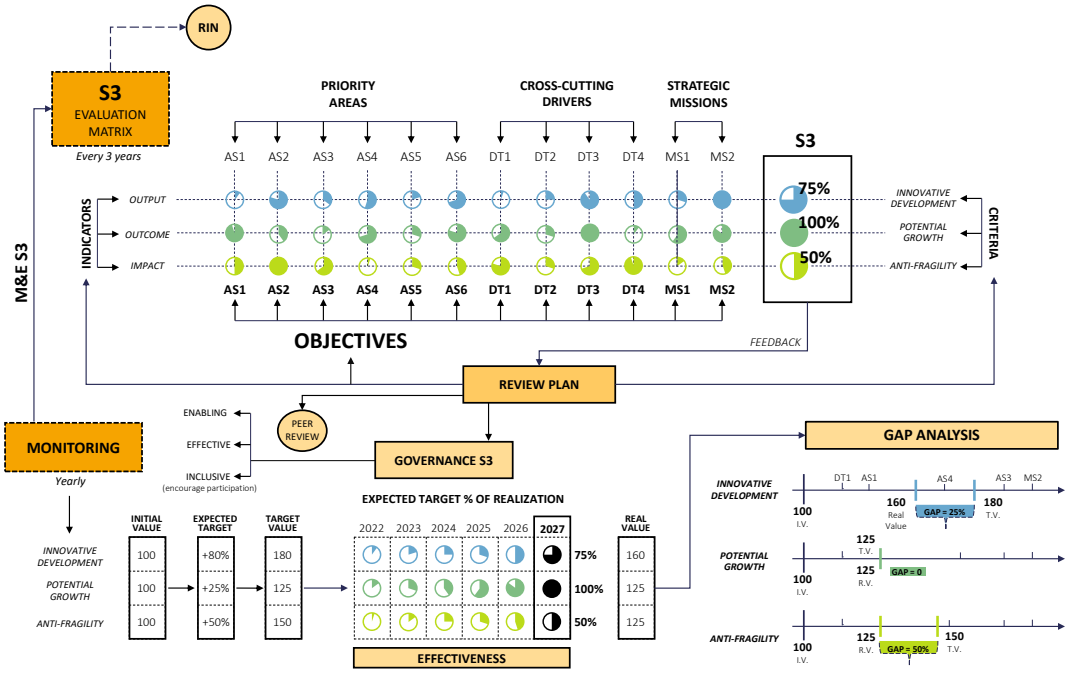
1.6 The monitoring and evaluation system

The monitoring and evaluation system (M&E), approved by the Veneto Region in late 2022[9], recalls the architecture of the S3 for methodological consistency, i.e. the matrix structure. In detail, the M&E matrix of the S3 is represented by the intersection among different levels of evaluation, priority criteria, objectives and areas of specialization.
The M&E system provides us for a multilevel analysis by considering the effects in terms of output, outcome, impact and three fundamental macro-criteria, namely: innovative development, potential growth and antifragility.
The underlying hypothesis is that investing in innovative development will increase growth potential and thus, in turn, contribute to raising the level of antifragility, through a process of improving the connection between the three elements. The relationship between the three evaluation themes is not

[9] Regional Council Resolution n. 1684 / dgr of 12/30/2022 object: Approval of the document "Monitoring and Evaluation Model of the Smart Specialization Strategy (S3) of the Veneto Region 2021 - 2027" - Regional Decree n. 474 of 29 April 2022.

linear but intertwined like three "clockwork gears", where each one can co-determine the others and also be co-determined by the others.
With the M&E process it will therefore be possible to verify how much the planned actions and projects are able to achieve specific objectives set for each priority criterion. Innovative development is measured through output indicators and takes into account three sub-criteria: disruptive effect, widespread growth of research and interdisciplinary research.

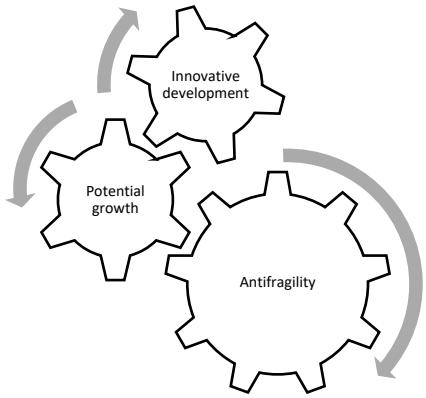
Figure 4 - Monitoring and evaluation system of the new S3 of the Veneto region



Source: elaboration by the authors, 2022

Potential growth is instead assessed through outcome indicators and is measured through three others sub-criteria, that is the multiplicative effect, the economic and strategic autonomy, the generation of new skills.

Figure 5 - The “clockwork gears” of the S3 evaluation system

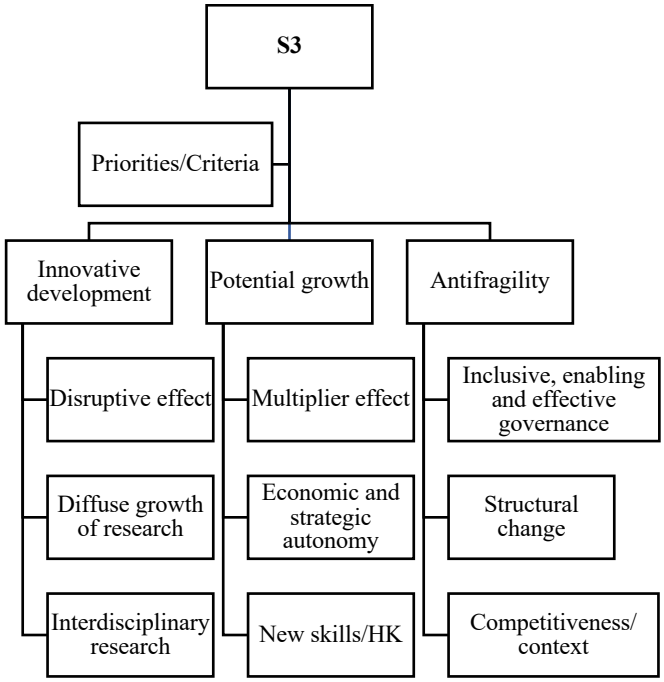


Source: elaboration by the authors, 2023

Finally, anti-fragility represents the assessment of the impact, in the medium-long term. It is a new, complex criterion of impact for measuring the structural change of systems. In this context it is

evaluated through the following three sub-criteria: competitiveness/context, specialization/change and Governance (that must be enabling, inclusive, effective).

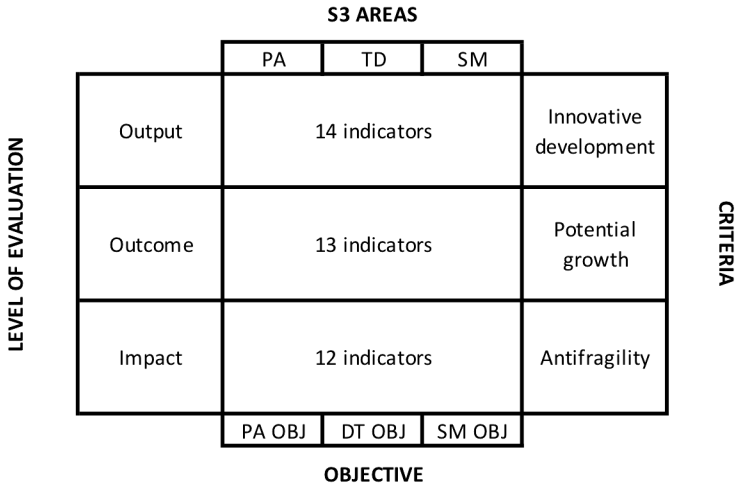
Figure 6 - The S3 evaluation criteria and sub-criteria



Source: elaboration by the authors, 2023

The M&E process develops according to a different timing, namely: yearly, biennial, triennial and has been designed according to principles of internal and external consistency. After a selection process, 39 indicators were identified, of which: 14 are related to the criterion of innovative development/output, 13 are related to potential growth/outcome and 12 refer to the criterion of antifragility/impact.

Figure 7 - The S3-I.39 matrix of the S3 evaluation indicators



PA = Priority areas
TD = Transversal drivers
SM = Strategic missions
Source: elaboration by the authors, 2022

An achievement target will be set for each level/assessment criterion and the achievement of this will be monitored annually. Subsequently, at the end of the programming period, a gap analysis will be carried out to evaluate the difference between the target and the value achieved. This will allow you to review both the content and goals of the S3.

2 The performance of the Regional Innovation Networks (RINs)

To test the M&E system of the S3 strategy the model has been applied to the 21 Regional Innovation Networks (RINs), currently recognized by the Veneto region. They are networks of enterprises, operating in specific economic areas, and institutions with the aim of promoting the innovative potential of enterprises and the territory. They represent one of the main instruments to carry out the objectives of the S3 in Veneto Region.

2.1 Methodological note

The performance of the 21 RINs was measured considering their participation in the 2017 and 2020 regional call for projects dedicated to them.
As regards information on public contributions paid to the RINs and information on the assessment of regional innovative projects presented by the RINs, data from a specific action of the POR FESR Veneto 2014-2020 was analyzed and used. This action envisaged the issue of two call for proposals through which the Regional Innovative Networks were able to finance their innovative projects.
The first call for proposal called "Call for financing Research and Development projects carried out by Innovative Regional Networks and Industrial Districts - DGR 1139_2017" envisaged a total eligible expenditure of 64.4 million euros with a total public contribution of 34.4 million euros; this action saw the involvement of 14 networks for a total of 17 projects presented, the composition of the participants was 182 companies and 9 Universities and research centres.
The second call called "Call for financing Research and Development projects carried out by Innovative Regional Networks and Industrial Districts - DGR 822_2020" envisaged a total eligible expenditure of 31.0 million euros with a total public contribution of 20.0 million euros; this action saw the involvement of 20 networks for a total of 11 projects presented, the composition of the participants was 165 companies and 10 universities and research centres.
Overall, the 21 RINs registered 1,145 participating companies, equipped with local units located in the Veneto region territory. Information and data have been divided into two blocks; a first block made up of internal databases from regional sources, a second block instead from entities external to the Veneto Region.
Detailed information on adhesions and cancellations of RINs companies comes from the Veneto Innovazione database, while information on public contributions paid to RINs and information on the evaluation of regional innovative projects presented by RINs comes from the Evaluation Technical Commission (SIU database for the Information System of the Veneto Region), graduates employed by company adhering to the RINs from the Veneto Lavoro database, turnover and employment from the database of the Chamber of Commerce, number of start-ups and innovative companies from the Chamber of Commerce database and, finally, the number of patents filed belonging to companies adhering to the RINs of the database of the Ministry of Enterprise and Made in Italy.
Then, following the definition of a set of 36 indicators potentially able to evaluate the functioning of the RINs in terms of output, outcome and impact, 22 indicators[10] were calculated taking into consideration the availability of data, the relevance of the indicators, the activities, characteristics and performances of the RINs for the period considered.

[10] The considered indicators are listed in the Annex II.

2.2 Main results of the RINs first projects evaluation

The first evaluation exercise[11] showed different RINs with as many different performances on the achievement of the objectives. For the first time, albeit partially, we have a clear image of the relevance of the RINs in raising the development of the Veneto Region.
By disaggregating the analysis by evaluation criterion, it can be seen that the best performances in raising innovative development come from the Improvenet and Ribes and Sinfonet RINs, i.e. RINs focused on the design, development and implementation of digital manufacturing and information technology solutions (Improvenet), or on promoting growth and development through the interaction between traditional sectors and emerging sectors that gravitate around the health and smart food ecosystem (Ribes), or on the creation of networks of smart and innovative foundries (Sinfonet) by investing in research and innovation and training.

Table 4 - The output performance of RINs about the innovative development criterium

N	Output/Innovative development	Score
1	Improvenet	84
2	Ribes	72
3	Sinfonet	67
4	Euteknos	63
5	Venetian smart Lighting	62
6	RIAV	58
7	Veneto Clima ed Energia	52
8	Innosap	52
9	Face Design	48
10	Foresta Oro Veneto	47
11	Veneto Green cluster	47
12	ICT 4 SSL	46
13	Venetian Innovation cluster heritage	30
14	M3NET	27
15	Sicurezza e protezione Sport	15

Note that the highest score is equal to 100 and minimum is 0.
Source: elaboration by the Department of Research, Innovation and Energy – Veneto Region

While the lowest performances on this criterion come from the RINs dedicated to safety and protection at work and in sport, precision mechanics, micro-technologies and additive manufacturing, or from what concerns cultural heritage.
Considering the potential growth evaluation criterion, we see that on the podium there are RINS ICT4SSL, Improvenet and Innosap. In other words, the RINs that have shown a greater effect on raising growth potential are involved in intelligent and sustainable living (ICT4SSL) or digital and IT production solutions (Improvenet) or innovation for production sustainability agrifood (Innosap). While the lowest performance comes from Face design, M3NET and Sinfonet RINs. In this context, design and creativity (Face design), precision mechanics, micro-technologies and additive manufacturing (M3NET) and intelligent and innovative foundries (Sinfonet) have shown a disappointing effect on strengthening the regional growth potential.
Considering the effects of the impact, i.e. the achievement of antifragility, the best performances come from the Veneto green cluster, the Venetian smart lighting and the Venetian innovation cluster heritage. In other words, the RINs that generate the greatest positive effects on the anti-fragility criterion deal with sustainability and circular economy (Veneto green cluster) or with the electronics industry and more specifically home automation for the design of new hardware and software

[11] The results proposed in this section refer to 15 RINs out of 21 that participated in the two calls, while we have excluded the other 7 RINs because 6 of them participated in only 1 call and 1 was not established at the time.

systems and interfaces aimed at facilitating the use of systems for all citizens, with particular regard to the elderly and disabled (Venetian Smart Lighting), or to cultural and environmental heritage (Venetian Innovation cluster heritage).

Table 5 - The outcome performance of RINs about the potential growth criterium

N	Outcome/Potential growth	Score
1	ICT 4 SSL	57
2	Improvenet	56
3	Innosap	55
4	Ribes	50
5	Veneto Clima ed Energia	45
6	RIAV	42
7	Venetian Innovation cluster heritage	41
8	Veneto Green cluster	40
9	Euteknos	39
10	Sicurezza e protezione Sport	39
11	Foresta Oro Veneto	35
12	Venetian Smart Lighting	32
13	Sinfonet	29
14	M3NET	29
15	Face Design	27

Note that the highest score is equal to 100 and minimum is 0.
Source: elaboration by the Department of Research, Innovation and Energy – Veneto Region

Table 6 - The impact performance of RINs about the potential antifragility criterium

N	Impact/Antifragility	Score
1	Veneto Green cluster	49
2	Venetian Smart Lighting	44
3	Venetian Innovation cluster heritage	39
4	Innosap	25
5	Foresta Oro Veneto	25
6	ICT 4 SSL	18
7	Euteknos	17
8	Improvenet	15
9	RIAV	12
10	Ribes	12
11	Sicurezza e protezione Sport	11
12	Face Design	8
13	Veneto Clima ed Energia	7
14	M3NET	6
15	Sinfonet	5

Note that the highest score is equal to 100 and minimum is 0.
Source: elaboration by the Department of Research, Innovation and Energy – Veneto Region

Instead, the lowest performances stem from Sinfonet, M3NET and Veneto Clima ed Energia. These RINs deal with smart and innovative foundries (Sinfonet), precision mechanics, micro-technologies and additive manufacturing (M3NET) and the development of systems, equipment and components for producing and storing energy with high efficiency, regulating air conditioning, producing hot water and steam, both for sanitary use and for heating buildings, with their intelligent management that minimizes their environmental impact (Veneto Clima ed Energia).

Table 7 - The total effect of RINs considering the three criteria

N	Total effect	Score
1	Improvenet	52
2	Venetian Smart Lighting	46
3	Veneto Green cluster	45
4	Ribes	45
5	Innosap	44
6	ICT 4 SSL	40
7	Euteknos	40
8	RIAV	38
9	Venetian Innovation cluster heritage	37
10	Foresta Oro Veneto	36
11	Veneto Clima ed Energia	35
12	Sinfonet	34
13	Face Design	28
14	Sicurezza e protezione Sport	22
15	M3NET	21

Note that the highest score is equal to 100 and minimum is 0.
Source: elaboration by the Department of Research, Innovation and Energy – Veneto Region

Considering the overall effect, in terms of innovative development, potential growth and antifragility, the best performances come from Improvenet, Venetian smart lighting and Veneto green cluster. In other words, investments in digital and IT production solutions as well as in home automation and sustainability and the circular economy have proven capable of generating an important effect on what can be defined as overall regional development.
This result tells us that digitalisation, technology and sustainability represent not only the main areas of the NRRP but also the pillars on which to focus and invest in order to improve regional development. Wanting to measure the overall contribution of all the RINs to the achievement of the three objective criteria, it can be seen in table 8 that a medium-level performance emerges, with a low variability of the contribution of each RIN.

Table 8 - The contribution of the RINs to the regional development

Performance RINs	Average score	Variance	Delta max-min
Innovative development	51	299	69
Potential growth	41	92	30
Antifragility	20	187	44
Total	**38**	**72**	**31**

Note that the highest score is equal to 100 and minimum is 0.
Source: elaboration by the Department of Research, Innovation and Energy – Veneto Region

Then by observing the data processed on the activity of the RINs[12], the following observations can be highlighted:

a. In general, the best performance is related to innovative development, followed by that of potential growth and then, lastly, that of antifragility. Therefore, the RINs are on average able to contribute to developing the regional innovative system and, in part, the level of potential growth, while their contribution to the generation of an antifragile system is quite minor.

[12] It must be taken into account that this analysis considers a limited number of indicators and therefore the results do not necessarily correspond to those that would be obtained by using all the indicators.

b. From the positions of the individual RINs in the rankings for each criterion, it can be seen that the first four RINs that contribute to elevating innovative development are not among the first in building an antifragile environment and vice versa. Furthermore, it can be observed that there is a slight coincidence between the RINs that perform best in innovative development and those at the top of the contribution to potential growth.
c. The distribution of the RINs in the various rankings highlights a partially fragmented RINs system which limits its certainly positive boost to overall development. There is, for example, a strong differentiation between the group of the best performing RINs and that of the least performing RINs especially at the output level. In this case the dispersion around the mean in innovative development is more than three times that relating to potential growth. This means that among the RINs there are substantial differences in the participation and implementation capacity of innovation projects especially for those of higher quality. Alongside this we see how the dispersion is greatly reduced considering the contribution to potential growth and then rises again with the effect on antifragility. In this case there is a flattening, in the sense that the RINs behave more similarly, with respect to the stimulus to potential growth, while the differentiation goes up again considering the effect on antifragility.

2.3 Policy recommendation

From the test conducted on the experience of RINs projects, some general policy recommendations can be drawn, the main ones being the following:
a. First of all, it is important to stimulate a greater general, systemic orientation towards innovation as a competitive lever and social and environmental as well as economic progress. It is particularly important to foster a superior and widespread culture of innovation.
b. Secondly, it is crucial to favor an evolution of innovative projects capable of combining innovations, both radical and incremental, more in line with the complex needs of the market and society. Above all, it is important to favor innovative projects with higher multiplicative, strategic and anticipatory potential with respect to the transformations in progress. In other words, we need projects that contemplate the enhancement of human capital, job placements, codification of innovation, new business models.
c. Thirdly, it is fundamental to encourage the development by companies of higher capacity to conceive and manage complex innovation projects because they are aimed at multi-sectoral, transversal or supply chain areas, capable of positive impacting both the growth potential and the antifragility.
d. Fourthly, it should be aimed at promoting, at the RIN system level, a recovery, on the one hand, of innovative efficiency and effectiveness and, on the other, an increase in the level of selection of quality projects, capable of generating positive effects both transversal and of strategic innovation and aimed at the future.
e. Finally, it is necessary to encourage processes of sharing successful design experiences and to explore the theme of an adequate design culture, aimed not only at production processes but also at products and company organization and at enhancing employment.

3 Conclusions

The new S3, both in contents and structure, represents a real innovative leap in the ambit of the regional innovation policy to favor the development and the antifragility of the territory. The logic of the S3 matrix is innovative both at the conceptual (theory) and at the applied (regional) level. It adapts well to the complexity of the social and economic as well as environmental context of the Veneto region.
The S3 monitoring and evaluation system, even if partially applied, proved to be able to capture the complexity of the effects of the projects presented. Indeed, the test showed different capacities of

RINs to favor the development of innovation and, above all, to transform the innovative effort into regional potential growth and conditions of antifragility. The way the development of innovation leads to higher growth and an antifragile environment is not linear, as it was in the past, but intertwined and the results have shown "lights and darks", from which we have proposed several policy suggestions, useful to unlock constraints and overcome some bottlenecks.
At the same time, overall, the analysis highlights how the role of RINs is important in terms of developing a widespread regional innovation system and their presence is a source of positive externalities for the territory.
However, high unexpressed potential also emerges, especially as regards the ability to transform innovation into a real factor of development and antifragility, which generates positive effects and strengthens the regional socio-economic system. So, a qualitative leap in planning and management skills and in the innovative content of projects is required. It also requires greater adaptations of entrepreneurial formulas, to better co-manage innovation processes involving multiple actors.
The challenge we now face is not just about growth and competitiveness, but concern social, ecological and technical change. Compared to the past, directionality is needed instead of general R&D and innovation (Laranja et al, 2022). Where previously it was sufficient to encourage economic growth, it is now necessary to transform growth into development and, above all, lasting, inclusive development capable of governing complexity. To this end, it may be useful to encourage mechanisms of competition, forms of rewarding, which direct the RINs towards more result-oriented, virtuous and more performing behaviors.
So, more generally, the new S3 of Veneto will seek to increasingly pursue the achievement of competitiveness and cohesion objectives, in order to transform innovation and knowledge into local development tools (Capello and Kroll, 2016). These tools, in turn, must be calibrated on the specific competitive advantages and needs of the Veneto, but they must also give rise to new opportunities and development trajectories, in other words they must be able to face and develop new vocations and specialization domains following an evolutionary logic.
The new S3 wants to enhance either the traditional/material or innovative/intangible territorial capital (Camagni, 2009 and 2017), in order to enhance the productivity of the factors as well as the total one. Considering the Veneto, entrepreneurial spirit and creativity are no longer enough if they are not linked to social and environmental issues. Considering the entrepreneurial capital (Audretsch and Keilbach, 2004 and 2008) the new S3 will allow a process of renewal of the development trajectory by integrating different spheres, economic but also social and environmental, towards an antifragile system.

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Annex I - List of trajectories of the S3

Table 9 - List of trajectories of the S3

N	Priority area	Trajectories	Intertwined with
1	Smart agrifood	Development of agriculture and precision animal husbandry	TD1 digital transformation TD2 green transition SM2 space economy
2	Smart agrifood	Development of more efficient products and equipment and enabling technologies for production in organic agriculture	TD1 digital transformation TD2 green transition
3	Smart agrifood	Innovations and resources for optimizing the nutritional status and eco-sustainable phytosanitary defense of crops	TD2 green transition SM1 bioeconomy
4	Smart agrifood	Recovery of by-products deriving from the production/transformation activities of the agrifood chains	TD2 green transition SM1 bioeconomy
5	Smart agrifood	Innovative and more sustainable packaging for agrifood products	TD2 green transition SM1 bioeconomy
6	Smart agrifood	Systems development innovations for food processing	TD2 green transition
7	Smart agrifood	Development of complete traceability systems	TD1 digital transformation
8	Smart agrifood	Control systems for food safety	TD2 green transition TD3 human capital
9	Smart agrifood	Microbiome for the improvement of agricultural productions	TD2 green transition TD3 human capital
10	Smart agrifood	Energy balance in greenhouse plants	TD1 digital transformation TD2 green transition
11	Smart agrifood	Resilient ecosystems	TD1 digital transformation TD2 green transition
12	Smart manufacturing	Intelligent management of production systems through the implementation of "digital twin solutions"	TD1 digital transformation TD3 human capital TD4 services for innovation and new business models
13	Smart manufacturing	Innovative processes for the treatment and/or reuse of industrial waste	TD2 green transition TD3 human capital
14	Smart manufacturing	New machinery and plants made with innovative materials and components, and aimed at safety, energy saving and rational use of resources	TD2 green transition TD3 human capital
15	Smart manufacturing	Tools for the sustainable supply chain and "green" energy solutions for manufacturing processes and for the renewal of product life	TD1 digital transformation TD2 green transition TD3 human capital TD4 services for digital innovation and new business models

16	Smart manufacturing	Development of enterprise 4.0 systems and tools through the integrated, innovative and multi-scale design of components, products and equipment	TD1 digital transformation
17	Smart manufacturing	Development and production of innovative materials	TD2 green transition SM2 space economy
18	Smart manufacturing	Innovative solutions for agile reconfiguration	TD1 digital transformation TD3 human capital SM2 space economy
19	Smart manufacturing	Innovative solutions for human-centric and inclusive spaces and organization of work	TD3 human capital TD4 services for digital innovation and new business models
20	Smart manufacturing	Artificial intelligence for the renewal of the corporate formula	TD1 transformation TD3 human capital TD4 services for digital innovation and new business models
21	Smart manufacturing	Data enhancements through digital solutions	TD1 digital transformation SM2 space economy
22	Smart manufacturing	Development of technologies for energy symbiosis	TD2 green transition
23	Smart health	Improving the health and well-being of consumers, through foods capable of providing useful and functional elements for improving health	TD2 green transition TD3 human capital
24	Smart health	Assistive technologies and services	TD1 digital transformation TD3 human capital
25	Smart health	Innovative textile materials and wearable technologies for health and safety	TD1 digital transformation TD3 human capital
26	Smart health	Development of molecular diagnostic systems	TD1 digital transformation TD3 human capital
27	Smart health	Development of technologies for preventive diagnostics and early diagnosis	TD1 digital transformation
28	Smart health	Systems for the prevention of cognitive decline	TD1 digital transformation
29	Culture and creativity	Recognizability and communicability of the product	TD1 digital transformation TD4 services for digital innovation and new business models
30	Culture and creativity	Technologies for cultural heritage	TD1 digital transformation TD2 green transition
31	Culture and creativity	Innovation and digitization in "made in" processes	TD1 digital transformation
32	Culture and creativity	Business models with value-added services	TD4 services for digital innovation and new business models

33	Culture and creativity	Technologies for the design and prototyping of creative products	TD1 digital transformation
34	Culture and creativity	Advanced digital technologies for the creative and cultural market	TD1 digital transformation TD4 services for digital innovation and new business models
35	Culture and creativity	Development of digital tools for the enhancement, use and promotion of the cultural and creative system	TD1 digital transformation TD3 human capital
36	Smart living and energy	Home automation and automation to improve the quality of life	TD1 digital transformation TD2 green transition
37	Smart living and energy	Innovative solutions and materials for the living	TD1 digital transformation
38	Smart living and energy	Development of technological solutions and integrated smart city management systems	TD1 digital transformation
39	Smart living and energy	Technologies for the design and management of buildings	TD1 digital transformation TD2 green transition
40	Smart living and energy	Safety in living places and privacy	TD1 digital transformation
41	Smart living and energy	Solutions for independent living	TD1 digital transformation
42	Smart living and energy	Innovation and digitization of technological systems used in the market	TD2 green transition
43	Smart living and energy	Improvement of waste management capacity, in particular development of innovative plants	TD2 green transition
44	Smart living and energy	Planned urban regeneration	TD2 green transition
45	Smart living and energy	Technologies for the decarbonisation of businesses and public administration	TD1 digital transformation TD2 green transition
46	Smart living and energy	Technologies for monitoring environmental pollution and sustainable use of water resources	TD2 green transition
47	Smart living and energy	Intelligent mobility systems for the territory	TD1 digital transformation TD2 green transition
48	Smart destination	Development of methods and technologies in favor of integrated systems between agri-food, tourism and ecology	TD1 digital transformation TD2 green transition
49	Smart destination	Technologies and virtual realities for the enhancement of tourism and of the artistic and cultural heritage	TD1 digital transformation
50	Smart destination	Technological solutions for the enhancement of integrated opportunities for sustainable hospitality in naturalistic areas	TD1 digital transformation TD2 green transition
51	Smart destination	Development of digitization to encourage the engagement of tourist demand	TD1 digital transformation

			TD4 services for digital innovation and new business models
52	Smart destination	Big data for tourism	TD1 digital transformation TD4 services for digital innovation and new business models

Source: elaboration by the Department of Research, Innovation and Energy – Veneto Region

Annex II - List of indicators of the S3

Table 10 - List of indicators for the first evaluation of the RIN performance

Code of indicator	Type of indicator	Criterium	Definition of indicator
RIN_OTP01	Output	Innovative development	Number of industrial research/experimental development projects with high prospects of using research results for each RIN
RIN_OTP02	Output	Innovative development	Number of projects with high impact of the results on the competitiveness of the regional innovative network
RIN_OTP03	Output	Innovative development	Number of projects with a high degree of innovation compared to the state of the art and contribution to the technological progress of the production system
RIN_OTP04	Output	Innovative development	Number of industrial research/experimental development projects presented with the involvement of several regional innovative networks and/or industrial districts for each RIN leader
RIN_OTP05	Output	Innovative development	Number of projects with a high degree of transferability to other sectoral areas
RIN_OTP06	Output	Innovative development	Number of projects contributing to develop sustainable technologies for each RIN
RIN_OTP07	Output	Innovative development	Number of projects that contribute to addressing situations of disability and/or promoting active aging for each RIN
RIN_OTP08	Output	Innovative development	Absolute value of the private contribution as co-financing of research projects
RIN_OTC01	Outcome	Potential growth	Change in the total turnover of the companies of each RIN (index number at the beginning of the turnover period equal to 100)
RIN_OTC02	Outcome	Potential growth	Change in the total turnover of the companies participating in the RIN tenders for each RIN (turnover index number at the beginning of the period equal to 100)
RIN_OTC03	Outcome	Potential growth	Cumulative change in employed persons for each RIN (number of employed persons at the beginning of the period equal to 100)
RIN_OTC04	Outcome	Potential growth	Cumulative change in the employees of the companies participating in the RIN tenders for each RIN (number of employees at the beginning of the period equal to 100)
RIN_OTC05	Outcome	Potential growth	Number of patents requested/filed by companies adhering to the RIN
RIN_OTC06	Outcome	Potential growth	Number of patents requested/filed by companies participating in RIN tenders adhering to RIN

RIN_OTC07	Outcome	Potential growth	Annual percentage of graduates hired in the companies participating in the RIN tenders of each RIN
RIN_OTC08	Outcome	Potential growth	% variation of the number of innovative enterprises present in the RINs
RIN_OTC09	Outcome	Potential growth	% variation of the number of innovative start-ups present in the RINs
RIN_IMP01	Impact	Antifragility	% variation of the number of trademarks and patents, product designs, filed with reference to each RIN in the reference period
RIN_IMP02	Impact	Antifragility	Annual % variation of the number of adhering companies within each RIN
RIN_IMP03	Impact	Antifragility	% variation of employees in knowledge-intensive sectors out of the total number of employees in each RIN in the reference period
RIN_IMP04	Impact	Antifragility	% variation in the number of SMEs adhering to the RINs
RIN_IMP05	Impact	Antifragility	% variation in the number of large companies adhering to the RIN

Source: elaboration by the Department of Research, Innovation and Energy – Veneto Region